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2002 - 2006 PROJECTS

PROJECT SYNOPSES – VOLUME 2

PROJECT SYNOPSES

SIXTH FRAMEWORK PROGRAMME

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Contents of this volume

During the Sixth Framework Programme (FP6, 2002-2006), there were nine calls for proposals related to aeronautics in the priority 'Aeronautics and Space'. While the first synopsis volume provided an overview of projects selected for funding in the three first calls, this second volume covers the subsequent calls.

Overall, during FP6, almost € 900 million of funding was made available, mostly for research actions. This resulted in the funding of 130 Specific Targeted Research Projects, 23 Integrated Projects, 2 Networks of Excellence, 7 Coordination Actions and 24 Specific Support Actions. This represents an amazing mass of work and knowledge created. The two volumes of this synopses book intend to give you a quick overview of the content of the projects. Each project is the subject of a short summary providing its background, its objectives, a description of the work, the expected results, the partnership and the contact details of the coordinators. We hope that this information will be very useful to those readers who want to be aware of past and ongoing projects. It can also be helpful to those who wish to participate in proposals within FP7. Finally, it is an important source of information for the scientific community, industry, policy-makers and the general public.

Similar to Volume 1, the projects are grouped in the following categories:

- Strengthening competitiveness
- Improving environmental impact
- Improving aircraft safety and security
- Increasing operational capacity.

These were the four research areas called for in the work programme.

Two indexes allow the identification of projects by their acronym (including the projects described in the first volume) and by contract number. Finally, an alphabetical index of all project participants gives the page number of every project in which the participant is involved. The contact details of the Commission staff involved in aeronautics and air transport is also provided. The European Commission would like to thank the project coordinators for providing the most up-to-date information on their projects.

The book also includes a list of National Contact Points. Should you have any question on activities related to aeronautics within the Framework Programme, you may contact them.

Note that an electronic version of the first volume can be found at

http://ec.europa.eu/research/transport/transport_modes/aeronautics_en.cfm

in the section 'More info: publications'.

Foreword

Aeronautics has become a key strategic sector for Europe. Growth in the aeronautics sector is dynamic, with an annual increase in passenger numbers over recent years of around 8.5%. Already in 2005, 3.3 million persons were employed across the air transport system as a whole in Europe, with a turnover of € 500 billion and a total of 1.3 billion air transport passengers. But outside Europe, certain regions are seeing more rapid growth than within the EU 25: Russia, China, India, in particular, all being regions of growth and all calling for cooperation across the air transport sector.

With more than 14% of turnover invested in research and development, aeronautics is recognised to be a research intensive sector. But investments in research only produce useful results if the funds are carefully invested, based on a sound and visionary policy. The role of the Commission is to develop such a policy at European level. For this purpose, in its Sixth Framework Programme for Research and Technological Development, the European Union has defined a Thematic Priority 'Aeronautics and Space'. The content of this priority has been based on the input of a large number of stakeholders, includes policy makers, industry, research centres, universities, etc. In particular, the Strategic Research Agenda, produced by the Advisory Council for Aeronautics in Europe, has been very useful as a basis on which to structure our policy (http://www.acare4europe.org). Similar to the Strategic Research Agenda, our work programme adopts a holistic approach to air transport, i.e. it considers not only the aircraft but also all the components of the sector (e.g. Air Traffic Management, Airports, etc.)

Over the four years of the Sixth Framework Programme (FP6, 2002-2006), almost € 900 million of funding was made available in the successive calls for proposals, which were run jointly by the Directorate-General for Research and the Directorate-General for Energy and Transport. These research actions also serve other policies which are important for Europe. The actions constitute the building blocks of the European Research Area. Not only was particular attention given to the participation of the countries which joined the Union in 2004 but in addition, the programme encourages participation of SMEs.

It is my pleasure to provide you here with the description of the latest research projects that were funded under the Sixth Framework Programme.

Our support to aeronautics research does not end with FP6. Quite the contrary: the last contracts were signed in 2006 and some of them will run until at least 2010. The SESAR joint undertaking is being established with a view to converging under a single European sky in the field of air traffic management.The Seventh Framework Programme has been launched. In addition to Collaborative Research, which will continue to adapt to a changing society, a new action has been proposed in the field of Aeronautics and Air Transport: the Clean Sky Joint Technology Initiative.

We have a number of interesting challenges before us. A strong European Union can help us meeting these challenges.

Janez Potočnik
European Commissioner for Research

Aeronautics and air transport in Europe

European air transport system

The air transport system (ATS) encompasses the aeronautics manufacturing industry, the airports, the airlines and the air navigation service providers. The European ATS is vital for the growth of the entire European economy and for the cohesion of the Union and its regions. In addition to its role in facilitating economic activity, the European ATS represents a significant economic factor: in 2005, it contributed € 500 billion to the European gross domestic product. The aeronautics manufacturing industry also contributes to EU exports, with 53% of its total production sold outside of Europe. This industry is very research intensive with 14.5% of its turnover invested in R&D.

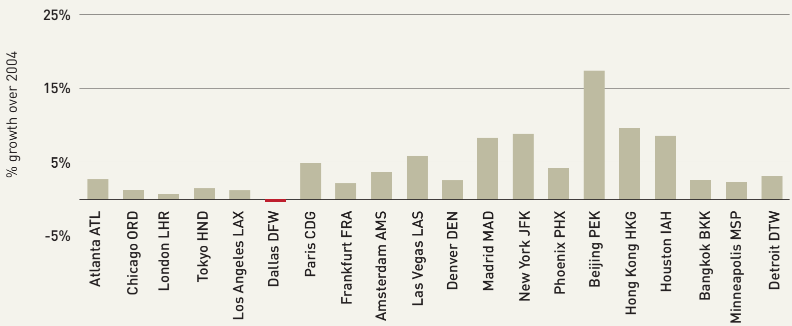
Some key air transport figures (2005):

- 3.3 million jobs (1.4% of all jobs in the EU)
- 130 airlines and 450 airports
- 5 500 aircraft fleet
- 1.3 billion passengers
- 18 million aircraft movements.

Society's growing transport needs in a changing context

In 2004 and 2005, the increase of air passenger transport amounted to 8.8% and 8.5% respectively. In particular, the low-cost airlines allowed an increasing number of citizens to have access to the air transport system. In addition, developing countries started to play an important role in the sector. For example, in 2005, out of a total of 2 448 aircraft orders, 15% were from India and 14% from China. Based on these figures, 51 000 aircraft will be needed over the next 20 years.

But these growing needs must be placed in the current context. The growth of air transport also generates increasing noise disturbance for the population. The use of hydrocarbon fuel results in the emission of CO_2 and NOx, i.e. greenhouse gases and pollutants. Currently, the European Commission is developing a plan to include aviation into the existing Emissions Trading Schemes, limited for the moment to industrial sectors producing large amounts of greenhouse gases. During the last few years, the oil price has grown continuously, making a profitable operation in these sectors more and more difficult. Its evolution is difficult to predict because it is linked to the political situation in oil producing countries, to the increasing oil requirements of developing countries and to the knowledge of the



Increase of passengers over 2004 in the top 20 airports (by passengers) in the world
Source: ACI

available reserves. Security also has to be a growing priority, especially in the light of preventing terrorist attacks; a high level of safety continues to be an important concern.

Therefore the research policy must also integrate these factors and take into account aspects linked to the environment, the economy, safety and security.

Vision 2020 and the Strategic Research Agenda

In 2000, the Commissioner for Research, Philippe Busquin, initiated a 'group of personalities' to draft a European vision regarding the future of aeronautics. This vision was published in the Vision 2020 report. Two top-level objectives were laid out:

- Meeting society's needs, in terms of demand for air transport, travel fares, travel comfort, safety, security and environmental impact;
- Ensuring European leadership in the global civil aviation market, by enabling it to produce cost-effective, operationally attractive and, from a performance point of view, highly efficient products at the pinnacle of current technologies.

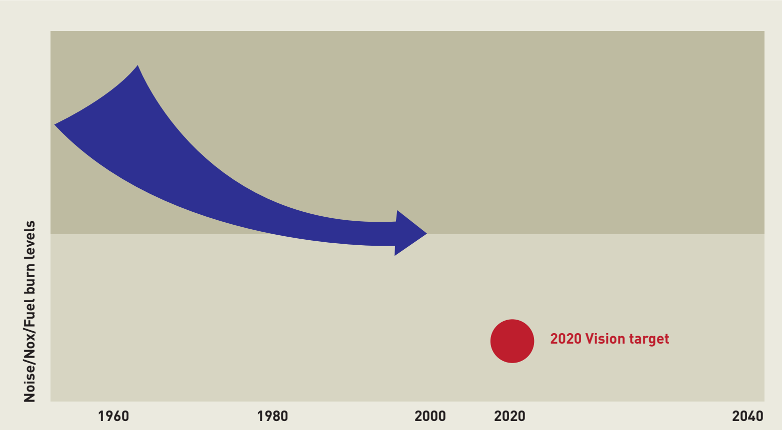
Based on this vision, the Advisory Council for Aeronautics Research in Europe (ACARE) was created with the role of defining and maintaining a Strategic Research Agenda (SRA) i.e. a roadmap for research into new technologies which were identified as critical to fulfil the objectives of the Vision 2020. Some of the ambitious goals for 2020, as defined in the SRA, taking the state of the art in the year 2000 as a reference point, are as follows:

- 80% reduction in NO_x emissions
- Halving perceived aircraft noise
- Five-fold reduction in accidents
- An air traffic system capable of handling 16 million flights per year
- 50% cut in CO_2 emissions per passenger kilometre
- 99% of flights departing and arriving within 15 minutes of scheduled times.

This first edition of the Strategic Research Agenda provided a main input for the definition of the aeronautics work programme in FP6.

A second edition of the SRA was published in March 2005, building upon and extending the original SRA, and illustrating the dynamic fashion in which the Agenda continues to develop and evolve. This version will constitute a solid basis for the FP7 work programme.

Cover page of the Vision 2020 report
http://ec.europa.eu/research/transport/more_info/publications_en.cfm



The challenge of the environment as depicted in the Strategic Research Agenda 1. http://www.acare4europe.org

The European Research Area and the Framework Programmes

The European Research Area

In 2000, at the Lisbon European Summit, Europe sets itself the ambitious goal of becoming 'the world's most competitive and dynamic knowledge-based economy' by 2010. To overcome the fragmentation of research and an absence of adequate networking and communication among a growing number of Member States, it was decided to create a European Research Area (ERA). The goals of the ERA are:

- to enable researchers to move and interact seamlessly, benefit from world-class infrastructures and work with excellent networks of research institutions;
- to share, teach, value and use knowledge effectively for social, business and policy purposes;
- to optimise and open European, national and regional research programmes in order to support the best research throughout Europe and coordinate these programmes to address major challenges together;
- to develop strong links with partners around the world so that Europe benefits from the worldwide progress of knowledge, contributes to global development and takes a leading role in international initiatives to solve global issues.

As stated in the Green Paper, *The European Research Area*, New perspectives, the Sixth Framework Programme is a key contributor to the ERA.

Aeronautics research in the Framework Programmes

Specific aeronautics research at European level was first introduced in 1989, under FP2, in the form of a pilot programme. The focus of the Framework Programmes has changed over time, reflecting the evolution of the programme, from modest beginnings to the current status:

- FP2 (1990-91), budget € 35 million: a pilot phase aimed at stimulating European collaboration;
- FP3 (1992-95), budget € 71 million: a consolidation phase with emphasis on key technical areas;
- FP4 (1995-98), budget € 245 million: focused on industrial competitiveness

Information on current and past Framework Programmes can be found at the

Community Research & Development Information Service

http://cordis.europa.eu/en/home.html

with increasing emphasis on subjects of wide public interest;

- FP5 (1999-2002), budget € 700 million: a specific key action aimed at industrial competitiveness and sustainable growth of air transport;
- FP6 (2002-2006), indicative budget € 900 million: part of the 'Aeronautics and Space' thematic priority, with equal focus on issues of public interest and industrial competitiveness.

The EU programme now contributes more than 30% of all European public funding of civil aeronautics RTD. Public funding, in turn, represents only 10% of the total spent on civil aeronautics RTD in Europe.

Aeronautics research under FP6

Elaboration and scope of the work programme

The work programme is a key document that is updated for every call. It defines the strategic fields in which Europe wants to concentrate its research and only the topics mentioned in its text are eligible for funding. The work programme is thus at the crossroads between EC policy and the research needs of the air transport sector.

The content of the FP6 work programme is the result of a broad consultation process that involves all the stakeholders in the field of aeronautics. The guidelines and objectives laid out in the ACARE Strategic Research Agenda were instrumental in defining the structure of the work programme. In this task, the Commission was assisted by the Aeronautics Advisory Group which checked the consistency of the document with the ACARE guidelines and the proposed strategic orientations. The work programme also adheres to guidelines set out in the Lisbon Strategy and in the White Paper on transport, entitled *European Transport Policy for 2010*: time to decide. It also takes into account the observations provided by research centres, universities and the industry.

Finally, the work programme integrates the comments and receives the approval of the Programme Committee which represents the Member States and Associated States.

The content of the aeronautics work programme follows an all-encompassing, global approach to commercial aviation, focusing not only on the improvement of aircraft technologies but also on the infrastructure of the operational environment.

The programme covers commercial transport aircraft, ranging from large civil aircraft to regional and business aircraft and rotorcraft, including their systems and components. It also encompasses airborne and ground-based elements of air traffic management and airport operations. However, note that the EU does not fund military aeronautics research.

Main research areas

Aeronautics research activities are divided into four general areas:

1. Strengthening competitiveness (of the manufacturing industry)

Objectives:

- Reducing development costs by 20% and 50% in the short and long term, respectively;
- Reducing aircrafts' direct operating costs by 20% and 50% in the short and long term, through improved aircraft performance, reduction in maintenance and other direct operating costs;
- Increasing passenger choice with regard to travel costs, time to destination, onboard services and comfort.

2. Improving environmental impact with regard to emissions and noise

Objectives:

- Reducing CO_2 emissions (and fuel consumption) by 50% per passenger kilometre in the long term, through improved engine efficiency as well as improved efficiency of aircraft operation;
- Reducing NO_x emissions by 80% in the landing and take-off cycle and conforming in the long term to the NO_x emissions index of five grams per kilogram of fuel burnt while cruising (10 g per kg in the short term), and reducing other gaseous and particulate emissions;
- Reducing unburned hydrocarbons and CO emissions by 50% in the long term to improve air quality at airports;
- Reducing external noise per operation by 4 to 5 dB and by 10 dB in the short and long term, respectively. For rotorcraft, the objective is to reduce the noise footprint area by 50% and external noise by 6 dB and 10 dB over the short and long term;
- Reducing the environmental impact of the manufacturing and maintenance of aircraft and their components.

3. Improving aircraft safety and security

This means ensuring that, irrespective of the growth of air traffic, there will be fewer accidents and aircraft will be more secure against hostile actions. Overall objectives include:

- Reducing the accident rate by 50% and 80% in the short and long term, respectively;
- Achieving 100% capability to avoid or recover from human errors;
- Increasing the ability to mitigate the consequences of survivable aircraft accidents;
- Reducing significant hazards associated with hostile actions.

4. Increasing the operational capacity of the air transport system

This entails major changes in the way air traffic services are provided. Overall objectives include:

- Improving safety, taking into account projected traffic levels by providing better information on surrounding traffic to both pilots and controllers;
- Increasing system capacity to safely handle three times the current air movements by 2020 through an improved planning capability, coupled with a progressive distribution of tasks and responsibilities between aircraft and ground facilities;
- Improving system efficiency and reliability, aiming to achieve an average maximum delay of one minute per flight;
- Maximising airport operating capacity in all weather conditions through improved systems to aid controllers and pilots.

Sixth Framework Programme: instruments and implementation

FP6 research instruments

In order to best support different types of research activities or initiatives in support of research, the Sixth Framework Programme proposed five instruments, two of which were new to FP5 (Integrated Project and Network of Excellence).

Specific Targeted Research Project (STREP)

These projects support *research, technological development and demonstration* or innovation activities that are located upstream along the line of technology development. In the field of aeronautics, the number of partners is typically below 20 and the total cost below € 10 million.

Integrated Project (IP)

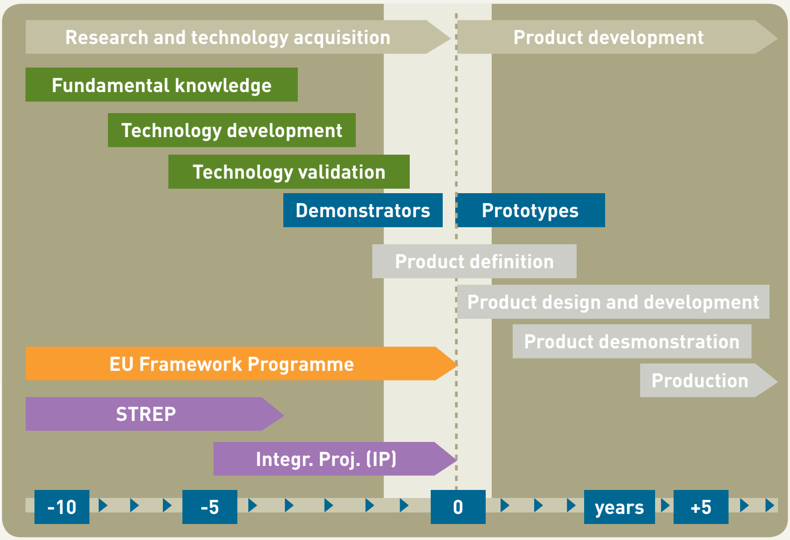
These projects support *objective-driven research*, where the primary deliverable is knowledge for new products, processes, services, etc. The research activities are thus more downstream along the line of technology development and the aspect of integration is key to the project. IPs bring together a critical mass of resources to reach ambitious goals aimed either at increasing Europe's competitiveness or at addressing major societal needs. In aeronautics, the partnership typically ranges between 20 and 60 with total costs of between € 10 and 100 million.

Network of Excellence (NoE)

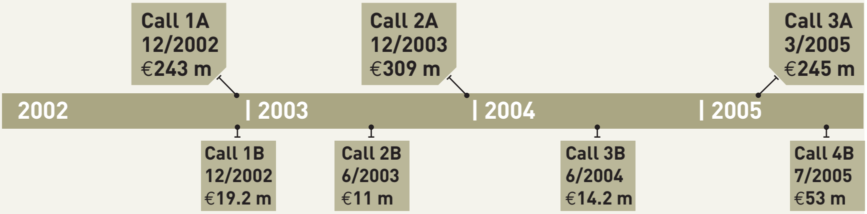
These multiple partner activities aim at *strengthening excellence on a research topic* by networking a critical mass of resources and expertise. This expertise will be networked around a joint programme of activities aimed primarily at creating a progressive and lasting integration of the research activities of the network partners while, at the same time, advancing knowledge on the topic.

Coordination Action (CA)

CAs are not about doing research but *coordinating research*. Their goals are to promote and support networking and



The place of STREP and IP instruments along the line of research and technology acquisition



In addition to the calls in the chart above, there was a permanent open call for SSAs with € 7 million and a TTC call with € 1.9 million

DG RTD

	Date	Indicative budget (M€)
1A	12/2002	243.0
SSA	12/2002	7.0
2A	12/2003	309.0
3A	3/2005	245.0
TTC	2/2006	1.9
Sum		**805.9**

DG TREN

	Date	Indicative budget (M€)
1B	12/2002	19.2
2B	6/2003	11
3B	6/2004	14.2
4B	7/2005	53
Sum		**97.4**

903.3

to coordinate research and innovation activities. This covers the definition, organisation and management of joint or common initiatives, as well organising conferences, meetings, exchanges of personnel, exchange and dissemination of best practice, performing studies, and setting up common information systems and expert groups.

Specific Support Action (SSA)

These single or multiple partner activities are dedicated to *supporting the Community research policy*. They support conferences, seminars, studies and analyses, working groups and expert groups, operational support and dissemination, information and communication activities, or a combination of these.

EU funding under FP6 covers up to 50% of eligible costs for research and industrial participants. For academic institutions, up to 100% of additional costs are covered. NoEs, CAs and SSAs are normally provided financing of up to 100% of actual costs.

FP6 implementation

During the Sixth Framework Programme (2002-2006), there were nine calls for proposals which were related to aeronautics in the priority 'Aeronautics and Space'. The responsibility was shared between the Directorate-General for Research (DG RTD) and the Directorate-General for Transport and Energy (DG TREN). Calls 1A, 2A and 3A from DG Research and 1B, 2B, 3B and 4B from DG TREN were targeting research projects or actions to coordinate the research, i.e. the tools were STREPs, IPs, NoEs and CAs. The indicative budgets and call dates are provided in the chart below. There was also one permanently open call for SSAs in DG RTD for actions mostly in support of the research policy and strategy, specific support for SMEs, international co-operation, etc. with an indicative budget of € 7 million.

Finally, the last call from DG RTD intended to reinforce the presence of partners from targeted third countries (TTC) in running projects, or in other words, to improve the dimension of international co-operation, and had an indicative budget of € 1.9 million. Overall, funds to the order of € 900 million were made available over four years for these actions.

The selection process

In order to evaluate the proposals received in response to each call, the Commission is assisted by evaluators who are experts in the technical fields of the proposals and who are independent of the partners involved.

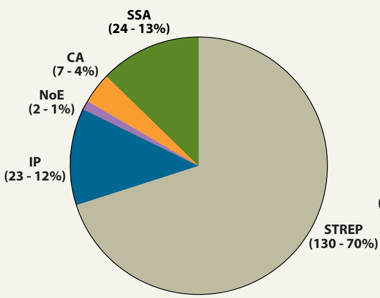
A proposal is first evaluated independently by the individual evaluators (typically three evaluators for STREPs, CSAs and CAs, and up to seven for IPs and NoEs). In many cases, the different evaluations providing a coherent assessment and the grades to attribute to the different criteria are easily agreed. When there are some divergences of views, a consensus discussion takes place, moderated by a Commission representative. If necessary, additional evaluators will be asked to provide their input before finding a consensus.

The pre-defined main selection criteria depend on the type of instrument a given proposal applies to. All projects have to be relevant to the objectives of the Programme and their potential impact must be apparent. Proposals must demonstrate good quality of project management, a crucial factor for mission success, and adequate mobilisation of resources to achieve the critical mass needed to carry out a project. Scientific and technological excellence is especially important for the technical aspects of IPs and STREPs. Quality of coordination is more crucial for CAs, while a degree of integration is an indicator of potential success in creating a NoE. The quality of the consortium must also be taken into account when assessing any type of instrument and, especially in the case of NoEs, all participants must demonstrate a high level of excellence.

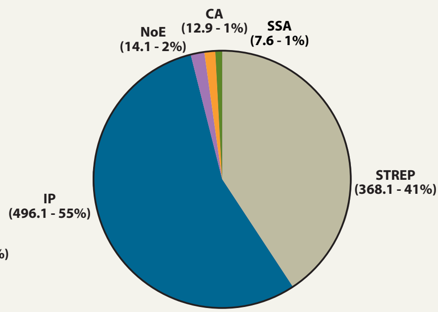
Proposals that pass the individual evaluation phase are then submitted to an extended panel consisting of selected experts. The panel establishes a ranked list of projects. When the budget is exhausted, proposals are put on a reserve list. It is the responsibility of the Commission to propose the final list of proposals eligible for funding.

Call results

The results of the selection process are provided below in two charts. One indicates the number of projects per instrument while the second provides the budget effectively allocated per instrument. One hundred and thirty STREPs have been funded for a total budget of € 368 million,



Number of projects per instrument and their associated percentage



EC funds allocated per instrument (M€, %)

i.e. the average EC funding per project is € 2.8 million. A typical funding rate ranges between 50% and 60%; thus a typical average project total cost ranges between € 4.7 and 5.6 million. To provide a very rough approximation of the effort that this represents, assume that the cost of an engineer is € 100 000 per year, that the budget is made up of only engineer manpower and that the duration of the project is four years: € 5.6 million represents 14 engineers working for four years.

IPs are much larger initiatives because part of their success lies in their capacity to gather a critical mass that is adequately integrated during the course of the project. The average EC funding of the 23 IPs is € 21.5 million; thus a typical total cost ranges between € 35.8 and 43 million.

Only two NoEs have been financed in such a way – this instrument's contribution is modest in the domain of aeronautics. Seven CAs help to provide an overview in sectors such as, for example, low emission combustion, noise, air traffic services, etc.

With an average EC funding of € 320 000, the 24 SSAs have modest budgets but these actions can have strategic importance.

A full analysis can be found in the final report of the Advisory Group on Aeronautics Research under the Sixth Framework Programme.

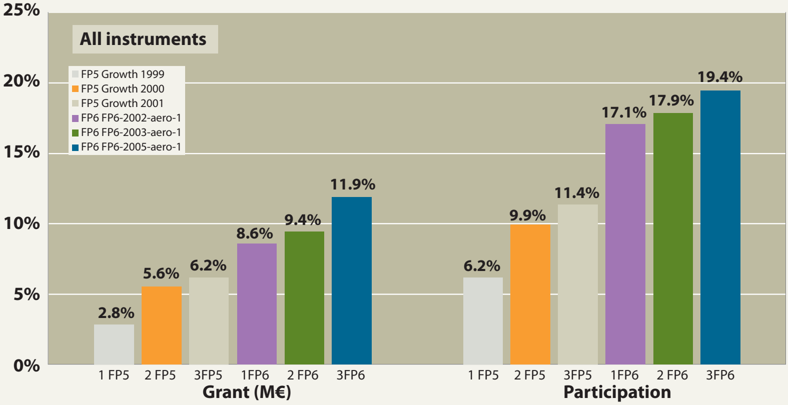
Participation of small and medium-sized enterprises

In Europe, 99% of all enterprises are SMEs. They account for 67% of European GDP and provide 55% of total jobs in the private sector. These numbers explain why Europe pays such special attention to SMEs.

While the aeronautics sector is mostly composed of large companies, SMEs play a key role in the supply chain and the Commission is supporting them to ensure an appropriate participation in the research projects.

FP6 has seen the introduction of Specific Support Action projects, such as AeroSME, SCRATCH, ECARE+ and DON Q AIR, all initiatives dedicated to helping SMEs gain access to EU funding. The graphic below is self-explanatory and proves the successfulness of the approach taken. Overall, in FP6 projects, 18% of the partners were SMEs that garnered 10% of EC funds.

Evolution of SMEs' participation in Aeronautics
(retained proposals before negotiation)



Countries

AT	Austria
AU	Australia
BE	Belgium
BG	Bulgaria
BR	Brazil
CA	Canada
CH	Switzerland
CN	China
CS	Serbia And Montenegro
CY	Cyprus
CZ	Czech Republic
DE	Germany
DK	Denmark
EE	Estonia
ES	Spain
FI	Finland
FR	France
GR	Greece
HR	Croatia
HU	Hungary
IE	Ireland
IL	Israel
IT	Italy
LT	Lithuania
LU	Luxembourg
LV	Latvia
MK	The former Yugoslav Republic of Macedonia
NL	Netherlands
NO	Norway
PL	Poland
PT	Portugal
RO	Romania
RU	Russian Federation
SE	Sweden
SI	Slovenia
SK	Slovakia
TR	Turkey
UA	Ukraine
UK	United Kingdom
WW	Internationnal
ZA	South Africa

Instruments

CA	Coordination Action
IP	Integrated Project
NoE	Network of Excellence
STP	Specific Targeted Research Project
SSA	Specific Support Action

Strengthening **Competitiveness**

Improving **Environmental** Impact

Improving Aircraft **Safety** and **Security**

Increasing Operational **Capacity**

Support **Actions**

CESAR

Cost-Effective Small AiRcraft

Background

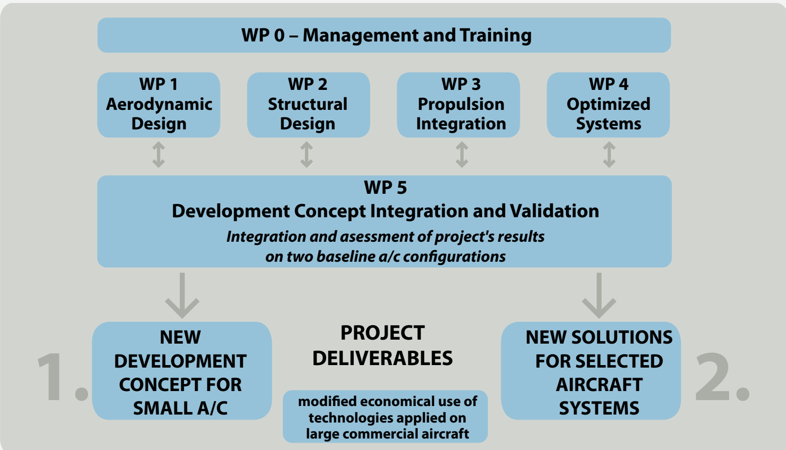
This project is aimed at providing European manufacturers of regional, commuter and business aircraft with an enhanced ability to become fully competitive in the world market of small-size commercial aircraft.

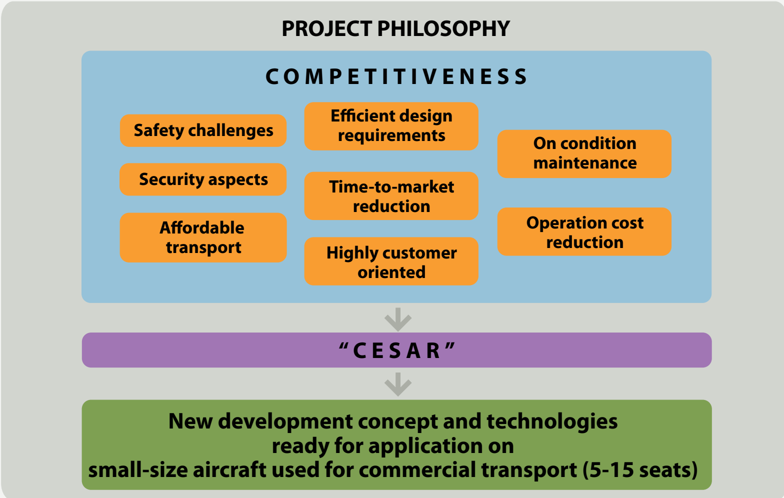
The European manufacturers of larger aircraft have achieved leadership on the global market and this part of European aviation industry is nowadays highly competitive. In the area of regional and small-size commercial aircraft the situation is completely different. In the past, a number of traditional aircraft manufacturers in this category have gone bankrupt or struggled with economic problems; only a few European aircraft manufacturers succeeded in establishing themselves in the world markets. In general, there is still sufficient potential for European aircraft manufacturers to regain an influential position in the world market of small-size commercial aircraft, which is nowadays dominated, in particular, by the American aircraft industry (predominantly by the USA, Canada and Brazil).

Objectives

CESAR's objective is to improve the competitiveness for European manufacturers and developers of small-size aircraft used for commercial purposes. The competitiveness in this aircraft category comprises complex quantitative as well as qualitative factors as perceived by potential customers – the aircraft operators. First of all it concerns the sale price and low operating costs. Besides these quantitative requirements, further qualitative characteristics are required, for example safety and reliability, sufficient passenger comfort and ecological aspects.

Affordable price: according to the economic theory, the sale price is determined by the competitive environment in the market. In the case of a twin-engine piston aircraft for nine passengers, potential customers nowadays expect to pay less than €1 million. For a double-engine turboprop for nine people they expect a price of less than €1.1 million, while for a four to five-seater biz-jet the expected price should be in the region of €2.5-3 million. To be price competitive puts stringent





requirements on the development process as well as on the production itself. The development cycle must be very cost-effective with short development time (time-to-market) and to achieve effective production it is necessary to use appropriate manufacture and assembly technology. At the same time efficient propulsion units and aircraft systems integrated into the aircraft, nowadays forming a substantial part of the costs, must be affordable to the manufacturers.

Other delivery terms: a number of further conditions, including warranty and post-warranty service (maintenance, repair and overhaul) also have their impact on the final price tag.

Acceptance: for an aircraft to be acceptable to the customer, it must be reliable and safe, it must offer sufficient passenger comfort corresponding to the given aircraft category and it must be also environmentally friendly, i.e., have low noise emissions, economic fuel consumption with low CO_2 and NOX emissions.

Low-cost operation: operating costs are of two types – direct operating costs (DOCs), i.e. costs of flight operations including fuel price and costs of maintenance, repair and overhaul (MRO), and indirect operating costs (IOCs) comprising mainly ground operating costs.

Description of work

CESAR will improve the competitiveness of its partners by an enhanced development cycle and new technologies for reduction of aircraft operating costs. A very comprehensive set of design and developmental procedures is necessary for aircraft development. Similarly the reduction of aircraft operational costs is characterised by many different features.

Therefore CESAR cannot work only with a single topic and a single objective; it has to reflect a real complexity. Hence CESAR has to be a quite involved integrated project to achieve the major competitiveness objective.

The project consists of five RTD work packages comprehensively covering the complexity of the aircraft design process, namely aerodynamic and structural design, and integration aspects including optimisation of development processes and knowledge management. In parallel, new technologies will be gained through CESAR for selected aircraft systems and propulsion systems.

Results

The expected achievements are:

- Proven high-fidelity aerodynamic tools customised for use on the development of small size aircraft,
- A catalogue of advanced airfoils,
- Advanced wing concept
- Reliable wing contamination tool
- More consistent tool chain and database for flight dynamics analyses,
- Affordable and complex tool for estimation of operational and fatigue load
- Advanced structure technologies cost-effectively tailored for small aircraft
- Reliable and relatively fast methods and tools for strength evaluation for category of CS 23 aircraft
- Real-time structural health monitoring system
- New approaches and methods for fast and reliable prediction of aero-elastic stability for CS 23 category
- Design tools and technologies necessary for efficiently supporting the development of modern turboprop engines
- Complex power-plant control system including propeller control for smaller category of engines
- Reliable and accurate prediction tool capable of estimating noise emission levels
- Competitive integrated environmental control system and cabin pressure system
- Integrated diagnostics and on-condition maintenance
- Integrated design system covering integration of software tools
- Distributed development of small aircraft by various companies on various locations in the EU. Optimised processes and knowledge management

Acronym:	CESAR
Name of proposal:	Cost-Effective Small AiRcraft
Contract number:	AIP5-CT-2006-030888
Instrument:	IP
Total cost:	33 785 228 €
EU contribution:	18 100 000 €
Call:	FP6-2005-Aero-1
Starting date:	01.09.2006
Ending date:	31.08.2009
Duration:	36 months
Objective:	Competitiveness
Research domain:	Advanced Design Tools
Coordinator:	Mr Paiger Karel Vyzkumny a zkusebni letecky ustav, a.s. Beranovych 130 CZ Prague
E-mail:	paiger@vzlu.cz
Tel:	+420 (0)225 115 332
Fax:	+420 (0)286 920 930
EC Officer:	J. Martin Hernandez

Partners:	Aero Vodochody a.s.	CZ
	ARC Seibersdorf research GmbH	AT
	Centre de Recherche en Aéronautique, ASBL	BE
	Centro Italiano Ricerche Aerospaziali ScpA	IT
	Deutsches Zentrum für Luft- und Raumfahrt e.V.	DE
	EADS Deutschland GmbH	DE
	Eurocopter S.A.S.	FR
	EVEKTOR, spol. s r. o.	CZ
	Swedish Defence Research Agency	SE
	GAMESA DESARROLLOS AERNONAUTICOS, S.A.U.	ES
	Hellenic Aerospace Industry S.A.	GR
	HEXAGON Systems, s.r.o.	CZ
	National Institute for Aerospace Research	RO
	Instytut Lotnictwa - Institute of Aviation	PL
	IVCHENKO PROGRESS SE	UA
	Jihlavan a.s.	CZ
	Jihostroj a.s.	CZ
	Liebherr Aerospace Toulouse S.A.S.	FR
	Materials Engineering Research Laboratory Ltd	UK
	MESIT pristroje spol. s r.o.	CZ
	Stichting Nationaal Lucht- en Ruimtevaartlaboratorium	NL
	Office National D'Etudes et de Recherches Aerospatiales	FR
	První brnenská strojírna Velká Bítes, a.s.	CZ
	Piaggio Aero Industries S.p.A.	IT
	Polskie Zaklady Lotnicze Sp. z o.o.	PL
	SICOMP AB	SE
	EADS SOCATA	FR
	SPEEL PRAHA Ltd	CZ
	Svenska Rotor Maskiner AB	SE
	Technofan SA	FR
	TURBOMECA	FR
	UNIS, spol. s r.o.	CZ
	University of Manchester	UK
	Brno University of Technology	CZ
	RWTH Aachen University	DE
	Université de Liège	BE
	Technische Universität München, Intitute of Energy Systems	DE
	Laboratory for Manufacturing Systems & Automation - University of Patras	GR

FASTWing CL

Foldable, Adaptable, Steerable, Textile Wing structure for delivery of Capital Loads

Background

FASTWing CL aims to develop a parafoil/payload system for cargoes of up to 6 000 kg that can navigate using a Global Navigation Satellite System GNSS (e.g. GPS/EGNOS/Galileo). FASTWing CL is the successor to the Fifth Framework Programme's FASTWing which was successfully completed in June 2005. The latter has developed a technology model capable of flying independently, successfully demonstrating this technology by dropping loads of up to 3 tons. This was the first time that such a heavy payload was dropped by a parafoil in Europe.

This approach is a clear step beyond the state of the art; currently such a system does not exist in Europe. All functions of the developed system will be tested and validated in a real drop test.

FASTWing technology will allow for a precise delivery of heavy loads, e.g. mobile medical aid units in disaster areas which are not accessible overland. In a second step, exploitation of the technology is expected for aircraft and space vehicle rescue systems, targeted in accordance with the European Space Agencies' future planning scenario.

Objectives

The objectives are:

- Development and manufacture of a high performance parafoil with a high glide ratio (→5) and a forward speed of more than 18m/s with high stand-off distances and independent of wind direction;
- Development and manufacture of an effective parachute system for low g-forces during deployment (←4g) for shock sensitive equipment and manned missions;
- Development and/or adaptation of a deployment analysis tool for parafoil material selection and reefing layout;
- Reusable system layout by means of short, cheap and easy refurbishment after a drop;
- Selection of an advanced flight termination system in order to reduce hazardous situations or damage on the ground;
- Adaptable low-cost, volume control and weight steering box for independent, remote-controlled flight and flight to a beacon;
- Development of advanced flight control software for all control modes;
- Development of a portable ground station for monitoring all control modes and measurements enabling remote control of the system;
- Adaptable flight data acquisition system for monitoring and transmitting the in-flight measurement data;
- Development and/or adaptation of software tools for aerodynamic design, deployment analysis and flare manoeuvre analysis;
- New concept for power distribution of all components for avionics, actuation and flight termination system in order to minimise number, weight and volume of batteries;
- New concept for actuation, steering manoeuvres and in particular the flare manoeuvre in order to reduce the weight of both the actuator system and the batteries;
- Design and manufacturing of a new advanced light-weight payload carrier

for different payloads, such as medical equipment, rice bags, vehicles.

In a number of cases, deployment and steerable flights will be performed to validate and optimise the different concepts.

Description of work

The following components will be designed and developed during the FASTWing CL project:
- parachute system
- parafoil
- steering box
- payload system
- actuation system
- emergency flight termination system
- power supply
- flight data acquisition system
- design and analysis software tool for dynamic flare manoeuvre.

The following components will be advanced during the project:
- Guidance and Navigation System
- Telemetry and Ground Control
- Deployment Analysis Software Tool
- Aerodynamic Design Tool.

The following components will be bought and adapted during the project:
- measurement devices for data acquisition system
- motors for actuation system
- submission device for radio signal for emergency system.

Results

The following results or developments will be available:
- A non-steered technology model for parachute verification tests allowing analysis of opening and in-flight behaviour of the parachute system;
- A technology model, a steering system and a flight control software capable of performing remotely controlled and independent flights to a pre-defined target with a payload of between 3 000 kg and 6 000 kg;
- Software capable of directing a number of flight systems to one single or to different targets and capable of controlling multiple co-operative systems;
- A modular lightweight and low-volume steering system;
- A reliable parachute system showing soft opening shocks below 4g and with a glide ratio of 5g, mostly independent from wind influence;
- Low energy-consuming actuation system;
- A landing shock below 3g to be realised by a new flare strategy and damping system for fragile payloads like medical equipment;
- An autonomous emergency system able to terminate flight in order to reduce the horizontal
- An adaptable flight data acquisition system capable of measuring location, altitude, accelerations, etc. for flight analysis during and after flight;
- Design software tools for the aerodynamic design and analysis of parafoils;
- Design software capable of analysing material selection and opening staging of the parachute system in order to reach a minimised opening shock;
- Software capable of analysing the interaction between parafoil and payload prior to landing in order to find the optimal activation of the flare manoeuvre;
- Two flight tests with the emergency system;
- Five non-steered parachute verification tests;
- Engineering tests with lower payload;
- Five remotely controlled steerable flight tests from a minimum drop altitude of 2 000 m
- Five independent flight tests from a minimum drop altitude of 2 000 m.

Acronym:	FASTWing CL
Name of proposal:	Foldable, Adaptable, Steerable, Textile Wing structure for delivery of Capital Loads
Contract number:	AST5-CT-2006-030778
Instrument:	STP
Total cost:	4 968 541 €
EU contribution:	2 900 000 €
Call:	FP6-2005-Aero-1
Starting date:	01.12.2006
Ending date:	31.01.2010
Duration:	38 months
Objective:	Competitiveness
Research domain:	Advanced Design Tools
Coordinator:	Mr Krenz Holger Autoflug GmbH Industriestrasse 10 DE 25462 Rellingen
E-mail:	h.krenz@autoflug.de
Tel:	+49 (0)4101 307 349
Fax:	+49 (0)4101 307 152
EC Officer:	J. Martin Hernandez

Partners:	Compania Espanola de Sistemas Aeronauticos, S.A.	ES
	CFD norway as	NO
	CIMSA Ingeniera de Sistemas, S.A.	ES
	Deutsches Zentrum für Luft- und Raumfahrt e.V.	DE
	Stichting Nationaal Lucht- en Ruimtevaartlaboratorium	NL
	Technion - Israel Institute of Technology	IL
	Dutch Space	NL

PLATO-N

A PLAtform for Topology Optimisation incorporating Novel, large-scale, free material optimisation and mixed integer programming methods

Background

Developing safe and minimum weight structures is the driving factor in aircraft structural design. Usually weight reduction programmes have to be launched deep into the detailed design phase, and are characterised by local, manual modifications to the design, applying more expensive materials or adjustments to the manufacturing process.

An improved overall arrangement of materials provides the largest potential for saving structural weight in airframe design. Tools for topology optimisation support these early, important decisions by suggesting optimal material distributions. Current commercial design tools do not allow the full potential of composite materials to be exploited in airframe design. This requires new tools that are targeted at the specific requirements within aerospace structural design.

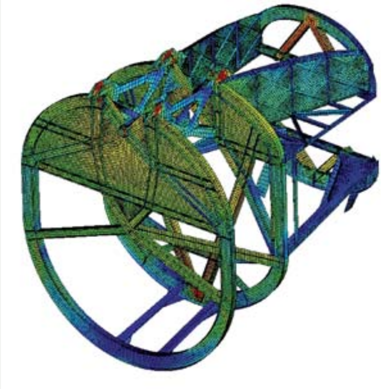
PLATO-N will enable the operational integration of optimisation assistance as a standard procedure in the conceptual design process for the European aerospace industry. PLATO-N will be validated against real case studies and will be implemented as a suite of softwares, integrated in a common environment, and its improvement in performance will be benchmarked against state-of-the art commercial products.

PLATO-N will help to win global leadership for European aeronautics, by providing advanced tools that reduce the time and cost of designing and developing new aircraft.

Objectives

PLATO-N aims to overcome the limitations of current state-of-the-art topology optimisation tools in order to enable integration into the conceptual design process of the European aerospace industry. The following operational parameters, performance criteria and novel features are targeted:

- reduction of turnaround time for practical solutions
- increase of manageable problem size
- increase in the number of manageable load cases
- consideration of composite materials, including post-processing



A design study using topology optimisation - a new layout of an aircraft tail section

– extension to multidisciplinary design criteria (stress, displacements, etc.).

The research goals are:

1. The platform should be flexible with respect to the inclusion of new optimisation algorithms and visualisation tools, and it should be geared to aeronautical needs.
2. The large-scale optimisation algorithms should employ some form of dedicated first-order algorithm.
3. The method should be extended to plate and shell problems and should be able to handle multiple objectives such as stiffness, vibration and buckling.
4. An algorithm should be developed in order to handle local constraints.
5. Benchmark examples should be generated using mixed-integer convex models.
6. The results should be interpreted and visualised in a manner consistent with aerospace needs, e.g. shell structures using laminate lay-ups.
7. The platform should be tested on examples of industrial origin.

Description of work

The core of the project, which binds the pieces together in terms of operational software, is the software platform PLATO. It provides a library of common subroutines, manages the dataflow between the modules and provides a graphical user interface. As well as the platform, an example library, called PLATOlib, of industrial and academic benchmark examples will be generated. For the individual parts there are different aspects to be developed, all in terms of upstream fundamental research. This encompasses the development of fast sub-algorithms for the optimisation methods, inclusion of these in the overall optimisation methods and the integration of these with the finite element analysis (FEM), which is required for the application at hand. For free material optimisation (FMO), the FEM analysis is an integrated part of the optimisation code itself while a supplementary approach using sequential convex programming results in an integration in the platform that is somewhat different. A central aspect of the software system called PLATO-N is the interpretation and visualisation of topology optimisation results in order to derive the design concepts. Likewise it is considered important to provide benchmark examples and an example library. For the latter, global optimisation will be pursued and these methods also constitute an aspect of data interpretation for FMO in terms of laminates.

Results

The main innovations and products are:

PLATO: A generic software platform for topology optimisation, which is specific for aeronautics applications.

PLATOlib.: A sample case library, which can be used as a benchmarking library for the topology optimisation community including challenging applications from industrial design problems.

PLATO-N: A high-performance software system integrating the implementations of algorithms and methods developed in the project.

Benefits from the multidisciplinary research approach are expected at all levels:

– The research community will profit from the 'technology pull' applied by the aeronautic industry.
– It will improve the awareness of entities outside the research community of the potential of topology optimisation.
– PLATO-N greatly extends the scope of topology optimisation and expands both its applicability and acceptance in the European aerospace industry. It provides a means for shortening development times and reinforces the competitiveness of the European airframe manufacturers on the global market.

– The European aeronautic industry will be more capable of responding to the growing demand of the European society for a more effective and sustainable air transport system, by being able to design and manufacture conventional and novel aircraft configurations at a reduced cost, with lower operating costs and reduced environmental impact.

A topology optimisation-based design for integrally stiffened machined ribs for the inboard inner fixed leading edge of the Airbus 380

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Acronym:	PLATO-N
Name of proposal:	A PLAtform for Topology Optimisation incorporating Novel, large-scale, free material optimisation and mixed integer programming methods
Contract number:	AST5-CT-2006-030717
Instrument:	STP
Total cost:	2 874 088 €
EU contribution:	2 357 159 €
Call:	FP6-2005-Aero-1
Starting date:	01.10.2006
Ending date:	30.09.2009
Duration:	36 months
Objective:	Competitiveness
Research domain:	Advanced Design Tools
Coordinator:	Prof. Bendsøe Martin P. Technical University of Denmark Anker Engelundsvej 101A DK 2800 Kgs. Lyngby
E-mail:	M.P.Bendsoe@mat.dtu.dk
Tel:	+45 (0)45253045
Fax:	+45 (0)45881399
EC Officer:	A. Podsadowski

Partners:		
	Technion - Israel Institute of Technology	IL
	Institute of Information Theory and Automation of the Academy of Sciences of the Czech Republic	CZ
	Friedrich-Alexander-University of Erlangen-Nuremberg	DE
	Universität Bayreuth	DE
	Altair Engineering Ltd	UK
	RISC Software GmbH	AT
	EADS Deutschland GmbH, Military Aircraft	DE
	Airbus UK Ltd	UK
	Eurocopter Deutschland GmbH	DE

SimSAC

Simulating Aircraft Stability and Control Characteristics for Use in Conceptual Design

Background

Present trends in aircraft design, towards augmented stability and expanded flight envelopes, call for an accurate description of the non-linear flight-dynamic behaviour of the aircraft in order to design the flight control system (FCS) properly. Hence the need to increase the knowledge about stability and control (S&C) as early as possible in the aircraft development process in order to be 'right first time' with the FCS design architecture.

FCS design usually starts near the end of the conceptual design phase when the configuration has been tentatively frozen and experimental data for predicted aerodynamic characteristics are available. Up to 80% of the life-cycle cost of an aircraft is incurred during the conceptual design phase so mistakes must be avoided. Today, prediction errors related to S&C result in costly fly-and-try fixes, sometimes involving the loss of prototype aircraft and crew.

Testimony to this problem is NASA's COMSAC project on computing S&C using linear aerodynamics. Indeed its rallying call is "...inaccurate prediction of aerodynamic stability and control parameters continue to have major cost impacts in virtually every aircraft class. These impacts include unacceptable increases in program costs, fly-and-try approaches to fixing deviances, extensive development delays and late deliveries..."

Objectives

Today's common practice in conceptual-design sizing for stability and control employs the so-called tail volume approach, basically achieving static stability of the design by empirical handbook methods. The design methodology rarely goes beyond static stability, does not distinguish whether the design driver is related to flight handling or operational performance, hardly concerns itself with control-surface sizing, and never considers static aero-elastic deflections that degrade the effectiveness of these control surfaces.

The SimSAC project objectives are:

1. to create and implement a simulation environment, CEASIOM (computerised environment for aircraft synthesis and integrated optimisation methods), for conceptual design sizing and optimisation suitably knitted for low-to-high-fidelity S&C analysis
2. to develop improved numerical tools benchmarked against experimental data.

In addition to enhanced S&C analysis/assessment, CEASIOM supports low-fidelity aero-elasticity analysis with quantifiable uncertainty supporting aircraft-level technical decision-making, thus advancing the state of the art in computer-aided concept design suitable for procuring economically amenable and ecologically friendly designs.

Description of work

The SimSAC project is organised into four technical work packages (WP) and one demonstration work package.

WP2: Development of the CEASIOM Simulation System: definition, development, implementation and testing the CEASIOM design system including paying special attention to geometry construction procedures and accounts of aero-elastic deformation.

WP3: Aerodynamic Modelling: link the linear aerodynamic models into conceptual design (WP2 and WP5); develop stability and control aerodynamic models from simulation; develop fast CFD methods for data generation to populate stability and control aerodynamic models; and link the high-fidelity aerodynamic models into the design process (WP2 & WP5).

WP4: Benchmark Aerodynamic Model: validate the different numerical tools of WP3 by experimental data of the DLR-F12 geometry; review the accuracy and efficiency of the CFD codes pertaining to WP3; and review numerical data to be used in the stability and control analysis in WP5.

WP5: Stability and Control Analyser/ Assessor: compatibility with the CEASIOM Simulation System (WP2) and Aerodynamic Modelling (WP3) modules; integration as a sub-space in the CEASIOM analysis environment; and perform integration and testing according to the results from WP6.

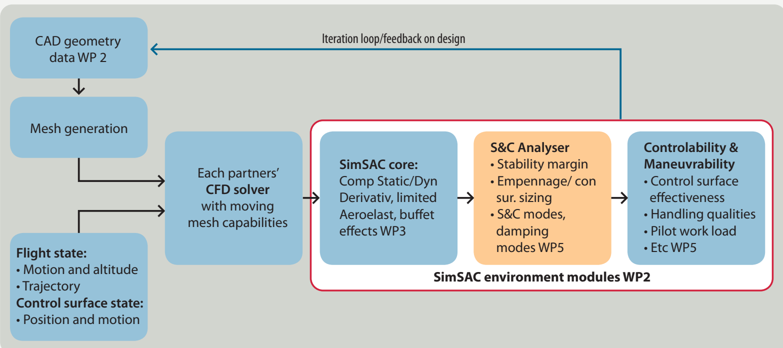
WP6: Test and Assess Design Process: specify requirements for a number of aircraft classes as test cases that span speed range, size and unconventional morphology; demonstrate, test and evaluate the CAESIOM simulation system for each of these cases and show that the enhanced designs are quantifiably better than those obtained with the contemporary design process are.

Results

The SimSAC project aims to address 'right first time' design, in which testing is about design verification with a minimum of post-freeze problem solving. The achievement of 'right first time' will initially lead to cost and time-to-market advantages resulting from minimising laboratory and flight-testing, and then a robust design methodology will allow the contemplation of bolder designs and radical new aircraft concepts. This is crucial since it is widely recognised that current aircraft concepts are not likely to be adaptable to meet the Vision 2020 targets for environmental impact. To this end, the nature of the SimSAC approach is intentionally of a generic nature, such that it will be applicable to most novel aircraft morphology configurations.

The outcome of the SimSAC project is the CEASIOM design environment. After the project, CFS Engineering, as leader of the dissemination, will be responsible for:

- Maintaining and coordinating further development of the CEASIOM software
- Training and the organisation of users' meetings
- Promotion of the CEASIOM environment
- Organising the SimSAC design workshop, possibly under the auspices of the EWADE group, or EASN, or some other suitable European body.



Acronym:	SimSAC
Name of proposal:	Simulating Aircraft Stability and Control Characteristics for Use in Conceptual Design
Contract number:	AST5-CT-2006-030838
Instrument:	STP
Total cost:	5 109 800 €
EU contribution:	3 282 550 €
Call:	FP6-2005-Aero-1
Starting date:	01.11.2006
Ending date:	31.10.2009
Duration:	36 months
Objective:	Competitiveness
Research domain:	Advanced Design Tools
Website:	http://www.simsacdesign.org/ http://gannet.pdc.kth.se:8080/simsac/
Coordinator:	Prof. Rizzi Arthur Kungliga Tekniska Högskolan Aeronautics TR 8 SE 100 44 Stockholm
E-mail:	rizzi@kth.se
Tel:	+46 (0)8 790 7620
Fax:	+46 (0)8 207865
EC Officer:	J. Martin Hernandez

Partners:	Alenia Aeronautica S.p.A.	IT
	University of Bristol	UK
	CERFACS - Centre Europeen de Recherche et de Formation Avancee en Calcul Scientifique	FR
	CFS Engineering SA	CH
	Dassault Aviation	FR
	Deutsches Zentrum für Luft- und Raumfahrt e.V.	DE
	EADS Deutschland GmbH, Militärflugzeuge	DE
	Swedish Defence Research Institute	SE
	University of Glasgow	UK
	J2 Aircraft Solutions Ltd	UK
	Office National d`Etudes et de Recherches Aérospatiales	FR
	Politecnico di Milano	IT
	Saab AB (publ)	SE
	Central Aerohydrodynamics Institute	RU
	Vyzkumny a zkusebni letecky ustav, a. s.	CZ
	Politechnika Warszawska (Warsaw University of Technology)	PL

SmartFuel ADSP

Automated digital fuel system design and simulation process

Background

Today's fuel system design and development process requires evaluation of the baseline specification to manually extract and describe the functional requirements, which are mainly laid down as non-standardised verbal descriptions.

Based on the specifications, rudimental simulations are performed, which can lead to initial feedbacks that influence the baseline requirement definitions. After the finalisation of rudimental simulation tasks, the software and hardware development/realisation begins.

Time-consuming and costly manufacturing of hardware is imperative for system and component testing. The realisation phase for software and hardware has to start at a very early stage of the programme due to time constraints and in order to get hardware available for verification purposes on the rigs.

Representative test rigs are essential for system testing in the conventional design process. These rigs are expensive and require a long time to set up, contributing to a large extent to programme schedules and costs. Any deviation in performance determined in the later stage of a programme has direct influence on software and/or hardware, thus often requiring new components to be built. The time necessary to update software and/or hardware directly extends the programme duration and requires repetition of rig and flight-testing.

Objectives

The scientific and technological objectives of SmartFuel ADSP are to develop and test a tool-based automated design and simulation process (ADSP) for aircraft fuel management systems. The system developed will also be applicable to other liquid-containing aircraft systems since those systems are basically designed with similar kinds of components.

The automated design and simulation system mainly comprises:
- the analysis of the general specification and automated system configuration/composition (i.e. definition of system functionality and number, type and arrangement of all necessary system components to fulfil the functionality);
- the automated generation of executable software codes;
- the verification of the system via extensive and sophisticated simulation.

The main topics of SmartFuel ADSP are:
- research and development on modelling tools for fuel systems
- standardisation of fuel system specification language
- standardisation of fuel system hardware and software interfaces
- research and technological development on tools for fuel system simulation
- fuel system certification aspects and documentation
- realisation of fuel system components to verify simulation in rig and flight tests
- development of automated design and simulation process tool chain
- evaluation of automated design and simulation process compliance with rig and flight tests
- evaluation of verification/validation compliance with certification authority requirements.

The goal of the project is to show that an automated system design process can be successfully and satisfactorily verified and validated.

Description of work

SmartFuel ADSP develops a tool-supported automated design and verification process for digital fuel systems.

Automating the design process will minimise the costs and time needed, while providing a high-quality result. Today the design of a digital airborne fuel system is a laborious, iterative process to be repeated each time a new aircraft variant or engine model is employed. It is expected that costly test benches may be made redundant by the new design approach, which will provide a significant competitive advantage to the user of the system.

In order to test the designed system, a simulation will be defined and developed for the verification of compliance of its functionality against the basic system requirements. Simulation of flight operation procedures will be done, thus allowing the testing and analysing of the newly developed system's functionality before any hardware is build.

The programme is structured in five Work Packages (WP).

WP1 specifies the fuel management system requirements and definition formats for automated transition from system requirements specification to a machine-readable system description/specification in order to automatically generate executable code for the fuel management control logic and database protocol.

WP2 analyses the certification and safety requirements needs in order to standardise the hardware and software parts of the smart components.

WP3 defines and sets up a modular fuel system simulator ready to be used for automated system design process verification and validation.

WP4 provides a complete airworthy set of equipment to build up a smart fuel system for the demonstrator aircraft.

WP5 aims to integrate all the smart components into the test rig (and also into a helicopter) to perform a ground and flight test programme to validate the overall smart fuel system. As preparatory work for this testing, the safety of flight (SOF) clearance for each smart component and the system will be achieved.

Results

It is anticipated that the automated designed system will produce the following benefits:

- 60% reduction in the time for developing a fuel system
- 70% reduction in the cost of developing a fuel system
- 50% reduction in the time-to-market for future complete fuel systems
- 25% improvement in the reliability of those systems developed using ADSP
- 50% reduction in the cost of the new system due to a better use of off-the-shelf components
- 40% reduction in maintenance cost due to the advanced quality of design.

Acronym:	SmartFuel ADSP
Name of proposal:	Automated digital fuel system design and simulation process
Contract number:	AST5-CT-2006-030798
Instrument:	STP
Total cost:	5 499 112 €
EU contribution:	3 224 957 €
Call:	FP6-2005-Aero-1
Starting date:	01.12.2006
Ending date:	30.11.2009
Duration:	36 months
Objective:	Competitiveness
Research domain:	Advanced Design Tools
Coordinator:	Mr Frewer Stefan Autoflug GmbH Industriestrasse 10 DE 25462 Rellingen
E-mail:	S.Frewer@autoflug.de
Tel:	+49 (0)4101 307 150
Fax:	+49 (0)4101 307 213
EC Officer:	M. Brusati

Partners:	ASG Luftfahrttechnik und Sensorik GmbH	DE
	Eurocopter Deutschland GmbH	DE
	Secondo Mona S.p.A.	IT
	Goodrich Actuation Systems SAS	FR
	Vysoké učení technické v Brně	CZ
	Universidad Complutense de Madrid	ES
	University of Alcalá	ES
	CSRC spol. s r.o.	CZ
	Piaggio Aero Industries S.p.A.	IT

TIMECOP-AE

Toward Innovative Methods for Combustion Prediction in Aero-engines

Background

The pressing demand to reduce emissions and noise levels in future aeroengines is of the greatest importance. These points are evidenced through the very ambitious pollutant and noise reduction targets set for 2020.

Several combustion technology-related programmes are underway to support these objectives, e.g. LOCOPOTEP, INTELLECT D.M. However, these programmes are not dedicated to improve methodology. Within previous European programmes (MOLECULES, CFD4C, $LESSCO_2$, etc.) advanced computation fluid dynamics (CFD) models, lower order models, and methodology rules have been developed in order to support the design of a low emission levels combustion chamber that will satisfy these 2020 targets. Within these projects, the main focus was on improving emissions at full power conditions. Little work was done on the modelling of unsteady phenomena including combustion and liquid spray modelling.

In TIMECOP-AE, the next major step forward is made: modelling aeroengine combustors which operate on liquid fuel and developing the capability to perform transient analysis. For this step to take place, the development of improved turbulence, turbulence-chemistry interaction, spray dynamics and the building blocks to model unsteady phenomena are required. This next step will further close the gap between the numerical model capabilities and the actual aero-engine combustors operating on kerosene.

Objectives

The main objective of the project is to enable European industry to design and develop innovative, optimised, low emissions combustion systems within reduced time and cost scales. This will be made possible by the development of state-of-the-art methods in the field of combustion modelling. These prediction methods will give the European industrial partners the advantage to improve in three pertinent fields:

Operability:
- ability to model a wide range of operating conditions,
- ability to model and cope with transient conditions,
- ability to model and thus avoid combustion instability,
- ability to model and secure capability for altitude re-lights.

Emissions:
- capability to lower combustion system emission levels during the design phase,
- ability to handle different fuel chemistry and calculate biofuelled engine.

Competitiveness:
- reducing development costs by attaining higher combustion module maturity before development tests,
- allowing more efficient design optimisation.

Within the MOLECULES project, significant advances were made in developing LES codes for turbulence modelling for combustors operating on gaseous fuels. Within this TIMECOP-AE project, it is proposed to extend this capability to liquid-fuelled combustors.

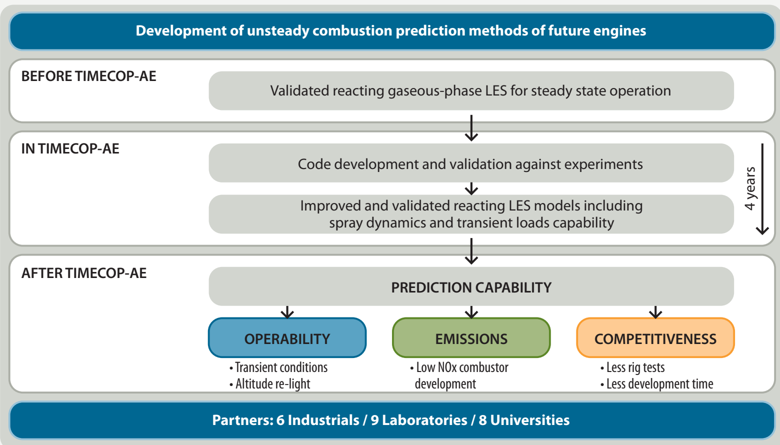
Description of work

Within TIMECOP-AE, the LES tools will gain the capability for modelling the combustion process within conventional and low-emission combustors over a wide range of operating conditions on liquid fuels. The operating conditions include mentioned transient phenomena. To be able to model these phenomena, improvements are required in the models of turbulence, chemistry, turbulence-chemistry interactions and liquid spray models. The methods and models will be evaluated against high-quality validation data which will be obtained by several validation experiments. Some are designed to validate specific models: one is a generic combustor, representative of an aero-engine combustor, and permits assessing the full range of models.

Results

CFD tools based on the LES approach will be developed to allow predictions of whether a combustion chamber will blow out or not at landing conditions. This is critical to the adoption of advanced combustor concepts. Another important operability aspect is whether or not the combustor will re-light at altitude. It is extremely difficult to comply with the requirements for these aspects for lean burn combustors, since lean mixtures are more difficult to ignite and are close to the lean extinction limit. Current CFD methods are obviously lacking in predicting these transient phenomena. These operability issues are challenges that have to be addressed before low-emission combustors can be realistically introduced into the next generation of aero-engines.

Currently it is prohibitively expensive and time consuming to perform rig testing to determine the operability of advanced combustor designs. TIMECOP-AE will develop the tools to allow virtual prototyping of new concepts, which will significantly reduce the testing required, thereby reducing cost and time taken to introduce innovative combustion technology into production engines.



TIMECOP-AE overview

Acronym:	TIMECOP-AE
Name of proposal:	Toward Innovative Methods for Combustion Prediction in Aero-engines
Contract number:	AST5-CT-2006-030828
Instrument:	STP
Total cost:	7 109 401 €
EU contribution:	4 800 000 €
Call:	FP6-2005-Aero-1
Starting date:	01.06.2006
Ending date:	31.05.2010
Duration:	48 months
Objective:	Competitiveness
Research domain:	Advanced Design Tools
Website:	http://www.timecop-ae.com
Coordinator:	Mr Hernandez Lorenzo TURBOMECA Combustion Group FR 64511 Bordes Cedex
E-mail:	lorenzo.hernandez@turbomeca.fr
Tel:	+33 (0)5 59 12 13 06
Fax:	+33 (0)5 59 12 51 45
EC Officer:	R. Denos

Partners:	Rolls-Royce Deutschland Ltd & Co KG	DE
	Rolls-Royce plc	UK
	MTU Aero Engines GmbH	DE
	SNECMA	FR
	AVIO S.p.A.	IT
	Centre Européen pour la Recherche et la Formation Avancée en Calculs Scientifiques (CERFACS)	FR
	Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR
	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
	Institut National Polytechnique de Toulouse	FR
	Centre National de la Recherche Scientifique (CNRS)	FR
	CENTRALE RECHERCHE SA	FR
	Foundation for Research and Technology	GR
	Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas	ES
	Institut Français du Pétrole (IFP)	FR
	The Chancellor, Masters and Scholars of the University of Cambridge	UK
	Technische Universität Darmstadt	DE

University of Karlsruhe, Institut für Thermische Strömungsmaschinen	DE
Technische Universiteit Eindhoven	NL
Imperial College of Science, Technology and Medicine	UK
Loughborough University	UK
Czestochowa University of Technology	PL
Department of Mechanics and Aeronautics, University of Rome 'La Sapienza'	IT

AIM

Advanced In-Flight Measurement Techniques

Background

The research project Advanced In-flight Measurement Techniques (AIM) has the aim of developing advanced, non-intrusive, in-flight measurement techniques for the purpose of efficient, cost-effective, in-flight testing for certification and in-flight research for aircraft and helicopters. In order to achieve this ambitious goal, AIM will organize and structure a close collaboration among leading experts from industry, research organizations, universities and a SME with complementary knowledge of and experience in in-flight testing, development of image-based measurement techniques and operation of small airports.

The results of the design process and thus the quality of a new aircraft will be verified during flight tests for certification. Extrapolating data obtained in the wind tunnel or at low Reynolds number simulations to real flight is not trivial and primarily based on engineering experience, sometimes exhibiting considerable deviations from the predictions.

In terms of measurement techniques, non-intrusive, optical image-based measurement methods have undergone considerable technological progress over the last decades and are now used as standard diagnostic techniques to measure planar distributions of velocity, pressure, density and model deformation in industrial wind tunnels.

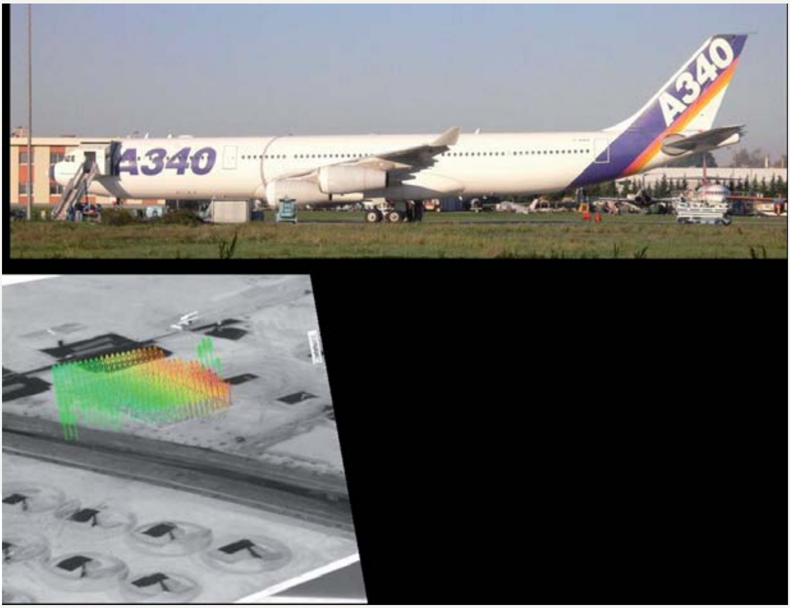


Image Pattern Correlation Technique applied to an Airbus A 340: Setup and result.

© Piaggio

P 180 after the take off

Objectives

Non-intrusive, optical image-based measurement techniques shall be further developed such that they can be routinely applied to flight tests to provide comprehensive information on various important parameters such as wing and propeller deformation, thermal loads on the structure of helicopters, the planar pressure distribution on a wing, density gradients in strong vortices generated by airplanes and helicopters and velocity flow fields near airplanes and helicopters.

The objectives of AIM are:

- To prepare new flight test measurement techniques with a significant improvement in accuracy, ease of installation and measurement speed resulting in a major reduction in the duration and cost of flight test programs for the industry. This advance is essential for both aircraft and helicopter development and certification,
- To facilitate new collaboration between European industry and the academic sector for the application of advanced in-flight measurement techniques,
- To assess the feasibility of implementing existing advanced image based measurement techniques for flow field measurements during in-flight tests,
- To validate the most promising techniques in an in-flight test performed with a large industrial transport aircraft, a helicopter and a light aircraft carried out by the flight testing department of the industrial partners.

Description of work

The work plan has been constructed on a fast-track with simultaneous efforts on all technological aspects. The same measurement techniques will be adapted to different applications. To avoid duplication of work and increase the innovation per time unit, the work packages are strongly linked. The work packages themselves are defined by the technological application:

1. Wing deformation studies,
2. Propeller deformation studies,
3. Helicopter studies,
4. Surface flow measurements,
5. High lift structures,
6. Industrial flight testing.

Results

The expected results of the project are reliable optical measurement techniques performed in-flight for certification as well as for research purposes. This project will demonstrate only the general feasibility of the measurement techniques, since not all possible application can be tested.

In particular, the goal of AIM is to use of the following measurement techniques for in-flight investigations:

- Image Pattern Correlation Technique (IPCT) for the measurement of local deformations of e.g. wing, aileron and flap and with help of Quantitative Video Technique (QVT) for the determination of local propeller and rotor deformations,
- Particle Image Velocimetry (PIV) for the measurement of a velocity flow field of a vortex and velocity fields in high lift configurations,
- Background Oriented Schlieren method (BOS) for the measurement of the density gradients of a flow field and therefore to determine the position and strength of spatial vortex filaments,
- Light detection and ranging (LIDAR) for the measurement of a velocity flow field of a vortex,
- Pressure Sensitive Paint (PSP) for the measurement of surface pressures,
- Infrared Technique (IRT) for the measurement of surface heat distributions.

Acronym:	AIM
Name of proposal:	Advanced In-Flight Measurement Techniques
Contract number:	AST5-CT2006-030827
Instrument:	STP
Total cost:	3 538 526 €
EU contribution:	2 000 000 €
Call:	FP6-2005-Aero-1
Starting date:	01.11.2006
Ending date:	31.10.2009
Duration:	36 months
Objective:	Competitiveness
Research domain:	Aerodynamics
Website:	http://aim.dlr.de
Coordinator:	Dr. Falk Klinge
	Deutsches Zentrum für Luft- und Raumfahrt e. V.
	Bunsenstrasse 10
	Linder Höhe
	DE 37073 Göttingen
E-mail:	falk.klinge@dlr.de
Tel:	+49 (0) 551 709 2471
Fax:	+49 (0) 551 709 2830
EC Officer:	R. Denos

Partners:	Airbus France	FR
	Eurocopter Deutschland	DE
	EUROCOPTER S.A.S.	FR
	PIAGGIO AERO INDUSTRIES S.p.A.	IT
	EVEKTOR, spol. s r.o.	CZ
	Stichting Nationaal Lucht- en Ruimtevaartlaboratorium	NL
	Office National d`Etudes et de Recherches Aérospatiales	FR
	Cranfield University	UK
	Moscow Power Engineering Institute (Technical University)	RU
	Flughafengesellschaft Braunschweig mbH	DE

AVERT

Aerodynamic Validation of Emission Reducing Technologies

Background

The AVERT project will deliver upstream aerodynamics research that will enable breakthrough technology and innovative aircraft configuration leading to a step change in aircraft performance.

The project will contribute towards:
– strengthening the competitiveness of the European manufacturing industry;
– improving the environmental impact of aircraft concerning emissions.

The main objective of the AVERT project is the development and industrialisation of active flow control technologies for application to a realistic configuration, thereby reducing drag significantly.

This research responds to a target set in the ACARE 2020 review for a substantial increase in aircraft cruise lift-to-drag ratio by realising the full potential of new configurations such as the 'pro-green' aircraft. Active flow-control technology can attack the two main sources of aircraft drag – profile drag and vortex drag – both directly and by unlocking traditional configuration constraints and altering the focus of many design rules. It is predicted that the combined drag reduction could be up to 10%, thus leading to large reductions in emissions.

Achieving this objective will give the aircraft manufacturers within AVERT confidence that emerging flow control technologies can be industrialised to the point of practical and beneficial application to an aircraft.

Objectives

AVERT aims for a 10% improvement in cruise lift-to-drag ratio in addition to that promised by the 'pro-green' configuration, due to direct reductions in profile drag and by unlocking traditional design constraints to reduce vortex drag.

Several flow control technologies have emerged recently that are considered to show sufficient promise, which might be usefully applied to an aircraft in order to reduce drag, either directly or by enabling variations in design that would result in lower drag. AVERT will investigate this selection of devices further with the development focused closely on industrial application. This activity will link directly with the work on manufacturing and control technologies, and will be constantly reviewed by industrial partners. This industrial review will assess the viability and gross performance benefits of the devices when applied to full-scale aircraft.

The following describes the five technical objectives of the AVERT project:
– Exploration and development of flow-control technologies for high-speed application;
– Exploration and development of flow-control technologies for low-speed application;
– Development of manufacturing and control technologies for sensors and actuators;
– Industrial validation of flow-control technology;
– Industrial assessment of flow-control technologies.

Description of work

Devices suitable for high-speed application include active transition control, passive and active turbulent skin friction, drag reduction and active buffet control.

Devices suitable for low-speed application include those which produce oscillatory blowing in a flap gap, and synthetic and fluidic jets for controlling flow separation at the leading edge.

The successful industrialisation and application of arrays of flow-control devices onto an aircraft will be highly dependent on the ability to manufacture and install them. Recent advances in MEMS technology (MEMS: microelectromechanical systems) have provided AVERT with the first real opportunity to assess and develop manufacturing processes for large volume production of flow-control devices. Additionally, by drawing on expertise from the field of structural health monitoring, optimisation of the type and distribution of the appropriate devices will be possible, together with the development of advanced means to control them such as open and closed loop systems.

Part of this process will be the validation that the manufacturing processes can deliver arrays of devices in sufficient quantity, quality and durability for industrial application. The final step prior to the inclusion of any of these technologies in the product design process will be a large-scale wind tunnel validation. This will evaluate possible performance gains and provide the final and most rigorous set of performance data for industrial assessment.

Results

The expected results are:
- Quantitative performance of each of the high-speed flow-control technologies;
- Identification of promising flow-control technologies for high-speed application through the use of the performance results in an industrial assessment process;
- Specification of the devices selected for industrial validation;
- Quantitative performance results for each of the low-speed flow-control technologies;
- Identification of promising flow-control technologies for low-speed application through the use of the performance results in an industrial assessment process;
- Specification of the devices selected for industrial validation;
- Feasibility studies concerning the manufacturing processes and costs of selected devices;
- Control laws for closed loop actuator systems;
- Optimisation tools for signal specification and array design for devices aimed at T-S instabilities;
- An array, or arrays, of selected devices manufactured to specifications resulting from the device development activity;
- Testing of these devices to measure their quality, performance and durability;
- Modification of one low-speed wind tunnel model and one high-speed wind tunnel model to incorporate selected devices;
- Test results from wind tunnel tests of the modified models;
- Validated performance characteristics of the selected devices.

Acronym:	AVERT	
Name of proposal:	Aerodynamic Validation of Emission Reducing Technologies	
Contract number:	AST5-CT-2006-030914	
Instrument:	STP	
Total cost:	7 494 957 €	
EU contribution:	3 900 000 €	
Call:	FP6-2005-Aero-1	
Starting date:	01.01.2007	
Ending date:	31.12.2009	
Duration:	36 months	
Objective:	Competitiveness	
Research domain:	Aerodynamics	
Coordinator:	Dr Wood Norman Airbus UK New Filton House UK BS99 7AR BRISTOL	
E-mail:	norman.wood@airbus.com	
Tel:	+44 (0)117 9364552	
EC Officer:	D. Knoerzer	
Partners:	Airbus España S. L. Sociedad Unipersonal	ES
	Alenia Aeronautica S.p.A.	IT
	Dassault Aviation	FR
	EADS Deutschland GmbH Corporate Research Center Germany	DE
	Deutsches Zentrum für Luft- und Raumfahrt e.V.	DE
	National Institute for Aerospace Research 'Elie Carafoli'	RO
	Office National d'Etudes et de Recherche Aérospatiales	FR
	Paragon Ltd	GR
	Vyzkumny a zkusebni letecky ustav, a.s.	CZ
	Technische Universität Berlin	DE
	Centre National de la Recherche Scientifique, Délégation Régionale 18	FR
	Universidad Politécnica de Madrid	ES
	University of Manchester	UK
	University of Nottingham	UK
	Centre National de la Recherche Scientifique	FR

ADIGMA

Adaptive Higher-Order Variational Methods for Aerodynamic Applications in Industry

Background

Computational fluid dynamics (CFD) has become a key technology in the development of new products in the aeronautical industry. Significant improvements in physical modelling and solution algorithms have been as important as the enormous increase of computer power to enable numerical simulations in all stages of aircraft development. However, despite the progress made in CFD, in terms of user time and computational resources, large-scale aerodynamic simulations of viscous high Reynolds number flows are still very expensive. The requirement to reliably achieve results at a sufficient level of accuracy within short turnaround times places severe constraints on the application of CFD for aerodynamic data production, and the integration of high-fidelity methods in multidisciplinary simulation and optimisation procedures. The limitations of today's numerical tools reduce the scope of innovation in aircraft development, keeping aircraft design at a conservative level. Consequently, enhanced CFD capabilities for reducing the design cycle and cost are indispensable for industry. Moreover on a longer term, advanced physical models like DES and LES will be used for evaluating the envelope of the final design, but it becomes clear that current results too often depend on the mesh which cannot be tuned sufficiently well, once more stressing the need for novel methods.

Objectives

The goal of the ADIGMA project is to add a major step towards the development of next-generation CFD tools for advanced aerodynamic applications with significant improvements in accuracy and efficiency. The project will focus on the development of novel and innovative adaptive higher-order discretisation methods for the solution of the Navier-Stokes equations at high Reynolds numbers.

The main scientific objectives of ADIGMA are:

– the improvement of key ingredients for higher-order space discretisation methods for the compressible flow equations
– the development of higher-order space-time discretisations for unsteady flows including moving geometries
– the development of reliable adaptation strategies including error estimation, goal-oriented isotropic and anisotropic mesh refinement
– the development of strategies for combining mesh refinement with local variation of the order of the discretisation scheme
– the utilisation of innovative concepts in higher-order approximations and adaptation strategies for industrial applications, as well as the critical assessment of newly developed adaptive higher-order methods for industrial aerodynamic applications, including the measurement of benefits compared to state-of-the-art flow solvers currently used in industry.

Description of work

In order to concentrate effort, the ADIGMA project focuses on two major innovative technologies: higher-order methods and reliable adaptation techniques. They have shown high potential to provide major achievements in CFD for aircraft design. Since the computational efficiency of higher-order methods is currently not compatible with the performance of classical lower-order methods, dedicated developments need to be addressed to improve this situation and to overcome current limitations and bottlenecks. Since ADIGMA is aiming at novel computational strategies for future industrial applications, it is indispensable that industrial partners specify the requirements on next-generation solvers at the beginning of the project and carry out a critical assessment of the newly developed technologies at midterm and towards the end of the project. With the help of a highly skilled consortium, the ADIGMA project is aiming at scientific results and algorithms/methods, which are completely novel in an industrial environment.

Results

The ADIGMA project focuses on the so far fragmented research in higher-order methods in Europe. It will foster the scientific co-operation between the universities, research establishments and the aeronautical industry. The transfer from innovative upstream technologies in CFD into the industrial design cycle will be significantly improved. ADIGMA will provide a major breakthrough in numerical simulation of high Reynolds flows and thus will be essential and indispensable to exploit fully the potential of computational fluid dynamics as the major source for determining data required to drive the aerodynamic design process. Moreover, to support the design of advanced flow control technologies (mainly driven by ecological topics like noise, emissions and by economic (DOC) effects), very precise CFD solutions – fulfilling the needs of, for example, aero-acoustics and complex flow control physics – are the key enablers to reach the ACARE Vision 2020 oriented design goals. ADIGMA is an important cornerstone to support the competitiveness of both the European research community and European aircraft manufacturers. As a benefit, the developed algorithms and solution methodologies will not be limited to aeronautical applications but can also be exploited for flow simulation in general.

Acronym:	ADIGMA
Name of proposal:	Adaptive Higher-Order Variational Methods for Aerodynamic Applications in Industry
Contract number:	AST5-CT-2006-030719
Instrument:	STP
Total cost:	4 887 080 €
EU contribution:	3 200 000 €
Call:	FP6-2005-Aero-1
Starting date:	01.09.2006
Ending date:	31.08.2006
Duration:	36 months
Objective:	Competitiveness

Research domain:	Aerodynamics	
Website:	http://www.dlr.de/as/adigma	
Coordinator:	Dr Kroll Norbert Deutsches Zentrum für Luft- und Raumfahrt e.V. Institute for Aerodynamics and Flow Technology Lilienthalplatz 7 DE 38108 Braunschweig	
E-mail:	norbert.kroll@dlr.de	
Tel:	+49 (0)531 295 2440	
Fax:	+49 (0)531 295 2914	
EC Officer:	D. Knoerzer	
Partners:	Alenia Aeronautica S.p.A.	IT
	Airbus Deutschland GmbH	DE
	Airbus France SAS	FR
	Dassault Aviation	FR
	EADS Military Aircraft	DE
	Centre de Recherche en Aéronautique, ASBL	BE
	Aircraft Research Association Ltd	UK
	Uppsala University	SE
	Institut National de Recherche en Informatique et Automatique	FR
	Stichting Nationaal Lucht- en Ruimtevaartlaboratorium	NL
	Office National d'Etudes et de Recherches Aérospatiales	FR
	von Karman Institute for Fluid Dynamics	BE
	Università degli Studi di Bergamo	IT
	Société d'Etudes et de Recherches de l'Ecole Nationale Supérieure d'Arts et Métiers	FR
	University of Nottingham	UK
	Charles University Prague, Faculty of Mathematics and Physics	CZ
	University of Wales Swansea	UK
	Universität Stuttgart	DE
	University of Twente	NL
	Warsaw University of Technology	PL
	Nanjing University	CN

NODESIM-CFD

Non-Deterministic Simulation for CFD-based Design Methodologies

Background

NODESIM-CFD addresses the EU objectives of reducing aircraft development costs and increasing safety, through the introduction of a new paradigm for CFD-based virtual prototyping, aimed at the incorporation of operational and other uncertainties in the simulation process. The potential for achieving these EU objectives largely depends on the reliability of the virtual prototyping of software systems upon which the design process is constructed. Since many uncertainties affect the parameters and results of a CFD (Computational Fluid Dynamics) simulation, the design process has to develop a methodology by which these uncertainties are taken into account in the decision process.

NODESIM-CFD adheres to the priority items of Strengthening Competitiveness, action 1.a: Integrated design and product development, particularly Advanced modelling and simulation tools, and action 1.1: Breakthrough technologies, particularly in simulation methods. It is believed that the outcome of NODESIM-CFD will have a significant potential towards safety improvement and the objectives of 1.3.1.3 Research Area 3: Improving aircraft safety and security as an inclusion of uncertainty management within the design phase will serve to identify safety aspects and provide a more effective risk management by a reduction of failure risks.

Objectives

As of today, analysis and design methods in the aeronautical industry, particularly the aerodynamic simulation tools based on computational fluid dynamics (CFD) and their multidisciplinary extensions (such as fluid-structure, fluid-thermal, aero-acoustic applications), are based on simulations with a unique set of input data and model variables. However, realistic operating conditions are a superposition of numerous uncertainties under which the industrial products operate (uncertainties on boundary and initial conditions, geometries resulting from manufacturing tolerances, numerical error sources and uncertain physical model parameters). The presence of these uncertainties is the major source of risk in the design decision process and therefore increases the level of risk of failure in a given component.

The technical objective of NODESIM-CFD is to introduce these uncertainties within the simulation process by applying non-deterministic methodologies in order to obtain, instead of a single predicted value, an associated domain of variation of the predicted output quantities.

The main industrial objective of NODESIM-CFD is to provide tools for the evaluation and quantification of uncertainties in aerodynamic and thermal performance predictions, thus supporting the goals of enhanced design confidence, risk reduction and improved safety.

Description of work

The NODESIM-CFD project is composed of the following action lines:

- The identification and probabilistic quantification of the most significant uncertainty sources, related to CFD and multidisciplinary based simulations, of aeronautical components (wings, aircraft and engines).
- The development and incorporation of efficient non-deterministic methodologies into the CFD simulation systems

in order to produce reliability bounds of the predictions (mean and standard deviations of relevant design quantities) in a rational way.
- Application and evaluation of the developed methodologies to the non-deterministic analysis of aeronautical components for industrial relevant configurations.
- The development and application of robust CFD-based design methodologies incorporating the non-deterministically based simulations, enabling rational estimates of probabilities of failure.

Results

Two levels of dissemination and exploitation are defined within NODESIM-CFD: an internal action (during the life of the project) from the developers, mainly university and research organisations and SMEs, towards the industrial end users; and an external action from the consortium to the external world.

The internal dissemination and exploitation consists of a strong action of knowledge transfer between developer partners and end-user partners.

The external dissemination will consist of publications, conference presentations of the new methods (mainly by the research partners), while the industrial partners will also consider application-oriented publications.

Due to the innovative character of NODESIM-CFD, a strong action of information and dissemination of these methodologies will be undertaken. This will take the form of dedicated presentations, for instance at meetings of other EU projects; demonstration of representative case studies by NODESIM-CFD partners; various illustrations of the potential impact of NODESIM-CFD on all future industrial projects where simulations are involved. A final workshop will be considered for a broader dissemination.

As a by-product, we hope that through the NODESIM-CFD project, many engineers and scientists in Europe will be made aware and become motivated to adopt, develop and apply non-deterministic approaches to analysis and design.

Acronym:	NODESIM-CFD
Name of proposal:	Non-Deterministic Simulation for CFD-based Design Methodologies
Contract number:	AST5-CT-2006-030959
Instrument:	STP
Total cost:	4 309 135 €
EU contribution:	2 300 000 €
Call:	FP6-2005-Aero-1
Starting date:	01.11.2006
Ending date:	31.10.2009
Duration:	36 months
Objective:	Competitiveness
Research domain:	Aerodynamics
Coordinator:	Prof. Hirsch Charles Numerical Mechanics Applications International Avenue Franklin Roosevelt, 5 BE Brussels
E-mail:	charles.hirsch@numeca.be
Tel:	+32 (0)2 642 28 01
Fax:	+32 (0)2 6479398
EC Officer:	A. Podsadowski

Partners:	Airbus UK Ltd	UK
	Alenia Aeronautica S.p.A.	IT
	QinetiQ	UK
	Centre Internacional de Metodes Numerics en l'Enginyeria	ES
	Dassault Aviation	FR
	Deutsches Zentrum für Luft- und Raumfahrt e.V.	DE
	Engin Soft Tecnologie per l'Ottimizzazione srl	IT
	Institut national de Recherche en Informatique et Automatique	FR
	MAN Turbo AG, Schweiz	CH
	Office National d'Etudes et de Recherches Aérospatiales	FR
	Scientific Production Association 'Saturn'	RU
	Sigma Technology	RU
	University of Trieste	IT
	Delft University of Technology	NL
	Vrije Universiteit Brussel	BE
	WS Atkins Consultants Limited	UK

KATnet II

Key Aerodynamic Technologies to meet the *Vision 2020* challenges

Background

Due to intense research and technology efforts, Europe is slowly reaching a status of industrial balance with the US, which, for decades, dominated the aeronautics industry worldwide. It is of prime importance that the achieved industry and financial balance is continuously supported by an equivalent co-operation in research and technology development in Europe.

For the achievement of the ACARE Vision 2020 goals, aerodynamic technologies play a dominant role. KATnet II, as a Coordination Action, provides support for reaching this goal in the area of key aerodynamic technologies. The project is the successor of KATnet I (2002 to 2005), a successful Thematic Network of the Fifth Framework Programme.

KATnet II focuses on open upstream research, providing input to the development of strategies and technologies to meet potential future aeronautical requirements on emissions, fuel consumption, noise and safety. The project supports ACARE's Strategic Research Agenda in order to maximise the industrial return of European R&TD investment.

Objectives

The main objective of KATnet II is to identify and assess the aerodynamic technologies that are needed to reach the Vision 2020 goals. This is done by:

1. supporting a joint European approach for defining the necessary technologies for improving aircraft performance. The findings will be reported in a strategy paper.
2. providing a platform supporting communication and strategy development. The platform will be realised by Internet publications, workshops and a major conference on the subject.

Whilst open upstream research in aerodynamics will be primarily addressed, structural, manufacturing, systems, and operational aspects will also be considered in order to ensure a realistic evaluation of the advanced technologies with respect to their application to future aircraft.

Description of work

KATnet I produced a strategy paper on key aerodynamic technologies, which was published in 2005. From this paper the following three technology areas were defined by the KATnet I technology groups as being important for reaching the Vision 2020 goals:

1. Aircraft configuration technologies, covering shape optimisation, adaptive sections, wing-tip devices, high lift systems, engine integration, and novel configurations.
2. Drag reduction technologies covering laminar flow technology, turbulence control, vortex drag reduction technologies, and wave and interference drag reduction technologies.
3. Separation control technologies covering control surfaces, vortex generators, surface suction, tangential blowing, MEMS and load control.

The above technology areas provide a thematic cover for the following ongoing EU-funded aerodynamic projects: AWIATOR (IP), EUROLIFT II (STREP), FLIRET (STREP), HISAC (IP), NACRE (IP), REMFI (STREP), SUPERTRAC (STREP) and TELFONA (STREP).

Other non-EU activities addressed by KATnet II are AIRnet, GARTEUR, ERCOFTAC and corresponding national programmes.

The networking activities provided by KATnet II are implemented through the following four work packages:

'R&T strategy development and exploitation', will identify critical technologies and promotes their development for meeting the Vision 2020 targets, raising industrial awareness, and promoting the exploitation of maturing technologies.

'Multidisciplinary technology assessment' pays special attention to technologies with a strong dependence on multidisciplinary effects, such as performance-related technologies, aerodynamic noise and safety.

'Dissemination of KATnet II information' will provide proactive network support by updating/using the existing KATnet website, distributing newsletters, and promoting the involvement of the academic community, e.g. via the EASN network.

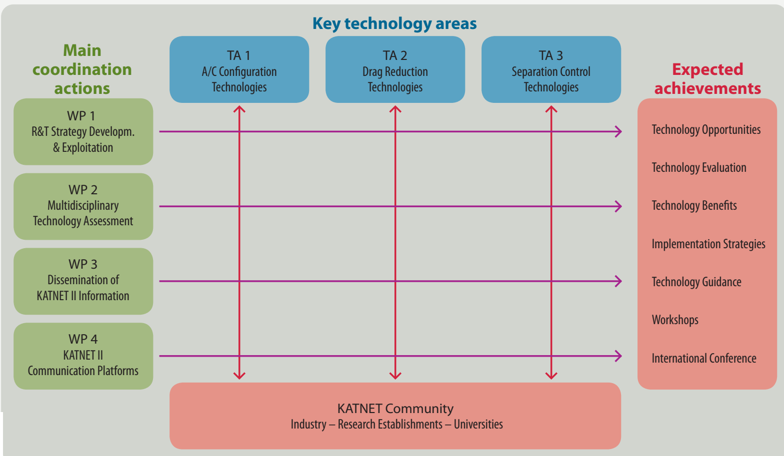
KATnet II communication platforms will make the existing KATnet organisational expertise available by organising workshops, an international conference and other networking events.

The workshops, conference and the dissemination of state-of-the-art technology via an Internet website allow interested parties to receive first-hand information about actual aerodynamic trends, achievements and future strategies of large enterprises. Through seminars, workshops and the conference, about 150 to 200 of the industry's leading specialists will personally be involved in KATnet II communication and dissemination activities.

Results

KATnet II brings engineers, designers and scientists together from all concerned disciplines in order to improve the environmental compatibility of future aircraft, to support the multidisciplinary design process, to foster the understanding between scientists and engineers, and to intensify the dissemination of relevant knowledge.

The expected main achievements of KATnet II are:
- the identification of technology opportunities, investigation of their maturity, benefits and confidence, and the development of strategies for their implementation into future aircraft



KATnet II matrix structure

- the multidisciplinary assessment of potential candidate technologies for virtual aircraft configurations as defined in KATnet
- the dissemination of KATnet II information and results via the KATnet II website and regular newsletters
- the development of strong contacts within the academic community and the integration of organisations in the new Member States of the European Union
- the organisation of seminars and workshops on topics of interest and an international conference on the subject.

Acronym:	KATnet II	
Name of proposal:	Key Aerodynamic Technologies to meet the *Vision 2020* challenges	
Contract number:	ACA5-CT-2006-030943	
Instrument:	CA	
Total cost:	1 183 376 €	
EU contribution:	850 000 €	
Call:	FP6-2005-Aero-1	
Starting date:	01.10.2006	
Ending date:	30.09.2009	
Duration:	36 months	
Objective:	Competitiveness	
Research domain:	Aerodynamics	
Website:	http://www.katnet.eu	
Coordinator:	Dr Schrauf Geza	
	Airbus Deutschland GmbH	
	Kreetslag 10	
	DE 28199 Bremen	
E-mail:	geza.schrauf@airbus.com	
Tel:	+49 (0)421 538 3232	
Fax:	+49 (0)421 538 4714	
EC Officer:	D. Knoerzer	
Partners:	Airbus UK Ltd	UK
	Airbus España S. L. Sociedad Unipersonal	ES
	EADS Military Aircraft Systems	DE
	Dassault Aviation	FR
	Alenia Aeronautica S.p.A.	IT
	Deutsches Zentrum für Luft- und Raumfahrt e.V.	DE
	Office National d'Etudes et de Recherches Aérospatiales	FR
	QinetiQ Ltd	UK
	Swedish Defence Research Agency	SE
	Vyzkumny a zkusebni letecky ustav, a.s.	CZ
	Dziomba Aeronautical Consulting	DE

DIANA

Distributed equipment Independent environment for Advanced avioNic Applications

Background

With the evolution of aircraft systems and technologies, electronics are becoming more and more a critical part of the civil aviation industry. As such, their influence in flight efficiency, safety, security and cost is increasingly becoming a key factor in the development of better aircraft.

With the forecasted demand for new airborne functions and systems, concerning mainly new safety, security and passenger service functionalities, a potential increase in aircraft electronic costs may be seen as an unacceptable factor by airlines. Additionally, the weight and areas available for avionics in an aircraft bay will also limit the introduction of new processing units.

To mitigate this scenario, aircraft industry suppliers are looking to emergent technologies, which have been developed and validated in other technological domains, in order to adapt them to the aeronautical safety critical standards and requirements.

By introducing new breakthrough technologies in the avionics domain, DIANA will contribute to the reduction of an aircraft's development and operating costs, enabling a faster upgrade and replacement of the avionics applications, and contributing to the overall reduction of weight onboard an aircraft through a better use of available computational resources.

Objectives

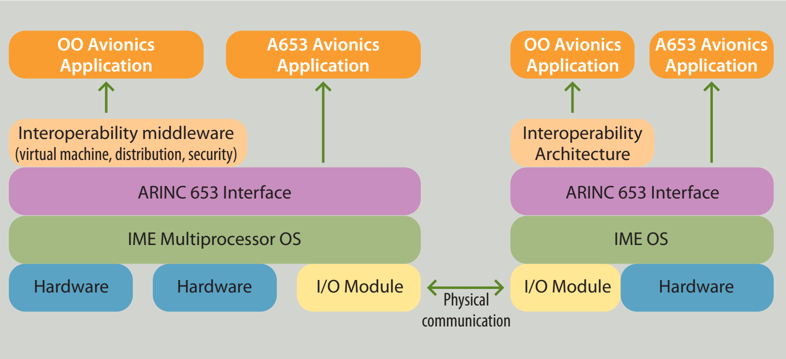
Building on previous work, the DIANA project has the objective to give a first level response for the definition of an enhanced integrated modular electronics (IME) platform, providing avionic applications with a secure distribution and execution on virtual machines. This new platform will be called, in the context of DIANA, Architecture for Independent Distributed Avionics (AIDA). The DIANA project will develop a simulation and evaluation test-bed for AIDA and its associated concepts.

The state of the art in the world of computer engineering development applications (tools, methodologies, etc.) will be analysed. Existing resources will be identified and evaluated in the light of requirements for avionics development. The final result will be a development and certification environment for the AIDA applications, which will include already existing tools, adaptations to these and the design of new ones.

AIDA will benefit greatly from the standardisation of its concept. Therefore, AIDA must be defined by taking as many inputs as possible from the relevant standardisation organisations. This will be done through the participation of these bodies by the members of the DIANA project. At the end of the project, the AIDA definition and associated evaluation test beds will reflect the results of the interaction with the referred standardisation bodies. The development and certification methods will also be designed in a way that will reflect these results.

Description of work

The DIANA project is the first step in the implementation of an enhanced IME platform, providing secure distribution and execution on virtual machines to avionic applications.



Deployment view of DIANA project architecture for independent distributed avionics

The following activities will be performed in DIANA:

a. Defining and evaluating an example IME platform, including:
b. object-oriented (OO) avionic applications running on virtual machines, like the java virtual machine (JVM)
c. services supporting secure distribution (like CORBA) for avionic applications
d. Defining the development process, based on the model-driven engineering (MDE) approach
e. Defining the certification
f. Standardisation of the results of the project.

Today, the development of avionics software accounts for 85% of the cost of the development of avionics. Applying the techniques mentioned above (MDE, OO, CORBA and JVM) into IT systems has achieved reductions of up to 80% in the cost of software development.

Results

DIANA will reduce costs in the development, maintenance and refitting of aircrafts, thus reducing the cost of air travel.

The innovation-related activities performed within the scope of DIANA will influence the following areas:

– The foreseen high degree of contribution to standards will add to the dissemination of the research results achieved in the project. It will also strengthen the influence of Europe in the involved standardisation committees, traditionally dominated by American contributions.
– The strong research focus of DIANA and the dissemination of its results among academic partners will contribute towards strengthening the technological and scientific background of Europe. It will contribute towards creating an image of Europe as a producer of advanced academic and technological results, which is a way of attracting postgraduate students from outside Europe: a known key factor for increasing scientific and technological capability.
– The exploitation of the results from DIANA will allow air framers to integrate more advanced avionic systems with significantly reduced costs. Avionic suppliers will be able to offer more competitive products in a shorter time.
– The advanced goals under study will allow partners to increase their intellectual property rights (IPRs) and consequently their competitiveness.

Acronym:	DIANA
Name of proposal:	Distributed equipment Independent environment for Advanced avioNic Applications
Contract number:	AST5-CT-2006-030985
Instrument:	STP
Total cost:	5 042 129 €
EU contribution:	2 899 694 €
Call:	FP6-2005-Aero-1
Starting date:	01.12.2006
Ending date:	30.11.2009
Duration:	36 months
Objective:	Competitiveness
Research domain:	Avionics
Coordinator:	Mr Neves José Skysoft Portugal - Software e Tecnologias de Informação SA Av. D. João II, Lote 1.17.02, Torre Fernão Magalhães, 7º PT 1998 - 025 Lisbon
E-mail:	jose.neves@skysoft.pt
Tel:	+351 (0)213829366
Fax:	+351 (0)213866493
EC Officer:	M. Brusati

Partners:	Thales Avionics SA	FR
	Alenia Aeronautica S.p.A.	IT
	Dassault Aviation	FR
	Stichting Nationaal Lucht- en Ruimtevaartlaboratorium	NL
	Societa' Italiana Avionica	IT
	Budapest University of Technology and Economics	HU
	AONIX SA	FR
	Universität Karlsruhe (TH)	DE
	Empresa Brasileira de Aeronáutica S.A	BR

MINERVAA

MId-term NEtworking technologies Rig and in-flight Validation for Aeronautical Applications

Background

MINERVAA takes a further step on the roadmap to acquire enabling technologies to implement the future aeronautical broadband network. MINERVAA is capitalising on the experience achieved in other EU-funded projects in the same area of research, particularly in ATENAA.

Indeed, all the studies and efforts carried out in recent years in this area demonstrate that the future aeronautical communication systems will have to support a large number of new services – flight safety, crisis management capability, air-traffic management capability, improvement in flight comfort, increase of onboard available services (in-flight entertainment, e-mailing, telephone calls, etc.) – and solve the relevant technological challenges.

New aeronautical network concepts, based on specific broadband communication technologies (outside-aircraft optical links, inside-aircraft optical links, Ka-band data links using avionic phased-array antennas) have been assessed in principle and are being evaluated and validated in the laboratory environment.

The MINERVAA project is expected to make good progress with this roadmap by bringing the above technologies from the lab to the aircraft.

Objectives

The MINERVAA project, by focusing on key emerging technologies investigated within the ATENAA project, will validate on aircraft and in-flight free space optical communication technologies, both for intra-cabin and outside-aircraft communications, and will continue the basic research on specific technological areas in the field of Ka-band avionic phased-array antennas.

In particular, MINERVAA will concentrate on three main flows of activity:

- outside-aircraft optical link (OOL): the project moves from state-of-the-art requirements and available research results, to concentrating on the implementation of an innovative, low-drag, compact, high data-rate terminal to be installed onboard a dedicated testing aircraft
- inside-aircraft optical passenger network (IOPN): the project takes advantage of the inside-aircraft optical link (IOL) technology, validated within the ATENAA project, to develop an overall passenger optical network, which is able to support different passenger-related applications and is connected to the outer links (e.g. optical and Ka-band) in order to provide broadband connection from ground to seat.
- Ka-band avionic phased-array antennas: this project progresses with ATENAA research activities by investigating at lab level both the integration of TX and RX Ka-band avionic phased-array antennas into a single one, and extending the Satcom design to match the air-to-air communications needs.

Description of work

Outside-aircraft optical link: the OOL airborne terminal will be designed by taking into account a trade-off between ATENAA optimal solutions and installation constraints, particularly with reduced size requirements. Such a terminal design will be validated in flight, together with an innovative ADS-B based pointing mechanism on a platform providing an air-to-ground communication link.

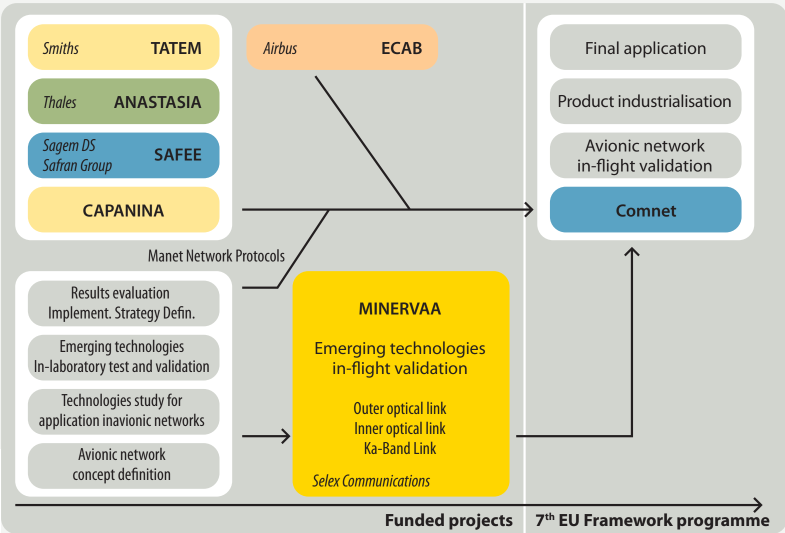
Inner optical passenger network (IOPN): the project exploits the ATENAA in-cabin optical link technology, which is based on diffuse reflected light, to design and implement a complete airborne passenger cabin network. This passenger network will be validated using different kinds of innovative e-services for passengers, such as passenger seat occupation monitoring, health monitoring, homeland security related services and video-on-demand. The validation platform will be implemented in a cabin mock-up to provide a realistic environment scenario.

Ka-band avionic phased-array antennas integration and validation: the project aims at investigating the technologies capable of increasing the Ka-band antenna's compactness in order to make easier antenna integration on aircraft, in particular by integrating TX and RX antennas, as well as developing specific calibration and a beam-forming algorithm for control of the steering antennas. A test-bed will evaluate aircraft-aircraft Ka-band communication and an algorithm will be developed, which addresses the calibration and beam-forming issues of TX/RX Ka-band antennas, thus going one step further from the ATENAA project on what concerns antenna integration and steering control.

Results

MINERVAA will deliver:

– an in-flight validated free-space optic communications system, aimed at civil aviation applications, including a compact airborne terminal and position auxiliary channel
– an integrated passenger optical cabin network, validated in a cabin mock-up using a set of passenger-related applications, ready for new aircraft development and aircraft refurbishment
– a design for an integrated TX/RX Ka-band avionic phased array antenna for aircraft-aircraft communications, and a steering control algorithm for both TX/RX Satcom and aircraft-aircraft Ka-band antennas.



MINERVAA project in the context of EU-funded research

Acronym:	MINERVAA	
Name of proposal:	MId-term NEtworking technologies Rig and in-flight Validation for Aeronautical Applications	
Contract number:	AST5-CT-2006-030808	
Instrument:	STP	
Total cost:	5 528 467 €	
EU contribution:	2 993 610 €	
Call:	FP6-2005-Aero-1	
Starting date:	01.03.2007	
Ending date:	28.02.2010	
Duration:	36 months	
Objective:	Competitiveness	
Research domain:	Avionics	
Website:	http://www.minervaa.org	
Coordinator:	Dott. Amirfeiz Massimiliano	
	Selex Communications SpA	
	Via Pieragostini, 80	
	Via Negrone, 1A	
	IT 16151 Genova	
E-mail:	massimiliano.amirfeiz@selex-comms.com	
Tel:	+39 010 614 4479	
Fax:	+39 010 614 4602	
EC Officer:	J. Blondelle	
Partners:	Deutsches Zentrum für Luft- und Raumfahrt e.V.	DE
	EADS Deutschland GmbH	DE
	IN.SI.S. SpA	IT
	SAGEM Défense Sécurité	FR
	Technological Educational Institute of Piraeus	GR
	Thales Communications	FR

COSEE

Cooling of Seat Electronic box and cabin Equipment

Background

New generations of in-flight entertainment (IFE) systems are required to provide more and more services (audio, video, Internet, flight services, multimedia, games, shopping, phone, etc.) at an affordable cost. But unlike other avionics systems installed in temperature-controlled bays, most of the IFE equipment and boxes are installed inside the cabin. They may be buried in small enclosed zones, not connected to the aircraft cooling system (ECS), and this situation creates thermal management problems that affect the reliability, safety and cost of the equipment. The most critical piece of equipment is the SEB (seat electronic box) installed under each passenger seat.

To face the increasing power dissipation, fans are used but with the following drawbacks: extra cost, energy consumption when multiplied by the number of seats, reliability and maintenance concern (filters, failures, etc.), risk of blocking by passengers' belongings, and noise, coupled with unpleasant smells creating disturbance in the overall cabin area.

The objectives of the project are, therefore, to develop and evaluate an alternate advanced cooling technique to the fans based on a loop-heat-pipe, phase-change passive system, adequately integrated inside the seat structure and taking advantage of the seat frame as a heat sink or of the aircraft structure when installed in the ceiling.

Objectives

A European collaboration is necessary due to the multidisciplinary nature of the problems to be solved and the fact that the necessary expertise and knowledge do not lie in a sole nation (e.g. phase-change simulation and design, heat pipe manufacturing, equipment cooling, seat integration and development, aircraft interfaces).

An international co-operation with ITP (Russian research leader and pioneer in the field of miniature loop heat pipes) is proposed to strengthen the consortium research team.

The quantified technical and scientific objectives are to develop a new cooling enhanced thermal link dedicated to cabin IFE equipment, which will have the following characteristics:

- transfer capacity up to 100 W (existing equipment is between 30 and 75W)
- thermal conductivity equivalent or greater than 800 W/m/°K (twice of that compared to copper)
- heat transportation distance 500 mm (max)
- resistance to aircraft cabin environment (vibration, acceleration, shocks, airbus specifications)
- minimum volume and low weight
- ease maintenance
- affordable cost target vs. cost of a fan system

Two Fifth Framework Programme projects are relevant to COSEE: MCUBE, dedicated to the development of micro heat pipes and ANAIS, dedicated to improved IFE architecture. Both are coordinated by Thales Avionics and will bring experience and results to this project.

Description of work

The technical programme is divided into six work packages (WP), distributed by type of activity.

Research and innovation activity:

WP1 General technical analysis:

- System specifications
- Comparison of existing cooling options
- System mock-up definition
- Test file definition

WP2 Loop-heat-pipe studies:
- Theoretical approach
- Technology mock-up experimentation
- LHP development

WP3 System integration designs:
- Equipment integration
- Seat integration

WP4 System mock-up development:
- LHP manufacturing
- Equipment adaptations
- Seat adaptations

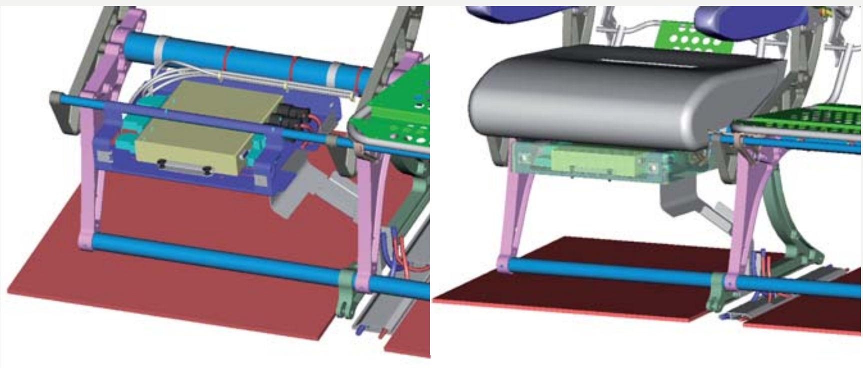
WP5 Performance evaluation:
- Thermo-mechanical performance evaluation

Management activity:
- WP6 Synthesis, exploitation and project management.

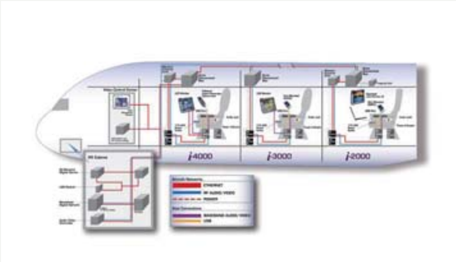
Results

The deliverables for this project are:
- D1 Technical report on module specificationsT0+6
- D2 Technical report on HP simulations and experimentationT0+18
- D3 Laboratory experimentationsT0+18
- D4 Technical report on system integrationT0+18
- D5 Technical report on system mock-up definitionT0+24
- D6 Technological system mock-up assembly reportT0+24
- D7 Test report on thermo-mechanical performanceT0+30
- D8 Final report with synthesis and limits of technologiesT0+30

All the companies providing IFE systems today are of American and Japanese ownership and origin. The top four players are supported by huge national companies that have the critical mass to fund research into new generations of products every two or three years. The technological revolution of recent years – moving from analogue systems to integrated digital systems – will continue over the coming years as components evolve in terms of package size and complexity, and because of the convergence of Internet, TV and audio standards; so-called multi-media. Currently the only realistic way for European players to compete in this market is by grouping the experience and knowledge of key partners in a given sector, as in COSEE.



Seat installation



Acronym:	COSEE
Name of proposal:	Cooling of Seat Electronic box and cabin Equipment
Contract number:	AST5-CT-2006-030800
Instrument:	STP
Total cost:	3 200 793 €
EU contribution:	1 886 137 €
Call:	FP6-2005-Aero-1
Starting date:	01.06.2006
Ending date:	30.11.2008
Duration:	30 months
Objective:	Competitiveness
Research domain:	Cabin Environment
Coordinator:	Mr Sarno Claude Thales Avionics SA 25 rue Jules Vedrines FR 26027 Valence
E-mail:	claude.sarno@fr.thalesgroup.com
Tel:	+33 (0)4 75 79 86 57
Fax:	+33 (0)4 75 79 86 06
EC Officer:	M. Brusati

Partners:	Avio Interiors	IT
	BRITAX Premium Aircraft Interior Group	UK
	RECARO Aircraft Seating GmbH & Co. KG	DE
	Euro Heat Pipes	BE
	University of Stuttgart	DE
	INSA LYON	FR
	Vyzkumny a zkusebni letecky ustav, a.s.	CZ
	Institute of Thermal Physics	RU

E-Cab

E-enabled Cabin and Associated Logistics for Improved Passenger Services and Operational Efficiency

Background

Travel has improved much in the last 100 years, from being an adventure to the height of the 'golden age', when the mere ability to travel accorded a person significant privilege. Back then, access to the aircraft was assured and once onboard, the facilities and service were very much representative of what would have been available in other situations to which the traveller would have been exposed.

Since then, there has been much diversification in travelling, with the development of many classes of travel in order to offer a wide choice of services for the passengers to select the overall travel quality experience that suited their means and their aspirations.

However, the ever-growing volume of passengers and the high complexity of airports have dramatically increased, to the point where travel quality is being considerably affected by the process prior to aircraft access. Thus, for ensuring seamless logistic processes that keeps the traveller contented, the entire flying experience is to be redesigned, covering the whole end-to-end process from start to finish.

Objectives

The E-Cab project will provide answers to the identified issues by improving the end-to-end-travel processes in a holistic approach. The objectives for this are threefold:

1. To increase passenger choice with regard to travel costs, time to destination, onboard services and comfort. This will be provided by a more convenient boarding/deplaning of passengers and by offering onboard office and home-like functionalities, which shall be adaptable to passengers' individual preferences and making use of the most advanced information and communication technologies available.
2. To reduce the aircraft's direct operating costs in order to improve the airline's competitiveness. This will encompass e-enabled optimised ground handling for a reduction in aircraft turnaround time, e-enabled mission adaptive cabins for a simplified cabin reconfiguration during operation, and cabin crew workload reduction through effective cabin e-management tools using air-to-ground communications.
3. To reduce aircraft development costs in order to enable the European aircraft industry to build cost-efficiently operable and easy customisable aircraft. This shall be achieved by modular and flexible system architectures, by introducing innovative wireless concepts for in-flight entertainment (IFE) and cabin/cargo management, leading to reduced aircraft manufacturing and customisation costs.

Description of work

In order to achieve E-Cab's ambitious goals and correctly manage the complexity of the development task, the project is organised around eight interconnected technical sub-projects, four of which reflect the four main streams under discussion:

– The end-to-end chain 'Passenger Services' will particularly concentrate on wireless and 3G (third generation)

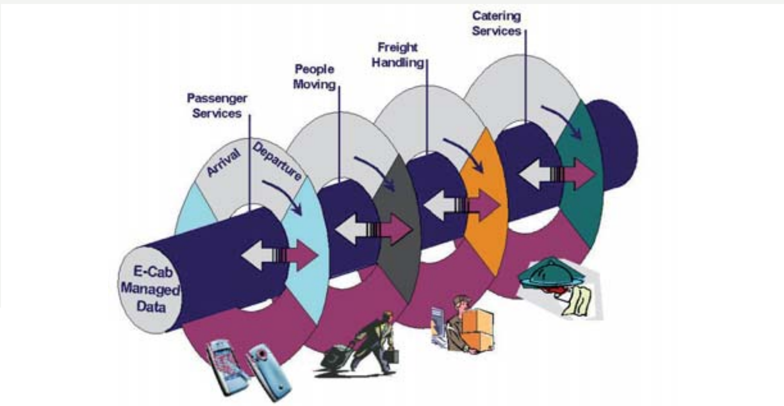
communication technologies applied to digital passenger entertainment and seamless connectivity.
- The end-to-end chain 'People Moving' covers the seamless fulfilment of passenger tracing, guidance and other useful information via stationary and/or mobile solutions.
- The end-to-end chain 'Freight Handling' addresses seamless, automated baggage and cargo management solutions, mainly based on radio frequency identification (RFID).
- The end-to-end chain 'Catering Services' will develop new technologies and processes for covering the ground logistics, the service onboard as well as the data intercommunication between booking and scheduling processes.

These four sub-projects cover most of the project development, starting from requirement definitions up to pre-integration and testing of subsystems. They are preceded and monitored by an additional sub-project 'Requirements, Concepts and Standards' that ensures the consistency and coherency between the four end-to-end chains.

The key part of the E-Cab project will be the 'Communication Infrastructure', which interconnects the different e-logistic chains and allows the developed service applications to 'talk' to each other and exchange data on an integrated network platform. For proving the smooth interaction between all end-to-end-chains, tests will be performed on a full-scale 'Integration and Verification' platform that will integrate all sub-systems under study. One last technical sub-project is dedicated to the 'Evaluation, Dissemination and Exploitation' of the project results.

Results

The E-Cab project will investigate and deliver improvements within each of the aforementioned end-to-end service and logistic chains, but more significantly will focus on the benefit to be derived from effective interaction between them. It will set up a framework of seamless, validated processes, comprising the set of enabling key technologies across the spectrum of E-Cab technical domains and the underlying common communication infrastructure. The successful completion of this project shall pave the way for the European aviation industry to offer a step change in passenger service concepts.



Deployment view of DIANA Project Architecture for Independent Distributed Avionics

Acronym:	E-Cab
Name of proposal:	E-enabled Cabin and Associated Logistics for Improved Passenger Services and Operational Efficiency
Contract number:	AIP5-CT-2006-030815
Instrument:	IP
Total cost:	23 084 246 €
EU contribution:	12 500 000 €
Call:	FP6-2005-Aero-1
Starting date:	01.07.2006
Ending date:	30.06.2009
Duration:	36 months
Objective:	Competitiveness
Research domain:	Cabin Environment
Coordinator:	Dr Rueckwald Reiner Airbus Deutschland GmbH Kreetslag 10 DE 21129 Hamburg
E-mail:	Reiner.Rueckwald@airbus.com
Tel:	+49 (0)40 743 76878
Fax:	+49 (0)40 743 76232
EC Officer:	M. Brusati

Partners:	Ascom (Switzerland) Ltd	CH
	B&W Engineering GmbH & Co. KG	DE
	CeBeNetwork France S.A.R.L	FR
	Centre National de la Recherche Scientifique	FR
	Dassault Aviation	FR
	Diehl Aerospace GmbH	DE
	Dansk Teknologi Udviklingsaktieselskab	DK
	EADS Deutschland GmbH	DE
	Bucher Leichtbau AG	CH
	Cranfield University	UK
	Giunti Interactive Labs S.r.l.	IT
	University of Malta	MT
	Centro IBERLog, Associação para o Desenvolvimento da Logística e da Organização	PT
	Identec Solutions AG	AT
	Jettainer GmbH	DE
	Microtech International Ltd Sp. z o.o.	PL
	OnAir N.V.	NL
	Rheinmetall Defence Electronics GmbH	DE

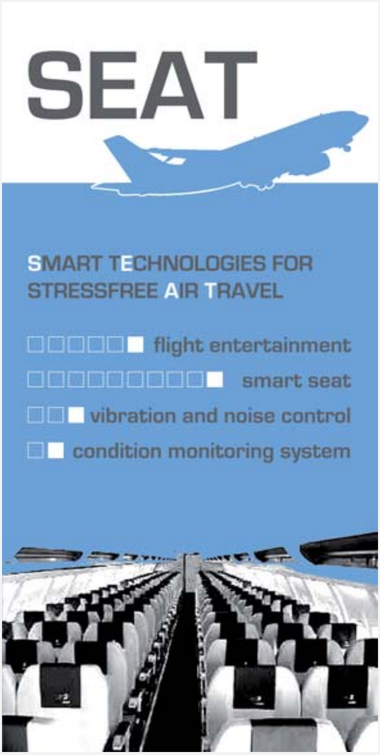
Fundación Robotiker	ES
SELEX Communications SPA	IT
Siemens Business Services GmbH & Co. OHG	DE
Siemens Business Services spol. s r.o.	CZ
ULTRA Electronics Limited trading as ULTRA Electronics Airport Systems	UK
SITA (Société Internationale de Télécommunications Aéronautiques) SC	BE
Thales Avionics UK	UK
Terma A/S	DK
TriaGnoSys GmbH	DE
Thales Avionics SA	FR
TNO - Nederlandse Organisatie voor toegepast-natuurwetenschappelijk onderzoek	NL
Universitaet Bremen	DE

SEAT

Smart Technologies for stress free AiR Travel

Background

Passenger comfort is clearly a main factor in a user's acceptance of transportation systems. An individual's reaction to a vehicle environment depends not only on the physical inputs but also on the characteristics of the individual. The findings of a number of passenger surveys and comfort-related research indicate that there is not a universal optimal setting for comfort-related parameters in a plane.



Hence individual passengers are always likely to have certain conflicting requirements as the perception of comfort is affected by a variety of factors – gender and ethnicity being among the most important ones.

SEAT promotes a radically new concept where passenger comfort is taken to a new level. The SEAT system will develop smart responsive seats and an interior environment with the capability of detecting physiological and psychological changes in a passenger's condition in real time. This in turn will be analysed and appropriate adjustments, such as temperature control, air ventilation, seat parameters, etc., put in place. Furthermore passengers will be able to create their own surroundings with personal entertainment and office characteristics in place. The entire approach is to create an environment that responds to individual requirements and desires which is not centrally controlled or manually adjusted. The system is based on advanced technologies and systems developed by the partners as breakthrough research developments or other advanced technologies.

Objectives

The project is focused on:

- the creation of a 'smart seat' that adapts the climatic characteristic to the passenger physiological status,
- integrated physiological monitoring system with health alert options,
- the development of a system for active/passive vibration dampening incorporating smart textiles
- the development of interactive entertainment,
- the development of fully integrated cabin passenger services.

The main SEAT objectives can be defined as follows:

1. To develop a system that suppresses overall noise, as well as for each passenger,
2. To develop novel approaches to active/passive vibration reduction incorporating smart technologies and textiles in particular,
3. To develop technology that allows a healthier cabin environment including temperature, pressure, airflow and humidity,
4. To develop onboard systems that will enable office-like and home-like services,
5. To develop a functional prototype of the SEAT system that will be an important stage in the development of an e-cabin.

Description of work

The aim of SEAT is to produce an integrated system for cabin services and environmental control. The work plan described in this section will ensure that all the key objectives of the project are met.

The project is structured as follows:
WP1: Physiological monitoring of passengers systems,
WP2: Smart seat,
WP3: Noise and vibration attenuation,
WP4: Interactive and integrated entertainment,
WP5: Development of an integrated adaptable system.

The philosophy of the work programme is simply to avoid unnecessary management complication and to ensure a superior but simple concept.

The work packages (WP) 1-4 are designed in a way to reflect the most important environment features from the passengers, point of view. They are run in parallel as WP5 is providing compatibility and co-work for the technologies and once developed they will be incorporated in the fully integrated SEAT system. The second important feature of this design, apart from compatibility, is flexibility and self-sufficiency – each of the developments will be compatible with the central system and will be able to function as a stand-alone feature. This modular approach will guarantee sufficient flexibility for the provision of different levels of service.

Results

Innovation-related activities: One of the major innovations of the SEAT project is the development of a novel integrated cabin environment that incorporates:

- physiological monitoring with a health alert option that is not in existence in aircrafts, but partners in this consortium have developed such technologies for different applications,
- a 'smart seat' that actively addresses potential health hazards and is an integral part of the onboard entertainment,
- 'smart textiles' and other smart technologies for vibration dampening and noise reduction,
- an innovative active/passive noise control based on advanced computational models,
- interactive context-based entertainment,
- an integrated approach to comfort, entertainment and creation of flexible home/office environment.

These innovative building blocks are based on:

1. Innovative wearable technologies for physiological modelling,
2. Transferring physiological models developed for sport and health applications,
3. Using intelligent textiles with built-in sensors and active dampening facilities,
4. Developing structural analysis tools that allow simulating and assessing the effect of different 'smart solutions',
5. Developing fully compatible modules that can work in isolation or communicate with each other,
6. Utilising existing working technologies developed by the partners in the area of avionics, onboard entertainment, noise control, smart textiles and wearable monitoring.

Acronym:	SEAT
Name of proposal:	Smart Technologies for stress free AiR Travel
Contract number:	AST5-CT-2006-030958
Instrument:	STP
Total cost:	3 065 000 €
EU contribution:	2 136 500 €
Call:	FP6-2005-Aero-1
Starting date:	01.09.2006
Ending date:	31.08.2009
Duration:	36 months
Objective:	Competitiveness
Research domain:	Cabin Environment
Website:	http://www.SEAT-Project.org
Coordinator:	Prof. Aliabadi Ferri M. H. Imperial College of Technology and Medicine Exhibition Road UK London
E-mail:	m.h.aliabadi@imperial.ac.uk
Tel:	+44 (0)207 594 5079
EC Officer:	J.L. Marchand

Partners:	Acústica y Telecomunicaciones, S.L.	ES
	Asociación de Investigación de la Industria Textil	ES
	Antecuir S.L.	ES
	Centre for Applied Cybernetics	CZ
	INSTITUTO TECNOLOGICO DEL CALZADO Y CONEXAS	ES
	Queen Mary and Westfield College	UK
	STARLAB	ES
	Technische Universiteit Eindhoven	NL
	Thales Avionics SA	FR
	DHS	IE

MOET
More Open Electrical Technologies

Background

In line with Vision 2020, MOET aims to establish a new industrial standard for commercial aircraft electrical system design, which will directly contribute towards strengthening the competitiveness of the aeronautical industry. The project will also contribute to reducing aircraft emissions and improving operational aircraft capacity.

Recent national and European research activities and state-of-the-art commercial aircraft developments have launched more advanced approaches for onboard energy power management systems. These benefits have also been recognised in North America where they are being given special consideration.

A step change is necessary to remove current air and hydraulic engine off-takes and further increase the electrical power generation capability. This in itself will require significant changes to current electrical generation and network techniques.

After Fly-by-wire, the Power-by-wire concept (PbW) will enhance aircraft design and use by power source rationalisation and electrical power flexibility. This will be achieved by developing the necessary design principles, technologies and standards.

Objectives

The main MOET objectives aim at validating design principles, technologies and standards for innovative PbW concepts with an open-system approach from components, from equipment through to design.

The project's objectives are:

- to define and validate new electrical networks up to 1MW. The deliverables will be innovative electrical network principles (full HVAC, full HVDC or hybrid) up to 1MW for a broad range of aircraft matching with PbW needs to be validated through component, equipment and network simulations and tests.
- to resolve and validate the transformation of users into all electrical solutions. These deliverables will be on air conditioning, wing ice protection, cooling and actuation systems validating the transformation into all electrical solutions with validation by hardware, such as integrated smart power pack or jamming-free EMA, tests and/or simulation.
- to develop and validate power electronics enabler technology. The deliverables will be a representative set of integrated power electronics converters validating high-performance technology capability based on potential innovative new standards.
- integration into aircraft. These deliverables will be a set of studies validating PbW integration into aircraft and highlighting new installation constraints and opportunities.
- to develop a coherent design environment to support PbW design and validation. The deliverables are a set of simulation and integrated rig platforms permitting future PbW concept development, validation, optimisation and assessment.

Description of work

MOET provides a comprehensive approach to PbW by simultaneously gathering a broad range of aircraft manufacturers with their requirements and a broad range of partners providing technologies ranging from components to systems.

The project will validate design principles of an innovative PbW concept.

The project aims at defining generic architecture, equipment and components by developing technologies based on standards for cost and risk reductions. Specialist power electronics companies have joined the project to add their expertise.

Integration aspects will be considered through numerical mock-ups to validate system integration. More composite aircraft will be considered based on ALCAS results.

Simulation and rig open platforms will allow the project to validate PbW concept-gathering models and hardware from generators up to users. Standard designs and validation rules will enhance their capability to integrate technologies securely into their equipment.

Results

MOET will establish and reinforce a critical mass of competences for a complete PbW solution across aircraft companies and supply chains by developing key technologies based on a broad European expertise.

At aircraft level, the PbW concept, by definition, will increase the criticality of electrical generation and distribution and move the boundaries between the systems.

At system level, the PbW concept, by definition, will increase the number of electrical users which significantly affects the electrical network. The PbW concept by definition will extend electrical system applications.

At component level, the PbW concept by definition will increase power electronics, which is no easy technology to master. PbW will extend the common technologies.

The European supply chain for PbW solutions and technology will be stronger than its competitors in the United States.

The project will also contribute towards burning less fuel by increasing electrical generation and distribution capabilities onboard aircraft.

Aeronautics is a key sector for European technology which powers other industrial fields. These major companies in turn power their associated supply chain. The supply chain, especially component manufacturers, will enrich their competitiveness by demonstrating their capabilities to produce innovative and high-quality components for their non-aeronautic market.

In addition to industrial benefits, MOET aims to develop an innovative electrical network to develop the PbW concept for which 2% fuel saving has been foreseen with respect to the current state of the art.

Acronym:	MOET
Name of proposal:	More Open Electrical Technologies
Contract number:	AIP5-CT-2006-030861
Instrument:	IP
Total cost:	66 489 777 €
EU contribution:	37 756 231 €
Call:	FP6-2005-Aero-1
Starting date:	01.07.2006
Ending date:	30.06.2009
Duration:	36 months
Objective:	Competitiveness

Research domain:	Electric & Mechanical Systems	
Website:	http://www.moetproject.eu	
Coordinator:	Mr Jomier Thomas Airbus France 316 route de Bayonne FR 31060 Toulouse cedex 9	
E-mail:	thomas.jomier@airbus.com	
Tel:	+33 (0)5 61 18 86 73	
Fax:	+33 (0)5 61 93 07 58	
EC Officer:	H. von den Driesch	
Partners:	Airbus Deutschland GmbH	DE
	Airbus España, S.L. (Sociedad Unipersonal)	ES
	Airbus SAS Central Entity	FR
	Airbus UK	UK
	Alenia Aeronautica S.p.A.	IT
	ARTTIC SAS	FR
	ARTUS S.A.S	FR
	EADS Astrium Crisa	ES
	CROUZET Automatismes	FR
	Dassault Aviation	FR
	Deutsches Zentrum Für Luft- und Raumfahrt e.V.	DE
	DYNEX Semiconductor Limited	UK
	EADS CCR	FR
	EADS Deutschland GmbH Corporate Research Centre	DE
	Egida Net	PL
	EURILOGIC MAGALI	FR
	Eurocopter SAS	FR
	Goodrich Actuation Systems	FR
	Goodrich Actuation Systems Limited	UK
	Goodrich Control Systems Limited,trading as Goodrich Power Systems	UK
	Hispano-Suiza	FR
	LABINAL S.A	FR
	Institut National Polytechnique de Toulouse	FR
	Institut National Polytechnique de Grenoble	FR
	Liebherr Aerospace Toulouse S.A.S.	FR
	Liebherr Aerospace Lindenberg GmbH	DE
	Liebherr Elektronik GmbH	DE
	Microtech International Ltd	PL
	MICROTURBO	FR

MOOG Ireland Ltd	IE
Stichting Nationaal Lucht- en Ruimtevaartlaboratorium	NL
Paragon Ltd	GR
První brnenská strojírna Velká Bítes, a.s.	CZ
PCA Engineers Limited	UK
Puissance Plus	FR
Rolls-Royce plc	UK
ROLLVIS SA	CH
Saab AB (publ)	SE
SAGEM SA	FR
Société Européenne D'Ingénierie multiTEchnique et de Communication	FR
SEMELAB plc	UK
Siemens Aktiengesellschaft	DE
Smiths Aerospace	UK
SNECMA	FR
Técnica Electronica de Automatismo y Medida SA	ES
Techniques et Fabrications Electroniques SA	FR
Thales Avionics Electrical Systems SA	FR
TTTech Computertechnik AG	AT
Ultra Electronics Limited - Controls Division	UK
A UK academic consortium consisting of the Universities of Nottingham, Sheffield, Manchester and Bristol	UK
Universitat Politècnica de Catalunya	ES
Gdansk University of Technology	PL
Technische Universität Hamburg-Harburg	DE
Lappeenranta University of Technology, Laboratory of Fluid Dynamics	FI
Seconda Universita degli Studi di NAPOLI II - Dipartimento di Ingegneria dell'Informazione	IT
Universidad Publica de Navarra	ES
Universita' degli Studi di Padova	IT
Technological Education Institute of Piraeus	GR
ECE	FR
Intertechnique	FR

NEFS

New track-integrated Electrical single Flap drive System

Background

The high lift system of large transport aircraft comprises leading edge slats and trailing edge flaps and is deployed during take-off and final approach, providing additional lift to get or stay airborne at low speeds.

Symmetric flap actuation is traditionally assured by coupling all flap surface actuators to a torque shaft system, which extends along the rear spar of both wings and is driven by a centralised hydraulic, electric or hybrid motor. The actuators are located at or near special flap support structures called track beams which transmit the lift produced by the movable flap surfaces to the wing.

Conventional flap drive systems have a low efficiency, require a high installation effort with shafts and gearboxes distributed across most of the wing trailing edges and offer no functional flexibility, e.g. differential surface deflection.

It is the target of NEFS to fundamentally change the high lift drive system and structure presently installed in commercial transport aircraft. It is proposed to develop a distributed electrical flap drive system that is completely integrated with the flap track beams. This new technology is an enabler for new functionalities, which are developed in related RTD projects like AWIATOR, NACRE or ATEFA. It will also allow an increase in the fault tolerance of the high lift system.

Objectives

The main objective of NEFS is to replace the traditional drive systems by a distributed electrical flap drive system that is completely integrated into the flap support structure. The transmission shaft system and centralised motor will be replaced. The track beams will be redesigned to enable an optimised system-structure solution for this new flap drive system. This provides the opportunity for an innovative composite design in flap support structures.

The proposed flap drive system offers a fundamental change in high lift drive technology compared to state-of-the-art systems. The expected benefits are:
- new functionalities of the high lift system via differential flap setting (DFS), like accelerated vortex decay, roll trim and roll control support
- reducing operational interruptions caused by high lift systems by at least 15%
- improving the drive system efficiency by at least 25%
- a 2-3% L/D improvement in cruise
- a 20% weight reduction of the flap track beam due to highly integrated composite design
- a 5% cost reduction in the manufacturing and assembly of the flap track beam due to the minimised number of parts
- improved maintainability
- reduced installation effort (for design and manufacturing).

Description of work

As a baseline for the boundary conditions and the assessment of improvements, reference data will be adopted from a state-of-the-art commercial transport aircraft.

One of the main criteria for the system to be developed is the high requested level of redundancy, primarily concerning the motors and electronics. To address this problem, advanced redundancy concepts will be developed.

Different drive system concepts are conceivable to reach the above-mentioned goals: a high torque/low speed approach with a rather heavy motor, but possibly making an additional gearbox obsolete, will be compared to a geared low torque/high speed drive. The competing solutions will be developed by different partners.

A highly integrated composite design has to be realised to achieve a significant weight reduction of 20% in the flap support structure compared to the metallic reference. In order to integrate a maximum amount of composite expertise into the design, two different concepts are developed by different partners. The concepts will be evaluated by all partners and the best solution will be realised in the design and manufacturing phase.

During the drive system development it will be assured and verified by CATIA installation studies that the drive system fits into the limited space below the track beam fairing, requiring a close link between system and structure development activities.

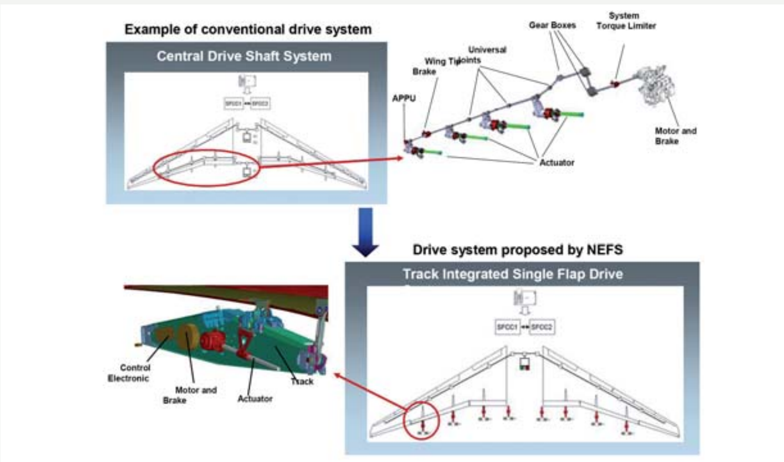
The analysis of repercussions of system performance and failures on aircraft behaviour requires combined system-aircraft simulation and aircraft performance analysis. Results from this analysis may reveal the necessity of additional monitoring functions or tighter monitoring thresholds.

Results

If successful, the NEFS flap drive and support system will set a benchmark for future aircraft models. The proposed approach will be flexible enough to cover almost all kinds of high lift system requirements including advanced aircraft and wing configurations.

The results of NEFS will be reported and engineering design recommendations will be published in order to assure a seamless exploitation of results. Utilisation of this technology will significantly contribute to the European aerospace industries' capability of supplying products that can maintain 50% of the market for large transport aircraft.

Although the European aircraft systems suppliers' global market share is significant, US system suppliers still have the dominant position in almost all product groups, with the US industry being strongly supported by its government.



Approach of NEFS

NEFS RTD work will support the systems industries' striving for hig hly competitive products and thus prepare the ground for a balanced market access comparable to the one achieved by Airbus. The same holds true for the partners involved in structure development.

Acronym:	NEFS	
Name of proposal:	New track-integrated Electrical single Flap drive System	
Contract number:	AST5-CT-2006-030789	
Instrument:	STP	
Total cost:	6 128 977 €	
EU contribution:	3 600 000 €	
Call:	FP6-2005-Aero-1	
Starting date:	01.03.2007	
Ending date:	28.02.2010	
Duration:	36 months	
Objective:	Competitiveness	
Research domain:	Electric & Mechanical Systems	
Coordinator:	Mr Christmann Markus EADS Deutschland GmbH, Corporate Research Centre Willy-Messerschmitt-Straße DE 81663 Munich	
E-mail:	markus.christmann@eads.com	
Tel:	+49 (0)89 607 20159	
Fax:	+49 (0)89 607 21717	
EC Officer:	J. Blondelle	
Partners:	ACE GmbH – Advanced Composite Engineering	DE
	BAE Systems (Operations) Ltd	UK
	Diehl Avionik Systeme GmbH	DE
	Deutsches Zentrum für Luft- und Raumfahrt e.V.	DE
	Airbus Deutschland GmbH	DE
	Goodrich Actuation Systems Ltd	UK
	RUAG Aerospace	CH
	SAAB AB (publ), Saab Avitronics	SE
	Stridsberg Powertrain AB	SE
	Helsinki University of Technology	FI
	Institut für Verbundwerkstoffe GmbH	DE
	Politechnika Warszawska (Warsaw University of Technology)	PL

DATAFORM

Digitally Adjustable Tooling for manufacturing of Aircraft panels using multi-point FORMing methodology

Background

DATAFORM is highly innovative because it is rapid and cost-effective in panel forming when compared to the traditional solid die forming or increment forming technology. Today there are three main surface sheet forming technologies and two thin-wall panel positioning technologies available for fabrication and assembly of aircraft bodies in terms of rapid and economical production. Forming technologies are well established: semi-die forming technologies, such as age creep forming and stretch forming; incremental forming technologies, such as the shot peen forming, laser forming and single-point incremental forming; and dieless forming technologies, such as reconfigurable tool forming and multi-point forming. The two positioning technologies are simple modular fixturing technologies used to clamp parts for machining, and extremely expensive reconfigurable fixturing technologies used to hold work pieces for inspection. With respect to current aircraft manufacturing technology, the advantage of DATAFORM is flexible dieless forming and extremely rapid jigless positioning, which are two decisive advantages regarding emerging new aeronautical production requirements. In general, DATAFORM has the following advantages compared with other aircraft panels manufacturing technologies: high flexibility, high efficiency, large deformation capability and low tooling cost.

Objectives

The main objectives of DATAFORM are the development and application of digitally adjustable multi-point forming tooling and multi-point positioning tooling for fabrication and assembly of aircraft panels. In particular, DATAFORM will enable flexible and digital manufacturing of skin panels in aircraft bodies.

The industrial and scientific objectives of the project are:

- to explore fundamental adjustable multi-point tooling technology for forming and fabrication;
- to develop digitally adjustable multi-point tooling systems comprising punch matrices to replace solid dies or hard tooling;
- to realise rapid dieless forming of skin panels and accurate jigless fabrication of panel segments;
- to investigate the implementation of the DATAFORM tooling in the manufacturing of aircraft products;
- to reduce tooling costs, set-up time, lead time and storage, and to increase tooling utilisation significantly.

It is the aim of DATAFORM to empower digitally adjustable tooling technology with a clear focus on its industrial use for aeronautics and to drive the rapid development of flexible tooling in manufacturing, which will lead to new processes and immediate industrial exploitation. The main advantageous features of DATAFORM will be digital and universal with high flexibility, compared with the present hard tooling for panel forming and panel fabrication.

© DATAFORM partner - JiLin University

The element group of a multi-point stretch-forming prototype developed by JLU

Description of work

DATAFORM addresses research into adjustable multi-point tooling technology, the development of digitally adjustable multi-point tooling, the innovation of flexible fabrication tooling, applications of dieless forming tooling and jigless positioning tooling. The work plan is broken down into the following six Work Packages (WP):

- WP1 focuses on the analysis of individual user needs and demands for digitally adjustable tooling, and will evaluate various flexible tooling technologies.
- WP2 aims to study the fundamentals of multi-point forming methodology and explore the capabilities of flexible fabrication tooling technology for aircraft panels.
- WP3 will build a novel and efficient digitally adjustable multi-point tooling system based on the principle of multi-point forming, and will develop automatic robotic control techniques for a flexible fabrication tooling.
- WP4 aims to integrate the developed hardware and software components into a digitally adjustable tooling system, to optimise the developed flexible tooling and validate the tooling for different applications.
- WP5 focuses on the dissemination and exploitation of the R&D results of the project.
- WP6 concerns all the management aspects of the project and the monitoring of progress, identifying shortcomings and recommending remedial action.

Results

DATAFORM will develop technologies and systems for the manufacturing of aircraft panels. The main deliverables and expectations of the project are:

- A solution to the key technological problems of adjustable multi-point tooling for the procedures of dieless forming and jigless positioning of aircraft panels.
- The building of integrated CAD/CAE/CAT software and robotic control devices for the modular system to deal with the data exchange interface, different material simulations and fabrication process control.

- The development and implementation of digitally adjustable multi-point tooling and techniques in the manufacture of aircraft products. Two prototypes of dieless forming tooling and jigless positioning tooling with punch matrices will be developed.
- DATAFORM will play a key role in realising the full potential of flexible tooling by combining multi-point forming technology and computer-controlled fabrication technology.

Acronym:	DATAFORM
Name of proposal:	Digitally Adjustable Tooling for manufacturing of Aircraft panels using multi-point FORMing methodology
Contract number:	AST5-CT-2006-030877
Instrument:	STP
Total cost:	3 725 230 €
EU contribution:	2 462 675 €
Call:	FP6-2005-Aero-1
Starting date:	01.10.2006
Ending date:	30.09.2009
Duration:	36 months
Objective:	Competitiveness
Research domain:	Manufacturing
Website:	http://www.cf.ac.uk

Coordinator:	Prof. Pham Duc Truong	
	Manufacturing Engineering Centre (MEC), Cardiff University	
	Queen's Buildings, The Parade, Newport Road	
	UK CF24 3AA Cardiff	
E-mail:	PhamDT@cf.ac.uk	
Tel:	+44 (0)29 20874429	
Fax:	+44 (0)29 20874880	
EC Officer:	P. Perez-Illana	
Partners:	Open Engineering S.A.	BE
	Centre de Recherche en Aéronautique ASBL	BE
	JiLin University	CN
	KAYSER ITALIA	IT
	SENER INGENIERIA Y SISTEMAS	ES

FANTASIA

Flexible and Near-net-shape Generative Manufacturing Chains and Repair Techniques for Complex-shaped Aero-engine Parts

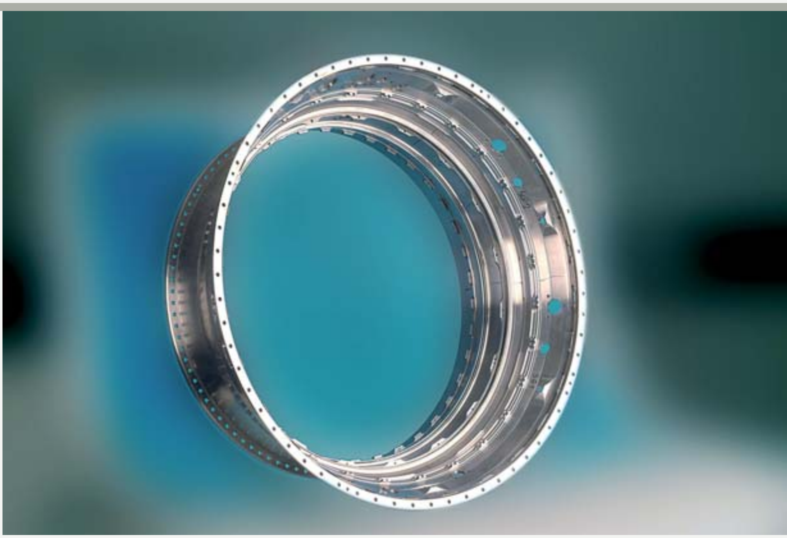
Background

The aim of FANTASIA is to contribute towards winning global leadership for European aeronautics by developing new flexible and near-net-shape additive manufacturing chains and repair techniques using laser metal deposition (LMD) and direct laser forming (DLF) processes. These techniques, in combination with conventional manufacturing processes, offer the possibility to realise a breakthrough in the manufacturing of aero-engine parts. In particular, the following potential can be achieved:

1. New design possibilities using the nearly unlimited geometrical freedom of DLF
2. Decrease time efforts in the whole life cycle of a part in the design and/or redesign phase, subsequent manufacturing and the repair phase
3. Savings in production and raw material costs due to reduced time effort and raw material quantity to be used in generative manufacturing
4. Processability of conventional nickel and titanium base alloys as well as upcoming advanced materials like TiAl and Udimet 720.

Objectives

1. Development of process layout for LMD to achieve the required characteristics with respect to material, part quality and economy
2. First time development of process layout for DLF to achieve the required characteristics with respect to material, part quality and economy
3. Development of heat treatment cycles before and after laser treatment to get microstructures and thermal stress fields that meet the mechanical properties
4. Determination of static and dynamic mechanical properties of the laser-processed and heat-treated samples together with correlation of these properties with microstructure and stress fields
5. First time workout of acceptance plus a non-destructive test (NDT) inspection criteria for LMD and DLF process (correlations between tolerable defects, microstructure, mechanical properties and process parameters)
6. Support of the process development by simulation of temperature, stress fields and microstructure formation to predict process parameters and build-up strategies
7. Development of equipment for LMD and DLF processes:
   - processing heads, including powder feeding nozzles and shielding gas units for 3D processing
   - process chamber for DLF
   - software for Computer Aided Design / Computer Aided Manufacturing (CAD/CAM) integration
   - sensors and systems for on-line process control
8. New manufacturing and repair chains by combining conventional (e.g. casting, milling, joining) and laser-based techniques (LMD, DLF).



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HPT Casing of a BR715 aero engine made of Nimonic PE16 manufactured by Rolls-Royce Deutschland

Description of work

The work is divided into work packages (WP).

In WP1, the test pieces and the additives for LMD and DLF will be manufactured. The additives (powder and wire) will be characterised.

The aim of WP2 is the Finite Element modelling of LMD and DLF processes to generate input for the process development (WP3). The main focuses are the calculation of the temperature and stress fields, as well as the microstructure formation in dependence of process parameters and part geometry.

In WP3, the process layout for LMD and DLF will be developed for different materials and part geometries. A further aspect in WP3 is the development of suitable heat treatment procedures after LMD and DLF processes.

In WP4, hard- and software for both techniques will be developed, modified and tested. For quality assurance and reliable LMD and DLF, process monitoring and on-line process control systems will be developed and tested in WP5. The focus of this WP is the development of on-line process control methods.

Simultaneously with the process engineering in WP3, a geometrical and metallurgical examination of the test pieces will be carried out in WP6.

In WP 7, test pieces from different materials for mechanical testing are fabricated with the suitable parameters determined in WP3. Different mechanical tests (e.g. tensile and HCF tests) will be carried out.

To ensure the required and defect-free structure of the processed parts, non-destructive tests (NDT) have to be carried out (WP8).

Based on WPs 2-8, demonstration parts will be repaired and manufactured in WP9 using the developed techniques and process chains. This work package includes the heat treatment, the final machining, NDT inspection and the mechanical tests.

In WP10, a technical and economical assessment of the results will be carried out. An additional essential aspect is working out the acceptance and NDT inspection criteria for LMD and DLF.

Results

FANTASIA will deliver new manufacturing and repair methods for use in 'older generation' and in future advanced performance aero-engines. In addition, it will contribute to a higher level of improvement in the reduction of emissions, fuel consumption, manufacturing and repair costs, engine reliability and raw material use that can be achieved in short, mid and long-term development. The directly exploitable outputs from FANTASIA will be:

1. Advanced manufacturing and repair technologies using LMD and DLF for complex shaped parts
2. New manufacturing and repair chains by combining conventional and laser-based techniques
3. Acceptance and NDT inspection criteria for LMD and DLF processes
4. Processability of new materials by LMD and DLF
5. Control methods for LMD and DLF for quality assurance
6. Heat treatment procedures before and after laser treatment
7. Mechanical properties of LMD and DLF processed materials
8. Industrial equipment for LMD and DLF
9. Models for temperature, thermal stress and microstructure simulation
10. New design possibilities by novel manufacturing techniques
11. Requirement profile for powder and wire additive materials.

High-integrated new cladding head for laser metal deposition

Acronym:	FANTASIA
Name of proposal:	Flexible and Near-net-shape Generative Manufacturing Chains and Repair Techniques for Complex-shaped Aero-engine Parts
Contract number:	AST5-CT-2006-030855
Instrument:	STP
Total cost:	6 483 880 €
EU contribution:	3 781 040 €
Call:	FP6-2005-Aero-1
Starting date:	01.06.2006
Ending date:	31.05.2010
Duration:	48 months
Objective:	Competitiveness
Research domain:	Manufacturing
Website:	http://www.fantasia.aero
Coordinator:	Dr Wissenbach Konrad
	Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e. V.
	Hansastraße 27 C
	Steinbachstrasse 15
	DE 52074 Aachen
E-mail:	konrad.wissenbach@ilt.fraunhofer.de
Tel:	+49 (0)2418906147
Fax:	+49 (0)2418906121
EC Officer:	A. Podsadowski

Partners:	Rolls-Royce plc	UK
	Industria de Turbo Propulsores, S. A.	ES
	AVIO S.p.A.	IT
	TURBOMECA	FR
	University of Manchester	UK
	TWI Ltd	UK
	Asociación Industrial de Óptica, Color e Imagen	ES
	TRUMPF Laser und Systemtechnik GmbH	DE
	Riga Technical University	LV
	TLS Technik GmbH & Co Spezialpulver KG	DE
	CLFA - GROUPEMENT D'ETUDE ET DE RECHERCHE POUR LES APPLICATIONS DES LASERS DE PUISSANCE (GERAILP)	FR
	Sulzer Innotec, Sulzer Markets and Technology Ltd	CH
	Precitec KG	DE
	SR Technics Switzerland	CH
	Rheinisch-Westfälische Technische Hochschule Aachen	DE
	BCT Steuerungs- und DV-Systeme GmbH	DE
	INCODEV	FR
	Council for Scientific and Industrial Research (CSIR)	ZA

RAPOLAC

Rapid Production of Large Aerospace Components

Background

Shaped metal deposition (SMD) is a prototyping system that allows complex parts to be built directly from a CAD model with minimum finishing. The system builds components layer by layer without the need for tooling. Complex parts can be made with improved material properties and hybrid components can also be created.

The advantage of SMD is that complex parts, or those that need a lot of machining, can be made quickly and cheaply: in some cases lead times have been reduced by 70%. The finished parts can also have improved material qualities, the process has low to zero harmful emissions and it does not require tooling. Uses include rapid prototyping, one-off parts, repair, and complex or hybrid components.

The SMD rig consists of a robot with a TIG welding head and a manipulator, housed inside a sealed chamber with wire fed in from outside. The system welds the wire in an inert argon atmosphere to prevent the substrate, electrode and part reacting with atmospheric gases. Once used, the argon can be safely vented via an extraction system, or re-circulated via a scrubber system. A water-cooled vision system allows the welding arc to be viewed and the size of the bead and weld pool to be monitored in real time. Features can be built in any orientation without the need for support structures.

Objectives

To exploit SMD technology fully within aerospace, it must be demonstrated that it is a valid and cost-effective manufacturing route. RAPOLAC will produce a business case for SMD to ensure the take-up of this technology. Further work will define material properties, achieve certification for the process and widen the range of materials which can be deposited. RAPOLAC will concentrate on aerospace materials such as titanium, steels and nickel-based alloys, which are costly and difficult to machine. This process has attracted interest from several aerospace companies, but take-up is limited because:

- weld parameters vary according to the material, substrate, geometry and size
- the material properties are not well understood
- the benefits of SMD over more traditional processes are not clear.

To validate SMD for commercial aerospace use, exemplar parts containing difficult-to-manufacture features will be constructed from a variety of materials. Material characterisation will be performed, and the process modelled using FE and mechanical techniques. A cost-benefit analysis will be carried out to compare SMD construction with traditional manufacturing routes, allowing a business case to be put forward to encourage take-up by SMEs. The time and material savings are expected to make SMD an attractive option for the manufacture of large aerospace parts.

Description of work

RAPOLAC's aim is to validate SMD to manufacture aerospace parts in a variety of materials. To do this, the properties produced by different materials, geometries and deposition parameters must be catalogued, heat-treatments and machining strategies developed, and the process modelled and controlled.

WP1 will build the parts needed for the microstructural analysis, fatigue and stress tests and will provide data for modelling. It will also investigate the effects of different weld parameters, materials, substrates, part sizes and geometries, and test the control strategies developed. It will look at post-heat-treatment and machining strategies for the finished parts.

WP2 will look at the properties of the parts produced, and develop a database of material properties, residual stresses and susceptibility to fracture.

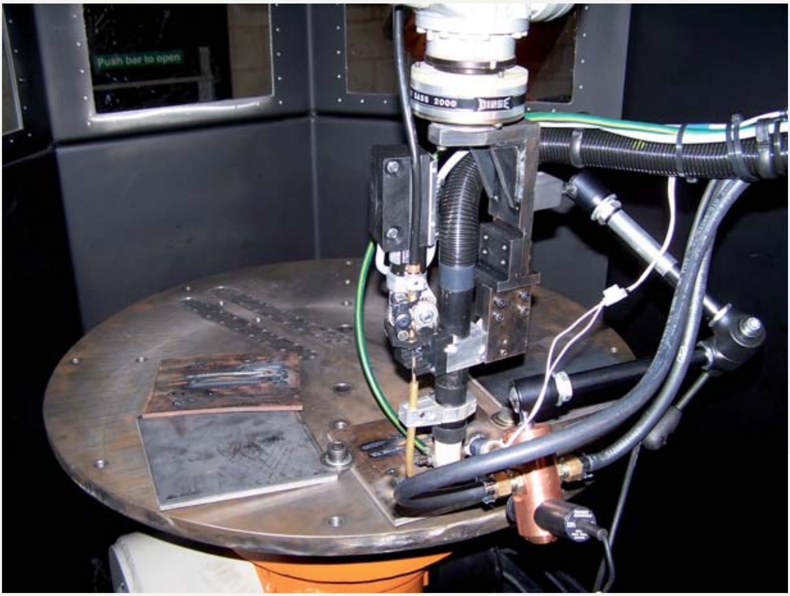
WP3 will develop both local models (optimising weld parameters to give the best material properties) and global robotic models of the SMD process.

WP4 will look at all aspects of the SMD process and quantify its benefits, comparing SMD with traditional manufacturing processes. It will highlight the cost and environmental advantages and develop best practice manufacturing methods, which will indicate where SMD should be used entirely, and where hybrid manufacture is more cost-effective. This will lead to the creation of a business plan for SMD and encourage its take-up in industry.

Results

The final deliverables for RAPOLAC have been chosen to improve process knowledge and to make SMD more attractive.

Investigations will produce post-heat-treatment strategies, optimum weld parameters and machining strategies for a variety of aerospace materials. These will be obtained by depositing parts and obtaining micro-structural results, tensile and fatigue test results, and surface analysis results. Mechatronic heat transfer models and residual stress models will be created to help in this process. This information will allow the SMD process to be certified for non-critical aerospace applications for the materials and parameters chosen, and will give companies confidence in the process.



Close-up of the Kuka robot with attached welding head and camera, preparing to deposit a part

© AMRC

SMD engineer examining a test component

As part of the drive to encourage SMD take-up, cost-benefit reports will be produced for SMD with respect to traditional processes, a business case for SMEs will be developed, and a best practice methodology for hybrid parts will be produced.

A website will be set up for the project, the papers used to publicise it and for workshops. Training modules will be developed for interested companies.

The impact of the above deliverables will be:

- Reduction of 60% in the lead time necessary to produce new parts through the elimination of tooling and the use of SMD parts as manufacturing prototypes
- Reduction of 40% in the cost of manufacturing products through reducing raw material use, finish machining and tooling
- Reduction of 90% in the inventory held, since the only stock item is wire.

Acronym:	RAPOLAC
Name of proposal:	Rapid Production of Large Aerospace Components
Contract number:	AST5-CT-2006-030953
Instrument:	STP
Total cost:	2 734 500 €
EU contribution:	2 140 650 €
Call:	FP6-2005-Aero-1
Starting date:	01.01.2007
Ending date:	31.12.2009
Duration:	36 months
Objective:	Competitiveness
Research domain:	Manufacturing
Website:	http://www.rapolac.eu
Coordinator:	Dr Gault Rosemary University of Sheffield Western Bank UK S10 2TN Sheffield
E-mail:	r.gault@shef.ac.uk
Tel:	+44 (0)114 222 7866
Fax:	+44 (0)114 222 7678
EC Officer:	P. Perez-Illana

Partners:	DIAD srl	IT
	Footprint Tools Ltd	UK
	Instituto de Desarrollo Tecnológico para la Industria Química (Universidad Nacional del Litoral)	AR
	K.U. Leuven Research and Development	BE
	Metec Tecnologie snc	IT
	SAMTECH s.a.	BE
	Università degli Studi di Catania - Dipartimento di Ingegneria Elettrica Elettronica e dei Sistemi	IT

MAGFORMING

Development of New Magnesium Forming Technologies for the Aeronautics Industry

Background

Magnesium is highly attractive for realising weight reduction in aeronautic structures due to its low density - 65% of that of aluminium. Magnesium wrought alloys can be made to have mechanical and surface properties similar to those of aluminium.

The most important advances of using magnesium shapes have been achieved in the automotive industry. Most projects were focused on cast alloys and methodologies. Only AEROMAG, in the Sixth Framework Programme, is explicitly concerned with wrought aeronautic applications. MAGFORMING complements AEROMAG by developing forming technologies.

It is evident from current research that the products manufactured by forming processes of aluminium could be produced by upgraded processes of magnesium alloys, but in a completely different domain of parameters. However, this possibility is severely limited by the lack of technologies in plastic processing and forming.

Objectives

The objective of MAGFORMING is to advance the state of the art in the technology of plastic processing of wrought magnesium alloys for aeronautical applications, by developing tools and methodologies for industrial technologies, and showing their feasibility in aeronautics. The measure for attaining the objective will be the fabrication of several prototypes, one or two for each of the technologies.

It will be achieved by the following:

1. Methodologies for the preparation of raw material for plastic deformation
2. Study of the lubrication needs of the plastic forming of magnesium
3. The development of special heated dies with controlled temperatures and temperature gradients
4. The development of cooling procedures, to attain the best qualities for the manufactured part
5. The development of a press loading application routine
6. Some minor geometric modifications, within the parts design, using modelling software, to make sure that the magnesium part meets the specifications required by the end users.

Description of work

MAGFORMING is divided into parallel work packages which are related to the various developed technologies. Theses activities will be enveloped in four work packages: Specifications and Testing & Validation, before and after the above activities, respectively, and Dissemination & Exploitation and Assessment & Review during the duration of the project.

First, technology demonstrators (TDs) and alloys will be selected and a preliminary estimation of production feasibility and costs will be done.

Then, the technological work packages will begin: design and production of tools and dies and manufacturing process of the TDs. Modelling and simulation will be done before the design of tools and dies, and between design and production of tools and dies.

The last step after the production of the TDs will be a verification of the required mechanical properties and compatibility checking to the required specifications, as well as an estimation of complete cost data for each technology process.

The final activity of the project will be a textbook for each technology demonstrator, specifying the process and approving tests.

Results

Aeronautics (decrease in the weight of aircraft), the environment (less fuel consumed) and metallurgy (development of new processes) will all benefit from the consequences of the successful completion of MAGFORMING.

The specific expected results during the project are:

1. A list of parts (TDs) with specifications
2. Preliminary economic feasibility report on the TDs
3. Improved semi-finished material and lubrication (suitable for each technology)
4. Drawings of designed tools and dies (for each technology)
5. A prototype (TD) of each technology
6. Technology textbook and economic analysis for each TD.

Acronym:	MAGFORMING	
Name of proposal:	Development of New Magnesium Forming Technologies for the Aeronautics Industry	
Contract number:	AST5-CT-2006-030852	
Instrument:	STP	
Total cost:	3 422 522 €	
EU contribution:	1 894 090 €	
Call:	FP6-2005-Aero-1	
Starting date:	01.08.2006	
Ending date:	31.03.2009	
Duration:	32 months	
Objective:	Competitiveness	
Research domain:	Structures & Materials	
Coordinator:	Mr Fein Amir Palbam Metal Works - AMTS En Harod IL 18960 En Harod Ihud	
E-mail:	amirf@palbam.co.il	
Tel:	+972 (0)4 6530 700	
Fax:	+972 (0)4 6531 904	
EC Officer:	H. von den Driesch	
Partners:	EADS Deutschland GmbH	DE
	Magnesium Elektron Limited	UK
	Airbus Deutschland GmbH	DE
	Israel Aircraft Industries	IL
	Liebherr Aerospace Toulouse S.A.S	FR
	SMW Engineering Ltd	RU
	Chemetall GmbH	DE
	ULTRATECH SP.ZO.O.	PL
	ALUBIN Ltd	IL
	Charles University, Prague - Faculty of Mathematics and Physics, Department of Metal Physics	CZ
	Universitat Hannover - IFUM	DE

PreCarBi

Materials, Process and CAE Tools Development for Pre-impregnated Carbon Binder Yarn Preform Composites

Background

Composites are the material of choice for many advanced aircraft structural applications (A380 – 28% and Boeing 787 – 50% content) and have proven weight/performance superiority over metals. The critical issues today are performance improvements: the development of faster, more cost effective manufacturing and simulation tools to optimise their manufacture and design.

Today's manufacture of advanced composites uses either layers of pre-impregnated plies (prepregs), or resin infusion of dry textiles (liquid composite moulding or LCM) to form a laminate. Prepreg composites give superior mechanical properties due to toughened resins, but suffer from high material costs, limited shapeability, expensive manufacturing and limited shelf life. LCM can overcome many limitations, but must use low viscosity resins for infusion, which have a poorer mechanical performance.

The PreCarBi project will develop new materials (carbon fibres and liquid resins) as well as supporting technologies that bring together prepreg and LCM technologies to combine the advantages of each. Essentially pre-impregnated carbon fibres with a polymer binder will be developed for LCM and tow placement processes. Activation via heat allows binder yarns to be repeatedly shaped prior to resin infusion. The binder yarns enhance mechanical properties, have indefinite shelf life, and improve pre-form handling/trimming and drapeability.

Objectives

The project includes three material specialist partners covering fibre, resins and textiles, four selected research and university partners, a finite element software company and four industrial partners representing Europe's aircraft manufacturing industry.

The key project objectives are:
1. the development of new binder yarns and compatible epoxy resins
2. new energy and process efficient activation methods, suitable for rapid manufacture, will be evaluated and partially industrialised
3. modifications of existing AdTP (automated tow placement) and textile machinery to suit binder yarn processing
4. a full materials testing program to characterise the process and mechanical performance of binder yarn composites. Detailed comparison with competitive LCM and prepreg composites will be made and the data will provide input to the CAE (computer-aided engineering) tools development/validation and demonstrator parts manufacture, design and validation
5. development/improvement of existing CAE tools for impregnation, drape, stress optimisation and cost will be undertaken and used to design the three chosen project demonstrator parts. The finite element (FE) codes to be used are based on existing commercial composite software owned by one of the partners

6. manufacture, CAE design and validation of three challenging aircraft demonstrator components will assess the validity of the new technologies.

Description of work

PreCarBi will develop a new manufacturing technology, including new base materials (binder yarns and compatible resins) and textile preforms that will lead from conception to final manufacture of three representative aircraft demonstrator components. The research will address techniques such as efficient heat activation and efficient preform construction that is relevant to industrial manufacturing. Special emphasis is placed on the work needed for automated processes and in-process inspection techniques (to control preform and final composites quality).

An important focus of PreCarBi is the development of CAE and simulation tools dedicated to virtual prototyping of process and design of the binder yarn composites. These tools will be adapted from existing composite simulation FE software for impregnation, draping and composites design. The final validation will be against the three diverse demonstrator structures. In this way software developments will be fully integrated into the research structure and will also provide the backbone for an integrated virtual design of industrial parts. These tools will allow improved, optimal composite parts to be designed and manufactured. The selected software tools are commercial products belonging to one of the project partners. Cost analysis and software tools are also included in the project.

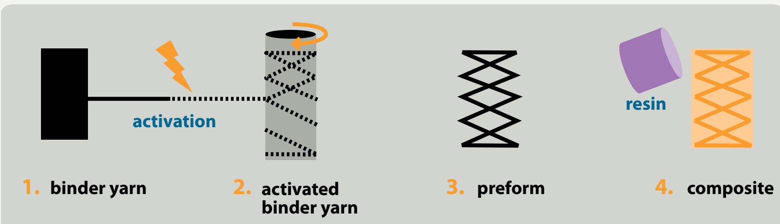
Results

The main project deliverables include:

1. Development and industrialisation of binder yarn reinforced composites with better toughness, improved compression after impact and better compression properties than conventional LCM composites.
2. Development of a new resin system that is fully compatible with the binder yarn and the new processing demands which conforms to current aerospace requirements.
3. Optimisation of yarn structure for faster and better impregnation by providing open carbon filament arrangements.
4. Development and industrialisation of composites suitable for plane, 2D and complex 3D geometries requiring drapeable fabrics, without compromising plane properties.
5. Reduction of so-called 'ply-drop-areas' by methods that can avoid/minimise this by continuous distribution (spread width of yarns that are fixed by the binder) and tailoring of the yarn architecture.

Automated dry tow placement machines are highly efficient, but at the moment demand expensive materials (slit tapes extracted from prepregs) and energy consuming storage conditions. Binder yarn textiles could also be applied on these machines and have the benefit that cold storage and hot curing conditions are not needed (energy savings).

The project will develop existing commercial FE software packages to simulate infusion, draping and stress optimisation, and enable full advantage of these properties to be taken.



Acronym:	PreCarBi	
Name of proposal:	Materials, Process and CAE Tools Development for Pre-impregnated Carbon Binder Yarn Preform Composites	
Contract number:	AST5-CT-2006-030848	
Instrument:	STP	
Total cost:	3 946 970 €	
EU contribution:	2 329 500 €	
Call:	FP6-2005-Aero-1	
Starting date:	01.09.2006	
Ending date:	31.08.2009	
Duration:	36 months	
Objective:	Competitiveness	
Research domain:	Structures & Materials	
Website:	http://www.cranfield.ac.uk/sas/materials/	
Coordinator:	Prof. Pickett Anthony	
	Cranfield University	
	School of Applied Sciences	
	Bedfordshire, Building 61	
	UK MK43 0AL Cranfield	
E-mail:	a.k.pickett@cranfield.ac.uk	
Tel:	+44 (0)1234 754034	
Fax:	+44 (0)1234 752473	
EC Officer:	H. von den Driesch	
Partners:	Airbus Deutschland GmbH	DE
	Airbus Espania SL	ES
	Eurocopter Deutschland GmbH	DE
	ESI Group	FR
	Fischer Advanced Composite Components AG	AT
	Sicamp AB	SE
	Sigmatex (UK) Ltd	UK
	Tono Tenax Europe GmbH	DE
	University of Latvia, Institute of Polymer Mechanics	LV
	Huntsman Advanced Composites	CH
	Laboratory of Technology and Strength of Materials	GR

SENARIO

Advanced sensors and novel concepts for intelligent and reliable processing in bonded repairs

Background

Current economic world conditions are forcing civil aircraft to operate well beyond their original lifespan, resulting in the need for innovative repair techniques. The development of high strength fibres and adhesives has led to the invention of new methodology for the repair of metallic structures by adhesively bonding patches manufactured by composite materials. The biggest challenge in this field is to ensure compliance with increased quality standards required at their processing and retrieve confident results on their integrity across their operational life.

The field repair is usually performed by the use of 'hot bonders', a self-contained console that applies and controls heat and vacuum/pressure over a repair patch, primarily through a heating blanket. The thermocouple readings from the blanket are currently used to assess the curing of the resin, through comparison of the actual temperature readings against the resin curing specification. The hot bonders cannot supply consistent and even heat over the whole repair, due to several inherent factors.

The main limitation of existing technology in the bonding repair of aerospace structures lies in the inability of the repair control systems to assess the actual material state and integrate the available tools (simulations, measurements, experience, knowledge) into an intelligent material-based control system.

Objectives

The objectives of the project are to achieve:

- a scientifically-based assignment of the correspondence between monitored dielectric properties and actual material state (Tg) for the adhesive material and the reinforcing composite;
- the development of thermo-mechanical process simulation tools validated on small coupons to correlate the internal stress development with changes in the material state during repair processes;
- the incorporation of robust optical sensors into repair patches to augment the information from the dielectric sensors and provide a means of long-term repair integrity assessment;
- an intelligent online process guidance algorithm for ensuring a predefined cure advancement and minimum internal stress development within the composite materials of the repair process;
- a wireless operation of non-intrusive dielectric sensors for measuring the material state and the integrity of the adhesive material online;
- a portable repair control console with multiple heating zones and blanket-mounted dielectric sensors with an active link to blanket heaters;
- an application of laser technology in repair processes (cutting, heating) and automated treatment of the repair surface;
- a multi-zone process control system demonstrated on large areas and thick components, capable of safely guiding optimal repair processes in terms of uniform cure advancement and globally determining the final material conditions.

Description of work

The proposed research utilises:

- extensively studied and widely applicable dielectric monitoring methods;
- expertise in designing durable dielectric sensors for monitoring resin cure, adapted to process the monitoring of bonded repairs;
- existing field repair control equipment utilising heating blankets, with the potential to incorporate multi-sensory technology.

The development route includes:

- developing material models for the cure process and the stress development;
- enhanced thermomechanical simulation tools with integrated functionality involving temperature effects, resin cure, heat transfer, contraction and compaction;
- multi-material process optimisation tools and strategies connected with simulation tools and repair control equipment;
- designing dielectric sensors with a down-scaled sensing area according to process requirements and capabilities;
- enabling wireless capability for the non-intrusive dielectric sensors in industrial operations;
- adapting in-process optical fibre sensors operating alongside the dielectric sensing;
- a miniaturised process monitoring modules with fast signal processing for integration with the portable repair control equipment;
- an intelligent model-based process guidance algorithm for single- or multi-zone heat actuation;
- a gradual integration of the developed systems towards a repair process control platform.

Results

The proposed novel multi-zone integrated process control scheme gains full benefit from the use of multi-sensory devices and the deployment of existing process knowledge (including cure and stress development) and enables the in situ monitoring of the bonded repair and the resulting adhesion quality at any stage in the process, while offering a potential tool for non-intrusive structural health monitoring.

Given the successful implementation of the scheme, the repair process uncertainty can be minimised or even eliminated, thus contributing to the easier certification and standardisation of the repair procedures. The global nature of the multi-sensor and multi-zone control scheme allows the single-step repair processes. This involves treating and co-curing the adhesive and reinforcing the composite using portable and usable repair systems, leading to increased safety and weight saving in the aircraft.

The project results resolve significant problems for two groups of end-users:

- for the aerospace component manufacturers and repair centres: the lack of standard, online and in situ information on and control of the bonding process and quality, and
- for the manufacturers of process and repair support systems: the missing link between the advanced industrial simulation and control systems and the developing material and process monitoring technology.

Acronym:	SENARIO
Name of proposal:	Advanced sensors and novel concepts for intelligent and reliable processing in bonded repairs
Contract number:	AST5-CT-2006-030982
Instrument:	STP
Total cost:	2 771 935 €
EU contribution:	1 789 355 €
Call:	FP6-2005-Aero-1
Starting date:	21.11.2006
Ending date:	20.10.2009
Duration:	36 months
Objective:	Competitiveness
Research domain:	Structures & Materials
Coordinator:	Dr Maistros George Integrated Aerospace Sciences Corporation (INASCO) 17, Tegeas St. GR Argyroupolis
E-mail:	g.maistros@inasco.com
Tel:	+30 (0)210 9943427
EC Officer:	A. Podsadowski

Partners:	Laser Zentrum Hannover eV	DE
	SENER INGENIERIA Y SISTEMAS	ES
	GENERALE DE MICRO-INFORMATIQUE	FR
	Tel Aviv University	IL
	Israel Aircraft Industries Ltd	IL
	FUNDACIÓN INASMET	ES
	National Technical University of Athens	GR
	Short Brothers PLC	UK

MOJO

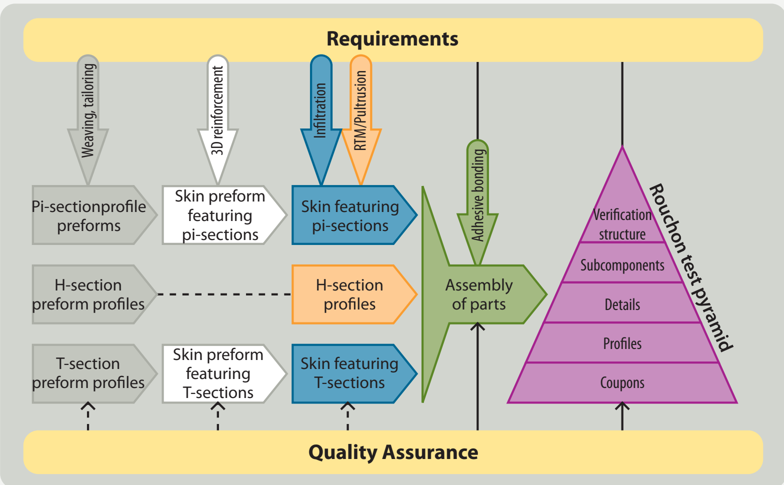
Modular Joints for Aircraft Composite Structures

Background

State-of-the-art technology for the manufacturing of primary CFRP (Carbon Fiber Reinforced Polymer) aircraft structures is still prepreg (pre-impregnated) technology. However, investigations have been carried out in recent years towards replacing this technology by cost-efficient manufacturing processes. One of these processes is the resin transfer moulding (RTM) process. With the RTM process, dry textile preforms are placed in the mould and injected with liquid resin after closing the mould. Many preform technologies are associated with the textile industry where they have reached a high level of automation. However, for state-of-the-art CFRP components, the designs are often not driven by the composite materials; parts are manufactured and subsequently assembled with the use of fasteners. So for joining cured parts, adhesive materials are becoming more important and paste adhesives allow a much more versatile application range than film adhesives. Significant cost savings are obtained through the option of automation, which is heavily applied throughout the automotive industry.

Objectives

The technical objective of MOJO is to develop a material-driven composite design philosophy. It combines the advantages of low-cost infiltration processes, advanced preforming technology and adhesive bonding, with the elimination of fasteners. The manufacturing risk of highly integrated parts is reduced through the differential design with decreased integration. The principle of MOJO lies in the design of CFRP joining elements for pure shear load transfer; peel stresses are generally avoided. The shapes of the joining elements are defined by a number of standard attachment situations. The



final assembly of components and elements is performed using adhesive bonding. Tension loads in interfaces (e.g. skin to spar) are handled using 3D stitching technology. In combination with appropriate preform architecture and design, high loads can be transferred without bolts.

Description of work

The project will focus on the development of three different joining elements. The project starts with WP2, 'Requirements and Design'. It gives a direct input of geometrical and architectural requirements for WP3, 'Advancement of the Loom'. This work package is dealing with the build-up of a special automatic 3D-profile weaving loom.

WP4: 'Preforming' will investigate other preform technologies. Furthermore, 3D reinforcement technologies, such as tufting and offline stitching, will be investigated. The preforms will also be used to validate the tooling and infiltration concepts developed in WP5, 'Infiltration and Assembly'. The consolidated parts will be provided for assembly, which is done using paste and film adhesives. The bonding process is supported with analytical and simulation methods.

Further simulation of failure mechanics of the interface and the bond lines will be investigated in WP6, 'Structural Analysis and Test'. This work package will also provide the test data as well as estimations regarding cost and weight savings. These data are used for further optimisation of the preforming process.

WP7: 'Quality Assurance' is dedicated to evaluating non-destructive test methods for modular joints. Furthermore, it addresses the tolerance management and possible damage repair scenarios and methods will be investigated.

WP8 is 'Exploitation and Dissemination'.

Results

Year 1

- Test programme with harmonised test procedures
- Loom operational and ready for test
- Delivery of non-woven preforms with H, T and pi-Shape
- Delivery of hedgehog tapes for preform assembly
- Delivery of skins featuring tailored joints

Year 2

- Software completed for weaving pi, T and H profiles
- Verified functionality of the loom, now ready for production
- Delivery of 3D woven preforms
- Delivery of skins featuring woven joints
- Assessment of textile bonding methods completed
- First components bonded and ready for test
- Establishment of a flow model which is verified by tests
- Design allowable for pressure-free bonded composites
- Completion of E, C and D-level testing

Year 3

- Drawing set for A and B-level components
- Report on influence of fibre volume fraction orientation and crimp of woven profiles
- Delivery of A and B-level structures
- Conclusion of A and B-level testing
- Catalogue of profiles for modular joints
- Guidelines for modular joints

The main outputs of the proposed MOJO framework will ensure a strong strategic impact by contributing to the two top-level objectives identified in the Strategic Research Agenda:

- To meet society's need for a more efficient, safer and environmentally friendly air transport
- To win the global leadership for European aeronautics by reinforcing competitiveness.

Acronym:	MOJO	
Name of proposal:	Modular Joints for Aircraft Composite Structures	
Contract number:	AST5-CT-2006-030871	
Instrument:	STP	
Total cost:	4 731 101 €	
EU contribution:	2 545 823 €	
Call:	FP6-2005-Aero-1	
Starting date:	01.09.2006	
Ending date:	31.08.2009	
Duration:	36 months	
Objective:	Competitiveness	
Research domain:	Structures & Materials	
Coordinator:	Dr Körwien Thomas EADS Deutschland GmbH (for courier only: Wareneingang Geb 6.1 Ludwig-Bölkow-Alle, 85521 Ottobrunn, Germany) DE 81663 Munich	
E-mail:	Thomas.Koerwien@eads.com	
Tel:	+49 (0)89 60728722	
Fax:	+49 (0)89 60732158	
EC Officer:	P. Perez-Illana	
Partners:	BITEAM AB	SE
	Secar Technologie GmbH	AT
	Royal Institute of TechnologyDepartment of Aeronautical and Vehicle Engineering	SE
	Laboratory of Technology and Strength of Materials	GR
	Vyzkumny a zkusebni letecky ustav	CZ
	Dassault Aviation	FR
	Eurocopter Deutschland GmbH	DE
	EADS CCR	FR
	Société Anonyme Belge de Constructions Aéronautiques	BE
	Deutsches Zentrum für Luft und Raumfahrt e.V.	DE
	Cooperative Research Centre for Advanced Composite Structures	AU

ABiTAS

Advanced Bonding Technologies for Aircraft Structures

Background

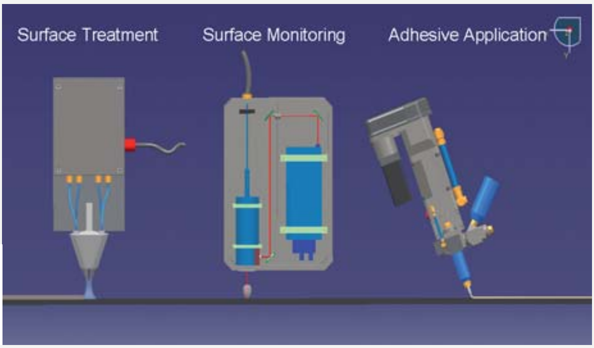
Aircraft manufacturers identified some decades ago that the joining of aircraft structural elements with adhesive bonding is a key technology to low weight, high fatigue resistance, robustness and an attractive design for cost structures. The early wooden aircrafts, the De Havilland Mosquito, Fokker 50, Saab 2000 and the new Airbus A380 are milestones, which prove a long tradition of adhesive bonding in the aircraft industry. However, the adhesive bonding of structural elements is still restricted, mainly due to a lack of universal, economic and robust processing techniques. Further technical progress in this area is crucial for increased functional and economic benefit.

It was identified by different European aircraft manufacturers (producers of helicopters, civil and military jets) that the advancement of adhesive bonding technologies is of great interest to all. Due to the complexity of this challenging issue, collaboration on a European level with support from selected research institutions could be very beneficial.

ABiTAS is therefore clearly contributing to both the top-level objectives identified in the Strategic Research Agenda and the Vision 2020 report to meet society's needs for a more efficient, safer and environmentally friendly air transport and to win global leadership for European aeronautics.

Objectives

The central target of ABiTAS is the development of a more robust, flexible and economic processing chain for the assembly of structural elements made from polymer composites and titanium by adhesive bonding in order to boost the feasibility of new structural concepts as they are envisaged by a number of current European and national research and demonstrator projects.



Surface Treatment and Monitoring, Adhesive Application

Therefore ABiTAS aims at the following four major innovations and their integration into one processing chain:

- Reliable, fast and cost-effective pre-treatments for polymer composites and titanium alloys, which assure durable bonding and which are applicable for automated processing
- On-line monitoring of the physico-chemical state of treated polymer composite surfaces for more effective quality control
- Adhesive chemistry, which enables more flexibility with processing and assembly via bonding on command and the introduction of new material functionalities
- Combination of advanced fit analysis, automated bond-line gap adapted application and advanced assembly technology, which incorporates techniques for fast fixation and reaction initiation to reduce assembly pressure and to shorten cycle times.

Description of work

The trans-national consortium of 15 partners is well prepared to achieve the objectives. It covers the full range of competencies required for all relevant topics and is well balanced, due to the involvement of major European aerospace manufacturers, SMEs and RTD groups, including a university from Greece.

The high complexity of the described challenges and the limited time-frame will force a parallel workflow and require strong interconnection between the partners. Starting with collecting, structuring and assessing the general and specific requirements in Work Package 1, research and basic developmental work will be performed in parallel in the field of new adhesive development, automated surface treatment and on-line sensing of physico-chemical conditions at the surface (Work Packages 2, 3 and 4). The work on surface pre-treatments and surface sensing methods will be concerted to form a basis for the development of a closed concept for on-line monitoring and surface pre-treatment, which is to be further developed and realised in Work Package 5. The processing technology for the new adhesive formulations will be developed in Work Package 6. Finally the prototypes developed within Work Packages 2, 5 and 6 will be combined into the envisaged novel processing chain, which will undergo a comprehensive and critical assessment in Work Package 7.

Results

The outputs of this project are the consequent advancements of young technologies like:

- automated surface pre-treatment
- a fast laser triangulation-based fit analysis system
- gap-adapted application system and new developments like:
  - adhesives, which combine high strength and durability with flexible processability like improved wetting behaviour, multiple curing temperature or a bonding-on-command functionality,
  - a monitoring system for sensing the physico-chemical state on polymer composite surfaces in an industrial manufacturing environment.

All these achievements enable the set-up of advanced bonding processing, which allow the integration of processing steps, reduction of heavy, costly manufacturing tooling and a cycle-time decrease in structural assembly.

This will give the European aerospace industry the opportunity to supply less expensive products than their competitors, reduce the direct operating costs and thus increase their market share.

Acronym:	ABiTAS
Name of proposal:	Advanced Bonding Technologies for Aircraft Structures
Contract number:	AST5-CT-2006-030996
Instrument:	STP
Total cost:	4 800 000 €
EU contribution:	2 585 600 €
Call:	FP6-2005-Aero-1
Starting date:	01.10.2006
Ending date:	30.09.2009
Duration:	36 months
Objective:	2
Research domain:	9

Coordinator: Dr Stöven Timo
Airbus Deutschland GmbH
Hünefeldstrasse 1-5
28199 Bremen
DE - Germany

E-mail: timo.stoeven@airbus.com
Tel: +49 (0)421 538 6031
Fax: +49 (0)421 538 4482

EC Officer: J. Blondelle

Partners:

Airbus España, S.L.	ES
Airbus UK Ltd	UK
Eurocopter S.A.S.	FR
Eurocopter Deutschland GmbH	DE
Dassault Aviation	FR
EADS Deutschland GmbH - Corporate Research Center Germany	DE
EADS CCR	FR
Laboratory of Technology and Strength of Materials	GR
Fraunhofer-Gesellschaft zur Foerderung der angewandten Forschung e.V.	DE
ALENIA Aeronautica S.p.A.	IT
Huntsman Advanced Materials Europe	CH
Upper Austrian Research GmbH	AT
LLA Instruments GmbH	DE
EDF Polymer-Applikation Maschinenfabrik GmbH	AT

AUTOW

Automated Preform Fabrication by Dry Tow Placement

Background

The content of fibre-reinforced materials, or composites, in primary aircraft structures continues to grow and with this growth comes the demand for continuous improvements in manufacturing technology.

The most common manufacturing technology for composites used today involves manual stacking of pre-impregnated sheets of material, followed by curing in an autoclave. It uses complex tooling, precludes a high level of part integration and increases assembly effort, making it a labour and capital-intensive manufacturing method.

A novel manufacturing method, often referred to as liquid composite moulding (LCM), uses dry fabric which is preformed into the component shape, placed in a mould, subsequently injected with resin and cured. The advantages of this process are that it is possible to use cheaper materials and simpler tooling. It also enables cheaper processing and part integration, thus reducing assembly costs.

So far, the potential advantages of LCM could not be achieved, because preforming is either a manual process or an automated process with limited scope, such as weaving or braiding.

Developing an innovative technology for the automated fabrication of complex preforms would overcome these problems. It could enable cost savings of up to 40% in comparison with current technology, due to cheaper part manufacturing, less scrap, reduced assembly and increased accuracy.

Objectives

The aim of the project is the development of a manufacturing technology for automated preforming, with a parallel development of a design capability to match.

The AUTOW project will develop the technology by adapting existing automated deposition capability for pre-impregnated materials (prepregs) with the capability to deposit dry fibre tows, allowing the fabrication of complex preforms. These can then be injected with a cost-efficient, automated LCM process. The complexity of the challenge to develop this new technology is in the multidisciplinary approach required to adapt, develop and explore:

- machine capability
- material format
- processing windows
- an integrated design engineering approach.

The critical areas that will be developed are:

- advanced machine and materials expertise to develop a material that is compatible with the machine, will stick to the mould or substrate and allow resin injection in a subsequent LCM-process
- aerospace expertise to determine the scope and constraints of the new fabrication capability with respect to preform shapes, fibre trajectories and processing parameters for relevant applications
- expertise in material modelling, process simulation, structural analysis and optimisation to obtain an integrated design engineering approach for the design of components to be made with the new fabrication capability.

Description of work

Machine capability for dry tow placement will be developed first by carrying out adaptations of existing machines. The machines will then be used to determine process window and preforming characteristics. Innovative lay-up tooling will be developed, addressing the problem of positioning the first ply.

Material configurations will be developed and approaches for the activation of the tackiness of the material will be studied.

The materials will be tested for compatibility with the adapted machines. Subsequently the characteristics of the preforms will be determined: (shape-) stability for handling purposes, and compressibility and permeability for injection purposes. A number of preforms will be injected and cured to evaluate the detailed fibre structure for modelling injection and mechanical performance.

A design approach will be developed to match the dry tow placement capability to account for the new options offered, such as fibre steering. The envisaged integrated design environment will not only combine the manufacturing constraints imposed by the tow-placement technology, but also fabrication issues associated with the resin infusion process.

The new technology will be compared to baseline technology and validated by carrying out the complete cycle of design, analysis, fabrication and testing using a suitable component chosen during a workshop.

The enhancement of the state-of-the-art achieved in this project will be summarised, and scope and guidelines for the new method will be presented as a manual for future designers.

Results

The project will result in:

A new capability for automated preform fabrication for LCM processes.

The development of aerospace quality, carbon fibre, dry tow material configuration with binder, which can be handled by the machine, will stick to the mould and is sufficiently permeable to allow resin injection.

Processing windows for fabrication, options and limitations with respect to component shape and tow trajectories.

An integrated design engineering approach with software capabilities for the design of components using dry tow placement.

A validated fabrication capability for the completedesign-analysis-fabrication-test cycle for a representative component.

The proposed research will contribute towards realising a validated fabrication technology for automated preform manufacture with advanced dry tow placement machines, which, in combination with automated liquid composite moulding and curing, enables building composite structures for aerospace vehicles in a fully automatic way. This will result in considerable time and cost savings. The possible cost reduction will strengthen the competitiveness of the European Aerospace industry and is in line with the European *Vision 2020*.

Acronym:	AUTOW	
Name of proposal:	Automated Preform Fabrication by Dry Tow Placement	
Contract number:	AST5-CT-2006-030771	
Instrument:	STP	
Total cost:	3 842 809 €	
EU contribution:	2 427 154 €	
Call:	FP6-2005-Aero-1	
Starting date:	01.01.2007	
Ending date:	31.12.2009	
Duration:	36 months	
Objective:	Competitiveness	
Research domain:	Structures & Materials	
Coordinator:	Ir. Müller Marcelo	
	Stichting Nationaal Lucht- en Ruimtevaartlaboratorium	
	Anthony Fokkerweg 2, 1059 CM	
	90502	
	NL 1006 BM Amsterdam	
E-mail:	autow@nlr.nl	
Tel:	+31 (0)527 248 792	
Fax:	+31 (0)527 248 210	
EC Officer:	H. von den Driesch	
Partners:	Dassault Aviation	FR
	Delft University of Technology	NL
	EADS CCR	FR
	Hexcel Reinforcements	FR
	Israel Aircraft Industries	IL
	Katholieke Universiteit Leuven	BE
	KSL Keilmann Sondermaschinenbau GmbH	DE
	Office National d'Etudes et de Recherches Aérospatiales	FR
	Universität Stuttgart	DE
	Vyzkumny a zkusebni letecky ustav	CZ

BEARINGS

New generation of aeronautical bearings for extreme environmental constraints

Background

Bleed systems decrease pressure and temperature to levels acceptable for downstream pipes and the air cooling system. Bleed valves, which regulate the pressure, have a strong safety issue: their failure can lead to aircraft depressurisation with the immediate request to land at the closest airport. In addition to all the direct consequences on passengers/crews' comfort, flight delay and traffic management, failures have a strong economic impact on airliners: a diversion is estimated to cost up to € 150 000. In 2004, ten diversions resulting from valve failure were reported for the AIRBUS fleet alone.

Valve failures, resulting from ball bearing blockages, are due to fretting and false Brinelling, known to occur in quasi-static assemblies in a vibratory environment. Due to the power increase in new aircraft engines and the extended service life of existing aircraft, vibration levels around engines are becoming extremely strong (about 25g). Temperatures can also reach up to 550°C. Systems surrounding engine zones are therefore submitted to new and extreme environmental constraints.

Even if the tendency is to develop more electrical aircraft, most of the aircraft developed today, based on bleed systems, will still be in use over the next 20 years and these issues have to be solved. Today's bearing designs and materials are no longer suitable.

Objectives

The main objective of the BEARINGS project is to develop a new generation of aeronautical bearings for extreme environmental constraints. The project will focus on the understanding of degradation phenomena and the definition of new bearing materials, processes and designs in order to answer the following constraints:
- corrosion and oxidation resistance
- impact resistance
- low friction torque (constant during lifetime)
- load variation resistance (0 to 5000 MPa)
- taking place in extreme environmental working conditions with temperatures of about 550°C and vibration levels at about 25g. An additional constraint will be that only dry lubricants will be authorised.

BEARINGS detailed objectives are:
1. To better understand the degradations encountered in bearings, using recent advances in contact modelling;
2. To propose innovative materials (bulk, smart sintered, nanomaterials) and adapted processes;
3. To propose relevant bearing designs.

To overcome the limitations, BEARINGS will introduce nanomaterials in aeronautical applications in order to reach the necessary properties in terms of hardness, toughness and strength.

Description of work

BEARINGS will reach the objectives defined due to advanced innovations in:
- Tribology
- Powder design and manufacturing
- Spraying processes

and because of technological developments focused on improving:
- Tribological test-bench capabilities
- Component test-bench capabilities
- Valve design integration.

The innovations can be summarised as:

- Innovation No. 1: Adaptation and improvement of a new tribological methodology based on numerical modelling, tribological characterisation and analyses with the objective of proposing a bearing generic model definition.
- Innovation No. 2: A better assessment of the local contact solicitations (amplitudes, directions and frequencies).
- Innovation No. 3: Measure and introduce new material behaviour laws, which are relevant to the problems with bearings, to greatly improve a new tribological methodology.
- Innovation No. 4: Improved understanding and modelling of the formation of the Superficial Tribological Transformations.
- Innovation No. 5: Large degree of freedom in designing/conceiving/producing tribomaterial systems adapted to material property expectations.
- Innovation No. 6: Responsible nanotechnology approach by using nanomaterials in agglomerated forms to avoid the release of nanoparticles in the environment which may affect human health.
- Innovation No. 7: Innovative, smart nano-composite sintered materials with dry solid lubricants.

Results

BEARINGS provides a unique opportunity to maintain European air systems and bearings suppliers' leadership by offering a superior and affordable European technology, which supports an invaluable strategic advantage for European airframe manufacturers and airliners. As BEARINGS will be a technological breakthrough, they will also have a considerable advantage on the world market.

Advances in the associated scientific/technological fields will give a strong advantage to the equipment supply chain and SMEs by improving their own skills and developing new ones. These competences will also be valid for sectors other than aeronautics.

Strong economic impacts are also expected for:

- the sectors which use solid lubricant bearings;
- the sectors which need to find corrosion resistant materials to replace chrome VI.

Acronym:	BEARINGS
Name of proposal:	New generation of aeronautical bearings for extreme environmental constraints
Contract number:	AST5-CT-2006-030937
Instrument:	STP
Total cost:	3 763 023 €
EU contribution:	2 000 000 €
Call:	FP6-2005-Aero-1
Starting date:	01.09.2006
Ending date:	31.08.2009
Duration:	36 months
Objective:	Competitiveness
Research domain:	Structures & Materials
Coordinator:	Dr Duquesne Nathalie Liebherr Aerospace Toulouse 408 avenue des Etats-Unis, BP52010 FR 31016 Toulouse Cedex 2
E-mail:	nathalie.duquesne@liebherr.com
Tel:	+33 (0)5 6135 22 58
Fax:	+33 (0)5 61 35 29 52
EC Officer:	M. Brusati

Partners:	První brnenská strojírna Velká Bítes, a.s.	CZ
	SKF Aerospace France	FR
	The Provost, Fellows and Scholars of the College of the Holy and Undivided Trinity of Queen Elizabeth near Dublin	IE
	Budapest University of Technology and Economics	HU
	Institut National des Sciences Appliquées de Lyon	FR
	Consorzio per lo sviluppo dei sistemi a grande interfase - CSGI	IT
	MBN Nanomaterialia S.p.A.	IT
	ARC Seibersdorf Research GmbH	AT
	Instytut Obrobki Plastycznej (Metal Forming Institute)	PL
	PyroGenesis SA	GR

TATMo

Turbulence and transition modelling for special turbomachinery applications

Background

Today's turbomachinery bladings for turbines can reach extremely high levels of efficiency at high levels of Reynolds numbers. Low pressure turbines (LPT) are operating at low Reynolds numbers which make them more sensitive to flow separation and may cause large aerodynamic losses. In addition, the current trend in LPT is to reduce the blade count (i.e. reduce the weight) resulting in more lift on each airfoil. For these reasons, special design features are necessary for LPT in order to preserve high levels of efficiency. If the high lift blade philosophy is to be maintained, these measures may need to be reflected in special designs or in the application of perturbation devices on the suction side of the blade preventing or reducing the massive separations near mid-span.

Within the TATMo project, these measures intend to preserve high levels of lift while increasing the efficiency. In addition, the existing database for higher Reynolds numbers, as a result of the Fifth Framework Programme project UTAT, will be extended to lower Reynolds numbers.

The performance of compressor blades will also be adressed by lowering or avoiding the detrimental corner separations by means of suction and blowing. Additionally, the effects of real geometry such as fillet radius, weld and wall roughness on the efficiency will be assessed.

Objectives

In conjunction with the two top-level objectives identified in the Strategic Research Agenda and the Vision 2020 report, TATMo represents a major contribution to both of these high-level objectives:
- to meet society's needs for a more efficient, safer and environmentally friendly air transport.
- to win global leadership for European aeronautics, with a competitive supply chain, including small and medium enterprises.

TATMo will improve calculation capabilities by a better modelling of the flow with and without span-wise roughness elements and synthetic jets, which is necessary for the prediction of these complicated flow fields and the losses, through improved design tools.

An improvement of simulation tools and understanding of the physics dominating the very low Reynolds number flows over the compressor and turbine blades will:
- enable the designers to reduce the number of engine design iterations by providing the right design the first time,
- lead to more efficient and lighter designs and thus to a reduction in the aircraft fuel burn which finally cuts the emission of CO_2.

Description of work

The TATMo project contributes to the above-mentioned objectives of the aeronautics priorities by combining experimental and analytical studies of compressor and turbine flows. The most appropriate test cases are chosen with the help of preliminary CFD computations.

The investigation for LPTs comprises:

- a flat plate with a typical LPT pressure distribution without upstream wakes,
- a flat plate facility with incoming wakes,
- a cascade at design Mach number with and without an upstream high-speed wake generator.

The critical Reynolds number is determined for three designs where massive separation occurs. All designs have the same turning but have two different suction side diffusions and two different pitch-to-chord ratios.

Benchmark tests for code validation of compressors with real geometry effects and for the LPT's very low Reynolds number high lift designs, with and without roughness elements or synthetic jets, are generated.

To account for specific flow phenomena and roughness effects, a range of different concepts of turbulence modelling will be investigated. The test cases, as defined in a Computational Fluid Dynamics test matrix, will be verified with the different turbulence models. The modelling work will be mainly done by the research establishments and the academic TATMo partners, while the verification work is primarily performed by the industrial partners.

Results

The understanding of the physics of separations in highly loaded compressor and turbine blades of axial flow turbomachines and the assessment of the potential benefit of active and passive devices is a prerequisite to reduce the losses and significantly increase the efficiency of (low-pressure) turbines and compressors of an aero-engine. Moreover, the higher possible load of the blades will decrease the weight of the engine and hence reduce the specific fuel consumption.

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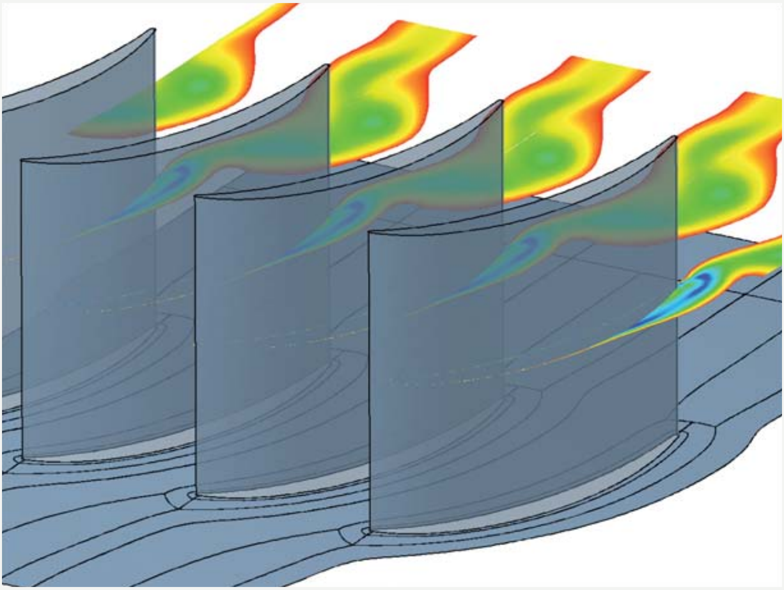
Cascade test section in the wind tunnel at VKI



Visualisation of calculation results: total-pressure distriution of a flow through a compressor cascade

The exploitable outcomes of TATMo will be:

– Improved aerodynamic simulation tools through code calibration and validation against high quality measurements,
– Improved understanding of the physics of low Reynolds number flows,
– New views and insights into a massively separated flow field by means of newly developed unsteady measurement techniques,
– Database and validated modelling of perturbation devices for highly loaded turbine blades,
– Database and validated modelling of active flow control devices for highly loaded compressor blades on the blade and on the casing,
– Derivation of new design rules for compressor and turbine blades in the very low Reynolds number flow regime.

In light of the arguments elaborated above, the TATMo project outcomes will have a significant beneficial impact on the competitiveness of the European aeronautic industry.

Acronym:	TATMo
Name of proposal:	Turbulence and transition modelling for special turbomachinery applications
Contract number:	AST5-CT-2006-030939
Instrument:	STP
Total cost:	4 905 970 €
EU contribution:	2 999 908 €
Call:	FP6-2005-Aero-1
Starting date:	01.10.2006
Ending date:	30.09.2009
Duration:	36 months
Objective:	Competitiveness
Research domain:	Propulsion
Website:	http://www.tatmo.eu
Coordinator:	Mr Servaty Stephan MTU Aero Engines GmbH Dachauer Strasse 665 DE 80995 Munich
E-mail:	stephan.servaty@muc.mtu.de
Tel:	+49 (0)89 1489 4261
Fax:	+49 (0)89 1489 99977
EC Officer:	R. Denos

Partners:	SNECMA	FR
	AVIO S.p.A.	IT
	Industria de Turbopropulsores, S.A	ES
	Techspace Aero S.A.	BE
	Rolls-Royce Deutschland Ltd & Co. KG	DE
	Deutsches Zentrum für Luft- und Raumfahrt e. V.	DE
	Office National d'Etudes et de Recherches Aérospatiales	FR
	Universita' degli Studi di Firenze - Dipartimento di Energetica 'Sergio Stecci'	IT
	Centre de Recherche en Aéronautique, ASBL	BE
	Technical University of Berlin	DE
	The Chancellor, Masters and Scholars of the University of Cambridge	UK
	von Karman Institute	BE
	Università degli Studi di Genova - Dipartimento di Macchine, Sistemi Energetici e Trasporti	IT
	Universidad Politecnica de Madrid	ES
	Imperial College of Science, Technology and Medicine	UK

PREMECCY

Predictive methods for combined cycle fatigue in gas turbine blades

Background

The modern gas turbine is a complex machine, the design and development of which takes many months and costs millions of euros. The European gas turbine manufacturing industry is under pressure to minimise the resources required to bring a new design to market due to global competitive pressure and increasing customer expectations. Accurate design and prediction tools are key to success in this process.

PREMECCY identifies the field of rotor blade combined cycle fatigue (CCF) as an area where there are shortcomings in the existing industry-standard design and prediction tools, and thus where significant benefits can be achieved.

Rotor blade CCF accounts for up to 40% of the total number of issues that arise during an engine development programme and a similar proportion of in-service problems. The primary objective of PREMECCY is to develop new and improved CCF prediction methods for use in the design process. These will halve the number of development and in-service CCF problems, thereby reducing the time and cost required to develop a new engine and reducing the operating costs once in service. They will also enable the design of lighter, more efficient blades, reducing engine Specific Fuel Consumption.

In order to develop the new prediction methods the project will first generate high quality material test data. All the industrial partners are in a position to exploit the resulting methodologies within their existing design processes.

Objectives

The fundamental aim of the PREMECCY project is to deliver new and improved combined cycle fatigue (CCF) prediction tools for exploitation in the industrial design process. This will be achieved through a programme of material characterisation and advanced testing.

The current industry standard assessment of High Cycle Fatigue integrity at the component design stage is based on the Goodman or modified Goodman (range-mean) approach. The Goodman method has been in existence for over a century and is undoubtedly a valuable tool for the mechanical design engineer. However, the demand for ever more powerful, efficient, reliable and safe gas turbines has led to a greater and greater complexity in rotor blade design. This leads to a state of affairs where the number of variables associated with the true component HCF integrity in the engine environment outnumber those considered at the design phase.

To meet these objectives the project will carry out the following key tasks:

- design advanced test specimens, representative of rotor blade critical features;
- define and execute a matrix of traditional testing to fully characterise the selected materials;
- modify existing test rigs to allow CCF testing of advanced specimens;
- define and execute advanced specimen testing to explore a range of CCF mechanisms on life;
- develop new and enhanced CCF prediction methods.

Description of work

The project can be broken down into the following sections:

Materials selection

The consortium partners have agreed upon three key expanding materials, including:

1. Titanium 6.2.4.2, used in IP and HP compressor rotor and stator components
2. Inconel 713LC, nickel alloy used in LP turbine blade and vanes
3. CMSX4, nickel alloy typically used in HP and IP turbine blades and vanes

Specimen design

PREMECCY will adopt the aerofoil-like working section that was shown to be effective in a previous Fifth Framework Programme named RAMGT. Detailed design, including the definition of critical features will be carried out using the latest design and finite element analysis techniques.

Material testing

The reality of gas turbine rotor blade resonance is that the alternating loads are typically generated by a flap or torsional mode-shape resonance resulting in a stress field that is considerably more complex than that generated in traditional tests. In order to carry out a representative test a more advanced test rig will be developed.

Methods development

The industrial partners will identify which modelling approach has the most potential for application at the component level. Based on this they will develop advanced engineering approaches that can be applied in the design process and that will offer improvements in both accuracy and timescale compared with existing design capabilities.

Results

This programme will yield the following deliverables:

1. A comprehensive database and reports characterising the HCF and CCF response of three gas turbine blade materials.
2. Validated engineering methods for prediction of component HCF and CCF strength and life.
3. New and improved models accurately describing the behaviour of features subjected to HCF and CCF.
4. Enhanced HCF and CCF test rigs capabilities.

These deliverables can be linked to direct and indirect economic benefits.

Direct – Reduced development lead-time/development cost/engine operating cost, increased competitiveness and hence market share and improved profitability.

Indirect – Improved airline profitability, increased supplier revenues, reduced cost of air travel and other gas turbine services such as electricity, shipping and fossil fuel supply.

Impact on society includes:
Quality of life – improved aircraft reliability will improve the passenger experience and the efficiency of air traffic operations. Savings are likely to be passed on to the customer who will thus enjoy improved service at reduced cost. Improving competitiveness will also safeguard highly skilled jobs.

Environment – improvements in the efficiency of the gas turbine as a result of PREMECCY will contribute to a reduction in fossil fuel usage and hence in CO_2 emissions which are linked to climate change.

Acronym:	PREMECCY	
Name of proposal:	Predictive methods for combined cycle fatigue in gas turbine blades	
Contract number:	AST5-CT-2006-030889	
Instrument:	STP	
Total cost:	6 729 345 €	
EU contribution:	3 708 882 €	
Call:	FP6-2005-Aero-1	
Starting date:	01.06.2006	
Ending date:	31.05.2010	
Duration:	48 months	
Objective:	Competitiveness	
Research domain:	Propulsion	
Coordinator:	Mr Webster Adrian Rolls-Royce plc 65 Buckingham Gate UK SW1E 6AT London	
E-mail:	adrian.webster@rolls-royce.com	
Tel:	+44 (0)1332 243528	
Fax:	+44 (0)1332 243530	
EC Officer:	D. Chiron	
Partners:	Rolls-Royce Deutschland Ltd & Co KG	DE
	INDUSTRIA DE TURBO PROPULSORES, S.A.	ES
	TURBOMECA	FR
	SNECMA	FR
	AVIO S.p.A.	IT
	MTU Aero Engines GmbH	DE
	Siemens Industrial Turbomachinery Ltd	UK
	Volvo Aero Corporation	SE
	FUNDACION INASMET	ES
	Technische Universität Dresden	DE
	Association pour la Recherche et le Développement des Méthodes et Processus Industriels	FR
	CENTRALE RECHERCHE S.A.	FR
	Institute of Physics of Materials, Academy of Sciences of the Czech Republic	CZ
	POLITECNICO DI MILANO	IT

HEATTOP

Accurate high-temperature engine aero-thermal measurements for gas turbine life otimisation, performance and condition monitoring

Background

Instrumentation is a key generic technology in the gas turbine industry that influences the development cost, efficiency and competitiveness of gas turbine products.

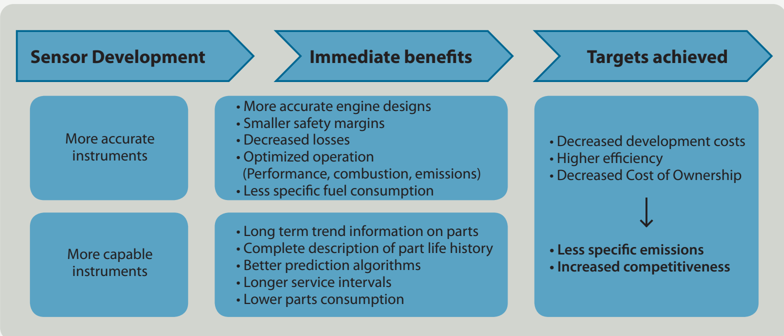
The very hostile gas turbine environment presents unique challenges for instrumentation. The drive to greater efficiency is steadily raising the temperatures and pressures in engines, and this further increases the challenge to the instrumentation. The cross sector impact of shortfalls in current instrumentation capability was assessed by the Fifth Framework Programme's European virtual institute for gas turbine instrumentation (EVI-GTI) thematic network. EVI-GTI (www.evi-gti.com) identified three areas where the lack of adequate instrumentation capability is perceived to be either holding back gas turbine engine development, or leading to increased uncertainty in design methods and component life prediction:

- Measurement of gas temperature, pressure, flow and blade tip clearances at very high temperatures (→1000°C);
- Measurement of component temperatures in the hottest parts of the engine;
- Measurement of component vibration on very hot components.

Objectives

The objectives of HEATTOP are:

- Reduced measurement uncertainty for design validation, enabling improved engine performance in new products;
- Instruments for validation of design in parts of engines which are inaccessible with current state-of-the-art instruments;
- Reduced engine development costs through more direct measurements of key component performance, reducing the amount of special testing required;
- Reduced cost of product ownership through reduced component life prediction uncertainty and therefore



- reduced parts consumption, and improved product performance giving reduced fuel burn;
- Sensors enabling better engine control and monitoring;
- Validation of all technology developments within the project in representative environments to provide instruments suitable for utilisation within three years.

To achieve these objectives within a period of three years, the work programme will develop measurement technologies in four areas:

- Quantum step of thermocouple technology for use at very high temperatures;
- Advanced, highly accurate, high temperature, surface temperature measurements;
- Advanced gas path aerodynamic measurements for high temperatures;
- Clearance measurements at high temperatures for long-term monitoring.

Description of work

There are nine Work Packages in total: four technical Work Packages for sensor development (as listed above) and two Work Packages for sensor validation in test facilities. The other Work Packages are dedicated to definitions of targets, coordination and project management, and dissemination of results.

The four technical Work Packages will be performed in parallel, followed by tests in rigs and production engines. Although there will be sensor development work in each of them, they have been set up according to the technical problem to be solved rather than according to the technology used for the solution. This will guarantee that the focus is on the solution of the problem rather than on the technology only.

Coordination and project management will be led by Siemens Power Generation.

The definitions will be led by the European leaders in aero engines to make sure that the final specifications will meet the aero engine manufacturers' needs.

The four technical Work Packages are led by engine OEMs (original equipment manufacturers) or by experienced industries or research institutes. Work packages, tasks and sub-tasks have been chosen and distributed amongst the partners in such a way that all consortium work is complementary rather than competitive.

The Work Packages for validation of sensors in test vehicles will verify if the idea behind the development works out. If the prototype rig test of a technology gives promising results, the technology will go into the final engine tests which will be done on production aircraft engines and power gas turbines.

Results

The expected results are:

- Understanding the impact of the exposure of new sensor technologies to very hostile environments, which have been previously used in laboratory conditions only;
- Reports on rig and engine tests, validating the technology readiness of the newly developed measurement capabilities;
- Sensor data from in-engine operation including the uncertainty analysis of the results;
- OEMs will use sensors for developing new improved products, and monitoring and control applications to reduce cost of ownership of new products;
- Vendors (SMEs, instrumentation supply chain) will ensure a rapid commercial exploitation of results by producing and selling sensors to the gas turbine OEMs;
- Academia will publish knowledge of new technologies to stimulate further advances in the field;
- Dissemination of information on technology developments in sensing technology for harsh environments through EVI-GTI open conferences and meetings.

Acronym:	HEATTOP
Name of proposal:	Accurate high-temperature engine aero-thermal measurements for gas turbine life otimisation, performance and condition monitoring
Contract number:	AST5-CT-2006-030696
Instrument:	STP
Total cost:	8 848 004 €
EU contribution:	5 219 660 €
Call:	FP6-2005-Aero-1
Starting date:	01.08.2006
Ending date:	31.07.2009
Duration:	36 months
Objective:	Competitiveness
Research domain:	Propulsion

Coordinator:	Flohr Patrick Siemens AG, Power Generation PE53 Gas Turbine Diagnostics Mellinghoferstr. 55 DE 45473 Mülheim a.d. Ruhr
E-mail:	patrick.flohr@siemens.com
Tel:	+49 (0)208 456 4757
Fax:	+49 (0)208 456 2714

EC Officer:	R. Denos	
Partners:	Rolls-Royce Group plc	UK
	Volvo Aero Corporation	SE
	Vibro-Meter SA	CH
	Meggitt (UK) Ltd trading as Vibro-Meter UK	UK
	KEMA Nederland B.V.	NL
	CESI Ricerca - Centro Elettrotecnico Sperimentale Italiano Giacinto Motta SpA	IT
	Farran Technology Limited	IE
	Von Karman Institute for Fluid Dynamics	BE
	Oxsensis Ltd	UK
	Advanced Optics Solutions (AOS) GmbH	DE
	Auxitrol SA	FR
	Institut für Physikalische Hoch-Technologie (IPHT)	DE
	The Chancellor, Masters and Scholars of the University of Cambridge	UK
	University of Lund	SE
	ONERA	FR
	The Chancellor, Masters and Scholars of the University of Oxford	UK

NICE-TRIP

Novel Innovative Competitive Effective Tilt-Rotor Integrated Project

Background

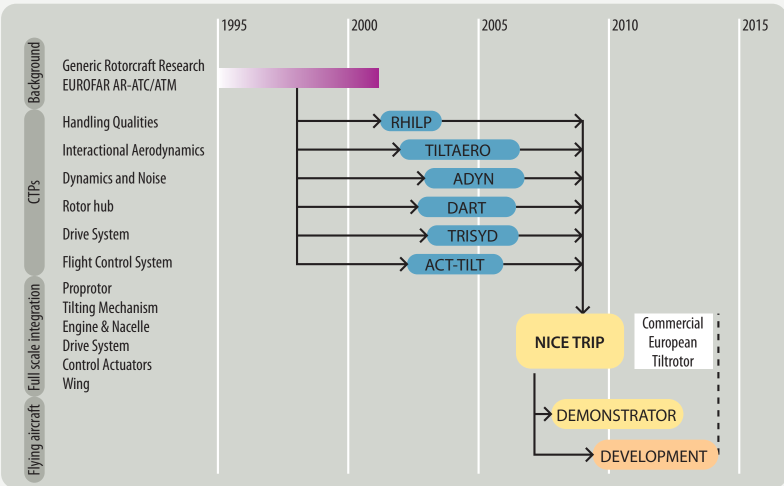
A tilt-rotor is a vehicle which is designed to take off and land vertically like a helicopter and cruise like a fixed-wing aeroplane by tilting its propellers. The USA has a lead over Europe as the only country with flying tilt-rotors.

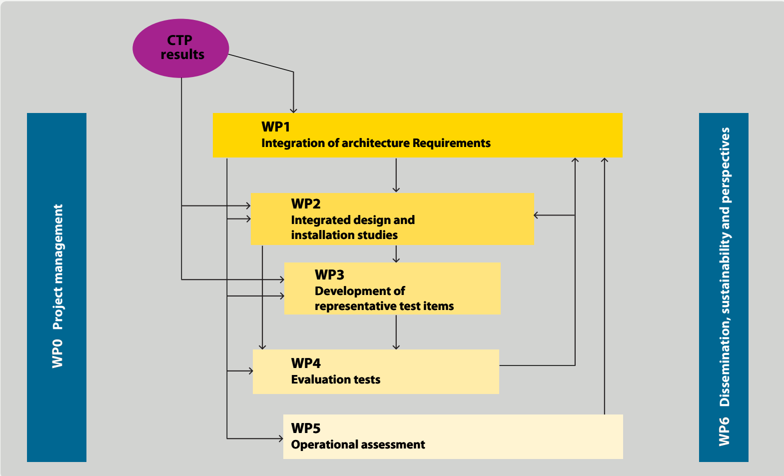
The European rotorcraft community has been engaged in studies on the tilt-rotor concept since the mid 1980s, particularly within the EUREKA programme (EUROFAR project). This initiative led to further studies and the bases were defined for a programme aiming to fly a tilt-rotor demonstrator by the early 2010s, opening the way for a possible first commercial aircraft. A research and development roadmap was defined and progressively implemented through several projects. In particular, several EU-funded projects were conducted such as RHILP, ACT-TILT, DART, TRISYD, TILTAERO and ADYN. Studies and development were also conducted under national support, more specifically for the tilt-rotor blade development under French government support.

Besides generating important knowledge, these projects have demonstrated technical feasibility in relation to key tilt-rotor specific issues in aerodynamics, dynamics, mechanics, rotor or flight control.

Objectives

The ERICA concept and architecture are very much innovative for tilt-rotor. Their implementation requires the development of new features and achieving technological breakthroughs, as was done in previous EU projects with full-scale manufacturing of a rotor hub and a gearbox,





elastomeric components, mixed metallic/composite material pieces, advanced manufacturing processes, optimised rotor blades, advanced control features, fly-by-wire/light technology, active side-stick, enhanced flight mechanics models, etc.

The NICE-TRIP project will continue along this innovation track and develop new features such as:

- the integration of critical technologies developed in previous projects;
- the design and manufacture of full-scale tilt-rotor parts;
- the definition of new generation actuators (for nacelle, wing, rotor);
- the development of a powered full-span mock-up (scale 1/5), fully movable;
- the development of new types of testing rigs to accommodate the novel features and to produce the much demanding tilt-rotor environment (aerodynamics, loads);
- the analysis of the integration of tilt-rotors in air traffic management/control.

Description of work

The following topics are addressed by this project:

- Design of the main tilt-rotor elements and their integration environment: fuselage, wing, tail surfaces, nacelle and engine integration, drive system, rotor system, flight control system, hydraulic system, electrical system and fuel system. General CAD integration of subsystems.
- Manufacture and integration of critical tilt-rotor parts: rotor hub, blades, drive system, drive system housing.
- Design and development of a rig for full-scale prop rotor gearbox (PRGB) and housing testing, and for whirl tower tests of the integration of rotor hub, blades and PRGB.
- Full-scale testing: functional, kinematics and performance of the critical parts (gearbox, input module, blades, rotor hub) under representative hover loads.
- Design, development and integration of a large-scale (1/5) full-span powered model for assessing, through wind tunnel tests, aerodynamic interference in helicopter, conversion and fixed-wing modes.
- Design and development of a full-span modular model (scale 1/8) for evaluating the aerodynamic coefficients of the aircraft through wind tunnel tests.

- Design and development of a small-scale partial model of nacelle, for optimising the interference between nacelle and engine through wind tunnel tests.
- Wind tunnel testing in appropriate facilities with the full-span modular model.
- Provision of appropriate full-scale and wind tunnel data for the assessment of the tilt-rotor flight demonstrator and weight/cost/reliability of a production aircraft.

The associated scientific and operational topics are:

- Consolidation and validation of computation codes: flight mechanics, CFD, aero-elastic, aero-acoustic and performance.
- Consolidation of the aircraft characteristics and architecture requirements: aircraft performance, general design, loads, handling qualities, aerodynamics, dynamics.
- Investigation of the tilt-rotor integration in air traffic management/control (ATM/ATC).
- Assessment of the sustainability of the tilt-rotor.
- Development of recommendations, strategies and plans for future work on the way to a flying prototype.

Results

The NICE-TRIP results will be:

- Research in several topics: flight mechanics modelling, aeromechanics modelling, simulation and computation codes improvement, aircraft performance prediction, handling qualities, aero-elasticity and aero-acoustic prediction, stress calculation, materials.
- Teaching and training programmes in aeronautics with enhanced tools.
- Exploitation for research and studies of the powered full-span mock-up and ground testing tilt-rotor parts built in the project.
- Exploitation for research and development of the enhanced testing facilities built in the project.
- Development of improved elements of traditional rotorcrafts (rotor, drive train) for more efficient and competitive products, including new manufacturing processes.
- Development of improved systems for conventional rotorcrafts (flight control, actuation).
- Exploitation of an enhanced expertise in rotorcraft development.
- Pre-certification studies (by rotorcraft manufacturers) and certification work (by airworthiness authorities).
- Integration of tilt-rotors in air traffic management and control (ATM/ATC).

Acronym:	NICE-TRIP
Name of proposal:	Novel Innovative Competitive Effective Tilt-Rotor Integrated Project
Contract number:	AIP5-CT-2006-030944
Instrument:	IP
Total cost:	38 302 000 €
EU contribution:	19 000 000 €
Call:	FP6-2005-Aero-1
Starting date:	01.11.2006
Ending date:	31.03.2010
Duration:	54 months
Objective:	Competitiveness
Research domain:	Novel Configurations

Website:	http://nicetrip.onera.fr	
Coordinator:	Mr Favennec Yves VERTAIR Aeroport Marseille-Provence FR 13725 Marignagne	
E-mail:	yves.favennec@eurocopter.com	
Tel:	+33 (0)4 42 85 62 74	
Fax:	+33 (0)4 42 85 86 05	
EC Officer:	P. Kruppa	
Partners:	Agusta SpA	IT
	Eurocopter	FR
	Eurocopter Deutschland GmbH	DE
	Westland Helicopters Ltd	UK
	Castilla y Leon Aeronautica S.A.	ES
	Galileo Avionica SpA	IT
	Gamesa Desarrollos Aeronauticos	ES
	Goodrich Actuation Systems SAS	FR
	IDS Ingegneria Dei Sistemi S.p.A.	IT
	Liebherr-Aerospace Lindenberg GmbH	DE
	MECAER Meccanica Aeronautica S.p.A.	IT
	PAULSTRA SNC	FR
	SAMTECH s.a.	BE
	Secondo Mona S.p.A.	IT
	Sener Ingenieria y Sistemas	ES
	ZF Luftfahrttechnik GmbH	DE
	Riga Scientific Experimental Centre 'AVIATEST LINK'	LV
	Centre de Recherche en Aéronautique, ASBL	BE
	Centro Italiano Ricerche Aerospaziali SCpA	IT
	Fundacion Centro de Tecnologias aeronauticas	ES
	Deutsches Forschungzentrum für Luft- und Raumfahrt	DE
	Stichting Nationaal Lucht- en Ruimtevaartlaboratorium	NL
	Office National d'Etudes et de Recherches Aérospatiales	FR
	Consorzio SICTA - Sistemi Innovativi per il Controllo del Traffico Aereo	IT
	Federal State Unitary Enterprise Central Aerohydrodynamic Institute named after Pof. N.E. Zhukovsky	RU
	Politecnico di Milano	IT
	University of Liege	BE
	The University of Liverpool	UK
	Universitaet Stuttgart	DE
	Politchnika Warszawska (Warsaw University of Technology)	PL

ATLLAS

Aerodynamic and Thermal Load Interactions with Lightweight Advanced Materials for High-speed Flight

Background

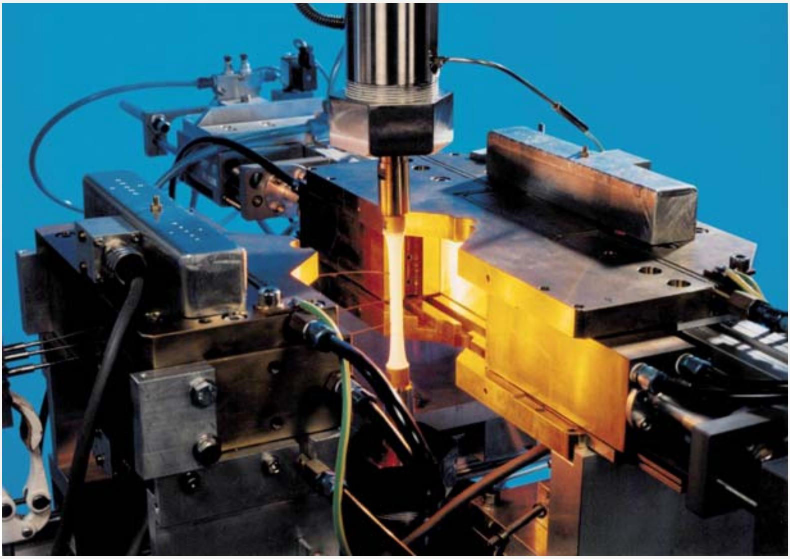
One option for a future air transport system is the use of supersonic vehicles allowing to reach the antipodes in a few hours. In Europe, very limited research has been carried out in the field of supersonic transport vehicles above Mach 3. Concorde and other studies on supersonic transport in America and Japan limit the flight speed to Mach 2 to 2.4, which still allows the use of classical aluminium alloys.

For high-speed aircraft, the lift to drag ratio of the vehicle and the material and cooling issues for both airframe and engine are some of the key elements which force the designer to limit the flight Mach number.

A wide range of heat-resistant and lightweight materials is available nowadays but their definition and implementation requires the availability of vehicle system conditions and constraints.

Indeed, the expected benefits of economical, high-performance and high-speed civil-aircraft designs that are being considered for the future will be realised only through the development of lightweight, high-temperature composite materials for structure and engine applications to reduce weight, fuel consumption and direct operating costs.

While the LAPCAT project investigates propulsion systems for flight Mach num-



Creep test facility

© DLR

ber ranging between 3 and 8, this ATTLAS project looks into the vehicle aerodynamics and the testing of potential materials that can withstand the high heat loads encountered at these very high velocities.

Objectives

The objectives of ATTLAS are:
- to evaluate two innovative supersonic aicraft concepts that will be able to provide acceptable levels of lift to drag ratios for flight Mach numbers ranging between 3 and 6,
- to identify and assess lightweight advanced materials that can withstand ultra high temperatures and heat fluxes enabling flights above Mach 3. At these high speeds, the classical materials used for airframes and propulsion units are no longer feasible and need to be replaced by high-temperature, lightweight materials, with an active cooling of some parts.

Description of work

First of all, the overall design for high-speed transports will be revisited to increase the lift/drag ratio and volumetric efficiency through the 'compression lift' and 'waverider' principles, taking into account sonic boom reduction. This should allow vehicle definitions for Mach 3 and Mach 6 cruise flights.

Second, materials and cooling techniques, and their interaction with the aero-thermal loads will be addressed for both the airframe and propulsion components. The former will focus on sharp leading edges, intakes and skin materials coping with different aerothermal loads, the latter on combustion chamber liners.

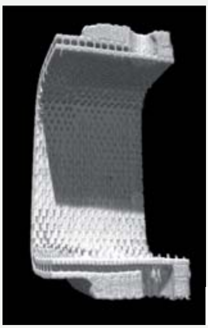
After carrying out material characterisation and shape definition at specific aerothermal loadings, dedicated on-ground experiments will be conducted. Both ceramic matrix composites (CMC) and heat-resistant metals will be tested to evaluate their thermal and oxidiser resistance. In parallel, novel cooling techniques based on transpiration and electro-aerodynamics principles will be investigated.

Combined aerothermal experiments will test various material specimens with a realistic shape at extreme aerothermal conditions for elevated flight Mach numbers. Dedicated combustion experiments on CMC combustion chambers will allow the reduction of combustion liner cooling resulting in a NOx-reduction and overall thermal efficiency increase.

Finally, a particular aerothermal-material interaction will strongly influence the aerothermal loadings. Conjugate heat transfer, transpiration cooling and compressible transition phenomena are investigated and modelled.

Results

The project will result in:
- the definition of the requirements and operational conditions at system level,
- the assesment of the performance of two supersonic vehicles,
- dedicated and thorough in-depth experiments performed on material characterisation in combination with aerothermal loads and combustion processes,
- setting-up and validating physical models integrated into numerical simulation tools.



PATH Structure

Acronym:	ATLLAS	
Name of proposal:	Aerodynamic and Thermal Load Interactions with Lightweight Advanced Materials for High-speed Flight	
Contract number:	AST5-CT-2006-030729	
Instrument:	STP	
Total cost:	8 430 843 €	
EU contribution:	4 776 000 €	
Call:	FP6-2005-Aero-1	
Starting date:	01.10.2006	
Ending date:	30.09.2009	
Duration:	36 months	
Objective:	Competitiveness	
Research domain:	Novel Configurations	
Website:	http://www.esa.int/techresources/ATLLAS	
Coordinator:	Dr Steelant Johan	
	European Space Agency - European Space Research and Technology Centre	
	Keplerlaan 1	
	NL 2200 AG Noordwijk	
E-mail:	johan.steelant@esa.int	
Tel:	+31 (0)71 565 5552	
EC Officer:	R. Denos	
Partners:	European Aeronautic Defense and Space - Space Transportation GmbH	DE
	MBDA-France	FR
	Alta S.p.A.	IT
	Deutsches Zentrum für Luft- und Raumfahrt (German Aerospace Center)	DE
	Office National d'Etudes et de Rescherches Aérospatiales	FR
	Swedish Defence Research Agency	SE
	Gas Dynamics Ltd	UK
	University of Southampton	UK
	University of Stuttgart	DE
	Technische Universität München	DE
	EADS Deutschland GmbH- Corporate Research Center Germany	DE
	Université Pierre et Marie Curie	FR

FLACON

Future high-altitude flight – an attractive commercial niche?

Background

It is the SpaceShipOne (SS1) whose experimental demonstration flights in the USA have shown that sub-orbital (high-altitude) flight is technically feasible. This actually represents the state of the art. Much more effort needs to be invested to advance from this demonstration flight to routine and potentially commercial flights. This is also indicated by the efforts undertaken by Virgin Galactic to market and produce SS2. This concerns not only technical but also non-technical issues.

However, at least for the flights to be anticipated, owing to the (comparatively) many start-up engineering companies attempting to provide flight opportunities, the American Authority FAA is preparing a legislation which mitigates and adapts the stringent rules which apply to the transonic transport. Polling investigations, for example by FUTRON, have shown that there is a substantial, small community which would be ready to pay the necessarily high price of the order of about USD 200 000 to enjoy the near-space ride in a flying vehicle. The correspondingly predicted financial revenue based on space tourism seems to be sufficiently high to let a niche industry survive (for example Virgin Galactic) in the long term. However, not everybody concerned would like to travel in adventure-like rough style; the more flight comfort that could be offered, the better.

Objectives

The objective is to identify and assess the long-term potential of commercial high-altitude flight in Europe for selected mission requirements. Furthermore, it is proposed to identify missing developments in technology for Europe and to address safety measures, as well as the required steps to satisfy legislation. A corresponding research and development strategy to enable commercial high-altitude flights will be worked out in order to secure the international competitiveness of European industries.

While the common understanding of the European community is that sub-orbital

In clockwise direction: SpaceShipTwo, Rocketplane XP, XCOR Xerus, Explorer C21 high-altitude flight is technically feasible within a few years, building on the available knowledge in aviation, it has never been proven experimentally. Such sub-orbital flight is also understood to be on the borderline of space, since the transport of people is approaching the orbital environment without really entering it fully, in the sense of having to master the harsh environment of hypersonic re-entry into the atmosphere. According to reports, the interest in the USA in high-altitude flying is very large in spite of the high price, suggesting a profitable niche for commercial flight and triggering innovation in small industries to satisfy such demand.

The key objectives are therefore:
1. assess worldwide activities and define reasonable mission requirements;
2. identify potential problems, technical but in particular non-technical ones, and the missing elements for carrying out commercial high-altitude flight;
3. propose a way forward to achieve commercial sub-orbital flight, including potential self-sustained development steps leading to human hypersonic flight, and a funding scenario for an initial experimental flight.

Description of work

The topics dealt with in this project are:
1. To evaluate the mission opportunities of sub-orbital, potentially commercial flights based on the review of available publications and existing in-house performed work.
2. To review the technical and non-technical elements required for sub-orbital flights, and to identify problems or missing elements/technologies. This includes the investigation of what has to be achieved in terms of legal issues, and other non-technology topics to be able to fly, and without too many restrictions regarding flying over land and inhabited areas. Another topic is the estimation of costs associated with sub-orbital flight based on selected mission opportunities. This would include the rough costing of a first experimental flight.
3. To investigate the possibility of an air launch for sub-orbital flight, including the effect on costs in the short and long term, and whether the launching carrier could be used for other purposes. The task would include choosing a launching strategy.
4. To summarise the experiences gained in the work on topics 1 to 3 by performing a synthesis and attempting a roadmap, including a rough scheduling of necessary events.

Results

Available/published approaches for high-altitude flight have been reviewed, and a corresponding assessment has been made. An analysis of potential market opportunities in addition to space tourism has been carried out. Descent trajectories for non-zero horizontal velocities at maximum altitude have been investigated with regard to loads on the vehicle and on the people. A tentative list of requirements for high-altitude flight has been set up.

The following agreement about the major user requirements for suborbital flight was obtained:
- → 100 km altitude
- ← 4-5 z-g mechanical load on passengers
- Low g-duration → 3 min
- Ticket price ← USD 200-250 000
- Number of passengers ← 8
- Crew necessary (1 or 2)
- Time to market ← 2015

Introduction of horizontal velocity for added attraction in future transportation.

Corresponding technical requirements (e.g. maximum dynamic pressure, realistic re-entry corridor, etc.) remain to be defined based on the existing preliminary sensitivity analysis.

Acronym:	FLACON	
Name of proposal:	Future high-altitude flight - an attractive commercial niche?	
Contract number:	ASA5-CT-2005-30712	
Instrument:	SSA	
Total cost:	127 784 €	
EU contribution:	110 000 €	
Call:	FP6-2002-Aero-2	
Starting date:	01.09.2006	
Ending date:	31.08.2007	
Duration:	12 months	
Objective:	Competitiveness	
Research domain:	Novel Configurations	
Website:	http://www.esa.int/techresources/ecflacon	
Coordinator:	Dr Kordulla Wilhelm	
	ESA/ESTEC	
	Keplerlaan 1	
	NL 2201 AZ Noordwijk	
E-mail:	Wilhelm.Kordulla@esa.int	
Tel:	+31 (0)71 565 4410	
Fax:	+31 (0)71 565 6615	
EC Officer:	J. Martin Hernandez	
Partners:	ASTRIUM ST (HB)	DE
	Dassault Aviation	FR
	DLR	DE
	ONERA	FR

MAGPI

Main Annulus Gas Path Interactions

Background

In a modern aero engine, up to 20% of the main annulus flow is bled off to perform cooling and sealing functions. The vicinity of these bleed ports and flow sinks is characterised by complex unsteady swirling flows which are not fully understood. Even the most up-to-date numerical tools have difficulties predicting the behaviour of the secondary flow system when interacting with the main annulus.

The expected results are a reduction of cooling and sealing airflow rates, improvements of the turbine and compressor efficiency and an increase in the safety margin of the engine components by better cooling.

The targeted outcome will contribute to the ACARE goal of reduced CO_2 emissions via reduced fuel burn of 2% to improve the environment and strengthening the competitiveness of European gas turbine manufacturers.

Objectives

The project addresses interactions between the main gas path and secondary flow systems in commercial gas turbines in a response to Research Activity AERO-2005-1.3.1.2a 'Concepts and technologies for improving engine thermal efficiency and reducing secondary air losses'.

Experiments in dedicated rigs are planned to validate the design tools and improve prediction capability of secondary flow systems when interacting with the main gas path.

Description of work

Within MAGPI, experiments are planned on turbine disc rim and compressor manifold cavity heat transfer, hot gas ingestion, and spoiling effects of cooling air flow and their impact on turbine and compressor performance, as well as a reduction of secondary air losses.

The experimental data will be used for a better understanding of the complex flow phenomena and improvements of platform and cavity design. Furthermore, the industrial partners will validate their design tools with these test data and improve their prediction capability of secondary flow systems when interacting with the main gas path.

Results

The expected technical results are:
- Knowledge of the interaction phenomena and its effect on cavity heat transfer, spoiling and performance;

Development of reliable aero engines

Durable gas turbines

- Experimental results for validation of improved numerical tools for secondary flow systems;
- Optimised design methods and computational fluid dynamics best practice guidelines.

The targeted outcome will contribute to the ACARE goal of reduced CO_2 emissions via reduced fuel burn of 2% to improve the environment and thus strengthening the competitiveness of European gas turbine manufacturers.

Acronym:	MAGPI	
Name of proposal:	Main Annulus Gas Path Interactions	
Contract number:	AST5-CT-2006-030874	
Instrument:	STP	
Total cost:	6 790 700 €	
EU contribution:	4 300 000 €	
Call:	FP6-2005-Aero-1	
Starting date:	01.09.2006	
Ending date:	31.08.2010	
Duration:	48 months	
Objective:	Environment	
Research domain:	Emissions	
Coordinator:	Dr Klingsporn Michael Rolls-Royce Deutschland Ltd & Co KG Eschenweg 11 DE 15827 Blankenfelde	
E-mail:	michael.klingsporn@rolls-royce.com	
Tel:	+49 (0)33 708 615 49	
Fax:	+49 (0)33 708 632 85	
EC Officer:	D. Chiron	
Partners:	SNECMA	FR
	Rolls-Royce plc	UK
	AVIO S.p.A.	IT
	Siemens Industrial Turbomachinery Ltd	UK
	Alstom Power Ltd	UK
	Industria de Turbo Propulsores S.A.	ES
	MTU Aero Engines GmbH	DE
	Turbomeca	FR
	University of Surrey	UK
	University of Sussex	UK
	Universitaet Karlsruhe (TH)	DE
	Darmstadt University of Technology	DE
	Università degli Studi di Firenze	IT
	Universidad Politecnica de Madrid	ES

NEWAC

NEW Aero engine Core concepts

Background

Global air traffic is forecast to grow at an average annual rate of around 5% in the next 20 years. This high level of growth makes the need to address the environmental penalties of air traffic all the more urgent. Consequently, Europe's aviation industry faces a massive challenge to satisfy the demand whilst ensuring economic, safe and environmentally friendly air travel.

A first step to reach these 2020 objectives has been set-up through the Fifth and Sixth Framework Programme projects targeting noise, NOX and CO_2 emission reductions. The recently started VITAL project is focusing on technologies for low-pressure system improvements to reduce CO_2 and noise. There is, however, complementary research to be performed on combustor technologies along with the introduction of new engine configurations to reduce NOX emissions and further reduce CO_2 to achieve the SRA 2020 objectives.

Alternative engine configurations consequently need to be researched in order to find a more significant and durable reduction of pollution. Such reductions can only be achieved by firstly considering new configurations with innovative components and secondly by integrating and optimising these components in new engines.

Objectives

ACARE identified the research needs for the aeronautics industry for 2020: a 20% reduction in CO_2 emissions per passenger-kilometre from the engine, whilst keeping the specific weight of the engine constant, and a significant reduction of the NOX emissions during the landing and take-off cycle in order to achieve the 80% reduction.

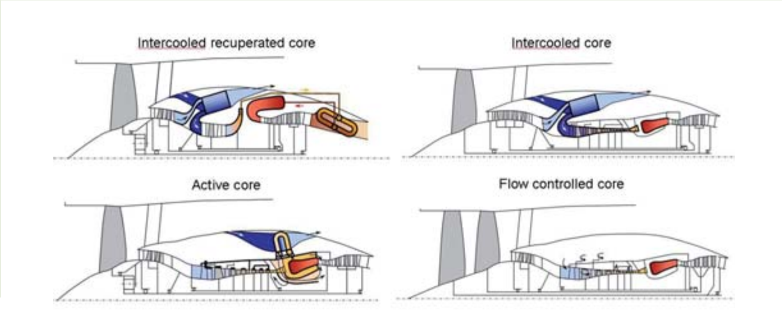
The existing programmes have already identified concepts and technologies to meet these goals. NEWAC will close the gap in the enabling technologies and will develop fully validated novel core engine technologies based on the results of past EC projects, which will deliver a further 6% reduction in CO_2 emissions and a further 16% reduction in NOX emissions.

If these results are combined with the expected results of VITAL (low spool technology) and other national programmes, and the different technology readiness levels are taken into account, the ACARE targets can be attained at a Technology Readiness Level of 5.

Description of work

The innovations provided by NEWAC will include:

- Intercooled Recuperative Aero Engine (IRA), which includes optimisation of the recuperator arrangement, an innovative duct design and a radial compressor;
- Intercooled core, with compact and efficient intercoolers, aggressive ducting and an advanced compressor capable of performing at the extremely demanding conditions of the intercooled cycle. The intercooler is also a critical technology for the IRA concept which was not developed during the EEFAE-CLEAN programme;
- Active core, with active heat management systems like active air cooling, active rotor venting system, smart compressor casing and active compressor flow control;
- Flow controlled core with outer flowpath control technology from casing air aspiration applied on blades and vanes, new advanced 3D aerodynamic compressor design and robust rotor/stator tight clearance management;



NEWAC

- Innovative combustors with LPP (lean premixed prevaporised) technology applied for low OPR engines (IRA), with PERM (partially evaporated rapid mixing) technology for low to medium OPR engines (engine with active heat management or flow controlled core) and LDI (lean direct injection) technology for medium to high overall pressure ratio (OPR) engines (intercooled engine).

The work in NEWAC is organised in seven sub-projects (SP):

- SP1 defines the requirements for the technologies to be researched and assessed at the whole engine level, and the corresponding benefits will lead to disseminating and exploiting the technology plans;
- Four sub-projects (SP2 to SP5) cover the development of innovative and complementary solutions;
- SP2 is on the Intercooled Recuperative Aero Engine (IRA engine) architecture (will provide the next step beyond the AEROHEX and CLEAN developments);
- SP3 is on intercooled high OPR configuration, which will give the CO_2 reductions associated with very high OPR whilst using the intercooler to avoid the associated NOX penalties;
- SP4 is on active heat management core configuration to reduce CO_2 without penalties for NOX;
- SP5 proposes a flow controlled core, which is a post CLEAN, new generation technology contributing to efficiency gain;
- SP6 will cover developments concerning innovative combustor solutions, which will complete the work done on new core configurations to support lean combustion;
- SP0, a management and dissemination sub-project, will assure the coordination of the work, its dissemination outside the consortium, and proper exploitation and technology transfer.

Results

NEWAC's main result will be fully validated novel technologies enabling a 6% reduction in CO_2 emissions and a further 16% reduction in NOX. Most importantly, the project will address the particular challenges involved in delivering these benefits whilst simultaneously contributing to the attainment of the ACARE targets.

All new configurations investigated in NEWAC will be compared, assessed and ranked according to their benefits and contributions to the global project targets. Detailed specifications will be provided for all innovative core configurations. As a result, NEWAC will identify the technology routes to environmentally friendly and economic propulsion solutions. The developed components will further result in optimised engine designs based on the NEWAC technologies, but also in combination with the results of the EEFAE, SILENCER and VITAL programmes.

Acronym:	NEWAC	
Name of proposal:	NEW Aero engine Core concepts	
Contract number:	AIP5-CT-2006-030876	
Instrument:	IP	
Total cost:	75 090 907 €	
EU contribution:	40 000 000 €	
Call:	FP6-2005-Aero-1	
Starting date:	01.05.2006	
Ending date:	30.04.2010	
Duration:	48 months	
Objective:	Environment	
Research domain:	Emissions	
Website:	http://www.newac.eu	
Coordinator:	Dr Wilfert Guenter MTU Aero Engines GmbH Dachauerstr. 665 DE 80995 Munich	
E-mail:	Guenter.Wilfert@muc.mtu.de	
Tel:	+49 (0)89 14894347	
EC Officer:	D. Chiron	
Partners:	Airbus France SAS	FR
	První brnenská strojírna Velká Bítes, a.s.	CZ
	ARTTIC	FR
	Aristotle University of Thessaloniki	GR
	AVIO S.p.A.	IT
	The Chancellor, Masters and Scholars of the University of Cambridge	UK
	Centre de Recherche en Aéronautique, ASBL	BE
	Chalmers University of Technology	SE
	Cranfield University	UK
	Deutsches Zentrum für Luft- und Raumfahrt e. V.	DE
	Ecole Polytechnique Fédérale de Lausanne	CH
	SCITEK Consultants Ltd	UK
	Loughborough University	UK
	National Technical University of Athens	GR
	Office National d'Etudes et de Recherches Aérospatiales	FR
	The Chancellor, Masters and Scholars of the University of Oxford	UK
	PCA Engineers Limited	UK
	Rolls-Royce Deutschland Ltd & Co KG	DE
	Rolls-Royce Group plc	UK

Aachen University of Technology	DE
SNECMA	FR
Société des Nouvelles Applications des Techniques de Surface	FR
Steigerwald Strahltechnik GmbH	DE
Sulzer Metco AG (Switzerland)	CH
University of Sussex	UK
Techspace Aero	BE
Graz University of Technology	AT
Turbomeca	FR
Università degli Studi di Firenze	IT
University of Karlsruhe (TH)	DE
Universidad Politecnica de Madrid	ES
Université de Liège	BE
Ecole Centrale de Lyon	FR
Universität Stuttgart	DE
Université de Technologie de Belfort-Montbéliard	FR
Volvo Aero Corporation	SE
Vibro-Meter SA	CH
Wytwórnia Sprzętu Komunikacyjnego «PZL-Rzeszów» Spółka Akcyjna	PL
Centre d'Essais des Propulseurs / Délégation Générale pour l'Armement	FR
EnginSoft	IT

ENFICA - FC

ENvironmentally Friendly, InterCity Aircraft powered by Fuel Cells

Background

Rapidly emerging hydrogen and fuel-cell power-based technologies can now be exploited to initiate a new era of propulsion systems for light aircraft and small commuter aircraft. In addition, these technologies can also be developed for the future replacement of onboard electrical systems in larger 'more-electric' or 'all-electric' aircraft.

The feasibility of this project is dependent on several key-enabling technologies including fuel-cell stacks and integrated systems, hydrogen fuel storage and a safe airport-based hydrogen-refuelling infrastructure. Another important consideration is that it should demonstrate the path to future economic viability.

The primary advantages of deploying these technologies are low noise and low emissions – features which are particularly important for commuter airplanes that usually takeoff and land from urban areas. The possibility to takeoff and land within the noise abatement regulations set for small airfields, in urban areas and near population centres, will allow the use of these airfields late at night when noise abatement regulations are even more stringent.

Objectives

The main objective of the ENFICA-FC project is to develop and validate the use of a fuel-cell-based power system for propulsion of more-/all-electric aircraft. The fuel-cell system will be installed in a selected aircraft which will be flight and performance tested as proof of functionality and future applicability for intercity aircraft. It will also demonstrate that noise levels and pollutant emissions can be significantly reduced, or even eliminated, by more-/all-electric aircraft in the air and on the ground.

No other project funded by the European Commission will give such ambitious results and it will be presented at both a ground level and an in-flight public event within the scheduled time.

A feasibility study will be carried out to define new aircraft propulsion systems that can be achieved by fuel-cell technologies, (with performance improvements expected within the next 10-15 years) together with other aircraft-based applications.

ISRAEL AIRCRAFT INDUSTRIES - Small Commuter Jet (20 PAX)

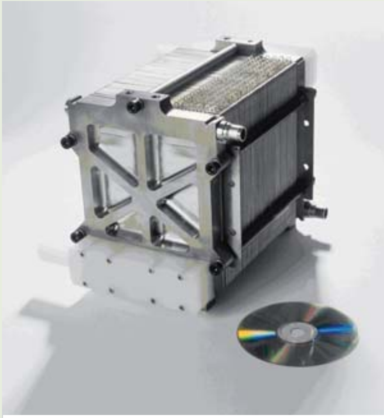
From these studies, and combined with detailed design and published results obtained from previous projects, scientific and technological innovations are to be pursued sequentially through the development of innovative technologies in the fields of more-/all-electric aircraft and then exploited through the design, building, installation and flight test validation of a small aircraft powered by a fuel-cell system. This will all be achieved within in the 36-month project duration.

Description of work

1. A feasibility study will be carried out to provide a preliminary definition of new forms of aircraft propulsion systems that can be obtained by fuel-cell technologies with the following objectives:
   - identification of requirements of specific applications for regional transport aircraft (APU, primary electrical generation supply, emergency electrical power supply, landing gear, etc.)
   - preliminary definition of propulsion system including: fuel stack (comparison between PEM, SOFC, MCFC, etc.), hydrogen storage or direct onboard production, fuel-cell system, electric motor and power management system
   - definition of preliminary relevant systems and subsystems; integration of fuel-cell systems in the pressurised structure of aircraft operational behaviour
   - safety, certification, maintenance and installation
   - reliability and maintainability concept definition; life-cycle cost evaluation.

2. A scale-size, electric motor-driven airplane powered by fuel cells will be developed and validated by a flight test.

An existing, highly efficient design of a two-seater aircraft that has already been certified will be used. The fuel-cell system and the electric motor will be integrated onboard; the flight control system will also be converted into an electric system.


INTELLIGENT ENERGY - 12 kWe Fuel cells stack

The following items will be pursued:

- a fuel-cell unit will be designed, built and tested in a laboratory ready to be installed onboard for flying
- highly efficient brushless electric motors and power electronics apparatus will be designed and manufactured ready to be installed onboard for flying
- an efficiency of greater than 90% should be obtained by an optimised aerodynamic propeller design
- a study of the flight mechanics of the new aircraft will be carried out to verify the new flight performance
- a flight test bed of the aircraft, capable of remaining aloft for one hour, will be the main goal of the project to validate the overall high performance of an all-electric aircraft system.

Results

In defining the intercity aircraft systems that can be powered by fuel cell technologies, the feasibility study will take into account future generation fuel cells (with the performance improvements expected within the next 10-15 years) and will thereby show the technical (and performance) advantages that could be obtained in contrast with existing conventional systems.

In addition, the feasibility of an all-electric propulsion intercity aircraft (10 to 15-seater), completely equipped by fuel cells, will be studied in order to assess the impact that a more silent and less polluting aircraft will have in being able to takeoff and land from congested urban areas using short airfields.

The other ambitious result will be to present, at a public event within the scheduled time, the flight test bed of the aircraft capable of remaining aloft for several hours, which will validate the overall high environmental performance of an all-electric aircraft system.

Acronym:	ENFICA - FC	
Name of proposal:	ENvironmentally Friendly, InterCity Aircraft powered by Fuel Cells	
Contract number:	AST5-CT-2006-030779	
Instrument:	STP	
Total cost:	4 445 400 €	
EU contribution:	2 918 600 €	
Call:	FP6-2005-Aero-1	
Starting date:	01.10.2006	
Ending date:	30.09.2009	
Duration:	36 months	
Objective:	Environment	
Research domain:	Emissions	
Website:	http://www.interdip.polito.it/aeronautica/gruppo_romeo/romeoindex.html	
Coordinator:	Prof. Romeo Giulio Politecnico di Torino Corso Duca degli Abruzzi 24 IT 10129 Turin	
E-mail:	giulio.romeo@polito.it	
Tel:	+39 011 5646820	
Fax:	+39 011 5646899	
EC Officer:	D. Knoerzer	
Partners:	METEC TECNOLOGIE SNC	IT
	Israel Aircraft Industries Ltd	IL
	Intelligent Energy Ltd	UK
	Brno University of Technology	CZ
	EVEKTOR, spol. s r.o.	CZ
	Jihlavan Airplanes, s.r.o.	CZ
	EnigmaTEC	UK
	Air Products plc	UK
	Université Libre de Bruxelles	BE
	INFOCOSMOS S.A.	GR

ERAT

Environmentally Responsible Air Transport

Background

ERAT aims at defining solutions that can be operationally implemented from 2012-2015 to improve the environmental performance of the European air transport system.The continuing growth in traffic and the increasing concerns about the environmental impact pose significant challenges for the long-term acceptability and sustainability of air transport. The challenge is to accommodate the forecast increase in demand whilst at the same time reducing the environmental impact of aviation.

Over the past 40 years, continued technical advances have minimised the environmental impact of aviation growth through the incorporation of technologies that have significantly reduced CO_2, noise and emissions. Although there is scope for further improvement, technological developments of aircraft and propulsion systems on their own are unlikely to offset the environmental impact of the expected growth in air traffic movements.

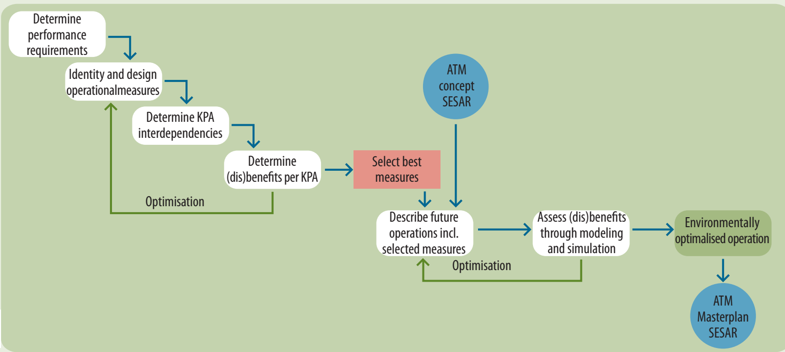
These technological developments need to be complemented by improvements in the management of air traffic and airspace. Implementation of environmentally sensitive airspace designs, the provision of efficient flight profiles in the vicinity of airports, and the implementation of advanced low noise and emissions routings and techniques may all serve to help reduce aviation's environmental impact.

Objectives

Existing RTD, such as the Sourdine and Sourdine II projects have developed and established the feasibility and potential benefits of new operational procedures (noise abatement procedures) to reduce the noise impact in the vicinity of airports.

Whilst a significant amount of research has been carried out, this has been primarily conducted in isolation and often results in adverse side effects, such as reduced system capacity. To obtain the full benefit, an integrated approach is required, which consolidates the various strands of research to support an environmentally optimised air transport operation whilst maintaining, and preferably improving, capacity.

The objective of ERAT is to contribute to the reduction of the environmental



Description of work

impacts of air transport in the vicinity of airports as of 2015 by:

1. Identifying and developing operational measures reducing the environmental impact;
2. Selecting the best operational measures while taking into account any trade-off between noise, emissions and capacity without sacrificing safety;
3. Embedding those operational measures within a concept of operations for two airports and their surrounding airspace, based on SESAR's high-level concept of operations;
4. Providing quantified advantages and disadvantages of the selected operational measures through assessments using ICAO key performance areas and the European Operational Concept Validation Process methodology.
5. Establish an understanding of the issues involved with implementation by ensuring user acceptance of the selected operational measures.

Description of work

The project is targeting two airport locations, which represent a high and a medium-density operating environment. The participation of both National Air Traffic Services and LFV show that two suitable sample locations for the proposed research are available, where, for instance, London eTMA operations may represent one operating environment and Stockholm eTMA operations the other. A final selection of the two sample locations will be made at the start of the project. A proper representation of different operating environments will be used as the criterion for selection.

As the effects will be assessed for two particular locations, the results will not necessarily be transferable to other situations without reconsideration. By seeking both a high and medium density operating environment the research may show which measures can deliver the greatest benefits in even the most challenging of ATM situations. The process through which the project has arrived at a particular type of operations is of itself generic and can as such contribute to the development of standards.

Bucharest Henri Coanda International Airport (BHCIA) may cover the other end of the operating spectrum. Experiencing an 8% growth in aircraft movements, it is facing a different set of challenges. BHCIA's experience will enhance the understanding of any obstacles for implementation of selected measures at this end of the operating spectrum, thus contributing to the selection of those measures carrying the greatest benefits over the full range of operations.

Results

ERAT will deliver an 'environmentally optimised' air transport operation addressing noise and emissions at airports and in the terminal phases of flight, demonstrated through modelling and simulation, providing quantified benefits and associated non benefits.

The ERAT project is:

- addressing the issue of environmental sustainability and ATM-related constraints in the eTMA;
- identifying and recommending best short-/medium-term operational measures which will improve the environmental performance, whilst addressing the interdependencies between performance objectives of different KPAs;
- validating selected operational measures in different operating environments using E-OCVM.

These results will:

- help consolidate various strands of research supporting an environmentally optimised ATM;
- help accelerate implementation of relevant environmental measures;
- contribute to SESAR's ATM master plan and help achieve the environmental objective of a 10% reduction in the effects that aviation has on the environment.

Acronym:	ERAT	
Name of proposal:	Environmentally Responsible Air Transport	
Contract number:	037182	
Instrument:	STP	
Total cost:	7 459 857 €	
EU contribution:	3 856 352 €	
Call:	FP6-2005-TREN-4-Aero	
Starting date:	01.06.2007	
Ending date:	31.05.2010	
Duration:	36 months	
Objective:	Environment	
Research domain:	Emissions	
Website:	http://www.erat.aero	
Coordinator:	Mr Boering J.H.L. To70 B.V. Postbus 43001 NL 2504 AA Den Haag	
E-mail:	harjan.boering@to70.nl	
Tel:	+31 (0)70 3922322	
Fax:	+31 (0)70 3658867	
EC Officer:	C. North	
Partners:	Airbus France	FR
	EUROCONTROL Experimental Centre	FR
	Nationaal Lucht- en Ruimtevaart Laboratorium	NL
	Deutsche Lufthansa	DE
	National Air Traffic Services	UK
	Snecma	FR
	Deutsches Zentrum für Luft- und Raumfahrt	DE
	LFV	SE
	Bucharest Henri Coanda International Airport	RO
	ENV-ISA	FR

TIMPAN

Technologies to IMProve Airframe Noise

Background

During the last decades, the replacement of older jet-powered aircraft by aircraft with high bypass ratio engines, progressively encompassing efficient acoustic design rules and noise reduction technologies, has significantly reduced the noise impact from individual aircraft operations on communities near airports. However, the continuous growth in air traffic makes it is necessary to achieve further noise reductions to ensure the air transport industry's sustainable growth.

In the report, *European Aeronautics* – a vision for 2020, a group of people gave their view on the future of air transport: very challenging noise reduction targets were defined; perceived noise levels must be reduced by 50%, i.e. -10 dB per aircraft operation by 2020.

To achieve such reductions, all fields of investigation have to be pursued simultaneously by reducing the noise at source: use new configurations with profitable installation effects and improved aircraft procedures around airports so as to limit the noisy areas to airport boundaries.

In recently designed aircraft, contributions from airframe noise (mainly due to the interaction of the airflow with the aircraft airframe) and engine noise sources to the overall aircraft noise are quite balanced at approach.

The approach noise source reduction challenge has to be addressed by reducing airframe noise to the same level as engine noise. Dominant airframe noise sources, which are due to the deployment of both high-lift devices and landing gears, are to be considered.

Objectives

TIMPAN will address airframe noise by tackling both landing gears and high-lift devices, which are the two main contributors to approach airframe noise. The investigations planned in TIMPAN are:

– the development and assessment of innovative technologies for airframe noise reduction application: a breakthrough technology for source noise reduction is required to meet the long-term objectives. TIMPAN will rely on state-of-the-art research findings of disciplines way beyond the aero-acoustics domain.
– the improvement of low-noise designs, for generic aircraft components,

© SILENCE(R)

SILENCE(R) advanced gear that will be used as the baseline for TIMPAN investigations which will take results from previous research investigations, such as EC (RAIN, SILENCE(R)), national or company-funded research projects linked to airframe noise investigations. They will target shorter-term objectives.

These investigations will focus on principles and will be applicable to any type of commercial/business aircraft, including new configurations such as those developed in NACRE. Furthermore, the approach proposed in TIMPAN includes a performance, cost and integration assessment of the technologies with multidisciplinary evaluation.

Description of work

TIMPAN is organised into three main work packages:

a. Landing gear noise reduction
b. High-lift device noise reduction
c. Technology evaluation

In both technical work packages (a) and (b), the work is split between the proof of concept of innovative technologies and the improvement of current state-of-the-art low-noise design.

Various innovative technologies will be investigated, including plasma actuation, air blowing, use of meshes for landing gear, and slat-less configurations and flow control techniques for high-lift devices. All these activities, led by research and academic partners, will be achieved in parallel, and conclude with laboratory tests to measure their noise reduction efficiency.

The conventional design tasks include, in addition to research and academia, the airframe noise partners from industry. On landing gear activity, it is planned to use the Silence(R) advanced gear as a basis and improve the design, in particular treating the currently noisier systems. The advanced design for high-lift devices concerns the wing leading edge acoustic liner and the aero-acoustic design process of a high-lifted configuration.

Transversally, the technology evaluation will be performed, specifying the needs in terms of integration, cost and performance, and analysing the results at aircraft scale, if relevant, with the use of three virtual aircraft platforms.

Results

The first deliverable will be the assessment of the efficiency of a selection of innovative concepts that could be tomorrow's breakthrough airframe noise-reduction technologies.

The second deliverable will be the improvement of proven low-noise technologies, which will have a direct impact on community noise for short-term new aircraft projects (2010-2015), with the expected reduction of 6 dB for landing gear noise and 4 dB for high-lift device noise levels compared to the 2000 state of the art. In both cases, a technology assessment will help to identify the potential impact of such findings in terms of overall aircraft noise reduction, integration, cost, etc., so further research needs will be also identified.

TIMPAN will benefit European aerospace companies, the academic/research world and European citizens beyond its main noise reduction objective by:

- Increased economic competitiveness of European companies in the world market
- Enhanced research skills and expertise in research establishments and academia, through the development and application of new techniques, which to a large extent will be carried out by PhD students or young scientists
- Expanded employment opportunities in the EU's aircraft industries and their associated supply industries, including high-technology SMEs
- Noise reduction for populations around airports, and thus improved quality of life and health.

Acronym:	TIMPAN	
Name of proposal:	Technologies to IMProve Airframe Noise	
Contract number:	AST5-CT-2006-030870	
Instrument:	STP	
Total cost:	5 260 175 €	
EU contribution:	2 965 000 €	
Call:	FP6-2005-Aero-1	
Starting date:	01.09.2006	
Ending date:	31.08.2009	
Duration:	36 months	
Objective:	Environment	
Research domain:	Noise	
Coordinator:	Mr Piet Jean-François	
	Airbus France SAS	
	316 Route de Bayonne	
	FR 31060 Toulouse	
E-mail:	jean-francois.piet@airbus.com	
Tel:	+33 (0)5 61 18 53 23	
Fax:	+33 (0)5 61 18 57 66	
EC Officer:	P. Kruppa	
Partners:	Airbus Deutschland GmbH	DE
	Airbus UK Ltd	UK
	ATECA	FR
	Dassault Aviation	FR
	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
	EADS Deutschland GmbH	DE
	Free Field Technologies	BE
	Messier-Bugatti	FR
	Messier-Dowty S.A.	FR
	Stichting Nationaal Lucht- en Ruimtevaartlaboratorium (NLR)	NL
	Office National d'Etudes et de Recherches Aérospatiales	FR
	Technical University at Braunschweig	DE
	University of Southampton	UK

CREDO

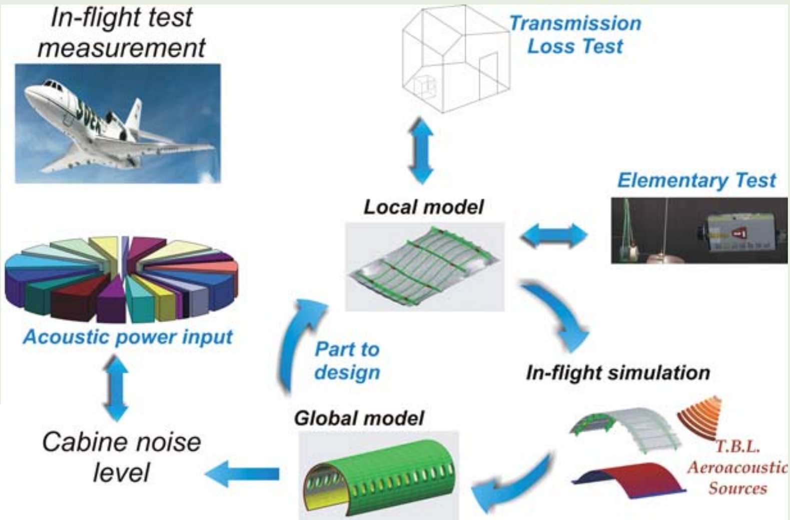
Cabin noise Reduction by Experimental and numerical Design Optimisation

Background

The reduction of interior noise in aircraft and helicopter cabins is a critical aspect of maintaining the competitiveness of the European aerospace manufacturing industry. Low cabin noise levels are crucial for passenger comfort and are a consequential factor in the commercial success.

Advanced design tools and prediction methods are necessary to reduce interior noise levels of aircraft and helicopter designs in a maximal cost-effective way. Accurate and reliable prediction methods facilitate large reductions in noise levels while minimising extra production costs through informed improvement of cabin design and the targeted selection and installation of acoustic treatments.

However, the development and implementation of advanced tools for interior cabin noise applications is severely impeded by the current difficulty and expense of measuring the sound power from principle external noise sources entering the aircraft cabin at different locations. This information is essential for the validation and calibration of prediction models and the subsequent development of design tools. There are currently no commercially viable methods of acquiring this information quickly and accurately. In fact conventional acoustic intensity or holography measurements are polluted by multiple reflections from the walls and other reflecting surfaces in the cabin.



Link between modelling and measurements at the local and global levels in the advanced vibro-acoustic design procedure

Objectives

Motivated by the aircraft industry's acute need to validate and calibrate prediction models and advanced design tools for the cost-effective design of low-noise cabins, the CREDO project addresses the development of experimental procedures and analytical tools by which the sound power entering an aircraft cabin can be determined sufficiently quickly, accurately and with the necessary spatial resolution.

Two parallel approaches are pursued. In the first, the sound power entering the cabin is locally extracted from local measurements of the total field by new techniques.

In the second approach, the sound power entering the cabin is determined globally through numerical inversions of measurements throughout the entire cabin using the new experimental tools. At all stages in the project, the interaction between local and global approaches and between measurement and processing is exploited to maximum innovative effect.

Description of work

The project is divided into seven work packages (WP). The first five WPs focus on research and technological development activities, WP6 is devoted to the synthesis of results and innovation-related activities, and WP7 covers the project management.

After a clear definition of industrial specifications and requirements (WP1), the basic idea of the project is to develop innovative experimental and numerical tools and procedures (WP2) for detailed local acoustic imaging of entering acoustic intensity inside aircraft and helicopter cabins, taking into consideration the reverberant nature of these environments. This approach employs a hitherto unavailable microphone array concept: the double layer array, together with purpose-developed processing and procedural algorithms. The feasibility study will be performed using adaptations of 3D beamforming and scanning laser Doppler vibrometry to provide acceptable results in a cabin environment in flight conditions. Specific design of experiment (DoE) procedures for cabin noise measurement, and uncertainty evaluation and inverse methods for test-based model identification for fibrous materials will be also developed.

As an interactive and mutual development, these techniques will be extended to a global acoustic model of the whole or a large part of the cabin interior and then inverting from measured sound data to the required entering sound power (WP3). This will be achieved with pioneering inverse finite element implementations and groundbreaking inverse simplified energy methods, developed in close connection with novel measurement technology and algorithms, extended from the local to the global level.

Subsequently, the developed techniques will be evaluated inside an aircraft cabin (WP4), during ground and flight tests. In WP5, these techniques will be employed in a more challenging environment, a helicopter's cabin interior, with the aim of separating the structure- and airborne paths from the gearbox into the cabin.

Results

The anticipated results are expected to be as follows:

- potential acoustic ground- and flight-test time and cost reduction of about 25%
- possibility of generating inputs for standardisation of flight test acoustic procedures
- exploitation of techniques in the most important and challenging aeronautic cases for both aircraft and helicopters, each of them requiring different solutions and procedures
- direct contribution to noise reduction and cabin comfort through the improvement of simulation reliability and validation levels

- improvement of acoustic design processes and of problem solution efficiency through the establishment of innovative accurate procedures for simulation model calibration (more improved solutions can thus be tested: possible reduction of noise and weight at the same cost level or vice versa)
- new fast procedures for panel contribution analysis (contribution of each source at the passenger position; the sources not contributing will not be treated, saving weight, costs and time)
- application of new measurement techniques in other fields with similar problems (automotive vehicles, trains, ships, civil buildings, workplaces, etc.).

Acronym:	CREDO
Name of proposal:	Cabin noise Reduction by Experimental and numerical Design Optimisation
Contract number:	AST5-CT-2006-030814
Instrument:	STP
Total cost:	3 494 099 €
EU contribution:	2 166 000 €
Call:	FP6-2005-Aero-1
Starting date:	01.07.0006
Ending date:	30.06.0009
Duration:	36 months
Objective:	Environment
Research domain:	Noise
Website:	http://mm.univpm.it/credo

Coordinator:	Prof. Tomasini Enrico Primo Università Politecnica delle Marche Piazza Roma 22 IT 60100 Ancona
E-mail:	ep.tomasini@mm.univpm.it
Tel:	+39 (0)71 2204441
Fax:	+39 (0)71 2204813
EC Officer:	D. Knoerzer

Partners:	Alenia Aeronautica S.p.A.	IT
	Brno University of Technology	CZ
	Brüel & Kjær Sound & Vibration Measurement A/S	DK
	Dassault Aviation	FR
	Deutsches Zentrum für Luft- und Raumfahrt	DE
	EADS Deutschland GmbH - Corporate Research Centre Germany	DE
	Ecole Centrale de Lyon	FR
	Eurocopter Deutschland GmbH	DE
	Free Field Technologies	BE

Laboratoire d'Acoustique de l'Université du Maine	FR
Ødegaard & Danneskiold-Samsøe A/S	DK
Politecnico di Milano	IT
Università di Napoli 'Federico II' - Dipartimento di Progettazione Aeronautica	IT
Agusta SpA	IT

MIME

Market-based Impact Mitigation for the Environment

Background

Airlines and airports will likely face an increasing number of noise-impact constraints in future. There are already at least 128 airports worldwide with some type of noise surcharges, and the situation that the air-transport industry faces regarding noise-related environmental constraints on future growth is very grave. As has been shown in other industries, there are conditions under which a market-based mechanism using transferable permits can be used to provide improved control over environmental impacts and, at the same time, allow efficient business operations. MIME is aimed at discovering whether, and how, such mechanisms can be used to improve environmental noise control in air transport.

Objectives

MIME seeks to determine the answers to several basic research questions:

1. How can noise be translated into tradable permits?
2. How would such a system be put into place?
3. Can a market increase the number of viable options?
4. How can air traffic management (ATM) contribute to enabling airlines to reach their noise goals?
5. Could this add a fifth dimension to the International Civil Aviation Organisation's 'Balanced Approach'?
6. What is the nature of an appropriate regulatory framework?

Successfully answering these questions in alignment with the evolution of Single European Sky ATM Research (SESAR) will establish a new and beneficial means of balancing environmental and operational concerns for European air transport. The project will also address interdependencies between noise and emissions with the consideration that noise should not be optimised at the expense of emissions.

Description of work

The MIME project contains seven Work Packages (WP):

WP1 – Project management and coordination, providing management of the overall project and coordination of the Work Packages, and reporting to the European Commission. This Work Package focuses on administrative, financial, schedule and coordination issues. To this end, the project coordinator (WP1 Manager) interacts with all the project partners, and serves as the principal intermediary between the European Commission and each of the partners.

WP2 – Noise technology, addressing all aspects of noise metrics and measurements relevant to the envisioned system of trading and environmental control. This Work Package focuses on noise technology, describes the state of the art, and addresses the key issue of how to translate noise impact into noise permits.

WP3 – Market mechanisms, addressing all aspects of design and evaluation of the envisioned system of tradable permits. This Work Package focuses on economic issues arising from the functioning of a noise tradable permit market. The validation strategy is defined in this Work Package. To this end, the WP3 manager interacts with other project partners in order to bring together the aspects linked with noise quantification, the economic background and view-point of the different market actors, and the needs in terms of combined ATM, noise and business case simulations.

WP4 – Simulation and analysis, addressing the simulation and analysis of the envisioned mechanisms in their operation with the broader air-transport system. This Work Package focuses on simulation and analysis, and describes which simulation capabilities are required and how they will be used to perform a number of case studies addressing noise impact, permits and the permit-trading market.

WP5 – Implementation framework, addressing the means of implementation of the envisioned system, including regulatory matters. This Work Package focuses on developing a workable implementation and regulatory framework, building on the outputs from WP2, 3 and 4.

WP6 – Scientific coordination, ensures that coordination is maintained between Work Packages 2-5 and that input from the scientific community is sought and integrated into the project. Whereas WP1 deals with the management of the consortium and reporting to the commission, WP6 deals with managing the scientific content of the project within the Work Packages.

WP7 – Dissemination, addressing dissemination of project progress and results to all relevant stakeholders. This Work Package ensures a wide understanding of the aims and objectives of MIME among stakeholders during the lifetime of the project, and a broad knowledge among these stakeholders of the final results and benefits of MIME.

Results

The MIME project will provide the following results:

- a system of transferable airline-based noise permits;
- a method of implementation of noise permits and the means by which the chosen system would be equitably put into place at an airport;
- requirements for tools for calculating airline noise permit use;
- an analytic framework that would enable a single airline to understand the operation of this market and the value of such noise permits;
- tools to enable airport situations to be judged as advantageous (or not) for such market-based approaches;
- propositions for enabling uniform implementation of the chosen noise permit system at European airports;
- the regulatory framework that would establish and govern this system.

Acronym:	MIME
Name of proposal:	Market-based Impact Mitigation for the Environment
Contract number:	037060
Instrument:	STP
Total cost:	4 458 740 €
EU contribution:	2 579 996 €
Call:	FP6-2005-TREN-4-Aero
Starting date:	01.05.2007
Ending date:	30.04.2010
Duration:	36 months
Objective:	Environment
Research domain:	Noise
Coordinator:	Javier Garcia Boeing Research and Technology Europe S.L. ES
E-mail:	javier.garcia3@boeing.com
EC Officer:	M. Jensen

Partners:	EUROCONTROL	BE
	SINTEF	NO
	Boeing Research and Technology Europe	ES
	Env-ISA	FR
	QinetiQ	UK
	University of Leeds	UK
	Technical University Munich	DE
	DHV	NL

X3-NOISE

Aircraft external noise research network and coordination

Background

Despite very significant technology improvements over the past 20 years and attention being paid to other environmental impacts, aircraft noise remains a major problem in Europe. This has to be solved by the air transport industry as a whole so as to deal with the expected growth. Stakeholders and policy-makers are faced with the particular challenge that, while noise reduction at source has generally been progressing well, particularly with the evolution of engine concepts, there is a need for an economically viable but continuously quieter airline fleet to accommodate the expected traffic growth without adverse environmental impact.

In practice, this calls for new, more encompassing systemic approaches, underlining that, associated with the successful development of novel technology by manufacturers, additional elements have to be taken into consideration for noise source reduction to meet its goals and play its full role in the face of expected future air transport developments.

Coordinating aircraft noise research at EU level thus implies the need to maintain a competitive position in a technical area where European manufacturers have always held a leading position. The specific European context with higher societal demands requesting new, efficient ways of managing the community impact also needs to be considered.

Objectives

The X3-NOISE Coordination Action, through its network structure and comprehensive work plan involving expert groups, scientific workshops, stakeholder seminars and a common information system, will address the aircraft noise challenges set by the ACARE 2020 Vision. To this end, the objectives are:

- to evaluate EC-funded project results and assess their contribution to the state of the art;
- to formulate, through the development of common strategies and complementarity with national activities, priorities and key topics for future projects aimed at noise reduction at source, and at improved understanding of the impact of aircraft noise in the community;
- to identify potential reinforcement of future project partnerships through expertise mapping, to foster new collaborations and promote novel ideas;
- to ensure dissemination and exploitation of anticipated technology breakthroughs and scientific developments, including providing technical information for regulatory bodies and policy-making agencies to make them aware of progress made in aircraft noise research;
- to contribute to an improved integration of the European aircraft noise research community through a network of national focal points, including the development of local networks in new EU Member States to foster participation in future projects.

Description of work

X3-NOISE involves 32 partners from 20 countries and is organised around five technical Work Packages (Reduction of noise at source, Management of noise impact, Scientific dissemination, Communication and feedback, Network support and Coordination). The project work plan will:

- establish detailed research plans to support the ACARE Strategic Research Agenda by means of dedicated roadmaps;

- investigate key enabling issues through ad hoc task groups (computing capacity, noise emissions tradeoffs, experimental benchmarks);
- seek constructive debates to address forward-looking issues (stakeholders' seminars on environmental interdependencies, noise mapping techniques, technology status and green airport concept);
- ensure dissemination through an annual thematic scientific workshop;
- pursue active collaboration with other environmental networks such as AERONET, ECATS and CALM;
- implement a network of national focal points over most of the EU-27.

An advisory board, made up of aviation stakeholders' representatives, will provide feedback on potential developments in the environmental domain.

The international co-operation aspects of the research agenda to be developed through the project activity are further reinforced by the participation of three partners, from Ukraine, Egypt and Brazil, acting as focal points at regional level.

Results

The expected results are:

- successful implementation of technology development priorities associated with improvement of appropriate research infrastructure;
- regularly updated technology status documents, including technology prospects and readiness levels;
- successful implementation of priorities aimed at harmonised environmental planning tools and instruments, including the evaluation of noise/emission interdependencies;
- clarification of aviation situation vs. the END directive from a technical standpoint;
- active technical debate to stimulate elaboration of research strategies in specific areas;
- widespread information on aircraft noise-related programmes and developments;
- continuation of international exchanges leading in particular to the presentation of a worldwide technology status within ICAO CAEP;
- better coordination of expertise at national and regional level (TTC), so that added-value contributions to EC projects are more clearly identified around a common set of well disseminated priorities and objectives;
- better identification and exploitation of national upstream research in coordination with EC projects;
- structured development of local networks in new EU Member States in order to foster participation in future projects;
- development of co-operation with NIS and Mediterranean INCO regions as well as South America.

Acronym:	X3-NOISE
Name of proposal:	Aircraft external noise research network and coordination
Contract number:	030840
Instrument:	CA
Total cost:	1 880 000 €
EU contribution:	1 880 000 €
Call:	FP6-2005-Aero-1
Starting date:	01.06.2006
Ending date:	31.05.2010
Duration:	48 months
Objective:	Environment
Research domain:	Noise

Coordinator:	Mr Collin Dominique
	SNECMA
	Site du villaroche - Rond-point René Ravaud
	FR 77550 Moissy Cramayel
E-mail:	dominique.collin@snecma.fr
Tel:	+33 (0)1 60 59 73 96
Fax:	+33 (0)1 60 59 78 53
EC Officer:	D. Chiron

Partners:	Airbus S.A.S. (Airbus Central Entity)	FR
	Rolls-Royce plc	UK
	ANOTEC Consulting, S.L.	ES
	Airbus UK	UK
	Stichting Nationaal Lucht- en Ruimtevaart Laboratorium	NL
	Free Field Technologies	BE
	Manchester Metropolitan University	UK
	Deutsches Zentrum für Luft- und Raumfahrt, e.V.	DE
	Zara web services	FR
	Airbus France	FR
	A2 Acoustics AB	SE
	Swedish Defence Research Agency	SE
	To70 B.V.	NL
	GFIC	FR
	Alenia Aeronautica S.p.A.	IT
	Dornier GmbH	DE
	University of Southampton	UK
	Office National d'Etudes et de Recherches Aérospatiales	FR
	Institute of Aviation (Instytut Lotnictwa)	PL
	Integrated Aerospace Sciences Corporation	GR

National Research & Development Institute for Gas Turbines - COMOTI	RO
Budapest University of Technology and Economics	HU
Czech Technical University in Prague	CZ
Vilnius Gedimino Technical University Institute of Thermal Insulation	LT
The Provost, Fellows and Scholars of the College of the Holy and Undivided Trinity of Queen Elizabeth near Dublin	IE
Instituto Superior Técnico	PT
Laboratoire d'Electromagnétisme et d'Acoustique - Ecole Polytechnique Fédérale de Lausanne	CH
National Aviation University, Department of Safety of Human Activities, Centre of Environmental problems of the airports	UA
Ain Shams University, Faculty of Engineering - ASU Sound and Vibration Lab., Department of design and production engineering	EG
Federal University of Santa Catarina, Mechanical engineering, laboratory of acoustics and vibration	BR
Teuchos Exploitation, Direction des études Division Nord	FR

ADVICE
Autonomous Damage Detection and Vibration Control Systems

Background

Some technologies and prototypes exist today for either damage detection or vibration damping but which are not able to combine both tasks under the same system. In addition, very few systems can perform the work in real time during the service life of the protected structure, without having to resort to dynamically intruding instrumentation and sacrifices in the electrical power of the structure.

The majority of existing technologies rely on retrofits of the damage detection and vibration control systems, usually constrained by existing designs and are therefore not optimising the locations and performance of their corresponding instrumentation.

The technology of ADVICE will overcome the shortcomings of existing fragmented approaches and will supply combined damage detection and vibration damping, a self-powered, wireless data transmitting system optimised for the location and whose effect on the dynamics of the protected structure will be known and controlled.

Indeed, compared with completed and current European projects with similar objectives and addressing similar issues, the ADVICE project presents the following differences, listed by order of originality:
- it tackles the problem of power supply for the network of sensors
- it incorporates vibration damping and damage detection at the same time, which is very beneficial from the point of view of probabilistic fracture analysis
- the data collection is ensured through a reliable network which operates with minimum energy and RF pollution
- ADVICE sets the focus on the structural integrity of the actuators, sensors and interfaces
- data are collected and analysed both locally and globally and the severity of damage is determined by a self-learning system.

Objectives

The global objective of ADVICE is to design, model, develop and validate a smart wireless network of self-powered devices that can be used for the simultaneous damping of structural vibrations and detection of damage in airplane and helicopter structures. The project concept is illustrated in the Figure.

ADVICE incorporates the following technical objectives:
- to use the vibrations of the structure as an energy source for the actuators, sensors and other electrical loads. This will induce significant space and weight savings compared with various existing smart systems
- to manage the sensor data collection through a smart RF network
- to address several monitoring strategies aiming at defining new condition-based maintenance programmes and inspection procedures
- to investigate the robustness of the system thoroughly, including the structural integrity of the device itself and of the interface between the device and the support made of composite material
- in terms of damage evolution, to couple both vibration damping and real-time monitoring towards a synergetic mechanism between delaying the occurrence of critical damage and accelerating its detection.

Among the ADVICE benefits, we can highlight:
- the definition of custom-tailored maintenance programmes

– an increase in the lifetime of the parts and of the vehicle.

All these elements help to reduce the total ownership cost while being a major contribution to the aircraft safety and reliability.

Description of work

The project is divided into four technical Work Packages (WP).

WP1 is mainly concerned with specifications of the target applications, definition of the basic and performance requirements of the autonomous damage detection and vibration control system, and specification of the test applications for validation. It also includes an exhaustive technological review and the evaluation of the economical impact of structural health monitoring on the total cost of ownership.

WP2 gathers the tasks dedicated to the design of the vibration and damage control units (VDCus), of the smart RF network and of other hardware and software, including the central treatment station. WP2 is also concerned with the definition of measurement/structural health monitoring strategies.

WP3 consists of the development and manufacture of the system and leads to the delivery of recommendations for SYSTEM integration.

WP4 is concerned with the integration, reliability and safety assessment, testing and validation of the system. The vibration damping and damage detection efficiencies of a set of VDCus on a simple structure are evaluated.

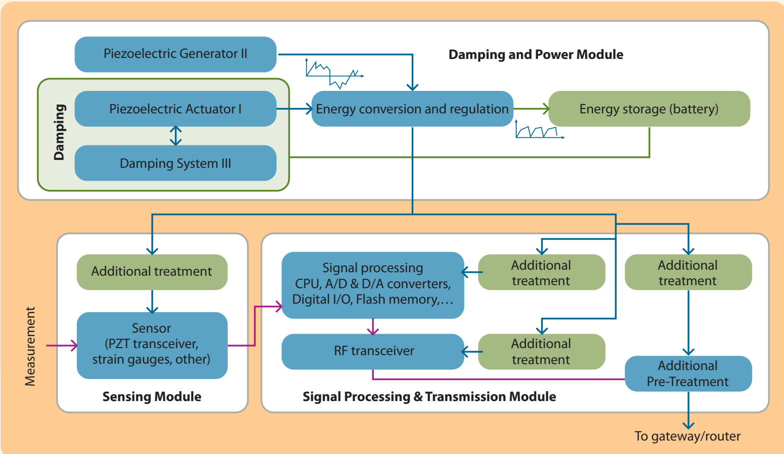
Among the technical innovations, the following advances can be highlighted: optimisation of semi-passive damping systems, on chip energy conversion and regulation from SOI technology, optimised network topology and management, ultra low energy components, simulation of the structural integrity of the system, etc.

Results

The major deliverables of the project are:

– a complete and operational autonomous damage detection and vibration control system with several VDC units (illustrated in Figure 2), associated RF network, central station, data treatment software, management APIs, etc.

– optimised and validated components (semi-passive piezoelectric patch, semi-passive visco-elastic constrained layer, on-chip energy management module from SOI technology, Lamb



View of a vibration and damage control unit

Wave transmitters and receivers, RF transmission module, etc.)

- a review of the structural health monitoring strategies and their technical and economical impact
- a list of recommendations for the integration and use of VDC units.

The project is carefully evaluated using a 'success measurement table'.

Acronym:	ADVICE	
Name of proposal:	Autonomous Damage Detection and Vibration Control Systems	
Contract number:	AST5-CT-2006-030971	
Instrument:	STP	
Total cost:	3 072 456 €	
EU contribution:	1 758 029 €	
Call:	FP6-2005-Aero-1	
Starting date:	01.10.2006	
Ending date:	30.09.2009	
Duration:	36 months	
Objective:	Safety & Security	
Research domain:	Accident Prevention	
Website:	http://www.advice-project.eu	
Coordinator:	Dr Nawrocki Anne	
	Centre de Recherche en Aéronautique, ASBL (CENAERO)	
	Avenue Jean Mermoz 30	
	Bâtiment Mermoz 1 - 2ème étage	
	BE 6041 Gosselies	
E-mail:	anne.nawrocki@cenaero.be	
Tel:	+32 (0)71 91 93 50	
Fax:	+32 (0)71 91 93 31	
EC Officer:	P. Kruppa	
Partners:	CISSOID S.A.	BE
	DDL Consultants	FR
	EADS Deutschland GmbH, Corporate Research Center Germany	DE
	Aernnova Engineering Solutions S.A.	ES
	Goodrich Actuation Systems S.A.S.	FR
	Israel Aircraft Industries Ltd	IL
	Institut National des Sciences Appliquées de Lyon	FR
	PROTOS EURO-CONSULTORES DE INGENIERIA S.L.	ES
	WYTWORNIA SPRZETU KOMUNIKACYJNEGO "PZL-SWIDNIK" Spolka Akcyjna	PL
	Université Catholique de Louvain	BE

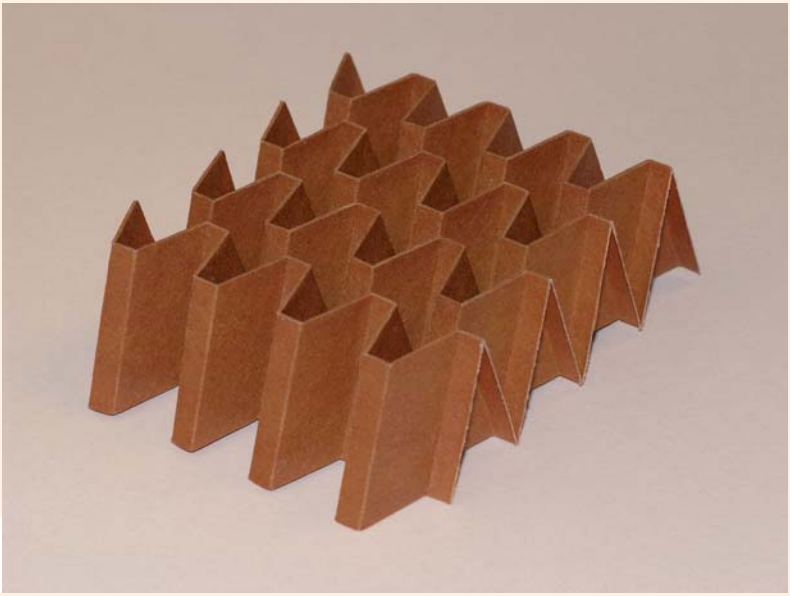
CELPACT

Cellular Structures for Impact Performance

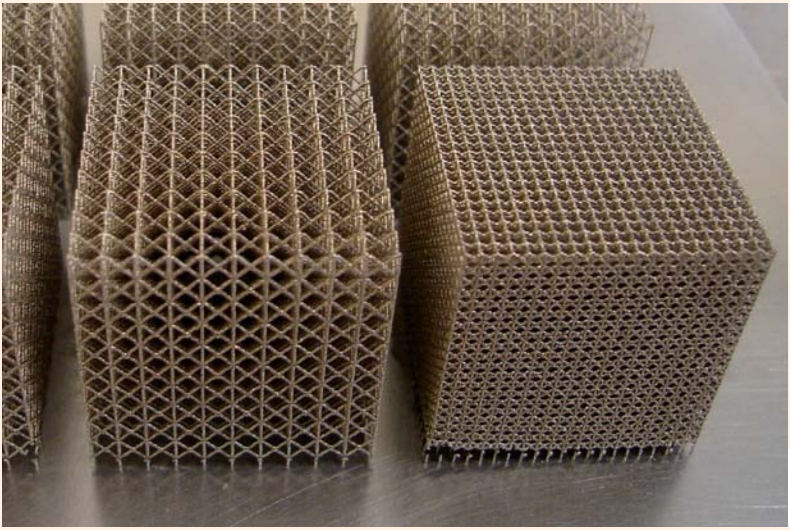
Background

The use of composite materials and new metal alloys in aircraft structural components has grown steadily with each generation of aircraft. The development of a complete pressurised fuselage in composites or hybrid metal/composites represents a big challenge, particularly because of increased vulnerability of these materials to impact threats.

The big jump in technology needed for the realisation of a new fuselage for the next-generation Airbus requires new production technologies and materials for integrated structural concepts. Current concepts for fuselage structures introduce composites in the fuselage barrel with conventional frame/stringer concept monolithic skins. In the longer term the aircraft industry sees a potential for twin-walled sandwich structures due to their much higher shell-bending stiffness than single skin designs and far higher strength/weight ratios. They would allow novel highly efficient fuselage concepts without stringers and with much larger frame spacings, and would also be appropriate for next-generation aircraft concepts such as the blended wing. Current aircraft sandwich structures are particularly vulnerable to impact damage, due to their thin composite skins and low-strength honeycomb or polymer foam cores. Thus for efficient lightweight future aircraft structures there is a requirement now to develop new sandwich materials concepts with improved impact resistance.



Folded core composite structural element



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Cellular metal lattice structure by selective laser melting

Objectives

The scientific and technological objectives of CELPACT are the development of new sandwich material concepts for primary aircraft structures with higher performance low-weight cores designed to enhance impact resistance. The new core materials to be investigated include folded composite elements, low-weight metal honeycombs and lattice structures. Sandwich structures with composite skins are expected to be used in fuselage barrels; however, in highly critical impact-loaded regions, such as wing leading edges and front cockpit panels, there is interest in metal-skinned sandwich structures.

To meet these technological objectives, CELPACT will employ advanced manufacturing techniques for novel cellular material designs at the micro scale, in order to improve structural performance for strength/weight, fatigue resistance, damage tolerance and crashworthiness. Physical phenomena associated with impact damage and progressive collapse of such structures are complex, and theoretical models and simulation tools for design and analysis will be developed. CELPACT will develop improved design techniques for sandwich structures based on advanced computational tools. Prototype structures will be fabricated and tested under high-velocity impact conditions in order to validate design concepts, and material parameters will be experimentally derived as input to the simulation software.

Description of work

CELPACT will develop new manufacturing techniques for both composite hybrid and metal cellular materials and structures. Candidate materials and geometries defined are cellular hybrid composites (CHC) with folded composite core structures, and cellular metal (CM) with closed cell and lattice cores. Open lattice geometry CM cores will be fabricated by selective laser melting (SLM) using aluminium, stainless steel and titanium for the core materials. Folded composite core structures will be fabricated in a new continuous folding process using aramid fibre paper pre-impregnated with epoxy resin.

Initial folding patterns to be investigated will be V-form zigzag geometry, which gives an open cellular structure.

The key to the design of improved cellular materials is modelling and simulation. Methods will be developed based on cell micromodels for optimising cell geometries, together with homogenised models and multiscale code developments for impact modelling in larger sandwich structures.

The structural case selected for study is foreign object impact damage from impactors such as bird strikes on CM panels and tyre rubber or runway debris impacts on CHC twin-skinned structures. Structural tests will focus on gas gun and drop tower impact tests on generic structures. Validation studies will assess the technology developments, verify the simulation and design methods by detailed comparison of impact damage predictions with test results, and finally make recommendations for aircraft designers. CELPACT will conclude with final assessment reports and design guides for aircraft industry users, the 'Road map to application' reports and a final workshop.

Results

CELPACT will provide new technologies for airframes which will facilitate novel aircraft configurations. They will be based on advanced twin-walled structural concepts, using advanced composite and metallic cellular structures as core materials and leading to structural weight reduction in airframes.

New advanced manufacturing processes will be developed and refined for cellular metal structures using selected laser melting technology, and for continuous fabrication of folded hybrid composite core structures. Concepts will be demonstrated for lightweight structures with improved impact resistance. These material developments have strong potential outside the aerospace industry such as filter technology and medical implants for CM structures, and boat hull and vehicle structures for CHC materials.

New design methods for advanced sandwich structures will be validated, based on new simulation tools which combine multiscale modelling with microscale cell models. They may be used to optimise structural concepts for improved behaviour under complex load systems such as impact and crash loads.

Acronym:	CELPACT	
Name of proposal:	Cellular Structures for Impact Performance	
Contract number:	AST5-CT-2006-031038	
Instrument:	STP	
Total cost:	3 109 000 €	
EU contribution:	2 430 000 €	
Call:	FP6-2005-Aero-1	
Starting date:	01.09.2006	
Ending date:	31.08.2009	
Duration:	36 months	
Objective:	Safety & Security	
Research domain:	Accident Prevention	
Coordinator:	Dr Johnson Alastair	
	Deutsches Zentrum für Luft- und Raumfahrt eV	
	Institute of Structures and Design	
	Pfaffenwaldring 38-40	
	DE 70569 Stuttgart	
E-mail:	alastair.johnson@dlr.de	
Tel:	+49 (0)711 6862 297	
Fax:	+49 (0)711 6862 227	
EC Officer:	P. Perez-Illana	
Partners:	University of Liverpool	UK
	The Chancellor, Master and Scholars of the University of Oxford	UK
	Laboratory of Technology and Strength of Materials	GR
	Aachen University	DE
	ENS Cachan	FR
	University of Stuttgart	DE
	Brno University of Technology	CZ
	ATECA	FR
	Airbus Deutschland GmbH	DE
	EADS CCR	FR
	EADS Deutschland GmbH	DE
	Alma Consulting Group S.A.S.	FR

LANDING

Landing software for small to medium-sized aircraft on small to medium-sized airfields

Background

Small to medium-sized aircraft are not usually equipped with the latest expensive aviation technology. In parallel, small to medium-sized airports are also not always equipped with the latest airport landing-guidance technology, such as ILS. The small to medium-sized aircraft business is expanding rapidly, so there is an emerging need to develop low-cost and effective technologies that are inexpensive whist providing additional added assistance to pilots, such as landing during difficult weather. Such a pilot product will be produced by LANDING.

Objectives

LANDING will deliver a low-cost software product assisting pilots of small to medium-sized aircrafts to land safely on small and poorly equipped fields, in bad weather and low-visibility conditions. A pilot can use LANDING for additional guidance during the three phases of the landing process: the 'approaching' phase, the 'tunnelling' phase and the 'runway' phase. LANDING thus offers integral software at a pre-industrial level as an 'add-on' for safety, which is loaded on 'portable' aircraft hardware navigation technologies.

Description of work

LANDING will integrate seven software and data components:

- the geo-referenced position of the aircraft with the use of satellite and other data;
- stage 1 software, based on input of digital information of the ambient space, available through commercial off-the-shelf (COTS) 3D digital maps, satellite data and elevation data;
- stage 2 software, based on medium resolution input of the larger field vicinity;
- stage 3 software, based on high resolution 3D geographical information system (GIS) data including all obstacles as input of the closer field vicinity;
- software for the integration of the above components, providing the aircraft position within the digitally represented space;
- 3D-visualisation software of the integrated flight guidance information on the hardware;
- the required approach from 3D-databases and a high resolution digital airport database.

Results

LANDING components run on COTS hardware onboard, which can be portable or there is the possibility of it being panel-mounted computing equipment (e.g. pen-PC or Figure 2a) with a fast rendering, including a display for 3D-visualization. The software is platform-independent. The 3D terrain and other airport, field or terrain data are pre-installed on the hardware. LANDING is cost-efficient since it is addressed to small or business aircrafts, hydroplanes and helicopters, and delivers software development, applications, dissemination and material for possible future certification.

Acronym:	LANDING	
Name of proposal:	Landing software for small to medium-sized aircraft on small to medium-sized airfields	
Contract number:	AST5-CT-2006-030905	
Instrument:	STP	
Total cost:	1 613 000 €	
EU contribution:	983 000 €	
Call:	FP6-2005-Aero-1	
Starting date:	01.01.2007	
Ending date:	31.12.2008	
Duration:	24 months	
Objective:	Safety & Security	
Research domain:	Accident Prevention	
Website:	http://www.landing-eu.eu	
Coordinator:	Prof. Bonazountas Marc	
	Epsilon GIS Technologies SA	
	Monemvasias 27	
	Polydron	
	GR 15125 Maroussi	
E-mail:	bonazountas@epsilon.gr	
Tel:	+30 (0)210 6898615	
Fax:	+30 (0)210 6821220	
EC Officer:	J.L. Marchand	
Partners:	Aeroservices SA	GR
	Airport Authority of Bolzano, ICAO: LIPB Ente Nazionale per l'Aviazione Civile	IT
	Aschenbrenner Geraetebau GmbH	DE
	Delft University of Technology	NL
	Diamond Aircraft Industries GmbH	AT
	Lugano Airport	CH
	Technische Universität München	DE
	TopoSys Topographische Systemdaten GmbH	DE
	Suediroler Transportstrukturen AG (STA)	IT
	IABG mbH	DE

PEGASE

helicoPter and aEronef naviGation Airborne SystEms

Background

Approaches, landings and take-offs or, more generally, manoeuvres or navigation in the terminal zone, are among the most critical tasks in aircraft operation.

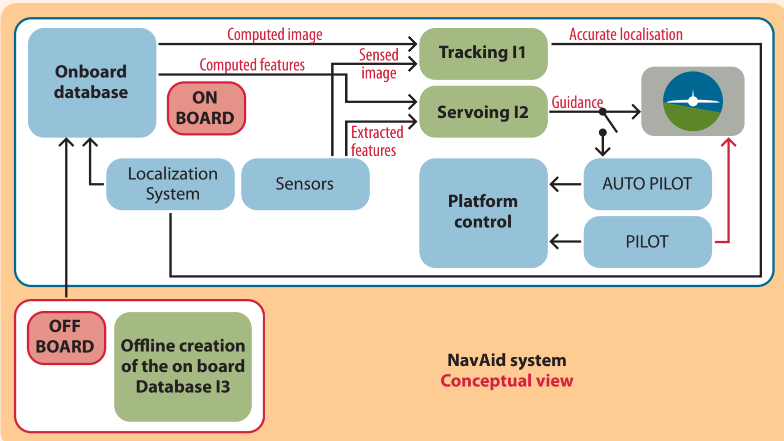
Today, the only certified navigation system available for landings, ground rolls and take-offs are the ILS and MLS which require heavy airport infrastructures. However, there has been a recent trend towards the GNSS systems but these do not have the necessary integrity. This clearly highlights the unmet need for new systems which could either replace or complement the existing systems.

Users and operators of aerospace transport expect improved all-weather operations and safer operations at an affordable cost. Easier and more efficient procedures in the terminal area's final zone will contribute to meet such expectations. PEGASE will introduce cost-effective higher levels of navigation accuracy and integrity in the final zone for fixed and rotary-wing aircraft, which when implemented correctly can result in:

- airport application without the need for ground-based precision landing installation systems,
- improved pilot confidence during both landing and take-off,
- reduced workload for the crew,
- reduced environmental impact through improved procedures,
- reduced fuel consumption through shorter waiting patterns,
- a system not susceptible to jamming/interference.

Objectives

The purpose of the PEGASE project is to prepare the development of an autonomous (no external assistance or ground equipment required), all-weather, localisation and guidance system based upon the correlation between vision sensor outputs and a ground reference database.



This innovative NavAid system is intended for use onboard in fixed as well as rotary wing aircraft.

The applications of such a NavAid System are twofold and can be considered either as a primary means of navigation to provide guidance to the aircraft for operation on any helipad/runway without any external assistance or ground equipment, or as a supplementary mean of navigation, i.e. a system used in correlation with other means such as ILS/MLS or GBAS/SBAS, in order to improve the integrity and potentially the accuracy of the total navigation system.

Once the feasibility has been demonstrated and the constraints relative to the implementation have been identified in this project, the definition and development of a proof of concept will be necessary. The application of the system is anticipated in concordance with the Single European Sky master plan (ATM 2000+, SESAR) in the period 2007-2012.

Description of work

PEGASE is a feasibility study of a new navigation system which will allow a three-dimensional, truly autonomous approach and guidance for airports and helipads, and improve the integrity and accuracy of GNSS differential navigation systems. This new navigation system relies on three key technologies:

- the specification of a reliable ground reference database,
- innovative correlation techniques between sensors and the onboard ground database,
- a robust serving algorithm for the management of the trajectories of both fixed-wing and rotary-wing aircraft.

Seven work packages (WP) will allow PEGASE to achieve its goals.

WP2 will establish the operational and functional requirements for the PEGASE NavAid System, based upon existing procedures and their possible changes.

The goal of WP3 is focused on one of the key technology of the project: the imaging sensor, which may be in the form of a CCD camera, infrared camera, laser active imaging, SAR imaging, fused sensors (electromagnetic and/or optronic sensor), etc.

WP4 will continuously and incrementally develop a shared simulation framework based upon existing tools. It will provide to the partners:

- a clear understanding of the specifications and requirements,
- a clear understanding of the models,
- the possibility to test the models within an existing simulation,
- to delivery of the models.

WP5 will compare different data sources and their qualities and refine quality metrics, taking into account the metrics needed for safe aircraft navigation.

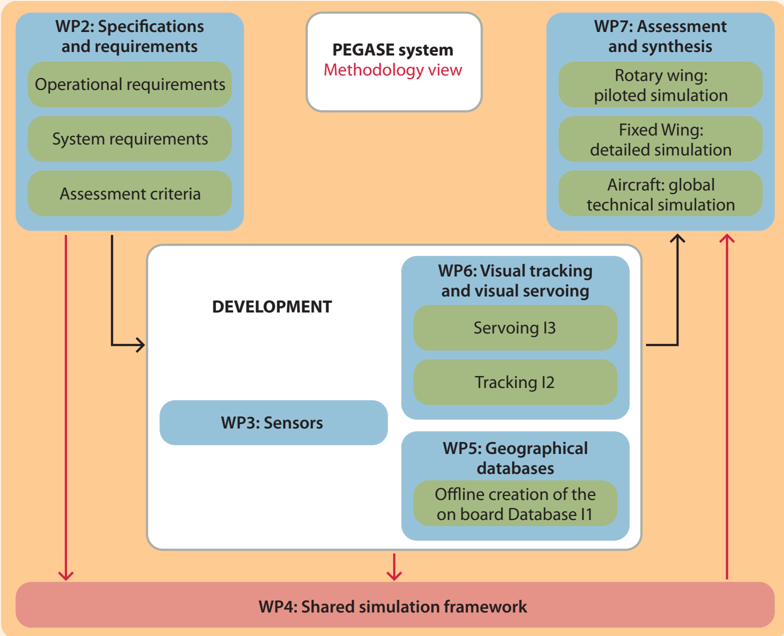
WP6 will develop new methods in image processing, visual tracking and visual serving to implement the functionalities required in the PEGASE Navaid system.

WP7 will assess the functionalities of the designed PEGASE NavAid System in the reference simulations.

Results

The NavAid System will contribute to the enhancement of the state of the art by:

- Increasing operations in all weather conditions/night and day (for instance, by maintaining the same landing rate),
- Consolidating RNP/RNAV approaches due to the improvement in the integrity of the means of navigation and thus permitting a reduction in the minima,
- Smoothing the ILS/MLS path, which will allow a more accurate approach and landing and reduce the risk of a missed approach,
- Allowing GPS/SBAS/GBAS CAT 3 operations with the possibility of selecting the vertical path (from 3° up to 7° for fixed wing aircraft or up to 12° for helicopters) and to define curved



approaches through a hybridisation with the system,

- Providing a supplementary/primary means for final approach, landing, roll breaking, taxi exit and take-off run,
- Contributing to the progressive reduction in ground facilities (lights, paintwork, ground Navaid, etc.) while ensuring current and future safety requirements.

Acronym:	PEGASE
Name of proposal:	helicoPter and aEronef naviGation Airborne SystEms
Contract number:	AST5-CT-2006-030839
Instrument:	STP
Total cost:	5 511 395 €
EU contribution:	3 000 000 €
Call:	FP6-2005-Aero-1
Starting date:	01.09.2006
Ending date:	31.08.2006
Duration:	36 months
Objective:	Safety & Security
Research domain:	Accident Prevention
Website:	http://www.pegase-project.eu

Coordinator:	Mr Patin Bruno Dassault Aviation 9 Rond-Point des Champs-Elysées Marcel Dassault FR 92552 Saint-Cloud Cedex
E-mail:	Bruno.Patin@dassault-aviation.com
Tel:	+33 (0)1 47 11 58 54
EC Officer:	J.L. Marchand

Partners:	ALENIA AERONAUTICA S.p.A.	IT
	Eurocopter	FR
	Eurocopter Deutschland GmbH	DE
	EADS CCR	FR
	Walphot S.A.	BE
	Elliniki Photogrammetriki Ltd	GR
	Consorzio Nazionale Interuniversitario per le Telecomunicazioni	IT
	Institut National de Recherche en Informatique et en Automatique	FR
	Centre National de la Recherche Scientifique	FR
	Eidgenoessische Technische Hochschule Zürich	CH
	Ecole Polytechnique Fédérale de Lausanne	CH
	Instituto Superior Tecnico	PT
	Jozef Stefan Institute	SI
	EADS DS SA	FR

VULCAN

Vulnerability analysis for near future composite/hybrid air structures: hardening via new materials and design approaches against fire and blast

Background

The increase of air traffic is not accompanied by a similar percentage of increase in airborne accidents; however, the absolute number of fatalities due to accidents has increased. Moreover, despite the strict safety measures, terrorist acts cause the probability of an internal or external incident of fire or blast to increase. More than ever, passenger airborne safety and consumer faith require hardening strategies, which should be incorporated in aircraft design.

Composite and hybrid metal/composite aerostructures are nowadays considered as the only way to obtain a safe, light, environmentally friendly and cost-effective aircraft. This fact is reflected in the constantly increasing usage of such materials in the new generation of civil aircrafts. The improvement of current aircraft against blast and/or fire incidents remains an open issue; therefore the vulnerability of composite and hybrid structures under such loading is requiring more intense research than ever.

Objectives

The objectives regarding blast are:

- development of algorithms, material models and failure criteria for high strain rate loading of composites and hybrid materials, and calibration of the numerical tools against experimental results;
- development of numerical tools for blast vulnerability analysis of composite and hybrid aeronautical structures;
- blast vulnerability map of composite and hybrid-scaled fuselage substructures for different charge locations and different explosive quantity;
- implicit and explicit blast hardening strategies of composite and hybrid aerostructures by design and by materials (including novel design approaches tailored to the new generation materials).

The objectives regarding fire are:

- development of algorithms, material models and failure criteria for fire behaviour: criteria for fire spread and fire burn-through;
- fire vulnerability map of in-flight fire spread and burn through conditions in composite and hybrid-scaled fuselage substructures for different types of flame intensity and location;
- Implicit and explicit fire hardening measures for composite and hybrid aerostructures by design and by novel materials to reduce fire spread.

Description of work

The scope of this project encompasses the development of novel materials and design optimisation strategies aimed at strengthening composite/hybrid airborne structures and preventing catastrophic damage. This will be obtained via the assessment of the vulnerability of model aerostructures to blast and fire. Numerical tools will be developed and validated against experimental findings in order to develop a vulnerability map of typical sub-structures. Vulnerable locations will be identified and reinforced in two ways: (a) by introducing novel design approaches, and (b) by using tailored novel composite and hybrid materials. Implicit and explicit measures will be considered based on reinforcing design strategies and novel materials.

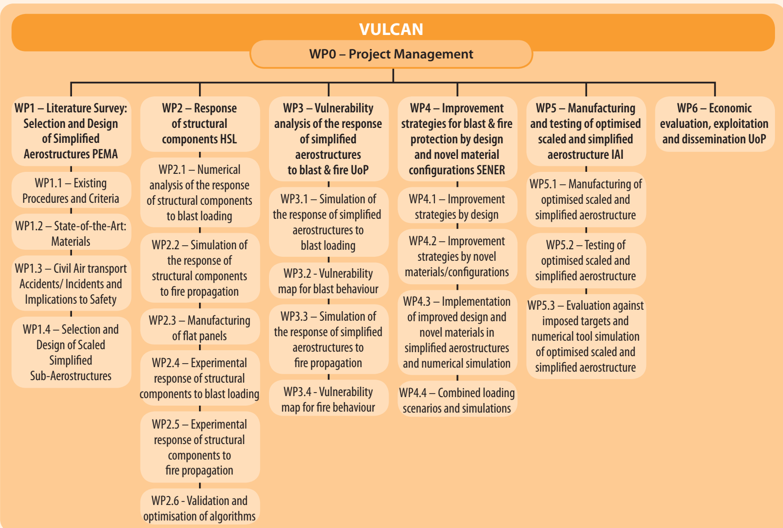
Finally, hardened sub-aerostructures will be designed, manufactured and validated aiming at a tenfold increase in blast and fire resistance compared to those currently used with the minimum weight penalty.

Results

One of the major innovations of VULCAN is the development of novel hardening methodologies for aircraft structures against blast and fire incidents. These methodologies will be based upon the adoption on novel materials (and material technologies) and the application of new design approaches which are expected to significantly enhance aircraft safety and security. Going one stage further, the experience gained through the envisaged test campaign will be consolidated in proposing new standards for the study of blast and fire incidents and thus provide the roadmap for an integrated approach to the issue of civil aircraft survivability.

This project is directly addressing the subject of passenger survivability: VULCAN will identify research, and specify and introduce strategic approaches which will bring major benefits to the safety of the passengers, thus minimising the number of fatal losses, even in the case of onboard terrorist actions.

The outcome of VULCAN will provide methodologies readily applicable to aircraft design and the anticipated benefits will reflect the realisation of safer airborne structures within the next five to seven years. In this way VULCAN is expected to contribute to the sustainable development of a sector that has suffered serious blows in the last few years and thus enables the European air transport sector to reinforce its current global position and continue to increase, offering employment and better customer service.



VULCAN project: Work Package breakdown

Acronym:	VULCAN
Name of proposal:	Vulnerability analysis for near future composite/hybrid air structures: hardening via new materials and design approaches against fire and blast
Contract number:	AST5-CT-2006-031011
Instrument:	STP
Total cost:	4 825 113 €
EU contribution:	2 987 524 €
Call:	FP6-2005-Aero-1
Starting date:	01.10.2006
Ending date:	01.04.2010
Duration:	42 months
Objective:	Safety & Security
Research domain:	Accident Prevention

Coordinator:	Mr Karagiannis Dimitri	
	Integrated Aerospace Sciences Corporation (INASCO)	
	Tegeas St., 17	
	GR 16452 Argyroupolis - Athens	
E-mail:	d.karagiannis@inasco.com	
Tel:	+30 (0)210 99 43 427	
Fax:	+30 (0)210 99 61 019	
EC Officer:	P. Perez-Illana	
Partners:	University of Patras	GR
	University of Sheffield	UK
	Health and Safety Executive	UK
	Netherlands Organisation for Applied Scientific Research	NL
	Institut fuer Vebundwerkstoffe	DE
	SICOMP AB	SE
	Fundacion Inasmet	ES
	PeMA Aerosapace - Associação	PT
	Royal Military Academy	BE
	Warsaw University of Technology, Institute of Aeronautics and Applied Mechanics	PL
	Hellenic Aerospace Instrusty S.A.	GR
	Israel Aircraft Industries Ltd	IL
	PIEP - Polo de Inovação em Emgenharia de Polímeros	PT
	SENER INGENIERIA Y SISTEMAS	ES

ADHER

Automated Diagnosis for Helicopter Engines and Rotating parts

Background

Aircraft availability, in-flight reliability and low-cost maintenance are major concerns for helicopter operators. HUMS (Health Usage Monitoring System) implementing sensor-based monitoring is an enabling technology seeking to provide a condition-based maintenance (CBM) relying on automated diagnosis/prognosis of the health of aircraft components. One challenge for HUMS is to implement automated low-cost CBM systems as an alternative to periodic physical inspections. Existing HUMS technologies tend to generate high rates of false alarms due to the use of fixed alarm thresholds. The automated analysis of fleet operating data on engine and rotating parts recorded by onboard sensors is a major scientific objective to reach adaptive, reliable, and low-cost HUMS systems. This objective will be explored in this project by addressing:

– Performance of simultaneous oil debris monitoring (ODM) and vibration monitoring using available ODM and vibration sensors;
– Analysis of new physical models for ODM and vibration characteristics of helicopter rotating parts (gearboxes, bearings, etc.) to calibrate 'ageing effects' and 'progressive emergence of failures';
– Design and validation of innovative software tools dedicated to self-adaptive diagnosis/ prognosis of potential failures of helicopter rotating parts.

Objectives

The project's main goal is to enable 'fleet-scale' health monitoring for helicopters with robust failure diagnosis and prognosis, relying on multi-sensor monitoring and automated analysis of sensor-recorded data. This will reduce false alarm rates and maintenance costs and increase operational aircraft availability, enabling efficient scheduling of preventive maintenance.

The main scientific and technological objectives of this project are:

– To obtain a better understanding of the physical behaviour of ODM, vibration and acoustic sensors through new theoretical models and through a series of bench test experiments on helicopter gearboxes, especially in terms of 'ageing effects' and 'progressive emergence of failures' for rotating parts;
– To define innovative self-adaptive algorithms enabling data-driven automatic learning to analyse time evolutions of sensor data and to generate anticipated health diagnosis, taking account of 'vehicle usage context variables';
– To test these algorithms on helicopter fleet vibration data;
– To evaluate the feasibility of automated health monitoring of helicopter fleets by self-adaptive software analysis of (ODM + vibrations) data.

Description of work

The project work breakdown structure includes three sub-projects (SP):

– SP1 is concerned with project management, scope specification, results evaluation and dissemination towards potential end users.
– SP2 addresses experimental data acquisition and physical modelling of three key categories of sensors known to have discriminating capabilities to monitor the health of helicopter rotating parts: oil debris monitoring, vibrations and acoustic emissions. The main goal of SP2 is to reduce the rate of undetected faults.

- SP3 focuses on innovative multi-sensor diagnosis software tools and explores the diagnosis potential of self-learning algorithms. It includes five work packages addressing a helicopter fleet sensor database, external variable impact on vibration-based diagnosis, multi-sensor data fusion for diagnosis, automatic elimination of defective sensor data and the overall technical evaluation of the project outputs. The main goal of SP3 is to reduce the rate of false alarms.

Results

It is expected to acquire/obtain the following knowledge elements and results:
- Oil debris fault detection rates for various damage modes and operating contexts;
- Quantitative impact of contextual variables on defects;
- Experimental evaluation of the potential of acoustic emission sensors for diagnosis;
- Database of vibration recordings for a helicopter fleet;
- Self-adaptive software tools for health diagnosis;
- Methods and tools for automated multi-sensor data fusion for diagnosis;
- Methods and tools for automated elimination of degraded sensor data;
- Bench test evaluation of defect diagnosis on helicopter rotating parts;
- Validation concepts and industrialisation feasibility;
- Perspective assessment for fleet-scale automated multi-sensor diagnosis.

Acronym:	ADHER	
Name of proposal:	Automated Diagnosis for Helicopter Engines and Rotating parts	
Contract number:	AST5-CT-2006-030907	
Instrument:	STP	
Total cost:	1 458 596 €	
EU contribution:	1 059 090 €	
Call:	FP6-2005-Aero-1	
Starting date:	01.12.2006	
Ending date:	30.11.2008	
Duration:	24 months	
Objective:	Safety & Security	
Research domain:	Maintenance & Reliability	
Coordinator:	Mr Derain Jean-Pierre	
	Eurocopter S.A.S.	
	Aéroport Marseille-Provence	
	FR 13725 cedex Marignane	
E-mail:	jean-pierre.derain@eurocopter.fr	
Tel:	+33 (0)4 42 85 91 98	
Fax:	+33 (0)4 42 85 87 65	
EC Officer:	P. Kruppa	
Partners:	RSL Electronics Ltd	IL
	Cardiff University	UK
	University of Patras	GR
	Ecole Normale Supérieure de Cachan	FR

SHM in Action

Structural Health Monitoring in Action

Background

Structural health monitoring (SHM) is an emerging technology, dealing with the development and implementation of techniques and systems where monitoring, inspection and damage detection become an integral part of structures and thus a matter of automation. It also merges with a variety of techniques related to diagnostics and prognostics.

SHM emerged from the wide field of smart structures and laterally encompasses disciplines such as structural dynamics, materials and structures, fatigue and fracture, non-destructive testing and evaluation, sensors and actuators, microelectronics, signal processing and possibly much more. To be effective in the development of SHM systems, a multidisciplinary approach among these disciplines is therefore required. Without this global view it will be difficult for engineers to holistically manage the operation of an engineering structure through its life cycle in the future and to generate new breakthroughs in structural engineering.

Objectives

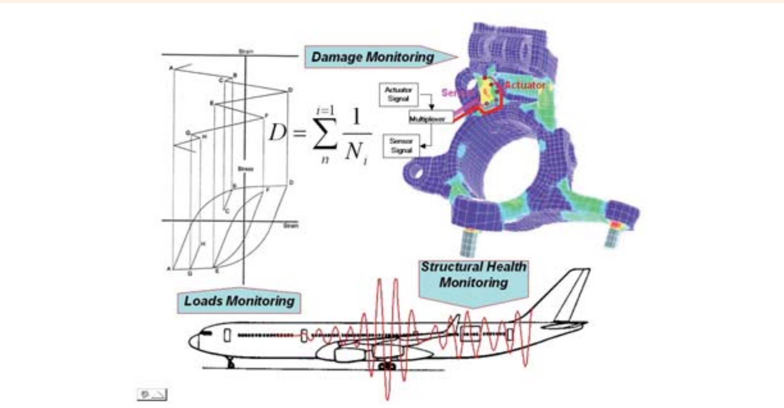
Advances in technology stem from advances in knowledge. The development and the usage of technologies depend on the dissemination of state-of-the-art information, which is the objective for this project.

Structural health monitoring (SHM) systems and technologies have acquired a significant relevance during the last two decades, and it is referred to as one of the key issues in long-term R&D aeronautic plans.

SHM in action will prepare the experts, required by European industry, to be able to design and manage the structural health of engineering structures in the future.

This will be achieved by shortening the delay among the existing knowledge and its industrial applications which was due to:

– the multidisciplinary aspect of the technology requiring a long learning period;



SHM approach

- the lack of basic teaching materials;
- few people having access to laboratories for hands-on experience;
- a large number of tests having been done on small specimens, but few demonstrations done on real structures.

Description of work

A matching network of experts from European universities and research institutions, selected by their technical competence and teaching experience, have prepared an intensive (40 hours) lectures series, covering all theory and techniques relevant to the understanding and handling of SHM. Laboratory and demonstration activities will also be included so that participants gain hands-on experience in the main techniques addressed.

This advanced course will be given two or three times each year, in different European countries and in close co-operation with industry.

Results

The first lecture series will be held in Madrid, 7-11 May 2007. Dates for further courses can be found on the website.

Acronym:	SHM in Action	
Name of proposal:	Structural Health Monitoring in Action	
Contract number:	ASA6-CT-2006-044636	
Instrument:	SSA	
Total cost:	786 060 €	
EU contribution:	265 000 €	
Call:	FP6-2005-Aero-1	
Starting date:	01.10.2006	
Ending date:	30.09.2009	
Duration:	36 months	
Objective:	Safety & Security	
Research domain:	Maintenance & Reliability	
Website:	http://www.aero.upm..es/es/departamentos/shm/	
Coordinator:	Prof. Güemes Alfredo	
	Universidad Politecnica de Madrid	
	Dpt Aeronautics	
	Plaza cArdenal Cisneros, 3	
	ES 28040 Madrid	
E-mail:	alfredo.guemes@upm.es	
Tel:	+34 (0)913366327	
Fax:	+34 (0)913366334	
EC Officer:	A. Podsadowski	
Partners:	University of Siegen	DE
	University of Sheffield	UK
	University of Lisbon	PT
	Polish Academy of Science	PL
	Risø National Laboratory	DK
	University of Patras, Mechanical and Aeronautical Engineering	GR

SICOM

Simulation-based corrosion management for aircraft

Background

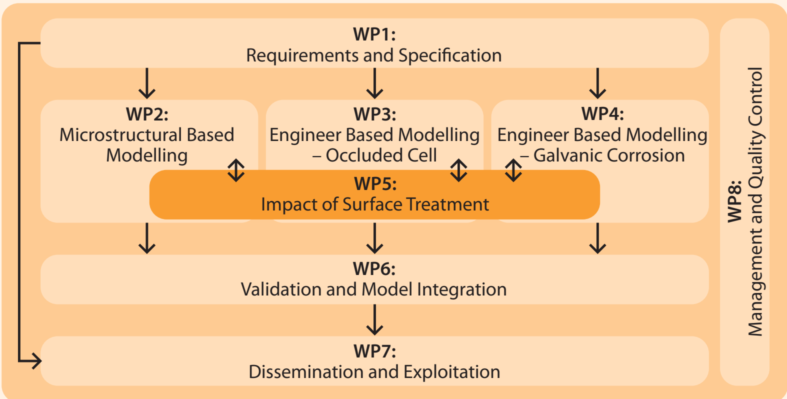
Corrosion management concepts utilising the application and integration of predictive tools for corrosion occurrence and growth will be a driver for new technical advances in the field of corrosion maintenance, and in the development of new structural designs, materials and processes for surface protection. Additional benefits can be expected by reduced time-to-market for new products.

Current maintenance philosophy claims that all corrosion damage has to be identified and repaired prior to becoming structurally critical. The consequences are unanticipated and result in unscheduled maintenance with high costs. The total annual direct cost of corrosion, for example to the US aircraft industry, is estimated at $2.2 billion, which includes the cost of design and manufacturing ($0.2 billion), corrosion maintenance ($1.7 billion), and downtime ($0.3 billion). A reliable prediction of the occurrence of corrosion flaws and corrosion propagation would provide the basis for new cost-efficient maintenance and repair strategies.

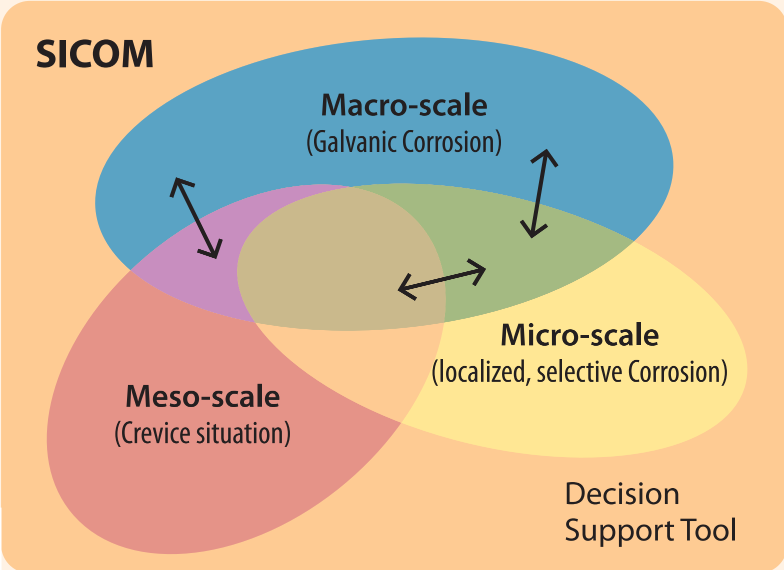
Objectives

SICOM will develop models that can become an essential part of future predictive maintenance concepts. They will deliver the information about onset and evolution of corrosion and thus fill the gap between corrosion detection or monitoring and the calculation of the structural impact of corrosion. Data from environmental condition or corrosion monitoring systems and non-destructive inspection can be used as input data. Model outputs will be utilised for the repair decision process or can supply structural integrity calculation programmes.

Modelling parameters will be defined, which represent corrosion condition and in-service experience of aircraft. Localised corrosion will be simulated by a numerical microscale model with regard to microstructure and the micro-electrochemical condition. The corrosion rate of alumin-



Project organisation



SICOM:
a decision-support tool

ium alloys in the meso-scale of occluded cells by means of numerical calculation will be modelled as a function of physical and geometrical factors for a given macro-environment. An engineering-based numerical model for prediction of galvanic corrosion behaviour will be developed and up-scaled for application to structural elements of aircraft. The models are intended to be incorporated into a decision-support tool to enable the engineer to view the data generated by the models but also to examine the trends of the data.

Description of work

A numerical microscale model will simulate localised corrosion of aluminium alloys with regard to microstructure and the micro-electrochemical conditions developed. The corrosion rates of aluminium alloys will be provided in the mesoscale of occluded cells by means of a numerical calculation as a function of physical and geometrical factors for given macro-environments. A numerical model for prediction of galvanic corrosion behaviour will be developed and up-scaled for application to structural elements of aircraft. The influence of surface treatment on modelling results will be included with regard to inhibitor release from protection systems, role of clad layer influence and oxide degrading effects. A decision-support tool will be established for exploitation and implementation of the project results in scientific and technical applications. A further extension of the models is to take into account specific surface treatment of the aluminium alloy and their localised breakdown.

Results

The following major results are expected:
- specification of requirements for in- and output data used in different fields of application;
- mass transport model and the evaluated, critical parameters that trigger localised corrosion;

- numerical calculation of the corrosion rate of aluminium in an occluded cell;
- advanced modified mass transport model for the impact of a clad layer that includes the relevant (complex) geometrical and chemical parameters;
- galvanic corrosion model predicting the corrosion rates for typical structural joints under varying conditions;
- a decision-support software tool will be designed and provided to enable a wide application in corrosion management.

Acronym:	SICOM	
Name of proposal:	Simulation-based corrosion management for aircraft	
Contract number:	AST5-CT-2006-030804	
Instrument:	STP	
Total cost:	3 088 766 €	
EU contribution:	2 569 583 €	
Call:	FP6-2005-Aero-1	
Starting date:	01.03.2007	
Ending date:	28.02.2010	
Duration:	36 months	
Objective:	Safety & Security	
Research domain:	Maintenance & Reliability	
Coordinator:	Hack Theo EADS Deutschland GmbH Willy-Messerschmidt-Strasse DE 81663 Munich	
E-mail:	theo.hack@eads.net	
Tel:	+49 (0)89 607 23389	
Fax:	+49 (0)89 607 32163	
EC Officer:	A. Podsadowski	
Partners:	Airbus Deutschland GmbH	DE
	EADS Corporate Research Center France	FR
	BEASY - Computational Mechanics Incorporated	UK
	Swiss Federal Laboratories for Materials Testing and Research	CH
	University de Bourgogne - Central National de la Recherche Scientifique	FR
	Friedrich-Alexander University of Erlangen-Nuremberg	DE
	Vrije Universiteit Brussel	BE
	Sheffield Hallam University	UK
	University of Patras - Laboratory of Technology and Strength of Materials	GR
	Politechnika Warszawska (Warsaw University of Technology)	PL

SUPERSKYSENSE

Smart maintenance of aviation hydraulic fluid using an onboard monitoring and reconditioning system

Background

Aviation hydraulic fluids are hygroscopic and, as a result, their lifetime is highly unpredictable. The performance of the entire aircraft hydraulic system is affected by the condition of the hydraulic fluid and, if degradation goes undetected, it may cause damages with serious consequences. These may be economic at best or catastrophic at worst. At present, assessing the condition of the hydraulic fluid in an aircraft is laborious, time consuming and expensive. Therefore the fluid is typically tested less than once a year, with the risk of unscheduled maintenance if the fluid has exceeded its limits of usage. Consequential interruption of the airline service bears a huge economic cost.

This project proposes the development of an optimised maintenance concept based on an autonomous onboard system capable of monitoring the fluid condition and restoring it when required. This will increase the lifetime of the fluid yet prevent damage caused by degraded fluid. If external reconditioning or a change of fluid should prove to be unavoidable, this could be scheduled to coincide with regular service and maintenance operations, thanks to the predictive capability of the monitoring system. Fibre-optic sensors using luminescent indicators as well as alternative optical and electrochemical sensors will be developed for fluid monitoring.

Objectives

The strategic objective is to strengthen competitiveness in the European civil aeronautics industry through substantially reduced maintenance costs, and, in addition, provide improved safety, reliability and reduced environmental impact – all related to the degradation of hydraulic fluid by means of an optimised maintenance concept based on an onboard fluid monitoring and reconditioning system.

The technical objectives are:

- to develop an optimised hydraulic fluid maintenance programme to reduce cost, downtime and environmental impact, and to increase safety and reliability of aeronautical hydraulics;
- to design, develop and validate an onboard intelligent multisensor system to monitor the critical parameters and evaluate the condition of the aviation hydraulic fluid used in most civil aircraft (phosphate ester-based fluids);
- to design, develop and validate an onboard hydraulic fluid reconditioning system to stop fluid degradation and thus enhance the fluid's lifetime almost indefinitely.

Description of work

Different water separation and elimination techniques will be investigated and selected. The chosen approach yields a balanced-risk strategy in which established techniques are combined with cutting-edge research, the outcome of which results in concurrent individual deliverables of high intrinsic value, thereby enhancing the combined benefits expected from the project.

The partial objectives of the project materialise into different technological deliverables, each of which have high intrinsic value on their own, representing ambitious research objectives, including:

1. Development of novel sensing procedures for the measurement of moisture, chlorine, dissolved gases, acidity and particles in an aggressive and unusual matrix such as hydraulic fluid.
2. Development of materials, electronics and software for the successful construction and operation of such robust sensors.
3. Obtaining adsorbent materials and membrane filtration technologies, and, in particular, optimised combinations thereof, to yield effective elements for the removal of water, particles and other undesired elements from hydraulic fluids.

Results

The material output of the project will consist of a preliminary test unit containing the multisensor and reconditioned subsystems. The system will be tested on the ground to verify the technology, and evaluate the system's performance within the new maintenance strategy. A sufficient number of units of the sensor subsystem and of the regeneration subsystem will be manufactured in the project and used for individual testing in the laboratory before assembly and preliminary testing of the complete system. The impact of this system will extend far beyond the consortium partners: the cost savings to airlines due to the optimised maintenance strategy will give European constructors such a competitive advantage that the entire industry will be strengthened. At the end of the SuperSkySense project, the consortium plans to have introduced a new hydraulic fluid maintenance, radically improved from the present one, and characterised by:

- hydraulic fluid condition monitored permanently;
- instantaneous results and trend curves available continuously;
- risk of corrosion or clogging virtually inexistent due to a smart maintenance system;
- no fluid substitution, or only when needed;
- lower cost and optimised use of resources;
- no hydraulic fluid-related, unscheduled maintenance (but probably no maintenance at all);
- reduced or zero-waste emission;
- lower environmental impact.

The consortium estimates that the proposed system may result in direct cost reductions for the airlines of several hundreds of thousand euros per aircraft. This represents between 10 and 30 times the initial system cost. For the entire airline industry (assuming 360 planes per year), this represents savings in the region of € 100 million per year in the middle to long term.

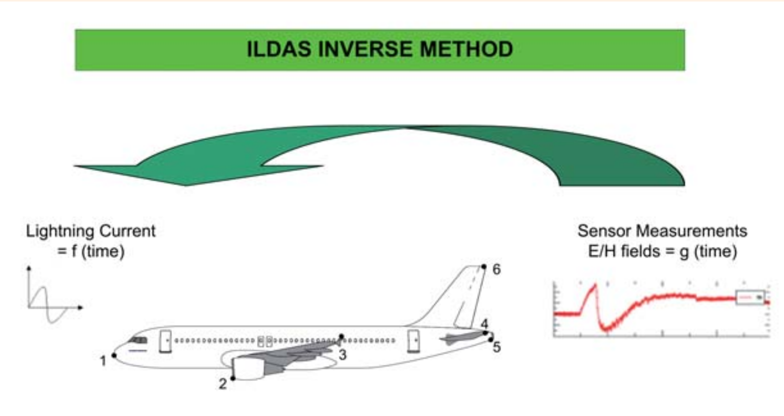
Based on the developed and proved concept, once the project has been successfully concluded, a specification for the Onboard Monitoring and Reconditioning System will be issued by Airbus.

Acronym:	SUPERSKYSENSE
Name of proposal:	Smart maintenance of aviation hydraulic fluid using an onboard monitoring and reconditioning system
Contract number:	AST5-CT-2006-030863
Instrument:	STP
Total cost:	4 731 237 €
EU contribution:	2 760 000 €
Call:	FP6-2004-TREN-3
Starting date:	15.10.2006
Ending date:	14.10.2009
Duration:	36 months
Objective:	Safety & Security
Research domain:	Maintenance & Reliability
Coordinator:	Mr Garcia Enrique Interlab Ingenieria Electronica y de Control S.A. C/ Maria Tubau, 4 - 2 ES 28050 Madrid
E-mail:	enrigarcia@interlab.es
Tel:	+34 (0)91 3589627
Fax:	+34 (0)91 3588327
EC Officer:	P. Perez-Illana

Partners:	Airbus France SAS	FR
	EADS Deutschland GmbH	DE
	Lufthansa Technik Budapest Kft	HU
	Instytut Lotnictwa (Institute of Aviation)	PL
	Loughborough University	UK
	Compañia Española de Sistemas Aeronauticos	ES
	Sofrance SA	FR
	Universidad Complutense de Madrid	ES
	EADS CCR	FR
	Fundación INASMET	ES
	Centre de Transfert de Technologies Céramiques	FR
	Groupe d'Etudes en Procédés de Séparation	FR

ILDAS

In-flight Lightning Strike Damage Assessment System



Background

Commercial passenger aircraft are on average struck by lightning once a year. The effects of lightning on aircraft and helicopters are minimal for low-amplitude strikes, but higher-amplitude strikes may result in expensive delays and important repair and maintenance.

The present certification threat level is derived from cloud-to-ground lightning strike data measured on instrumented towers. While historically this threat definition has served the purpose of lightning protection adequately on metallic airframes, modern aircraft incorporate an increasing amount of composite materials that make them more susceptible to damage. Moreover, aircraft now employ more high-authority electronic control systems that are susceptible to upset and damage. As a result of the introduction of extra protection measures the advantages of modern materials could be cancelled by the addition of weight and higher cost.

To be able to design appropriate lightning protection, aircraft manufacturers have a strong need for a well-defined real lightning threat to aircraft.

Objectives

The ILDAS project is to provide important data concerning the properties of real lightning strikes to flying aircraft and possibly helicopters. The first project objective is to use this knowledge to develop tailored and efficient maintenance inspection procedures which must be applied after a recorded strike. Secondly, improved knowledge provides a better insight into the actual effects of a lightning strike to a fixed-wing aircraft or a helicopter, which can be used to improve aircraft design.

In order to achieve these high-level objectives, the derived objectives are:

- to develop an innovative and efficient measurement system prototype called ILDAS (In-flight Lightning Strike Dam-

age Assessment System) for in-flight measurement of lightning strikes to aircraft. ILDAS uses advanced smart sensor techniques which enable characterisation of lightning strike parameters and current flowing through the aircraft skin during an in-flight lightning strike.
- to adapt existing electromagnetic modelling software and to develop and validate enabling electromagnetic software technology for calculations of current flow resulting from a lightning strike to an aircraft. The development and implementation of a very innovative inverse method based on a numerical simulation of the lightning current propagation will be performed within ILDAS.
- to define a database dedicated to the measured and deduced lightning data, enabling subsequent exploitation.

Description of work

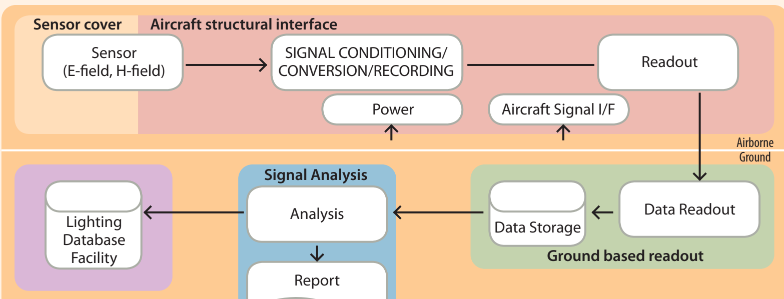
At the start of the ILDAS project the inputs will be defined in terms of end-user needs and state-of-the art technology. The need for the measurement system will be further detailed with all stakeholders involved, defining the measurement requirements and in-flight lightning measurement sensor constraints. During this early study phase, the need to protect aircraft and helicopters against the effects of lightning strikes and the cost of the protection measures will be taken into account.

The state of the art in lightning strike measurements, available sensor technologies and electro-magnetic modelling will be defined as a starting point for innovation. During the development of the solution, the needs will be transformed into requirements for a lightning strike measurement system prototype with on-board recording of the data. The technology development for the prototype of the measurement system will focus on innovative and reliable sensor technology, measurement chain and data recording technology development.

There will be a strong interaction between the prototype development and the electro-magnetic analysis research in order to further define the related measurement data recording chain, the analysis and the management of the lightning data, and other data collected during the lightning events.

Results

The ILDAS research project will yield a complete system concept that has been verified during simulated on-ground lightning tests. The project will also yield the validation of the inverse method for deriving the strike amplitude and attachment points on fixed-wing aircraft and on helicopters.



ILDAS preliminary system architecture

After future industrialisation and final certification, the actual application of ILDAS in aircraft and helicopters enables a rapid build-up of the lightning database contents.

Improved knowledge of the actual lightning strike should lead to executing a tailored and efficient maintenance inspection procedure after a recorded strike. This will strengthen the competitiveness of the industry by reducing aircraft operating costs through a reduction in maintenance time and other direct operating costs.

Better knowledge of lightning properties also enables European and other standards committees, which act on behalf of the European aircraft industry, to verify and possibly improve the lightning test standards. This should also enable optimisation of the protective measures of aircraft, through tailoring the design to the properties of real lightning, and resulting in a reduction in the cost and weight penalty of protective measures.

Acronym:	ILDAS	
Name of proposal:	In-flight Lightning Strike Damage Assessment System	
Contract number:	AST5-CT-2006-030806	
Instrument:	STP	
Total cost:	4 255 247 €	
EU contribution:	2 331 793 €	
Call:	FP6-2005-Aero-1	
Starting date:	01.10.2006	
Ending date:	31.03.2009	
Duration:	30 months	
Objective:	Safety & Security	
Research domain:	Maintenance & Reliability	
Website:	http://ildas.nlr.nl	
Coordinator:	Ing. Zwemmer Rob	
	Stichting Nationaal Lucht- en Ruimtevaartlaboratorium (NLR)	
	Anthony Fokkerweg 2	
	NL 1059 CM Amsterdam	
E-mail:	zwemmer@nlr.nl	
Tel:	+31 (0)20 511 3327	
Fax:	+31 (0)20 511 3210	
EC Officer:	P. Perez-Illana	
Partners:	EADS CCR	FR
	Airbus France SAS	FR
	Culham Lightning Ltd	UK
	LA Composite s.r.o.	CZ
	Technische Universiteit Eindhoven	NL
	OFFICE NATIONAL D`ETUDES ET DE RECHERCHES AEROSPATIALES	FR
	GROUPE SOCIUS SA	FR
	Eurocopter Deutschland GmbH	DE
	Air France	FR
	Lufthansa Technik AG	DE
	Vector Fields Ltd	UK

DRESS

Distributed and Redundant Electro-mechanical nose wheel Steering System

Background

An aeroplane is steered on the ground by orienting the nose landing gear wheels. On all commercial aeroplanes today, these wheels are oriented by a hydraulically actuated steering system. On automatic landings, during the automatic braking sequence, the steering system is commanded by the flight control computers in order to keep the aircraft on the runway's centre line. When reaching the end of the runway, pilots have to regain manual control of the aeroplane as there is no automatic ground guidance on taxiways.

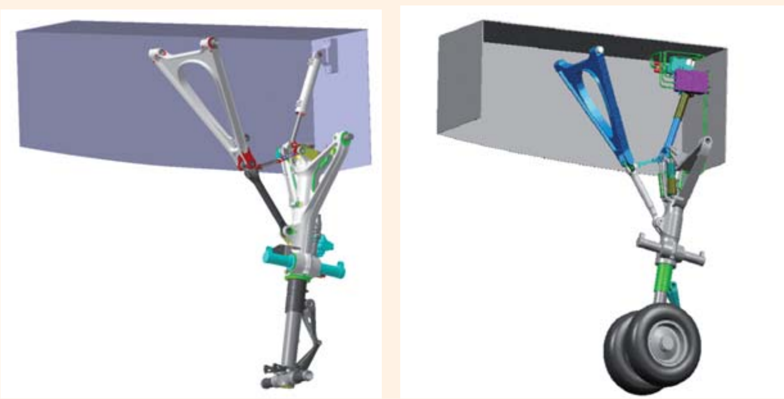
Even the automatic steering during the automatic braking sequence is of limited use since, due to the low safety level of the current steering systems, airworthiness regulations impose a minimum visibility that would allow the pilots to be able to safely regain manual control in case of steering system malfunction and keep the aeroplane on the runway by using manual differential braking. In lower visibility conditions, all landings, ground manoeuvres and take-offs have to be interrupted.

Continuous efforts are being made by the aeroplane manufacturers and the air traffic management sector to fully automate the approach, landing, ground manoeuvres and take-off in order to increase the air transport system efficiency by being able to operate the airports in true 'all weather' conditions.

The weak link today is the current nose landing gear steering system, which must be improved in terms of safety so that it is able to be integrated into the future fully automated ground guidance system, allowing the expected air transport efficiency levels to be reached.

Objectives

The project objective is, therefore, to gradually increase the reliability and safety levels of the aeroplane ground steering system.



Single-aisle aircraft nose landing gear

Electromechanical redundant actuation technology associated with new modular control system architecture, based on a digital bus network, should allow large improvements in the reliability and safety of the ground steering system to levels compatible with the requirements of a fully automated ground guidance system.

The DRESS architecture will improve safety and fault tolerance while offering an open and modular structure through the digital bus network reconfiguration capabilities, and will provide an easy and safe connection to the future automatic guidance system. The system fault management will be improved by automatic failure localisation.

Another step will be made towards the all-electric aircraft and its associated advantages by eliminating the current hydraulically actuated steering system and its well-known drawbacks.

An overall steering system weight reduction at aircraft level will also be reached, even if the electromechanical actuators could turn out to be slightly heavier than the current hydraulic actuators, since many current hydraulic components associated with the hydraulically actuated system will be deleted.

Description of work

DRESS will achieve this technology breakthrough, investigating in the fields of both system architecture and electromechanical actuation.

DRESS is composed of the following work packages:

- The 'Specifications and assessment criteria' work package will identify all the requirements, providing a base on which high-level as well as detailed specifications for this new steering system will be established. Assessment criteria will be defined to assess the final validation results in an easier and better way.
- The 'Research on optimised system architecture' work package concerns modular and redundant open control system architecture studies, and also addresses the complex nose landing gear oscillations damping control.
- The 'Electromechanical technologies' work package concerns the electromechanical actuator, a new electric motor architecture, and a safe and segregated power electronics control system
- The 'Components manufacture' and 'Technology Integration' work packages will cover the manufacture and then the assembly of various components with first sub-assembly tests.
- 'Technology evaluation': the main components and then the complete validation prototype of the new steering system will be tested against the specifications. An evaluation of this new technology regarding its integration in a production aircraft system will be provided.

Results

A steering system demonstrator will be available at the end of the project which will have been tested on a dedicated rig.

DRESS will develop a cost-effective steering system with an improved level of safety allowing automatic aircraft guidance. Furthermore, DRESS has a global approach: improving the safety critical system architecture with modular and open real-time control loop architecture while introducing jamming-free electromechanical redundant actuators.

DRESS will improve the European aeronautic industry competitiveness, contributing to securing long-term employment in this industry.

It will contribute to education and training via the development and application of new digital and electromechanical techniques, to a large extent based on work carried out by PhD students or young scientists coming from different European countries.

DRESS aims to provide the technology to improve competitiveness and safety, which will contribute towards airport traffic efficiency. This will allow aviation growth in harmony with society needs and efficiency, and thereby enable air travel to become a more efficient transport medium for both people and goods.

By helping to improve airport traffic efficiency, DRESS will contribute towards reducing the air transport system's energy consumption with a more efficient service without delays.

Acronym:	DRESS	
Name of proposal:	Distributed and Redundant Electro-mechanical nose wheel Steering System	
Contract number:	AST5-CT-2006-030841	
Instrument:	STP	
Total cost:	4 223 456 €	
EU contribution:	2 586 477 €	
Call:	FP6-2005-Aero-1	
Starting date:	15.06.2006	
Ending date:	14.06.2009	
Duration:	36 months	
Objective:	Safety & Security	
Research domain:	Maintenance & Reliability	
Website:	http://www.dress-project.eu	
Coordinator:	Mr Dellac Stephane	
	Messier-Bugatti	
	Parc Jean Monnet	
	41, Avenue Jean Monnet	
	FR 31770 Colomiers	
E-mail:	stephane.dellac@messier-bugatti.com	
Tel:	+33 (0)5 34 50 77 19	
Fax:	+33 (0)5 34 50 77 03	
EC Officer:	M. Brusati	
Partners:	Saab AB	SE
	Airbus UK Ltd	UK
	Messier-Dowty	FR
	Institut National des Sciences Appliquées de Toulouse	FR
	Université catholique de Louvain	BE
	UNIVERSITATEA DIN CRAIOVA	RO
	Université de Haute-Alsace	FR
	Budapest University of Technology and Economics	HU
	TTTech Computertechnik AG	AT
	Equip'Aéro Technique	FR
	Stridsberg Powertrain AB	SE
	Institute of Aviation	PL

COFCLUO

Clearance of Flight Control Laws using Optimisation

Background

Proving to the certification authorities that an aircraft is safe to fly is a long and complicated process. It is the responsibility of the manufacturer to show that the aircraft complies with the certification specifications, and especially the so-called airworthiness code. This code contains a huge amount of different criteria that has to be met. Before manned flights are performed to show that an aircraft meets all the clearance criteria, simulations and computer computations are performed. This project will focus on the computer computations in the certification process. If the computations can be made faster, time is saved which will reduce time to market for new products and will also allow for rapid prototyping. Moreover, it is also desirable to make the computations more detailed and accurate which would improve the quality of the certification process, and thus increase the safety of aircraft.

Objectives

It is important to keep in mind that the questions addressed in this project are not purely technical, since industry is already technically able to successfully clear flight control laws. The main industrial benefits of the new methods should be related to reducing the involved effort and cost, while getting sufficiently reliable results, or increasing the reliability of the analysis results with a reasonable amount of effort. Therefore a benchmark problem will be defined according to current industrial standards and the results obtained from optimisation-based clearance will be compared with a baseline traditional solution based on gridding the parameter space and testing the flight control laws for a finite number of manoeuvres.

More specifically the following objectives will be demonstrated:

1. a higher reliability of optimisation-based clearance of flight control laws (CFCL) in detecting safe and unsafe flight conditions as compared to the current industrial standard
2. a reduction in effort and cost in terms of simulations and flights when optimisation-based CFCL is used prior to final in-flight validation in order to define the test campaign
3. a significant increase in safety through better quality and confidence in the clearance process when optimisation-based CFCL is used prior to final in-flight validation in order to define the test campaign.

Description of work

The clearance criteria will be selected so that the successful use of them in conjunction with optimisation-based CFCL will result in fewer off-line and manned simulations. For civil aircraft, dynamics related to the flexible structure require different, more detailed and thus larger models than what is necessary for military aircraft. Therefore new, integrated models will be developed and special attention will be paid to the fast trimming and linearisation of these models. Also the question of how to obtain rational approximations of the state space matrices of the linear parameter-varying systems resulting from the linearisation will be addressed. This will be essential in order to build so-called linear fractional transformation-based parametric models, which are the state-of-the-art model representations used in robustness and stability analysis of control systems.

In addition to this, the optimisation problem for CFCL is in some cases non-convex, hence there are local optima. This means that many optimisation methods will not find the global worst-case parameter combination, which for the CFCL might result in the wrong conclusions. Moreover, optimisation algorithms for non-convex problems often have tuning parameters which for the ordinary engineer might be difficult to understand. Also some optimisation problems might have such a large dimension, or the number of problems to be solved might be so large, that answers might not be found in reasonable time. Thus there is a need for more research in optimisation algorithms dedicated to CFCL in order to overcome the above-mentioned obstacles.

Results

When the methods and tools developed in the frame of COFCLUO prove to be reliable, accurate and relevant in the validation and clearance process performed by design engineers, they are expected to become very soon part of the internal Airbus flight control laws validation process. Later on when confidence has been gained internally on such a new process involving optimisation-based methods, Airbus could propose to airworthiness authorities that they include the methods in the official clearance process. Some of the results of the project will be developed into production quality clearance tools. These tools will either be sold or licensed, and used in-house or for consulting services.

The results from the project are useful not only for clearance of flight control laws for civil aircraft but also for military aircraft. Many of the results obtained are general and can be adapted for clearance of control laws for vehicles other than aeroplanes, such as unmanned aerial vehicles, cars and trucks. Flight clearance for unmanned aerial vehicles is expected to be even more important than for manned aircraft. For the car industry, one application of optimisation-based clearance of control laws could be to improve the reliability of existing systems, such as vehicle stability control and traction control. Another application in future control systems development is automatic obstacle avoidance. The results obtained can also be used in the connection of validation of many other different types of systems, and thus the results will strengthen the ability of European industry to validate safety-critical systems in general.

Acronym:	COFCLUO	
Name of proposal:	Clearance of Flight Control Laws using Optimisation	
Contract number:	AST5-CT-2006-030768	
Instrument:	STP	
Total cost:	3 253 686 €	
EU contribution:	2 055 516 €	
Call:	FP6-2005-Aero-1	
Duration:	months	
Objective:	Safety & Security	
Research domain:	Maintenance & Reliability	
Coordinator:	Prof. Hansson Anders Linköpings Universitet Department of Electrical Engineering Division of Automatic Control SE 58183 Linköping	
E-mail:	hansson@isy.liu.se	
Tel:	+461(0)3281681	
Fax:	+461(0)3282622	
EC Officer:	A. Podsadowski	
Partners:	Airbus France SAS	FR
	Deutsches Zentrum für Luft- und Raumfahrt e.V.	DE
	Office National d'Etudes et de Recherches Aérospatiales	FR
	Swedish Defence Research Agency	SE
	Universita' degli Studi di Siena	IT

NESLIE

NEw Standby Lidar InstrumEnt

Background

An air data system usually consists of a primary system that includes three redundant channels and has, in addition, a separate stand-by channel.

Traditional air data standby channels are composed of pitot tubes and pressure ports, which deliver parameters such as airspeed and pressure altitude. The standby channel has generally neither a temperature probe nor an angle of attack probe. The standby static pressure probe location on the fuselage is selected so as to limit the influence of sideslip.

Air data standby channels are therefore composed of equipment very similar to that encountered on the primary channels: pitot probes, static probes and pneumatic tubing.

The main reason for aircraft accidents to be linked to air data systems is probe obstruction due to icing problems, volcano ash or bugs, although some accidents have occurred due to the failure of pneumatic connection after maintenance operations.

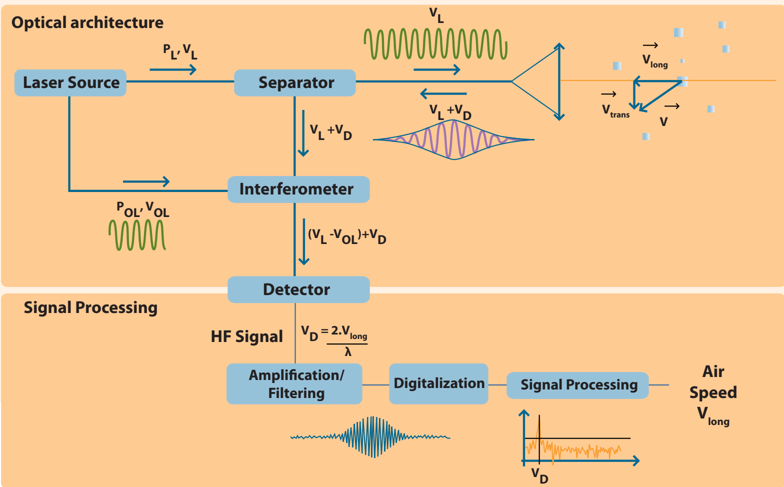
Even though efforts are made by manufacturers to design dissimilar air data channels, there is no reason that external aggressions such as ice, ash or bugs will independently affect the primary air data system probe and the standby air data system probe.

The purpose of NESLIE is, therefore, to demonstrate that a LIDAR-based (light detection and radar) air data standby channel will help to suppress the major drawbacks of existing pneumatic systems whilst maintaining the performance required by the related standards.

Objectives

LIDAR will allow the implementation of a measurement principle that is very differ-

Single – particle measurement principle



Single particle measurement principle

ent from existing systems. The sensitivity of LIDAR to wear and pollution differs from traditional pneumatic systems because there is no part of it outside the fuselage (the LIDAR window is mounted flush with the fuselage); in fact, the presence of air pollution-like droplets or ash improves the LIDAR signal.

The LIDAR can be installed in a large range of available locations on the fuselage whereas standby channel probes should be installed on locations where there is minimal sideslip effect. NESLIE should demonstrate that it is possible to design an entire LIDAR-based air data standby channel with few or no pneumatic measurements.

This technology will also allow a non-protruding probe to measure Pt, AOA and SSA in comparison to traditional probes, which have protruding parts that are subject to damage.

NESLIE goes one step further in the domain of LIDAR size, weight and cost reduction, with the use of emerging integrated optic technology (integration on substrate, guided optics, etc). The required technological parts (laser, separator, commutation, pump hybridisation, etc.) will thus be merged into a minimal number of integrated modules.

Description of work

The project is organised into four work packages:

- The specification of a functional architecture of LIDAR-based standby air data system
- The research and development of innovative technologies
- The development and in-flight test of a complete functional mock-up
- The consortium management

All the necessary skills to achieve the project goals are present in the NESLIE consortium:

- Airbus and Dassault will define airborne LIDAR-based air data measurement optimal architecture and requirements
- TEEM Photonics and IMEP will develop an integrated optical circuit for aeronautical application
- EADS CRC will derive the Airbus and Dassault specifications at LIDAR level, to develop an adapted free space optic and aircraft window
- XENICS will deliver an optimised detector
- CERTH will develop a signal processing software that is able to deal with low signal level compared to noise level
- NLR will test the LIDAR in flight and support Thales and CERTH in the interpretation of test results
- Thales Avionics will manage the consortium, and assemble and test the mock-up before flight-testing.

Results

NESLIE's main output will be a mock-up that will be tested on NRL aircraft, which, after the project, will be installed on an Airbus aircraft for a testing period lasting thousands of hours.

The product that Thales will develop, based on the NESLIE experience, will replace the standard Pitot, AOA and SSA probes, which are too sensitive to outside damage.

A second output of the NESLIE project will be a series of high quality documents such as:

- Air data parameter requirement and equipment performances for use as a standby instrument
- State of the art of the required technologies for NESLIE (laser specification)
- LIDAR and subassembly specification of IR airspeed measurement channel report
- Airborne installation constraints
- Signal processing interfaces and signal characteristics
- Flight test plan

- Certification requirement for a laser airborne system
- Requirement for flight-tests on a commercial aircraft
- Ground accuracy test and report
- Report on literature study, specification and integration possibilities with IR airspeed system, and technological risk assessment
- Flight test evaluation report
- Laser passivation report
- Final exploitation report and technological implementation plan of a laser anemometer on production aircraft and its benefit.

Acronym:	NESLIE	
Name of proposal:	NEw Standby Lidar InstrumEnt	
Contract number:	AST5-CT-2006-030721	
Instrument:	STP	
Total cost:	5 983 001 €	
EU contribution:	3 100 000 €	
Call:	FP6-2005-Aero-1	
Starting date:	02.05.2006	
Ending date:	30.04.2009	
Duration:	36 months	
Objective:	Safety & Security	
Research domain:	Security	
Website:	http://www.neslie-fp6.org	
Coordinator:	Dr Olivaux Pascale	
	Thales Avionics SA	
	45, rue de Villiers - 92526 Neuilly sur Seine	
	25, rue Jules Vedrines	
	FR 26027 Valence	
E-mail:	pascale.olivaux@fr.thalesgroup.com	
Tel:	+33 (0)4 75 79 35 93	
Fax:	+33 (0)4 75 79 86 55	
EC Officer:	M. Brusati	
Partners:	Airbus France SAS	FR
	Dassault Aviation	FR
	EADS CRC	DE
	IMEP	FR
	XenICs	BE
	Centre for Research and Technology - Hellas	GR
	Teem Photonics SA	FR
	NLR	NL

SOFIA

Safe automatic flight back and landing of aircraft

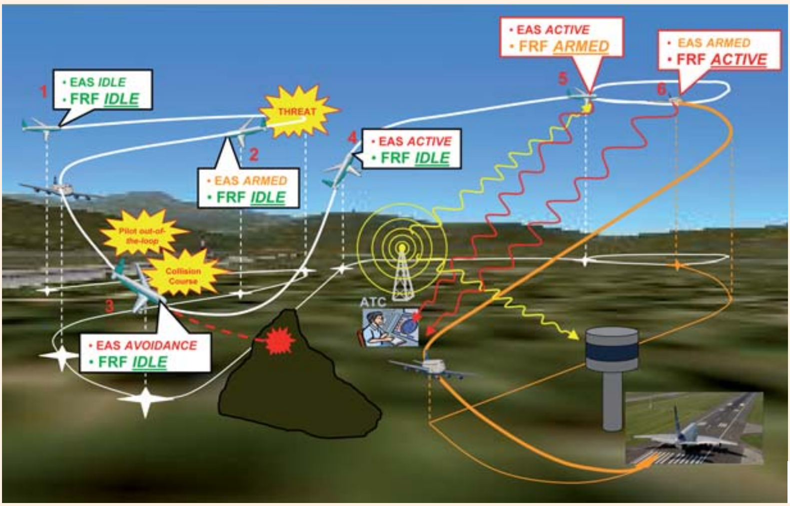
Background

The SOFIA project is a response to the challenge of developing concepts and techniques enabling the safe and automatic return of an aeroplane in the event of hostile actions. This is proposed as the continuation of the SAFEE works on FRF (flight reconfiguration function), a system which returns aircraft automatically to the ground. SOFIA will design architectures for integrating the FRF system into several typologies of avionics for civil transport aircraft. This requires the development of one of these architectures, the validation (following E-OCVM) of the FRF concept and of the means to integrate it in the current ATM. A safety assessment of FRF at aircraft and operational (ATC) levels (applying ESARR) is also needed.

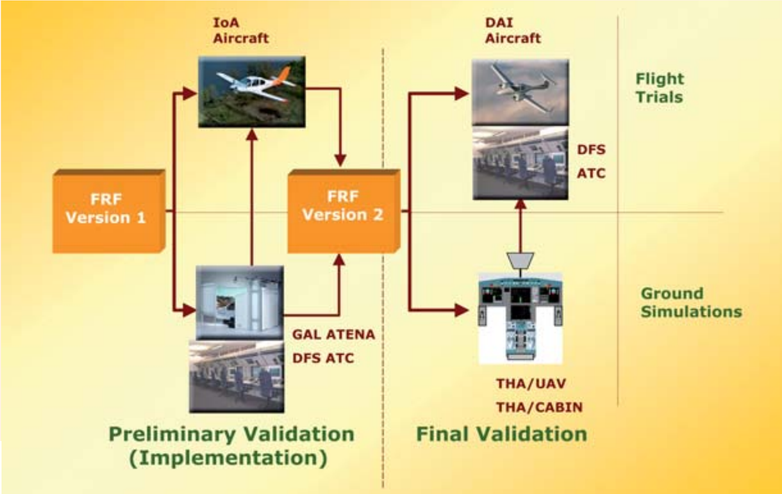
SOFIA will produce the FRF system, which will take control of the aircraft and safely return it to ground under a security emergency (e.g. hijacking), disabling the control and command of the aircraft from the cockpit. This means creating and executing a new flight plan towards a secure airport and landing the aircraft at it. The flight plan can be generated on the ground (ATC) or in a military airplane and transmitted to the aircraft, or created autonomously at the FRF system.

Objectives

The main objective of SOFIA is to develop and validate the FRF system to safely and automatically return civil transport aircraft to the ground when they come under hostile action conditions. The project will also analyse what kind of conflicts can generate FRF in the airspace and will propose some solutions to minimise the impact. The overall SOFIA objectives are as follows:



SOFIA scope



Validation resources

- demonstrate that FRF can be designed and developed in a reliable and affordable manner;
- demonstrate that an FRF equipped aircraft is safe during its normal operation;
- demonstrate that when FRF is in command of an aircraft it can be safely and securely returned to the ground at a designated airport;
- formulate a proposal to integrate FRF in the current and future (ADS-B, CDM, 4D Trajectory Negotiation) airspace;
- determine the modifications needed in the ATC systems on the ground to handle FRF;
- implement FRF and necessary modifications in ATC to perform validation trials representative of two operation modes;
- flight plan re-planning with negotiation: flight plan generated by ATC and executed by FRF;
- flight plan re-planning without negotiation: FRF creates and executes the flight plan.

Description of work

SOFIA is chiefly a technological project with a strong technical component to design, develop and validate the flight reconfiguration function. It also dedicates an important part to assessing the operational issues related with the integration of the FRF system into the airspace.

SOFIA will benefit from the UAV experience regarding 'sense and avoid', and especially automatic flight, and the commercial aviation experience regarding certification, whereby one common FRF function will be developed in compliance with international aviation rules.

SOFIA follows a stepwise approach in its development. It is formed by four interrelated main steps that are complemented by the dissemination and exploitation activities:

a. **Assessment of the issues related with the operation of the FRF in airspace**
   In this task, the air and ground system environment in which the FRF will be used is defined. The necessary procedures for the operation of the FRF including all air and ground (ATC) procedures will be detailed. The regula-

tory and certification frameworks will be assessed, identifying possible conflicts for the FRF operation.

b. Design of the FRF system

Here the specification and integration of the FRF on some typical avionic architecture that are anticipated for future aircraft will be examined. The design covers the three solutions: FPL generated and sent by ATC, FPL generated autonomously by FRF and station keeping.

c. Development of the FRF system for enabling the validation exercises

In this task, the simulation environments that allow FRF functional validation are set-up. This includes the adaptation of already available flight simulator components and the development of appropriate new mock-up components. The station keeping solution will not be developed.

d. Validation of the FRF system and its integration into the airspace

This will be performed by experimental validation in three steps:

a) Preliminary validation on virtual GAL ATENA cabin simulator linked to the DFS ATC simulator, and a preliminary flight test (IoA);

b) Final validation on THA cabin and UAV simulators;

c) Experimental flight tests (DAI) linked to the DFS ATC simulator.

Results

The main expected result from the SOFIA project is the development of a system that provides the airplane with the capacity to return automatically to the ground when an onboard hostile action takes place, e.g. hostile individuals have replaced the pilots. This assumes such hazards for which the activation of FRF is the only solution to avoid any major damage, not only to the aircraft and its passengers but also to the population and infrastructures on the ground.

Furthermore, FRF development poses a great challenge for European industry, ANSP and research centres because of the difficulties in carrying out such a system and integrating it in the airspace whilst maintaining safety levels in the aircraft operation. SOFIA will allow the aeronautical European community to acquire knowledge about the required techniques and solutions. Such developments will therefore enable the European industry to assume a leadership position to implement this kind of solution worldwide.

Acronym:	SOFIA
Name of proposal:	Safe automatic flight back and landing of aircraft
Contract number:	AST5-CT-2006-030911
Instrument:	STP
Total cost:	4 997 984 €
EU contribution:	2 589 623 €
Call:	FP6-2005-Aero-1
Starting date:	01.09.2006
Ending date:	31.08.2009
Duration:	36 months
Objective:	Safety & Security
Research domain:	Security
Website:	http://www.sofia.isdefe.es

Coordinator:	Mr Herreria Garcia Juan Alberto ISDEFE, Ingenieria de Sistemas para la Defensa de España, S.A. Edison, 4 ES 28066 Madrid
E-mail:	jherreria@isdefe.es
Tel:	+34 (0)91 271 17 47
Fax:	+34 (0)91 564 51 08
EC Officer:	J.L. Marchand

Partners:	DFS Deutsche Flugsicherung GmbH	DE
	GALILEO AVIONICAUNA SOCIETA` FINMECCANICA	IT
	Skysoft Portugal, Software e Tecnologias de Informação S.A.	PT
	Teleavio Srl	IT
	Thales Avionics SA	FR
	Institute of Aviation (Instytut Lotnictwa)	PL
	Rheinmetall Defence Electronics GmbH	DE
	Diamond Aircraft Industries GmbH	AT

CASAM

Civil Aircraft Security Against MANPADS

Background

Commercial aircraft are a target of terrorists because they represent one of the best achievements of our society: an attack has a big psychological impact on population, and thus economical activity. If a multiple attack like the ones on the Madrid railways and the London Underground were to occur in several airports spread over the globe, economy would be severely weakened. This effect would be reinforced if the terrorists underlined that London occurred after Madrid.

There exists another threat besides the 11 September twin-towers type of event: 15 000 disseminated shoulder-launched infrared guided missiles (MANPADS) which are in uncontrolled hands. Several attacks have already occurred and evidence of trafficking has been reported. Taking into account the large number of MANPADS currently known to be in the possession of over 27 terrorists groups, their relatively low cost and the vulnerability of large aircraft on landing or taking off, the probability of such attacks appears to be high.

The US is preparing some regulations to force commercial aircraft to be equipped with onboard protection systems. It is vital for Europe from a security and an economical standpoint to be able to answer this requirement. Future protection systems must be competitive, i.e. low cost and minimal perturbation on the aircraft (low mass, low drag and low consumption).

Objectives

The likelihood of a terrorist attack against a commercial aircraft by firing several MANPADS missiles towards it from a populated area nearby a large airport appears to be high. The global objective of the proposed CASAM project, is to design, and validate a closed-loop laser-based DIRCM (directed infrared countermea-

sure) module for MANPADS jamming the fired missile(s), which will comply with the constraints of commercial air transportation, including the civil aircraft profile of flight, and will be able to defeat first and second generation MANPADS (currently the most available worldwide) and also third generation ones which may be available in the future. CASAM objectives consider that this DIRCM system shall be designed with reference to the specific requirements and constraints relevant to commercial aviation. For example, consideration must be given to the following:

- environmentally friendly for ground objects and inhabitants close to the airport, safe for the aircraft (for maintenance, handling and usage), highly efficient against the recognised threats,
- upgradeable for further and future disseminated threats,
- maintainable within commercial budgets and processes.

A protection system is made of a missile detector and deceiving equipment. CASAM will concentrate research on the latter: innovative directed infrared countermeasure (DIRCM) equipment which represents the most expensive and heaviest part of a global defence system.

Description of work

During the 26-month project, CASAM will explore several technological breakthroughs in laser, optics, electromechanics and processing that will be the core of the future competitive equipment. A technical validation prototype will be tested against actual missile seeker heads. Specific effort will be put on threat analysis and simulation, economical analysis, aircraft installation constraints and impact. A specific study will be carried out on legal and regulation issues which have a prominent position in the roadmap.

The goal of the research is to progress on innovative technologies that will identify an efficient and competitive DIRCM system for use on a commercial aircraft. Military research has shown that it is possible to get efficient jamming capability. The interesting challenge and the possible risk are linked to the global requirements of airlines and airframers: low total volume, low drag, low mass, low power consumption, high reliability, low LCC, and no risk on-ground and during take-off and landing.

Part of the challenge lies in technology improvements and simplifications through an innovating approach.

The main technical DIRCM modules need innovative work:

- Optronics have to be low volume, low mass and low cost. The opto-mechanical turret will reach outstanding performance in steering and stabilisation. New focal plane array (imagery sensor) will integrate passive and active detection modes for improved passive and active tracking modes. Line of sight stabilisation will use innovating low-cost devices.
- Laser technology will be based on new progress in OPO crystals with a simplified architecture. For the pump laser, research will be focused on mass, volume and consumption reduction, as well as output power and pulse rate frequency improvement. OPO research will deal with wavelength conversion stage optimisation, crystal choice, arrangement and optimisation.
- Laser technology will be based on new efficient approaches including fibre lasers and simpler frequency conversion modules (OPO), as well as directly emitting mid-infrared semiconductor lasers.
- Tracking technology will be adapted and optimised in synergy with hardware development.

Results

The results of the project will be:

- a DIRCM prototype test article to be ground tested,
- a validation of this developed innovative DIRCM system's effectiveness with respect to the operational requirements due to a set of laboratory tests and open range tests.

Due to the sensitivity of the topic related to the security of commercial flights, the vast majority of technical data, drawings and sketches released by the project during its course will be classified as confidential and put under tight access control.

Acronym:	CASAM	
Name of proposal:	Civil Aircraft Security Against MANPADS	
Contract number:	AST5-CT-2006-030817	
Instrument:	STP	
Total cost:	8 651 122 €	
EU contribution:	4 543 581 €	
Call:	FP6-2005-Aero-1	
Starting date:	01.06.2006	
Ending date:	31.07.2008	
Duration:	26 months	
Objective:	Safety & Security	
Research domain:	Security	
Coordinator:	Mr Vergnolle Jean-François	
	SAGEM Défense Sécurité	
	Le Ponant de Paris 27, rue Leblanc	
	FR 75512 Paris	
E-mail:	jean-francois.vergnolle@sagem.com	
Tel:	+33 (0)1 58 11 25 37	
Fax:	+33 (0)1 58 11 70 84	
EC Officer:	J.L. Marchand	
Partners:	EADS Deutschland GmbH	DE
	Diehl-BGT-Defence GmbH & Co. KG	DE
	Thales Optronique SA	FR
	INEGI - Instituto de Engenharia Mecânica e Gestao Industrial	PT
	A. BRITO, Industria Portuguesa de Engenagens, Lda.	PT
	Clyde and Co.	UK
	Institute for Economic Research	SI
	Office National d'Etudes et de recherche Aérospatiales	FR
	Adria Airways the Airline of Slovenia d.d.	SI
	Lufthansa Technik AG	DE
	KEOPSYS	FR
	Laser Diagnostic Instruments AS	EE
	Deutsches Zentrum für Luft- und Raumfahrt e.V.	DE
	Forschungsgesellschaft für Angewandte Naturwissenschaften e.V.	DE
	Hellenic Aerospace Industry S.A.	GR
	Thales R&T	FR
	Alcatel Thales III-V Lab	FR

ART

Advanced Remote Tower

Background

The enhanced situational awareness is one of the main prerequisites for improved regularity at the aerodrome, which has proven to be one of the bottlenecks in today's ATM system.

A cost-benefit analysis regarding remotely operated towers shows substantial economical benefits when compared to traditional ATC operations at airports. These benefits for the ANSP will in turn reduce the cost for airline operators and travellers.

Objectives

The concept of placing the controller of the airport in a high building with windows overlooking the area of responsibility has remained unchanged. However, this involves a number of limitations to the concept of operations. Some of these are:

– low utilisation of personnel resources
– a need for redundant resources at each ATC unit
– adding new aids and sensors often implies stand-alone equipment
– stand-alone equipment adds to the head-down time thus removing focus from the primary field of view.

The ART project aims to change this concept and evolve airport operations. Its objectives are to:

– remotely operate an airport ATC unit
– combine remote operation with enhanced visibility and composite presentation of view and operational data
– - evaluate operational pros and cons of the remote airport concept.

Description of work

The following steps are planned to achieve these objectives:

1. Design and construct a remote tower cab.
2. Evaluate controller workload and situational awareness.
3. Evaluate operational benefits with new possibilities to present information.
4. Identify and quantify vital parameters for remote airport operations.
5. Evaluate technical and operational safety issues.

Results

The intention is to prove the concept and technology in low-density areas in order to explore the applicability in medium- and high-density areas. The ART concept will in turn be one of the bricks in the future concept of highly automated ATM at airports.

The concept of ART will also have spin-off effects in the areas of incident and accident investigation. ART will explore the possibility of not only using recorded voice communication but reproducing the course of events with audio and video copies of the controllers' situation.

Major deliverables are the ART concept of operations, system design, incorporation and adaptation of sensors, and an ART demonstrator on a low-density airport in Sweden with the possibility to explore the concept at an operational airport. The possibility to control live traffic at specific events at the airport will be analysed.

Acronym:	ART
Name of proposal:	Advanced Remote Tower
Contract number:	37179
Instrument:	STP
Total cost:	2 900 000 €
EU contribution:	1 504 500 €
Call:	FP6-2005-TREN-4-Aero
Starting date:	01.06.2007
Ending date:	31.05.2009
Duration:	24 months
Objective:	Capacity
Research domain:	Airport Operations
Coordinator:	Mr Fält Kari Saab AB Ljungadalsgatan 2 SE 35180 Vaxjoe
E-mail:	kari.falt@aerotechtelub.se
Tel:	+46 (0)470 42135
Fax:	+46 (0)470 42071
EC Officer:	E. Martin

Partners:	Luftfartsverket	SE
	National Aerospace Laboratory	NL
	Equipe Electronics Ltd	UK
	LYYN AB	SE

EMMA2

European airport Movement Management by A-smgcs - Part 2

Background

Due to the recovered growth in air transport, airport capacity is expected to become the major bottleneck in the near future. The A-SMGCS (Advanced Surface Movement Guidance and Control System) project EMMA2, the successor of EMMA, aims to become the most significant R&D contribution to the Vision 2020 goals by maturing and validating the A-SMGCS concept as an integrated air-ground system, seamlessly embedded in the overall air traffic management (ATM) system. In a two-phase approach, EMMA has consolidated the surveillance and conflict alert functions, and EMMA2 will focus now on advanced onboard guidance support to pilots and planning support to controllers.

Objectives

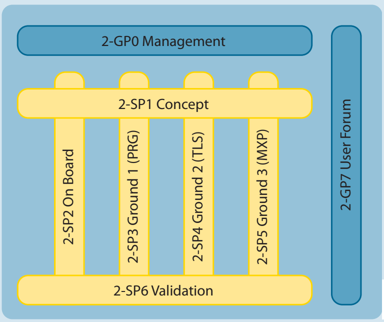
The main objectives of EMMA2 are the consolidation of higher A-SMGCS functions in the operational environment. Building upon the harmonised levels 1 and 2 of the ground movement assistance tools and procedures, further functions will be realised and validated. The focus of EMMA2 will be:

- the routing and planning function realised by several planners (Departing Manager, etc.) and the adequate Human Machine Interface (HMI);
- the guidance function mainly realised by information displayed to the pilot thanks to CPDLC (control pilot data link communication);
- the information management function realised by embedding A-SMGCS into the ATM smoothly.

Within EMMA2, these functions will be developed at least as prototypes, the adequate operational procedures will be worked out and as far as possible the modular system will be validated in an operational environment. Moving ahead from current level 1 and 2 of A-SMGCS towards these higher levels, further constraints will be taken into account and further applications will become possible to get the full A-SMGCS benefit. The project results will feed the relevant documents of international organisations involved in the specification of A-SMGCS (ICAO, EUROCAE, EUROCONTROL) and so should be mandatory for all future implementations.

Description of work

In order to meet the objectives mentioned above, installations at international airports and in test and airline aircraft will be promoted and used. Building upon the previous work (e.g. EMMA, EUROCONTROL AOP), the harmonised concepts of operations will be applied and validated thanks to functional and operational testing under real operational conditions. Active participation of licensed controllers and pilots from different countries are mandatory. Finally the Integrated Project EMMA2 will lead to comprehensive results which will support the regulation and standardisation bodies, as well as the industry in early and efficient implementation of A-SMGCS worldwide.



EMMA2

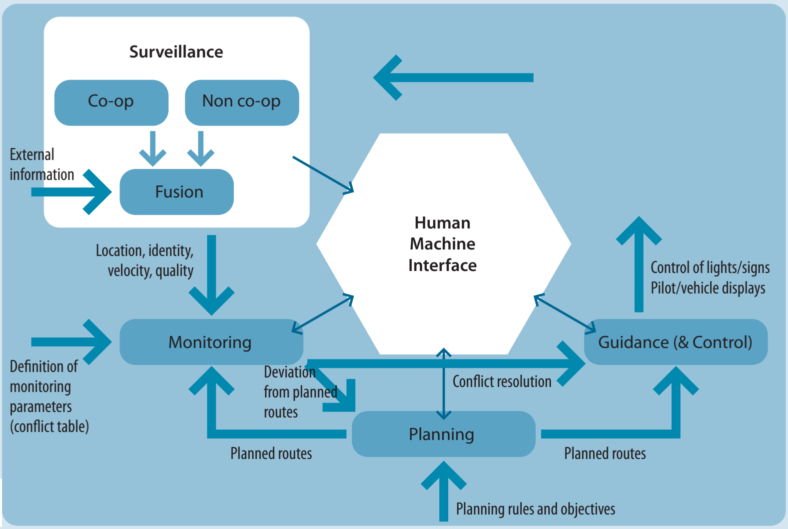
Validation is split into two test phases to ensure an iterative process and provide the chance to build up a full level A-SMGCS. Licensed controllers and pilots, as well as simulators, aircraft and ground vehicles, will be involved in the testing in order to gain realistic results. Controllers and pilots will be trained in simulation and on site to prepare them for coping with a full A-SMGCS under real operational conditions.

EMMA2 is organised the same way as its predecessor EMMA was in six different subprojects, which will be coordinated by six different partners. There are four vertical development subprojects, three being dedicated to the development of ground systems for the three test sites and the fourth one being dedicated to onboard systems. These four subprojects are independent of each other. This organisation was used to minimise frictional losses to give the partners involved the chance to use their own existing systems. However, these four subprojects are interlinked with the subprojects 'concept' and 'validation' to guarantee that different systems are based on a common A-SMGCS interoperable air-to-ground co-operation concept and validated with the same criteria. This structure is surrounded by the overall management and a user forum, which is used as a 'speakers' corner' or as an interface to the project for additional users or other interested stakeholders.

Results

At the end of EMMA2 the relevant concept documents will be updated by the results and experiences gained. Furthermore, recommendations will be issued that directly affect the A-SMGCS standardisation bodies.

Therefore the expected results of EMMA2 are:
- The operational concept for all A-SMGCS levels;
- The derivation of the necessary performance requirements;
- A-SMGCS integration in simulators at three airports and in several aircraft;
- Two iterative test periods;
- Verification of performance requirements;
- Validation of operations;
- Guidelines and recommendations to common technical and operational system performance, safety requirements, certification aspects and procedures for the transition phase.



Acronym:	EMMA2
Name of proposal:	European airport Movement Management by A-smgcs - Part 2
Contract number:	TREN/05/FP6AE/S07.45797/513522
Instrument:	IP
Total cost:	20 816 840 €
EU contribution:	10 997 830 €
Call:	FP6-2003-TREN-2
Starting date:	01.03.2006
Ending date:	28.02.2009
Duration:	36 months
Objective:	Capacity
Research domain:	Airport Operations
Website:	http://www.dlr.de/emma
Coordinator:	Mr Roeder Michael German Aerospace Center e.V. Lilienthalplatz 7 DE 38108 Braunschweig
E-mail:	michael.roeder@dlr.de
Tel:	+49 (0)531 295 3026
Fax:	+49 (0)531 295 2180
EC Officer:	M. Jensen

Partners:	Aeropuertos Españoles y Navegación Aérea (representing Airport Council International)	ES
	Airbus France S.A.S	FR
	SELEX Sistemi Integrati S.p.A.	IT
	Air Navigation Service of the Czech Republic	CZ
	BAE Systems Limited	UK
	Direction des Services de la Navigation Aérienne	FR
	ENAV S.p.A.	IT
	Nationaal Lucht- en Ruimtevaart Laboratorium	NL
	Park Air Systems AS	NO
	Thales Air Traffic Management S.p.A.	IT
	Thales Avionics S.A.	FR

SINBAD

Safety Improved with a New concept by Better Awareness on airport approach Domain

Background

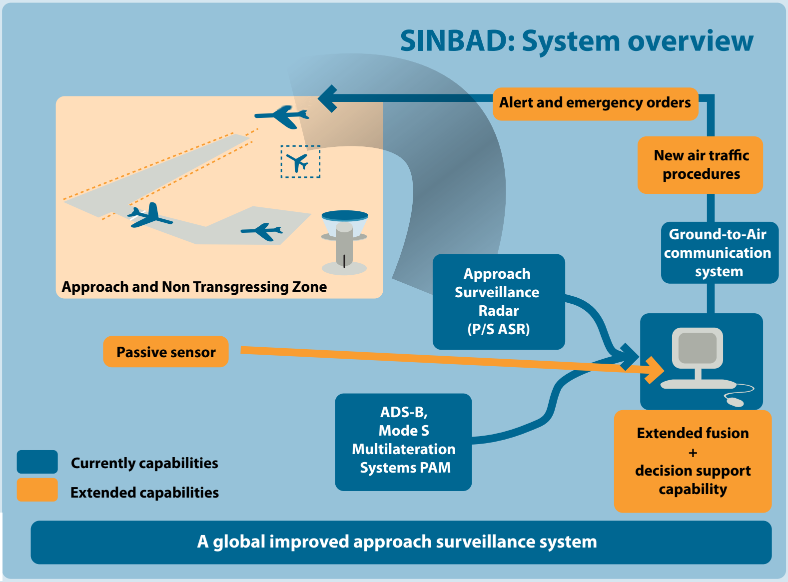
In recent years, the European aviation industry has faced enormous challenges. Fierce competition has restructured the industry and the aftermath of 11 September has turned the industries' uneasy situation into an economic crisis, leaving no stakeholder unaffected.

While competition in the aviation industry remains fierce and the threat of safety or security related incidents is still imminent, there is an urgent need to take new actions to face such threats and secure the European aviation industries competitive position.

Objectives

Improving the ability to monitor air traffic in a rapidly growing density of aircraft, and raising an anticipated alert to endangered aircraft in case of confirmed collision risk, is a crucial element towards significantly increasing aircraft safety and security, especially in the airport control terminal region (CTR) zone.

SINBAD aims to perform the proof of application of a new functionality, intended to improve aircraft safety and security at airport CTR to wards the 2010 horizon.



SINBAD: system overview

Description of work

To achieve this goal, the tasks performed in SINBAD are:

- to refine the air traffic control (ATC) and security management (SMS) operational concepts for those parts that could make use of such enhanced surveillance capabilities;
- to develop a new concept of primary multilateration surveillance (PMS);
- to develop a new concept of Active Hazard Assessment (AHA) functionality for the ATC sub system;
- to perform their proof-of-concept at two different sites (Brno and Frankfurt airports).

Results

The expected outcomes of this project are:

- an assessment of the safety and security improvements with respect to collision avoidance, provided by the introduction of the new PMS and AHA technologies currently existing in ATM systems. This assessment will be made according to the EUROCONTROL Operational Concept Validation Method (E-OCVM),
- a cost-benefit analysis, which will show in a parameterised approach which costs would be generated and which benefits would be extracted from the insertion of SINBAD technology into the European Air transportation system, according to various deployment hypotheses,
- a technology analysis and the related technology implementation plan, showing the future steps to be taken in order to provide the market with a certified operational product.

This project will give the Europeans a leading position in aircraft, passenger, crew and airport, safety and security management.

Acronym:	SINBAD
Name of proposal:	Safety Improved with a New concept by Better Awareness on airport approach Domain
Contract number:	37164
Instrument:	STP
Total cost:	5 585 966 €
EU contribution:	3 084 636 €
Call:	FP6-2005-TREN-4-Aero
Starting date:	01.07.2007
Ending date:	30.06.2010
Duration:	36 months
Objective:	Capacity
Research domain:	Airport Operations

Coordinator:	Mrs Greverie Wilfried Thales Air Defence 7-9 rue de Mathurins FR 92221 Bagneux
E-mail:	wilfried.greverie@fr.thalesgroup.com
Tel:	+33 (0)1 64 91 99 74
Fax:	+33 (0)1 64 91 67 66
EC Officer:	E. Martin

Partners:	Thales ATM Ltd	FR
	National Aerospace Laboratory	UK
	ECORYS	NL
	German Air Navigation Services	DE
	Air Navigation Services of the Czech Republic	CZ
	Thales ATM GmbH	DE
	ADV Systems	DE
	Budapest University of Technology and Economics	HU

SKYSCANNER

Development of an innovative LIDAR technology for new generation ATM paradigms

Background

Laser detection and aircraft tracking systems (LIDARs, LIght Detection And Ranging systems) are emerging as a critical design trend in the development of new generation ATM (air traffic management) paradigms, of which they are the main innovations. The realisation of laser sensors as rotating laser range-finder arrays and their combination with versatile systems lead to major advantages for their application with air traffic control (ATC), airport surveillance and ground-to-air laser communications, and last but not least to save cost, usually at the same time as achieving an improved ATC performance. These laser systems, developed these days without any particular difficulty, are challenging classic ATM paradigms in many aspects. Nevertheless it is commonly recognised that the effectiveness of these systems relies strictly on their capability to reliably perform a track data fusion with airport radars, and to manage a new generation ATM paradigm. Also driving and controlling a data fusion between laser tracking data and radar tracking data requires a very high computation power.

Objectives

SKYSCANNER's target consists of developing a demonstrator model of an innovative LIDAR technology, which can detect and track aircraft up to six nautical miles from the ATZ (aerodrome traffic zone) barycentre and which can be the base concept for the development of new ATM paradigms based on laser positioning and ground-to-air laser communications (landing and take-off supported by a laser guide).

Description of work

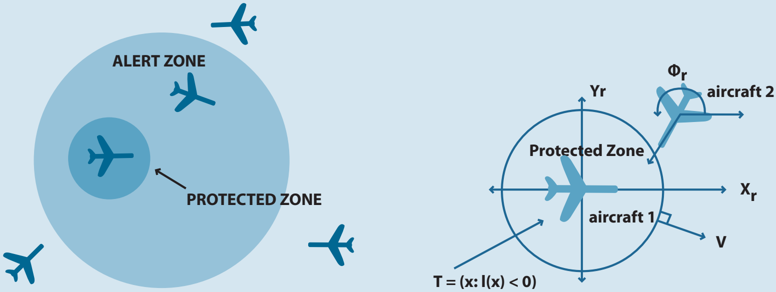
The work is divided into 16 Work Packages (WP):

- WP 1: System and testing requirements specification
- WP 2: First measurement session
- WP 3: Laser beam and airframe interaction model design and development
- WP 4: Simulation software design and development
- WP 5: Sensor control software design and development
- WP 6: Laser sensor design and development
- WP 7: Sensor management computer design and development
- WP 8: Data handling and C2 software design and development
- WP 9: Aircraft collision probability and decision-support model design and development
- WP 10: Field-testing target design and development
- WP 11: New generation ATM paradigm specification
- WP 12: System prototype integration
- WP 13: Field testing
- WP 14: Dissemination
- WP 15: Exploitation
- WP 16: Consortium management.

Results

The expected results of SKYSCANNER are:

- development of a demonstrator based on a rotating cylindrical laser range-finder array, capable of detecting and tracking aircraft up to at least six nautical miles from the ATZ barycentre;
- development of alpha release software for the computation of the aircraft collision probability and optimal decision



SKY Scanner simulations - protected and alert zone for one aircraft

on corrective actions (decision support system) based on data fusion between radar data and laser tracking data fusion, and ground-to-air laser communications;

- new generation ATM paradigm requirements specification based on data fusion between radar data and laser tracking data fusion, and ground-to-air laser communications.

The compliance of the above SKY Scanner technical objectives to the technical objectives of the 'Aeronautics' priority is demonstrated with reference to the following project output effects:

- development of an innovative technology useful to increase the traffic capacity of airports, by means of full laser control of ATZ volumes and the related aircraft movements in a new generation ATM paradigm perspective provided as an output of the project;
- development of a useful innovative technology to attain optimal operational performance of the aircraft-supporting infrastructure, seeking to reduce the number of transport fatalities.

Acronym:	SKYSCANNER	
Name of proposal:	Development of an innovative LIDAR technology for new generation ATM paradigms	
Contract number:	37161	
Instrument:	STP	
Total cost:	4 457 159 €	
EU contribution:	2 427 107 €	
Call:	FP6-2005-TREN-4-Aero	
Starting date:	01.07.2007	
Ending date:	30.06.2010	
Duration:	36 months	
Objective:	Capacity	
Research domain:	Airport Operations	
Coordinator:	Mrs Crispino Maria Vittoria	
	Nergal Srl	
	Viale Bardanzellu 8	
	IT 00155 Rome	
E-mail:	crispino@nergal.it	
Tel:	+39 06 4080 1869	
Fax:	+39 06 4080 1283	
EC Officer:	C. Bernabei	
Partners:	Institute on Laser and Information Technologies, Russian Academy of Sciences	RU
	University of Rome 'Tor Vergata'	IT
	LAMEP S.r.l.	IT
	Hytech Electronics Ltd	UK
	Olympus Engineering S.r.l.	IT
	Vilnius University	LT
	Piaggio Aero France S.A.S.	FR
	AIR Support S.r.l.	IT
	ENAV S.p.A.	IT
	SAGA S.p.A.	IT

SPADE-2

Supporting Platform for Airport Decision-making and Efficiency analysis - Phase 2

Background

A major challenge in the Strategic Research Agenda for European Aeronautics is for airport utilisation to be able to accommodate rising traffic without undue delays, while preserving safety, improving efficiency and service, and reducing the burden of operations on the environment. This implies that airport stakeholders and policy-makers have to solve challenging airport decision-making questions with strong interdependencies and often conflicting objectives.

Objectives

The objective of the SPADE-2 project is to implement, test and evaluate a user-friendly decision-support system for airport stakeholders and policy-makers, based on the system design in the preceding SPADE project. This system will seamlessly integrate a set of case studies, which can be considered as airport studies in the form of decision-making questions supported by the system. As such, each case study concerns one or more specific airport decision-making questions on airport development, planning or operations, and enables trade-off analyses for a variety of measures of airport effectiveness (e.g. capacity, delay, level-of-service, safety, security, environmental impacts, and cost-efficiency). This concept enables the user to perform the analysis under consideration through 'pre-structured' and built-in, 'wizard-type' navigation aids in a single run by shielding the user from the complicated model and tool world, thus enabling the him or her to focus on the real question to be addressed.

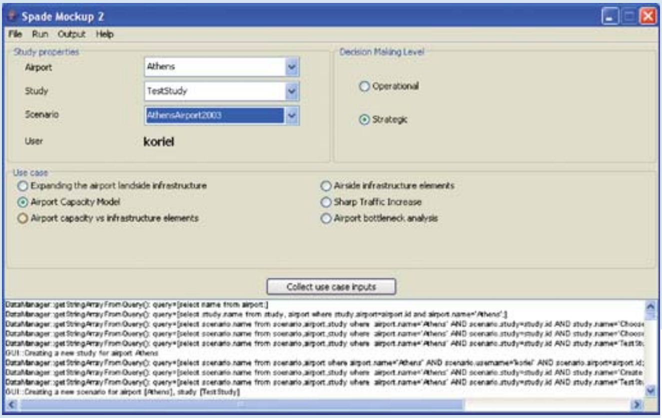
Description of work

The implementation, testing and evaluation of the SPADE system consist of five major activities:

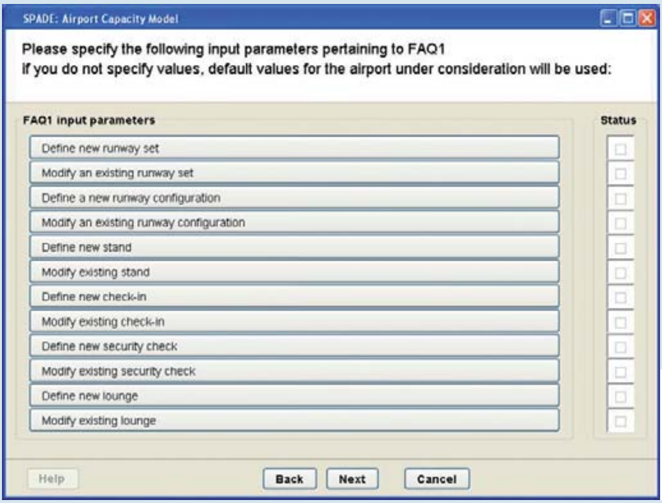
1. Preparation. The results and feedback of the SPADE project are assessed so as to update and detail the activities to be performed in the SPADE-2 project.
2. Implementation and testing of system components. The system generic components (i.e. components that are generic to the system and which may be used by different case studies) are implemented and tested.
3. Implementation, testing and integration of case studies. Each case study is implemented and tested: its input and output interface, and its computational component. Furthermore, the implemented and tested case studies are seamlessly integrated into the SPADE system.
4. Validation. Any areas where the design and implementation of the case studies and the overall system do not properly support the provision of the functionality specified, the case-study requirements are identified and any correction is carried out.
5. Field exploitation. This activity concerns an operational assessment of the system by airport stakeholders in their real environment, and the determination of the future use and commercial exploitation of the final system.

Results

The SPADE-2 project will have one main result: a user-friendly, fully tested and validated decision-support system for airport development, planning and operations. This system seamlessly integrates a set of case studies, enabling airport stakeholders and policy-makers to perform integrated impact analyses at the various levels of decision-making through pre-structured paths and built-in, 'wizard-type' navigation aids.



Graphic user interface for the selection of the use case



GUI for the specification of a specific airport decision-making question (assessment of changes in infrastructure) associated with the selected use case.

Acronym:	SPADE-2
Name of proposal:	Supporting Platform for Airport Decision-making and Efficiency analysis - Phase 2
Contract number:	TREN/05/FP6AE/S07.45797/518362
Instrument:	IP
Total cost:	12 592 515 €
EU contribution:	7 688 395 €
Call:	FP6-2004-TREN-3
Starting date:	01.01.2006
Ending date:	31.12.2009
Duration:	36 months
Objective:	Capacity
Research domain:	Airport Operations
Website:	http://spade.nlr.nl
Coordinator:	Dr van Eenige Michel Nationaal Lucht- en Ruimtevaartlaboratorium (National Aerospace Laboratory NLR) Anthony Fokkerweg 2 NL 1059 CM Amsterdam
E-mail:	eenige@nlr.nl
Tel:	+ 31 (0)20 511 3383
Fax:	+ 31 (0)20 511 3210
EC Officer:	E. Martin

Partners:		
	Aeropuertos Españoles y Navegación Aérea	ES
	Research Centre of Athens University of Economics and Business	GR
	Deutsches Zentrum für Luft- und Raumfahrt	DE
	International Air Transport Association	CA
	Amsterdam Airport Schiphol	NL
	Athens International Airport	GR
	Airport Research Center	GE
	ECORYS Nederland	NL
	Incontrol Management Consultants	NL
	Ingenieria y Economia del Transporte	ES
	Ingenieria de Sistemas para la Defensa de España	ES
	Office National d'Études et de Recherches Aérospatiales	FR
	Trasferimento di Tecnologia e Conoscenza	IT
	Polar Consultores	ES
	Sistemi Innovativi per il Controllo del Traffico Aereo	IT
	Delft University of Technology	NL

CREDOS

Crosswind-reduced separations for departure operations

Background

ICAO separation standards for landing and take-off were implemented in the 1970s to protect an aircraft from the wake turbulence of a preceding aircraft. However research has shown that the transport and persistence of wake vortices are highly dependent on meteorological conditions, so that in many cases the ICAO standards are over-conservative. By developing a full understanding of wake vortex behaviour in all weather categories separations could be reduced under certain suitable conditions.

Objectives

The CREDOS project will study the operational feasibility of this approach by focusing on the situation for take-off under crosswind conditions. Although this represents only part of the scope of application, the methods and tools developed by this project can be later used to cover arrivals and other meteorological conditions.

The objectives are:
- to demonstrate the feasibility of a Concept of Operations allowing reduced separations for Single Runway Departures under crosswind;
- to provide all stakeholders with the required information to facilitate the implementation of this concept where appropriate in the near-term (pre-2012);
- to increase the body of knowledge concerning wake vortex behaviour during initial climb phase of flight.

Description of work

The project will use recordings of wake vortices (WV) taken at St Louis and Frankfurt airports to develop models of wake vortex behaviour. Using Monte Carlo simulation techniques these models will be used to establish safe separations under various crosswind conditions. An operational concept for crosswind departures will be developed and validated in accordance with the Operational Concept Validation Methodology. The project will also produce an algorithm for detecting wake vortex encounters from flight recordings and this will be used as part of the validation process.

The project is structured as follows:
- WP1 – Data collection and acquisition
- WP2 – Data analysis and WV behaviour modelling
- WP3 – Quantitative risk assessment and safety
- WP4 – Operational concept and validation
- WP5 – Stakeholder communication and dissemination

Results

The expected results are:
- validated operational concept for reduced separations for crosswind departures;
- implementation support package and guidance;
- enhanced wake vortex behaviour models and encountered risk models capable of use for departure situations;

CREDOS

- proven wake vortex detection configuration for departures;
- database of wake vortex recordings for departures including weather conditions from two sites;
- documented application of validation method for reduced separations concept (OCVM).

Acronym:	CREDOS	
Name of proposal:	Crosswind-reduced separations for departure operations	
Contract number:	AST5-CT-2006-030837	
Instrument:	STP	
Total cost:	5 467 964 €	
EU contribution:	2 809 309 €	
Call:	FP6-2005-Aero-1	
Starting date:	01.06.2006	
Ending date:	30.11.2009	
Duration:	42 months	
Objective:	Capacity	
Research domain:	Ground Based ATM	
Website:	http://www.eurocontrol.int/eec/credos	
Coordinator:	Mr Harvey Andrew	
	European Organisation for the Safety of Air Navigation (EUROCONTROL)	
	EUROCONTROL Experimental Centre	
	BP15	
	FR 91222 Bretigny-sur-Orge	
E-mail:	andrew.harvey@eurocontrol.int	
Tel:	+33 (0)1 69 88 74 13	
Fax:	+33 (0)1 69 88 73 52	
EC Officer:	J.L. Marchand	
Partners:	Deutsches Zentrum für Luft- und Raumfahrt e.V.	DE
	Airbus Deutschland GmbH	DE
	Stichting Nationaal Lucht- en Ruimtevaartlaboratorium	NL
	M3 SYSTEMS SARL	FR
	Office National d'Etudes et de Recherches Aérospatiales	FR
	Université catholique de Louvain	BE
	Technische Universität Berlin	DE
	NATS En-Route Limited	UK
	DFS Deutsche Flugsicherung GmbH	DE
	Ingeniería y Economía del Transporte SA	ES

RESET

Reduced separation minima

Background

Many sources in the ATM arena are warning about the expected high traffic demand in the future: three times more movements by 2020, as mentioned by the European Commission in the document *European Aeronautics – a vision for 2020*. If the aeronautical community is to accommodate a factor three growth, an efficient and safe use of airspace within the context of the supporting ground system and airframe system infrastructures is needed. Separation minima standards form one of the key instruments in defining what a safe usage of airspace and infrastructures is. A widespread belief is that advanced technology, concepts and applications under development will allow reduced separation minima to be facilitated in the near future during some or all flight phases while maintaining, or even increasing, the level of safety.

Objectives

The main objective is to identify what reductions in separation minima are safe and feasible to contribute towards enabling a 'factor of 3' (x3) traffic growth over Europe. The following specific objectives are steps towards achieving that aim:

1. Derive from the 'x3 traffic load over Europe' a set of separation minima targets for the various phases of a gate-to-gate operation.
2. Identify gaps in enabling the 'x3' by the operational concepts and technology in other projects.
3. Develop a qualitative (and quantitative where possible) model to capture the rationale of existing and future separation minima standards.
4. Develop high-level advanced operational concepts.
5. Identify how to accomplish the process of change.
6. Prioritise and select (at least) three separation minima potential reductions for detailed safety, efficiency and economic assessments.
7. Identify and apply methods to safely (fulfilling ICAO/ESSAR requirements) and cost effectively assess the prioritised separation minima reductions.
8. Provide feedback on the outcome of the safety and economy assessments.
9. Disseminate the RESET developed process of change across the ATM community.

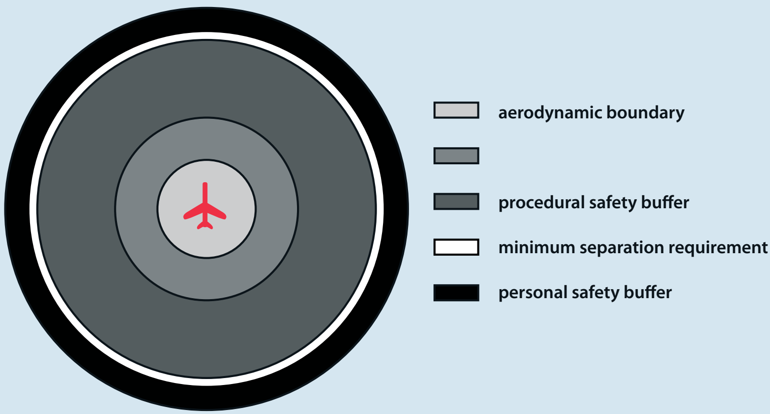
Description of work

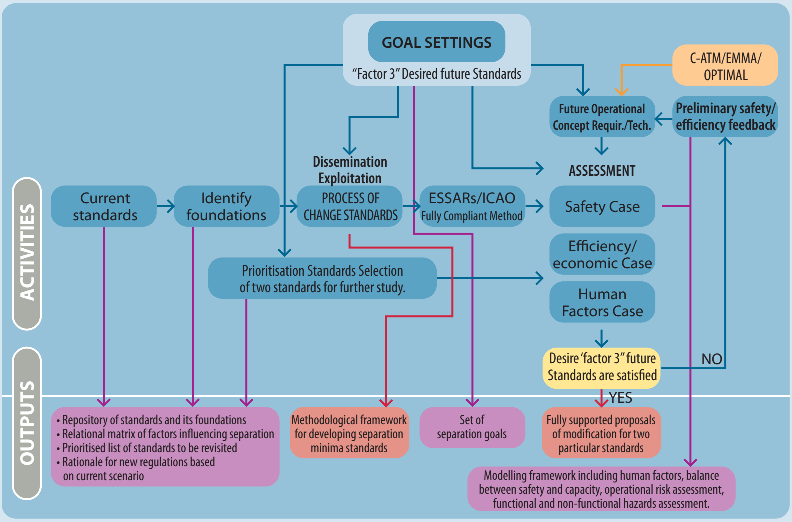
The sequence of problems to be solved is as follows:

- First identify per flight phase if and by how much the separation minima have to be reduced in order to accommodate a x3 growth of air traffic over Europe. This will be addressed independently of the particular operational concept, which means that the feasibility remains to be proven.
- Next identify what the combination of a factor three traffic growth and the reduced separation minima means for the roles, tasks and responsibilities of the pilots and the air traffic controllers.
- Identify what the impact is on the technology needs, and if this technology is already in use, in development or at a conceptual stage.
- Finally, provide adequate supporting evidence and justification, in terms of safety, efficiency and economic assessments, to press for changes in separation minima.

Nine Work Packages (WP) have been defined:

- WP1: Goal setting of desired future standards
  To define clear objectives and goals in terms of separation standards that should come from real operational needs.
- WP2: Identify current separation minima standards
  Compilation of the applicable regulations and separation minima.
- WP3: Qualitative model of current and future separation minima
  To generate a comprehensive model of the separation assurance budget identifying the various budget components or influencing factors that contribute to the establishment of the separation minima.
- WP4: Future operational concept
  It is obviously not sufficient to just reduce the separation minima as identified in WP1. In addition to this there are many more improvements needed on the operational concept.
- WP5: Prioritisation of separation minima reduction
  To determine the preferred priority in which the reduced separation minima settings identified in WP1 should be introduced, and which three (at least) should be further evaluated within RESET.
- WP6: ESARR and ICAO compliant safety and safe separation methods
- Learn about the methods currently available and in development which will support the safe design and safety assessment of future ATM, and learn about how these methods can be combined and/or extended.
- WP7: Preliminary safety and human factor assessment
  This Work Package performs safety and human factor (HF) assessments of the reduced separation minima of WP1 in combination with the operational concept specified in WP4. The aim here is to verify whether, safety-wise and HF-wise, a 'factor of three' traffic growth over Europe can be accommodated.
- WP8: Preliminary efficiency and economy assessment
  This activity is focused on providing evidence that supports and demonstrates if the modifications to the separation minima regulations are feasible from a business perspective.
- WP9: Exploitation and dissemination
  This covers all activities necessary to disseminate the results from the project to all the involved stakeholders, and specifically to promote the achievements of the project within the regulatory and standards organisations and the industry.





Results

- Set of separation goals
- Repository of standards and its foundations
- Relational matrix of factors influencing separation
- Prioritised list of standards to be revised
- Rational for new regulations based on the current scenario
- Methodological framework for developing separation minima standards
- Fully supported proposals of modification for two particular standards
- Modelling framework including human factors, balance between safety and capacity, operational risk assessment, functional and non-functional hazard assessments.

Acronym:	RESET	
Name of proposal:	Reduced separation minima	
Contract number:	TREN/06/FP6AE/S07.62916/037146	
Instrument:	STP	
Total cost:	6 774 026 €	
EU contribution:	3 668 148 €	
Call:	FP6-2005-TREN-4-Aero	
Starting date:	30.10.2006	
Ending date:	29.10.2009	
Duration:	36 months	
Objective:	Capacity	
Research domain:	Ground Based ATM	
Website:	http://reset.aena.es	
Coordinator:	Mr de Pablo José Miguel AENA C/ Josefa Valcárcel 30 ES 28027 Madrid	
E-mail:	jmdepablo@aena.es	
Tel:	+34 (0)91 321 33 92	
Fax:	+34 (0)91 321 31 20	
EC Officer:	C. North	
Partners:	Entidad Pública Empresarial Aeropuertos Españoles y Navegación Aérea	ES
	Boeing Research and Technology Europe S.L.	ES
	ECORYS Nederland B.V	NL
	The European Organisation for the Safety of Air Navigation (EUROCONTROL)	BE
	Ingeniería y Economía del Transporte S.A:	ES
	Ingeniería de Sistemas para la Defensa de España S.A.	ES
	Luftfartsverket (The LFV Group)	SE
	NATS En Route plc	UK
	Stichting Nationaal Lucht- en Ruimtevaartlaboratorium	NL
	Athens University of Economics and Business - Research Center	GR
	Sociedad Estatal para las Enseñanzas Aeronáuticas Civiles S.A.	ES
	Sistemi Innovativi per il Controllo del Traffico Aereo	IT
	Honeywell Aerospace SAS	FR
	University of Belgrade	CS

NEWSKY

Networking the sky for aeronautical communications

Background

Due to the continuing growth of air traffic and an increasing need for communication, it is expected that current ATC/ATM communication will be running out of capacity within the next 10-15 years, even with full VDL Mode 2 deployment and a further conversion of 25 kHz to 8.33 kHz DSB-AM channels.

As a result of different driving needs, several communication systems are currently being developed for ATC/ATM and Airline Operation Center (AOC) communication. In addition, several aeronautical communication systems for commercial and non-safety critical AAC and APC communication exist or are likely to become available within the next few years.

Objectives

The main goal of NEWSKY is to integrate all of the different communication technologies and different application classes into a global heterogeneous airborne network with appropriate priority properties. The NEWSKY approach enables the achievement of improved communication capabilities and assists the expected ATM paradigm shift. Moreover, real air-ground integration is achieved and the information sharing concepts of collaborative decision-making (CDM) and system-wide information management (SWIM) are made available to the aircraft. As a consequence, the NEWSKY approach assists the realisation of the Single European Sky concept and helps to create a future European ATM system which is viable well beyond 2020.

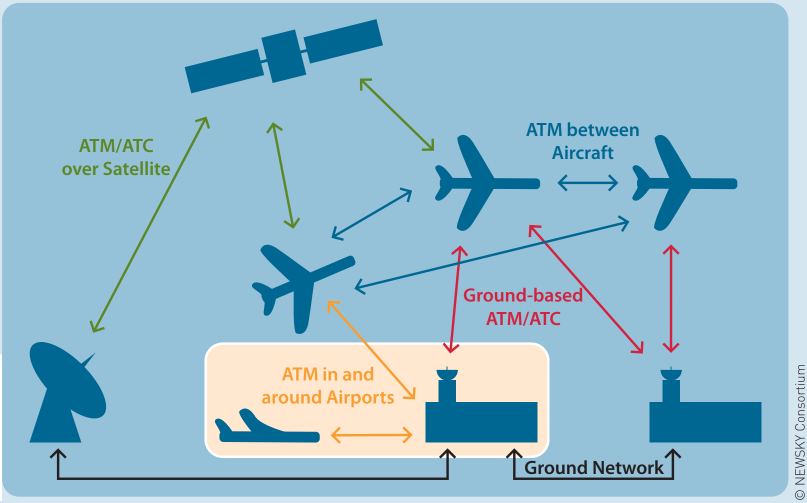
NEWSKY takes an innovative approach to embracing aircraft within a global networking environment by supporting all forms of communication from safety critical ATC/ATM and AOC communication to non-safety critical AAC and APC communication. Work on this topic is underway in the United States where the 'network-enabled operation' is being taken from the military environment to the civil ATM world.

Description of work

NEWSKY will make possible, by 2020 and beyond, an innovative ATM network-enabled vision for which there is already an urgent need. Increases in current air-traffic movements and forecasts for the next 10 to 20 years reinforce the vital requirement for a fresh ATM perspective: an ATM transformation philosophy which includes new networking concepts, new ATM elements and new ATM operational concepts. Addressing this transformational paradigm shift in a viable way implies defining in detail the changes required and a migration strategy to achieve the NEWSKY concept. This project is being proposed at an ideal time to bring Europe into a leading position as a key player for future network-enabled ATM.

The 'networking the sky' concept of NEWSKY does not aim to develop new link technologies. Instead NEWSKY aims to develop an innovative networking concept to integrate different existing and emerging link technologies into a single, global ATM network for a secure, seamless and robustly redundant ATM system, which is also scalable to cope with future long-term increasing demands.

To achieve this objective, NEWSKY will start by defining the requirements of this approach without restricting its view to current constraints. Secondly, ATM particularities and constraints will be understood, in order to define in a feasible way



Integration of different aeronautical communication systems into a global heterogeneous airborne network to realise the vision of 'networking the sky'

the network transformation required by NEWSKY, and how to implement it efficiently and on time.

Co-operation opportunities with related projects and initiatives will be identified and concrete interactions will be defined to achieve the highest possible synergy for future ATM research. Relevant initiatives and projects include, but are not limited to, SES initiative, SESAR, CASCADE, NexSAT, ATENAA, and B-VHF. The NEWSKY objectives do not compete with other ATM initiatives; rather NEWSKY aims to mutually benefit from other related activities by efficiently disseminating and exchanging achievements from both sides.

Once the framework to enable ATM network transformation is agreed, the basic NEWSKY architecture will be defined. Next, innovative networking concepts will be developed, assessed, tested and validated by means of software simulations and limited laboratory trials.

Results

The benefits of the scientific and technological NEWSKY approach will realise future aeronautical communication with considerably increased capacity, coverage and reliability. This improved communication capability is a key enabler for many high-level target concepts which are described in the strategic research agenda of ACARE (Advisory Council for Aeronautical Research in Europe). Thus, NEWSKY will support the expected sustainable growth of European air transport.

Acronym:	NEWSKY
Name of proposal:	Networking the sky for aeronautical communications
Contract number:	TREN/07/FP6AE/S07.68685/037160
Instrument:	STP
Total cost:	3 590 792 €
EU contribution:	2 125 828 €
Call:	FP6-2005-TREN-4-Aero
Starting date:	26.02.2007
Ending date:	25.08.2009
Duration:	30 months
Objective:	Capacity
Research domain:	Ground Based ATM
Website:	http://www.newsky-fp6.eu
Coordinator:	Dr Schreckenbach Frank DLR (German Aerospace Center), Institute for Communications and Navigation Münchner Strasse 20 DE 82230 Wessling
E-mail:	frank.schreckenbach@dlr.de
Tel:	+49 (0)8153 28 2899
Fax:	+49 (0)8153 28 1442
EC Officer:	M. Jensen

Partners:	Alcatel Alenia Space	FR
	QinetiQ Ltd	UK
	Paris Lodron Universität Salzburg	AT
	Frequentis GmbH	DE
	TriaGnoSys GmbH	DE
	Deutsche Flugsicherung GmbH	DE

SUPER-HIGHWAY

Development of an operationally driven airspace traffic structure for high-density high-complexity areas based on the use of dynamic airspace and multi-layered planning

Background

The complexity of the European upper airspace regions, together with the expected traffic growth rate of 3-4%, will affect the performance of the European ATM system. The seventh Performance Review Report states that in order to preserve good performance in terms of delays, effective capacity needs to grow at an annual rate consistent with traffic forecasts. Capacity increases need to be carefully planned. To address this in the long term (2020+), SUPER-HIGHWAY develops an innovative airspace traffic structure based on the simplification of the route network around the major traffic flows.

Objectives

The project has three objectives related to operational improvements and user benefits:

- decreasing controller workload
- improving situational awareness
- ensuring on time performance.

The expected reductions in workload arise from the application of the layered planning principles, the redistribution of tasks, the simplification of the airspace structure, and the use of ASAS and SWIM applications. The decrease in workload affects the capacity and economy high-level objectives.

Improving situational awareness enables a reduction in the number of incidents, and a reduction in aircraft separation, thus also affecting the capacity and safety of high-level objectives. Improvements arise from the use of CDM and technological enablers. The existence of mostly conflict-free route structures simplifies the airspace, thus easing the generation of situational awareness.

Improvements in on-time performance arise from a combination of the first two objectives, together with trajectory control and timely information exchange. Their success results in an improvement of the predictability of the entry/exit times on the highway routes, and thus in on-time performance.

Description of work

The project focuses on the assessment of the workload per aircraft, and of the situational awareness for both junctions and lanes. The assessments mainly address the effect of the new airspace structure on the controllers and these will be performed on the two elements of the super highways (S-H): lanes and junctions.

The strategy to carry out the project objectives will be based on two axes: the design of operational scenarios, and the assessment and exploitation of these operational scenarios through the use of fast-time and real-time simulations. The operational concept scenarios will identify and describe the operations and activities related to the use of the S-H by the relevant actors. The operational scenarios will also support the identification of the tools and technologies needed to implement the S-H.

The fast-time and real-time simulations will be used to identify the potential benefits that could be accrued by the S-H and also to identify its operability. Since the project will be focused on the determination of the viability of the proposed organisation, the assessments will address the effect of the new airspace structure on the controllers. The assessment will be performed on the operational concept scenarios in the two main S-H elements: lanes and junctions.

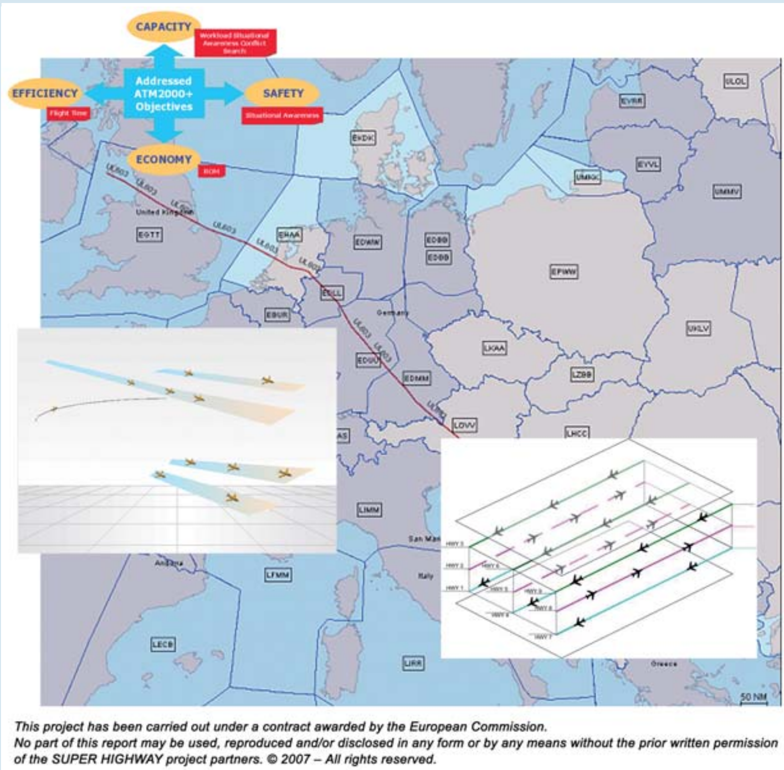
For the planner controller the following aspects will be considered:

- conflict search and resolution for future traffic
- planning of entry/exit conditions
- sector coordination.

For the executive controller the following aspects will be considered:

- planning (as regards conflict solving)
- actual traffic conflict search
- monitoring (deviations from flight track)
- implementation of solutions
- handover procedures.

As a result of the assessment, the project will include a list of initial requirements for the new support tools that might be necessary.



Overview of the Super-Highway operational concept scenario

Following the stated technical principles and the development strategy, the project is organised into four work packages: Operational concept scenario elaboration, Benefits assessment, Development of conclusions and recommendations, and Exploitation and dissemination. Additionally there will be a project management and coordination work package.

Results

The Super-Highway is an airspace structure located in an area with complex, high-density traffic. It is defined by both its physical parameters (length, number and arrangement of lanes) and by the related set of procedures (e.g. entry/exit, crossing). The Super-Highway will make assessments using fast- and real-time simulations, including the expected safety, capacity and efficiency benefits derived from its use.

Appropriate result awareness within the aeronautical community will be obtained through coordination with related projects, workshop, participation in conferences and the project website.

Acronym:	SUPER-HIGHWAY	
Name of proposal:	Development of an operationally driven airspace traffic structure for high-density high-complexity areas based on the use of dynamic airspace and multi-layered planning	
Contract number:	TREN/06/FP6AE/S07.56057/019544	
Instrument:	STP	
Total cost:	1 886 328 €	
EU contribution:	977 372 €	
Call:	FP6-2004-TREN-3	
Starting date:	01.04.2006	
Ending date:	31.03.2008	
Duration:	24 months	
Objective:	Capacity	
Research domain:	Ground Based ATM	
Website:	http://www.sh.isdefe.es	
Coordinator:	Mr Suárez Nicolás	
	Isdefe	
	Edison 4	
	ES 28006 Madrid	
E-mail:	nsuarez@isdefe.es	
Tel:	+34 (0)91 271 17 51	
Fax:	+34 (0)91 564 51 08	
EC Officer:	M. Jensen	
Partners:	Aena	ES
	DFS	DE
	EUROCONTROL	FR
	SENASA	ES

SWIM-SUIT

System-Wide Information Management – supported by innovative technologies

Background

To date, the management of different types of information has evolved independently, based on sub-system and service-specific requirements. As a result of this bottom-up approach, today's ATM information systems are insufficiently integrated, resulting in organisational and institutional barriers which prevent timely use of relevant information.

Although several initiatives have been launched with the aim of studying the interoperability solutions, none of these projects identifies the characteristics of the infrastructure required to make interoperability possible.

Objectives

Although the importance of introducing a system-wide information management (SWIM) capability-facilitating co-operation among stakeholders is now generally recognised, there is still no clear indication as to how to implement this capability and, in particular, which technologies would enable its successful operation. As a consequence, there is a need to identify different options and demonstrate the feasibility of realising SWIM in all its aspects. SWIM-SUIT moves in this direction and intends to target the following objectives:

– Specification of the requirements for the SWIM implementation;
– Design and development of a SWIM test platform (SWIM prototype) supporting the evaluation of the SWIM concepts;
– Evaluation of the technologies identified as enablers of the SWIM concept by means of a test campaign performed on the developed test bed;
– Assessment of the organisational, legal and financial implications, including an analysis of the possible impact they may have on the SWIM implementation and, thus, to the associated enabling technologies.

Description of work

SWIM-SUIT aims to demonstrate the feasibility of initial system-wide information management functionality for the air transport system.

Starting from the preliminary results of the SESAR definition phase, the project will firstly specify the requirements of ATM information management, exploiting the expertise derived from the large participation of users in the project.

Secondly a tailoring of the requirements will be done to define the context of the SWIM-SUIT prototype. Then a SWIM-SUIT prototype will be specified, designed, developed and tested, based on several existing user applications connected to the test bed, such as ACC/APP centres, airport CDM, airline operating centres, CFMU and flight simulators.

Finally two evaluation sessions will be performed in order to evaluate the potential benefits of SWIM's functionality, and to identify different options and SWIM's overall consequences and implications.

The development of a SWIM prototype is considered a key task of the SWIM-SUIT project. It has the objective to provide measurable indicators relevant to the technologies enabling the implementation of the SWIM concept. It is a multi-site structure, covering several ATM domains and integrating different legacy applications.

The work structure has been organised into Work Packages (WP) as follows:
- WP 0: Management and dissemination, which aims at the management and coordination of all the project activities;
- WP 1: Information management users' requirements, which aims to identify the set of user requirements for both SWIM and its prototype;
- WP 2: SWIM design, development and testing, which aims at producing a SWIM prototype and represents the core design and implementation activity;
- WP 3: Test-bed integration and testing, which aims at the adaptation of the existing legacy applications to be used in the test bed for the evaluation;
- WP 4: Technical evaluation, which includes all activities required for the technical evaluation of the selected solution(s) from WP2, using the test bed developed in WP2 and integrated with the legacy applications (WP3);
- WP 5: Financial and institutional, which aims to perform the cost benefit analysis of the selected technical solutions based on the SWIM concept.

Results

Although the SWIM concept is expected to represent the basis upon which the future interoperable ATM systems will be built, there are still enormous uncertainties over its actual technological implementation. SWIM-SUIT will predominantly contribute to this need for technological assessment by developing a SWIM prototype, which will provide the basis for assessment of the technological solutions adopted. The significant involvement of users will also ensure that the requirements for SWIM implementation will be identified and legal and financial implications will be assessed.

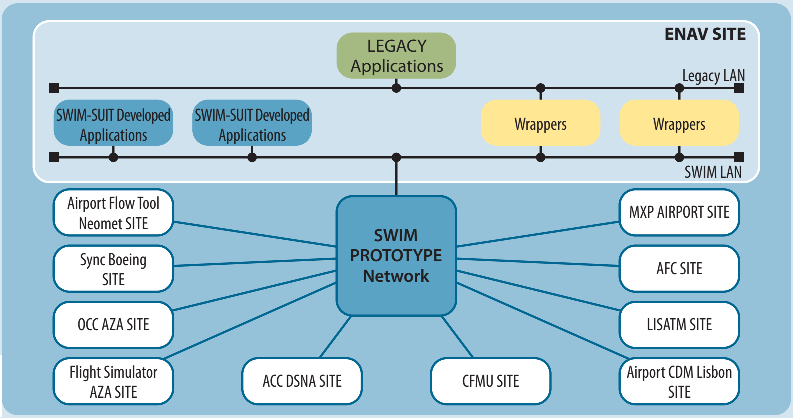


Figure 2: SWIM prototype - physical layout

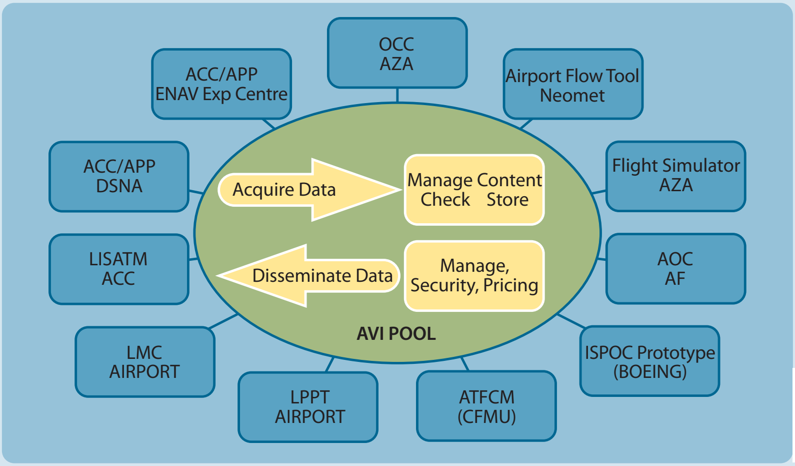


Figure 1: SWIM prototype - logical layout

Acronym:	SWIM-SUIT	
Name of proposal:	System-Wide Information Management – supported by innovative technologies	
Contract number:	TREN/07/FP6AE/S07.69084/036990	
Instrument:	STP	
Total cost:	11 855 123 €	
EU contribution:	6 285 912 €	
Call:	FP6-2005-TREN-4-Aero	
Starting date:	20.04.2007	
Ending date:	19.04.2010	
Duration:	36 months	
Objective:	Capacity	
Research domain:	Ground Based ATM	
Website:	http://www.swim-suit.aero	
Coordinator:	Mr d'Auria Giuliano	
	SELEX Sistemi Integrali	
	Via Tiburtina km 12.400	
	IT 00131 Rome	
E-mail:	gdauria@selex-si.com	
Tel:	+39 06 4150 4448	
Fax:	+39 06 4150 2722	
EC Officer:	M. Jensen	
Partners:	Alcatel Alenia Space	FR
	Advanced Resources	PT
	Air France Consulting	FR
	Air Traffic Management Bureau, CAAC	CS
	Alitalia S.p.A.	IT
	Boeing Research and Technology Europe, S.L.	ES
	Direction des Services de la Navigation Aerienne du Ministere des Transports, de l'Equipment, du Tourisme et de la Mer de la Rupublique Francaise	FR
	Frequentis GmbH	AT
	Navegacao Aerea de Portugal	PT
	Neometsys	FR
	QinetiQ Ltd	UK
	SELEX Communications S.p.A.	IT
	SEA S.p.A.	IT
	SECTOR SA	GR
	Consorzio SICTA	IT
	University of Zilina	SK
	EUROCONTROL Experimental Centre	FR

ERASMUS
En Route Air traffic Soft Management Ultimate System

Background

The ACARE Strategic Research Agenda (ACARE SRA II) proposed in October 2004 is strongly pushing the Air Traffic Management (ATM) sector to get more capacity, greater efficiency and increased safety. ACARE SRA II stresses the inability of the current ATM system to cope with this growth if no radical changes are performed. This makes it clear that revolutionary measures are a necessity to respond to these objectives. Several fields of improvement require urgent investigations and among them, two are of particular interest to the ERASMUS project:
- more automation for ATM;
- shifting responsibilities from the ground to the air.

Objectives

Considering the high level of automation that has been introduced in the air segment during the last 50 years, the Flight Management System (FMS) being a recent example, one can question why this has not taken place for the ground segment. The ATM system seems to be 'archaic' for many observers, and has not taken full advantage of Precision Area Navigation (P-RNAV), air-to-ground communication facilities or the FMS, all of which are in use worldwide. Airlines, aircraft manufacturers and system designers have difficulties in understanding why such potential in terms of data precision and computing capacity, both on the ground and in flight, still remains unused.

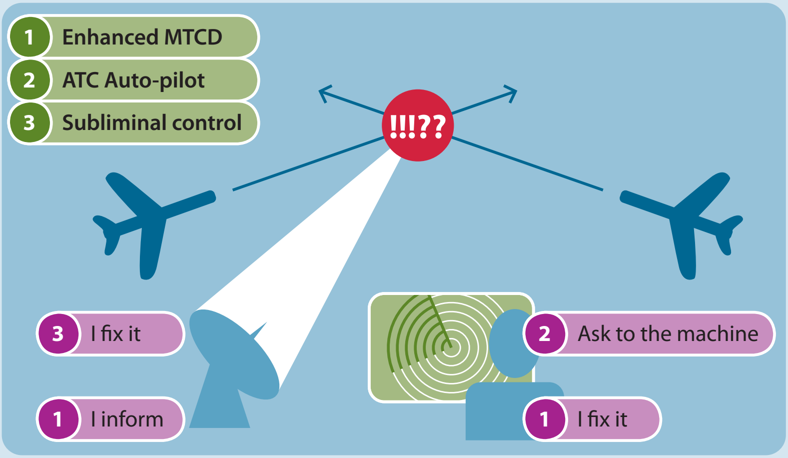
ERASMUS proposes innovative ways to re-synchronise automation between the air and ground segments seeking to develop high co-operation between the human being and the machine, and aiming at a better use of the current potentials offered by the air segment.

The strategic objectives addressed through ERASMUS are to propose an innovative ATM solution which is able to respond to the challenge of traffic demand, and to improve the efficiency and safety level of the European Air Transport System as stated in the ACARE SRA II.

Description of work

ERASMUS adopts an air-to-ground co-operative approach aiming at defining and validating a human-centred innovative ATC automation for the sector safety and productivity, and maintaining the controllers in the decision-making loop.

Today, the controller, when extrapolating the present position and speed of each individual aircraft, takes a large margin of manoeuvre due to the limited accuracy. The uncertain environment in which controllers work represents a domain that allows the automated system to optimise the traffic flow by using the Precision Area Navigation (P-RNAV), the air-to-ground communication facilities and the airborne Flight Management System (FMS). In the same way that the autopilot system performs minor adjustments (roll axis, level control) not perceivable by the pilot, the ATC automation system would use minor adjustments (vertical/horizontal speed, rate of climb/descent) to resolve (or dissolve) a large number of the conflicts. Such minor actions are not directly perceivable by the controllers and are not conflicting with their own action and responsibility. Assuming that the air speed can be safely adjusted by this automatic control (e.g. changes of horizontal/vertical speed or rate of climb/descent),



it is estimated that the residual number of conflicts to be considered by the controllers could therefore be significantly reduced (by up to 80%).

The ERASMUS project considers this subliminal control and proposes to assess a set of three envisaged applications to be applied from the strategic to the tactical level. These three applications range from a full automation (i.e. a full delegation to the machine) to a lower automation (i.e. the computer being an adviser to the controller):

– subliminal control;
– 'ATC autopilot';
– enhanced medium-term conflict detection (MTCD).

Results

The ERASMUS results will provide:

– a definition of operation concepts for the air and ground segments (including advanced tools, working methods);
– detailed specification and design of the prototype;
– assessment and refinement of the hypothesis and proof of concept in terms of safety, efficiency, capacity, security and economy;
– clear identification of quantified benefits in terms of safety, efficiency, capacity, security and economy;
– identification of the transition plan before full implantation, if any.

There is a high expectation that early benefits could be forwarded into SESAR.

Acronym:	ERASMUS	
Name of proposal:	En Route Air traffic Soft Management Ultimate System	
Contract number:	TREN/06/FP6AE/S07.58518/518276	
Instrument:	STP	
Total cost:	5 635 326 €	
EU contribution:	3 150 101 €	
Call:	FP6-2004-TREN-3	
Starting date:	11.05.2006	
Ending date:	10.11.2008	
Duration:	30 months	
Objective:	Capacity	
Research domain:	Ground Based ATM	
Website:	http://www.atm-erasmus.com/	
Coordinator:	Mr Brochard Marc	
	EUROCONTROL	
	Experimental Centre, Centre de Bois des Bordes	
	BP15	
	FR 91222 Brétigny sur Orge	
E-mail:	marc.brochard@eurocontrol.int	
Tel:	+33 (0)1 69 88 76 08	
Fax:	+33 (0)1 69 88 69 52	
EC Officer:	M. Jensen	
Partners:	DSNA/DTI/SDER	FR
	Honeywell	CZ
	University of Linköping	SE
	Swiss Federal Institute of Technology	CH
	SICTA	IT

ASPASIA

Aeronautical Surveillance and Planning by Advanced Satellite-Implemented Applications

Background

In the aeronautical world, new concepts, procedures and technologies, including ASAS applications, are being studied and developed to optimise task distribution between aircraft and ground with a medium-term perspective.

In the satellite world, ICAO standardised the AMSS System in the 1990s, but this standard has experienced little evolution, and nowadays the AMSS use for ATM-related functions remains limited to remote and oceanic airspace due to service cost and technical limitations.

Objectives

The main objective of ASPASIA, in the framework of innovative surveillance and tactical applications, is the combination of new advanced satellite communication (SatCom) technologies as a complementary ADS-broadcast data link in the provision of Airborne Separation Assistance Systems (ASAS) and Approach Management systems (AMAN).

Hence, ASPASIA's objectives are:

- to study SatCom applicability to surveillance applications, considering the benefits of SatCom not only when it is the only means of communication, as in oceanic airspace, but also when it can be the most appropriate method of communication, even in core Europe;
- to explore and develop three selected surveillance applications;
- to validate SatCom requirements for surveillance applications by developing a satellite architecture that supports new surveillance scenarios, stressing the performance capability of the new generation satellite systems;
- to perform an economic cost-benefit analysis which assesses the benefits of SatCom systems for surveillance applications.

Description of work

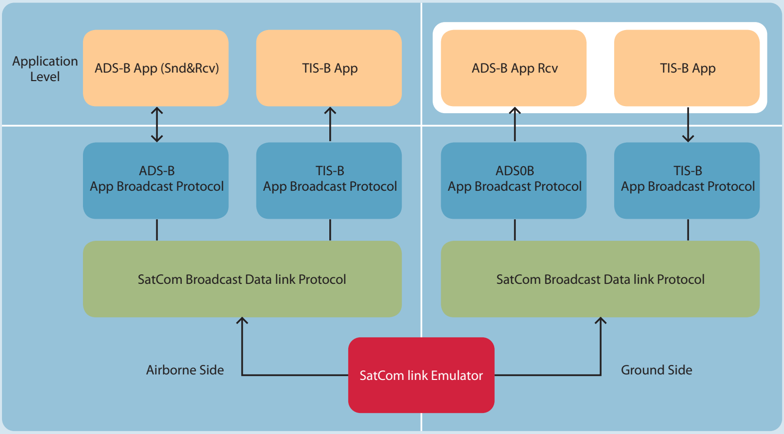
The work to be done can be structured into several sections.

Surveillance applications:

A group of surveillance application scenarios will be configured for a simulation study of their operation with the availability of satellite data links. Then three chosen applications (ADSB-NRA, ADSB ADD, and ASPA S&M) will be developed and tested over the validation platforms.

SatCom and ground broadcast protocols: The study and development of the SatCom architecture will include the following topics:

a. Air/air satellite-based data link: the study of the technological feasibility of air/air satellite based data links, which is of paramount importance for the final conclusions of ASPASIA;
b. Broadcast SatCom data link protocol for the air/ground data link: the proejct will evaluate several options for upgrading the current AMSS specification and make it efficient for broadcast applications;
c. Broadcast application protocols, for airborne and ground systems: access to data link services will be done through a simple protocol or set of protocols;
d. Ground inter-networking infrastructure to support broadcast applications: definition of an inter-networking infrastructure to support broadcast applications, and a ground broadcast application server forming part of the ground earth station.



Simulator broadcast architecture

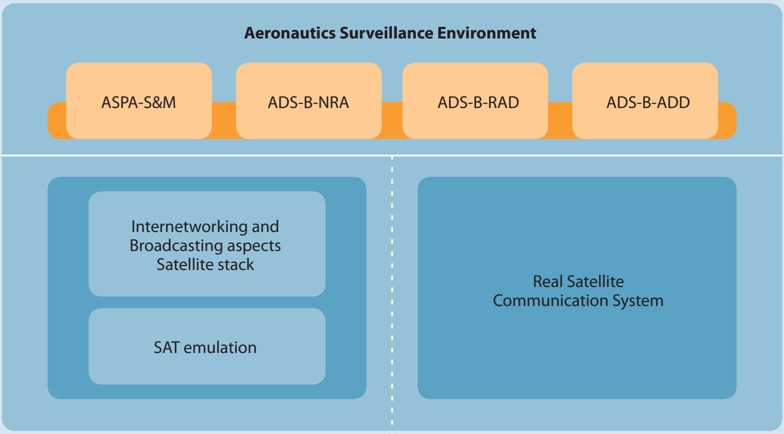
Validation platforms:
Two main platforms will be used in order to validate the feasibility of using SatCom technology to provide ADS-B and TIS-B applications. These two platforms are:

- a satellite emulation platform, composed of a satellite link emulator, the applications and the required traffic generators, designed for application tests and validation;
- a real capacity satellite demonstrator, based on an Alcatel DVB-RCS satellite system, but adapted to ASPASIA requirements.

Cost-benefit analysis:
The cost-benefit analysis will include a study of system deployment and operation costs and groundside integration costs, followed by the assessment of benefits resulting from the use of SatCom technology compared to ground technology, and finally an overall cost-benefit balance.

Results

The outcome of this project will be a fully integrated surveillance applications/satellite platform allowing the assessment of satel-



Test beds and validation platforms

lite as a powerful enabler of surveillance services adoption in many European areas. In detail, the main expected results are:

- Requirements of GS/AS applications in a SatCom environment
- Design and implementation of the application test beds
- Requirements and design of the SatCom architecture
- Implementation of the validation platforms
- Cost-benefit analysis
- System validation and conclusions.

Acronym:	ASPASIA	
Name of proposal:	Aeronautical Surveillance and Planning by Advanced Satellite-Implemented Applications	
Contract number:	TREN/06/FP6AE/S07.57614/019717	
Instrument:	STP	
Total cost:	4 241 750 €	
EU contribution:	2 374 310 €	
Call:	FP6-2004-TREN-3	
Starting date:	07.03.2006	
Ending date:	06.03.2008	
Duration:	24 months	
Objective:	Capacity	
Research domain:	Ground Based ATM	
Website:	http://www.aspasia.aero	
Coordinator:	Mr Paradell Antonio	
	Atos Origin, SAE	
	Diagonal 210	
	ES 08018 Barcelona	
E-mail:	antonio.paradell@atosorigin.com	
Tel:	+34 (0)93 486 1818	
Fax:	+34 (0)93 486 0766	
EC Officer:	M. Jensen	
Partners:	Alcatel Alenia Space France	FR
	BAE Systems (Operations) Limited	UK
	University of Glasgow	UK
	Société Française d'Etudes et de Réalisations d'équipements Aéronautiques	FR
	Skysoft Portugal - Software e Tecnologias de Informação, S.A.	PT
	Airtel ATN Limited	IE
	Entidad Pública Empresarial Aeropuertos Españoles y Navegación Aérea	ES
	Euro Telematik AG	DE
	Indra Espacio, S.A.	ES
	Ingeniería y Economía del Transporte S.A.	ES

CATS
Contract-based Air Transportation System

Background

CATS is proposing an innovative air traffic management (ATM) solution which will be able to deal with the challenges of traffic growth (2012+ horizons), and improve the efficiency of the European air transport system.

This new ATM paradigm is based on an innovative operational concept: Contract of Objectives. This concept introduces an innovative way of managing ATM by mutually agreed objectives, leading to a market-driven air transportation system. It addresses the entire air transport supply chain by reconciling operational links between air and ground services. This functional and operational continuity between air and ground will enhance efficiency by increasing the predictability of the air transport system. The objective assignment and negotiation are performed through a collaborative decision-making process which will establish the operational agreement, including the right balance between productivity and safety. Through the Contract of Objectives, a guarantee of results respecting punctuality will be offered to the airline by the air traffic system.

Objectives

The CATS project aims at giving a common, known and agreed objective to all the air transportation system actors with an integrated input of their own constraints through a negotiated trade-off, leading to an efficiency improvement in the organisation of flights and so to a cost reduction.

The objectives are:

– to link ATM actors together through agreed objectives and interfaces
  The Contract of Objectives allows 'reconciling' ATCo, airlines and airports by giving mutual awareness of the constraints (i.e. target window) and focusing on the ultimate target – punctuality at destination.
– to integrate flexibility to cope with uncertainties
  Target window modelling includes both technical level constraints and room to keep sufficient flexibility when disruptions occur. The target window gives the available management space for ATCos and aircrew to deal with any uncertainty during airborne flight life, but always respecting the initial schedule.
– the coordination of actors' resources to deliver the best service
  The Contract of Objectives is the elementary unit of the collaborative process – built, agreed and shared by all the actors. It represents a 'guarantee of service results' where each actor provides the relevant resources and infrastructure to deliver the appropriate service.
– enhanced collaboration over Single European Sky
  The Contract of Objectives and target windows represent a commitment on agreed interfaces between actors. To be efficient, the network should be considered at a European level.
  The Contract of Objectives involves the collaboration of all actors focused on a unique area – the European airspace.

Description of work

The first step will be devoted to define, with the air transportation community partners, the concept of operation that is linked to the Contract of Objectives and to describe the objectives of the operational assessment performed through human-in-the loop (HIL) experimentations.

The assessment of the concepts will then be performed.

The systemic view will concentrate on three aspects:

- Safety and risk assessment of the concepts:
  The aim is to develop a model-based assessment strategy for the key elements of the concept based on the target window. The strategy will evolve around case studies that will attempt to identify both typical and risk sensitive scenarios that may arise with the target window concept.
- Benefit assessment of the concepts:
  A cost-benefits analysis at three hierarchical levels (strategic, organisational and operational) will be carried out for the different stakeholders.
- Legal assessment of the concepts:
  The objective is to establish a legal framework governing the service provision for ATM activities in the multipartite relationship between airlines, airports and ANSPs. The Contract of Objectives should be implemented through target agreements and/or service level agreements between the actors.

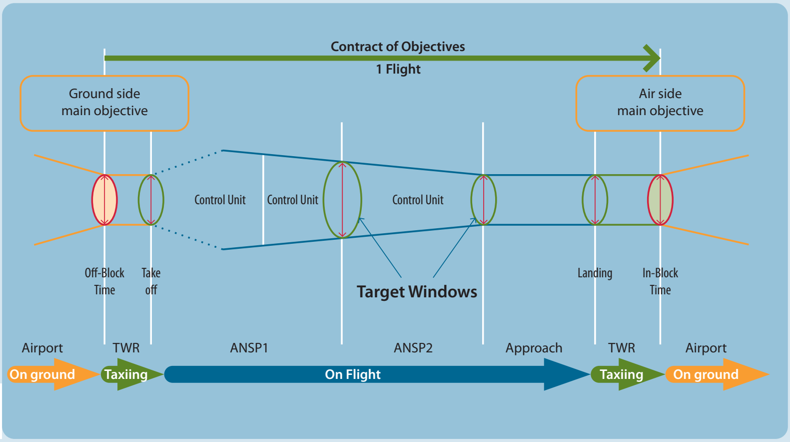
In the meantime, the operational approach will focus on three main assessments:

- Impact of the Contract of Objectives between ATCos:
  The acceptability and the impact of the Contract of Objectives are evaluated in the context of the border area of two ANSPs.
- Impact of the Contract of Objectives between ATCos and aircrews:
  The acceptability and the impact of the Contract of Objectives will be mainly evaluated in a given sector.
- Evaluation of the renegotiation process involving ATM actors (airline, airport and ANSP):
  This will involve all ATM actors (airlines, pilots, ATCos, airport) in case the Contract of Objectives is not fulfilled.
  The assessments will be performed by means of human-in-the loop (HIL) experiments.

Results

The project will produce various outputs applicable not only within the project-partner organisations but also in other similar organisations in the aeronautical industry:

- a new concept of operations and the adequate modus operandi;



The Contract of Objectives

- its assessment, highlighting:

- a better use of available resources
- an increase of predictability
- a better respect of punctuality
- a better resilience to uncertainty
- an overall increase of the system's efficiency.

- a modelling of Target Window;
- prototypes of potential tools for both ground and air selected during operational assessment;
- collaborative platform for multi-actors' experiments fitted to European environment data;
- economical models of the identified stakeholders provided by the cost-benefits analysis.

Acronym:	CATS	
Name of proposal:	Contract-based Air Transportation System	
Contract number:	036889	
Instrument:	STP	
Total cost:	2 906 654 €	
EU contribution:	1 669 314 €	
Call:	FP6-2005-Aero-1	
Starting date:	01.05.2007	
Ending date:	30.04.2010	
Duration:	36 months	
Objective:	Capacity	
Research domain:	Ground Based ATM	
Coordinator:	Rihacek Christoph	
	FREQUENTIS AG	
	Innovationsstraße 1	
	AT - 1100 Vienna	
E-mail:	christoph.rihacek@frequentis.com	
Tel:	+ 43 01 811 50 0	
Fax:	+ 43 01 811 50 1009	
EC Officer:	M. Jensen	
Partners:	EUROCONTROL Experimental Centre	BE
	Air France Consulting	FR
	DSNA / Centre En Route de la Navigation Aérienne Nord	FR
	Unique	CH
	Leiden University	NL
	Swiss Federal Institute of Technology	CH
	Laboratorio di Ricerca Operativa Trieste University	IT
	L'Ente Nazionale Assistenza al Volo	IT

iFly

Safety, complexity and responsibility-based design and validation of highly automated air traffic management

Background

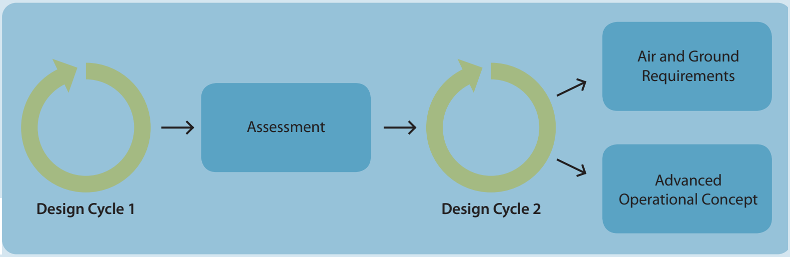
During recent years, the ATM community research trend has been to direct large airborne self-separation research projects to situations of less dense airspace. Typical examples of this trend are the EC research projects MFF (Mediterranean free flight) and ASSTAR (Advanced safe separation technology and algorithms). This is remarkable because airborne self-separation has been 'invented' as a potential solution for high-density airspace. iFly aims to develop a step change in this trend, through a systematic exploitation and further development of the advanced mathematical techniques that have emerged within the HYBRIDGE project of the European Commission's Fifth Framework Programme. See http://www.nlr.nl/public/hosted-sites/hybridge/

Objectives

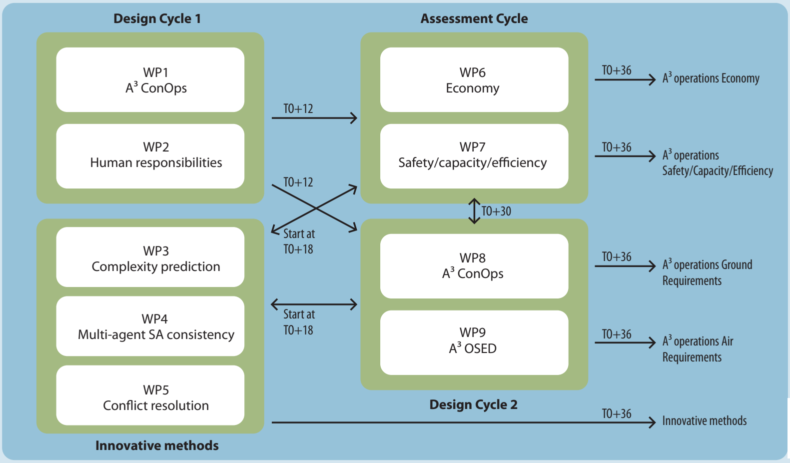
The objectives are to achieve a separation design and a highly automated ATM design for en-route traffic, which takes advantage of autonomous aircraft operation capabilities and which is aimed to manage a three-to-six-times increase in current en-route traffic levels. This incorporates an analysis of safety, complexity and pilot/controller responsibilities and an assessment of ground and airborne system requirements, which make part of an overall validation plan. The proposed iFly research combines expertise in air transport's human factors, safety and economics with analytical and Monte Carlo simulation methodologies providing for 'implementation' decision-making, standardisation and regulatory frameworks. The research is aimed at supporting SESAR and actively disseminates the results among the ATM research community.

Description of work

iFly will perform two operational concept design cycles and an assessment cycle comprising human factors, safety, efficiency, capacity and economic analyses. The general work structure is illustrated in Figure 1. During the first design cycle, state-of-the-art research, technology and development



iFLY work structure



Organisation of iFly research

(RTD) aeronautic results will be used to define a 'baseline' operational concept. For the assessment cycle and second design cycle, innovative methods for the design of safety-critical systems will be used to develop an operational concept capable of managing a three-to-six-times increase in current air traffic levels. These innovative methods find their roots in robotics, financial mathematics and telecommunications.

As depicted in Figure 2, iFly work is organised through nine technical Work Packages (WPs), each of which belongs to one of the four types of developments mentioned above:

Design cycle 1

The aim is to develop an Autonomous Aircraft Advanced (A3) en-route operational concept which is initially based on the current state of the art in aeronautics research. The A3 ConOps is developed within WP1. An important starting and reference point for this A3 ConOps development is formed by the human responsibility analysis in WP2.

Innovative methods:
To develop innovative architecture-free methods towards key issues that have to be addressed by an advanced operational concept:
- Develop a method to model and predict complexity of air traffic (WP3);
- Model and evaluate the problem of maintaining multi-agent situation awareness (SA) and avoiding cognitive dissonance ((WP4);
- Develop conflict resolution algorithms for which it is formally possible to guarantee their performance (WP5).

Assessment cycle:
To assess the state of the art in Autonomous Aircraft Advanced (A3) en-route operations design-concept development with respect to human factors, safety and economy, and identify which limitations have to be mitigated in order to accommodate a three-to-six-times increase in air traffic demand:
- Assess the A←sup→3←/sup→ operation on economy, with emphasis on the impact of organisational and institutional issues (WP6);

– Assess the A³ operation on safety as a function of traffic density increase over current and mean density level (WP7).

Design cycle 2

The aim is to extend the A3 Concept of Operations (ConOps) of design cycle 1 with highly automated ATM support, so that this safely accommodates a factor of three-to-six-times more traffic then at current busy traffic levels. WP8 develops the corresponding A4 ConOps. WP9 develops preliminary safety and performance requirements on the applicable functional elements of the A4 ConOps focused in order to identify the required technology to make this concept a reality.

Results

There are ten expected iFly results:

1. Autonomous Aircraft Advanced (A3) ConOps
2. Human factors of A3 ConOps
3. Safety/capacity of A3 ConOps
4. Cost-benefit of A3 ConOps
5. Predict traffic complexity
6. Maintaining multi-agent situation awareness (SA)
7. Guaranteed conflict resolution
8. Automated ATM supported A3 (A4) ConOps
9. Airborne requirements
10. Overall validation plan.

Acronym:	iFly
Name of proposal:	Safety, complexity and responsibility-based design and validation of highly automated air traffic management
Contract number:	037180
Instrument:	STP
Total cost:	5 245 900 €
EU contribution:	3 309 000 €
Call:	FP6-2005-TREN-4-Aero
Starting date:	24.05.2007
Ending date:	23.08.2010
Duration:	39 months
Objective:	Capacity
Research domain:	Ground Based ATM
Website:	http://www.ifly.org
Coordinator:	Mr Blom Henk National Aerospace Laboratory NLR P.O. Box 90502 Anthony Fokkerweg 2 NL 1006 BM Amsterdam

E-mail: blom@nlr.nl
Tel: +31 (0)20 511 3544
Fax: +31 (0)20 511 3210
EC Officer: C. North

Partners:

National Aerospace Laboratory NLR	NL
Honeywell	CZ
Isdefe	ES
University of Tartu	EE
Athens University of Economics and Business Research Centre	GR
Eidgenössische Technische Hochschule Zürich	CH
University of l'Aquila	IT
Politecnico di Milano	IT
The Chancellor, Masters and Scholars of the University of Cambridge	UK
National Technical University of Athens	GR
University of Twente	NL
Ecole Nationale de l'Aviation Civile	FR
Dedale	FR
NATS En Route Ltd	UK
Institut National de Recherche en Informatique et en Automatique	FR
EUROCONTROL	FR
DSNA-DTI-SDER	FR
University of Leicester	UK

CAATS-II

Co-operative Approach to Air Traffic Services II

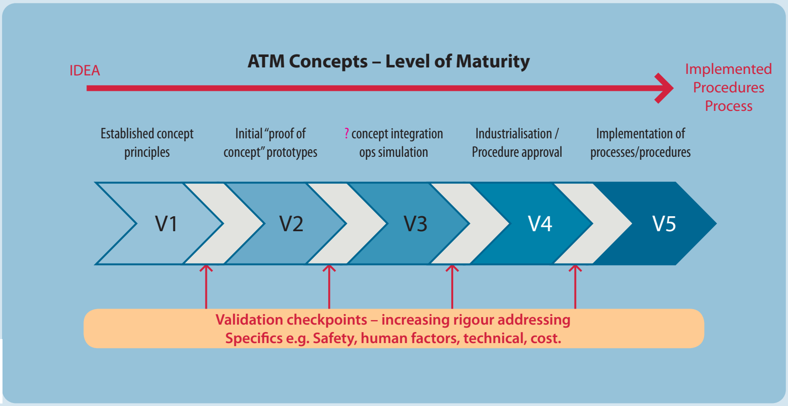
Background

In order to avoid unrealistic expectations being placed upon experimental teams, there is a need to create a 'validation strategy and plan'; at the level of programme management. CAATS, this project's predecessor, identified the E-OCVM as the best concept validation methodology due to it being seen as the most applicable to the first three phases from the AP5 maturity model. The Operational Concept Validation Strategy Document developed by FAA/Eurocontrol proposed a five-level concept maturity scale: idea, establish concept principles (V1); initial 'proof of concept', prototypes (V2); concept integration and pre-ops simulations (V3); industrialisation/procedure approval (V4); and implementation of processes/procedures (V5). In this process, the stakeholders play an important role: they make decisions about the progress of the concept, based on its maturity, beyond the world of ATM R&D.

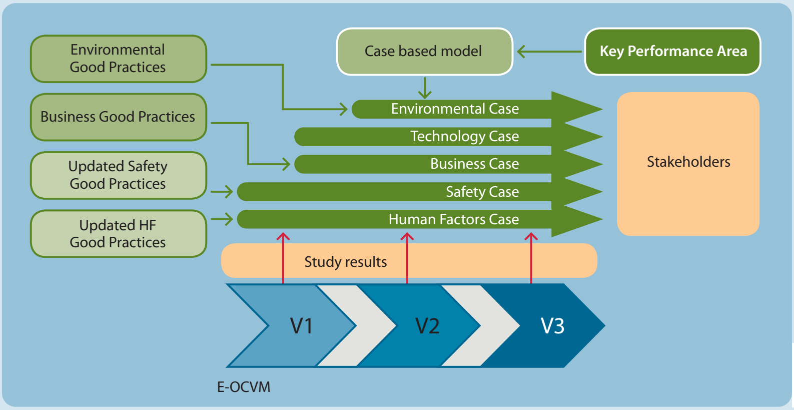
The E-OCVM focuses on describing the type of information that should be expected from the validation process and how this information should be structured in order to ensure that it is accessible and understood by all stakeholders. To this end the 'case' format is used to collate this information. Good practices to perform a 'human factors case' and a 'safety case' were identified by the CAATS project. The CAATS II project will further develop these 'cases' and will extend them to also include a 'business' case and an 'environmental' case.

Objectives

The objective is to continue the work begun within the CAATS project by managing, consolidating and disseminating the knowledge produced in European ATM-related projects. The project will focus on five areas namely safety, human factors, business, environment and validation.



Levels of maturity of ATM concepts



CAATS II contribution to overall case-based view

Description of work

The CAATS II work plan is divided into three Work Packages (WP) and five sub-Work Packages, each comprising closely related activities.

WP 0: Project management and coordination will assure project progress according to the planning, control the quality and delivery of deliverables on time, and control the various (and total) budgets for the project.

WP 1: Knowledge management and consolidation will cover all activities of interaction with other Sixth Framework Programme (FP6)/ATM projects. The main task will be to collect, collate and analyse the obtained knowledge in the areas of safety, human factors, business, environment and their integration in the E-OCVM.

A specialised team is assigned to each of these areas. These activities involve:

- collecting and collating the information generated by the ATM projects in the areas of safety, human factors, business and environment;
- identifying and analysing the lack of a coordinated approach within the current ATM projects and the gaps;
- updating the projects' best practices in the areas of safety and human factors identified in CAATS II;
- identifying the projects' best practices in the areas of business and environment;
- developing guidelines for typical safety, human factors, business and environment cases;
- applying the cases developed in FP6 projects;
- integrating the above practices and cases in the E-OCVM.

WP 2: Dissemination and interaction with the projects will provide the basic infrastructure needed to operate the CAATS II website and dissemination activities in order to create the appropriate coordination and collaboration environment with the projects and with the stakeholders.

Results

The expected results are:

- Best practices for business and environmental areas;
- Case-based approach models for human factors, safety, business and environment. The 'case' approach includes detailed information on performance capabilities and behavioural characteristics;
- Integration of the cases in the E-OCVM;
- Dissemination and support on the use of best practices for the projects.

Acronym:	CAATS-II
Name of proposal:	Co-operative Approach to Air Traffic Services II
Contract number:	TREN/06/FP6AE/S07.63283/036826
Instrument:	CA
Total cost:	3 452 212 €
EU contribution:	3 000 000 €
Call:	FP6-2005-TREN-4-Aero
Starting date:	06.11.2006
Ending date:	05.11.2009
Duration:	36 months
Objective:	Capacity
Research domain:	Ground Based ATM
Website:	http://www.caats2.isdefe.es
Coordinator:	Valmorisco Fernandez Marcial Isdefe Edison 4 ES 28006 Madrid
E-mail:	mvalmorisco@isdefe.es
Tel:	+34 (0)91 271 17 52
Fax:	+34 (0)91 564 51 08
EC Officer:	M. Jensen

Partners:	Ingeniería de Sistemas para la Defensa de España (Isdefe)	ES
	Imperial Collage London	UK
	Entidad Publica Empresarial Aeropuertos Españoles y Navegación Aérea (AENA)	ES
	Eurocontrol Experimental Centre	FR
	Integra	DK
	INDRA	ES
	Ingeniería y Economía de Transporte, S.A (INECO)	ES
	Deep Blue s.r.l	IT
	Stichting Nationaal Lucht- en Ruimtevaartlaboratorium (NLR)	NL
	Boeing Research and Technology Europe, S.L.	SE
	NATS (Services) Limited	UK
	Nickleby HFE Ltd	UK

INOUI
INnovative Operational UAV Integration

Background

The driving force behind creating the INOUI project is stemming from the fact that no ongoing European ATM project focuses on the crucial matter of unmanned aerial vehicles (UAVs). Regardless of the fact that drones are already furrowing the skies, albeit either at a very low altitude or in segregated airspace due to their mostly military nature, integration in the non-restricted airspace is not happening. In particular, the topic of UAV is almost totally absent from SESAR and its high-level Definition Phase (Phase I). INOUI aims at complementing SESAR to compensate for this.

Objectives

The main objective of the INOUI project is to provide a roadmap for the future of UAVs in the context of the ever-changing ATM environment. Furthermore, INOUI aims at complementing the SESAR activities with regard to the operational concept and the architecture, as well as the roadmap for research and development activities.

In particular INOU is aiming at:
- Identifying the spread of operational concepts for UAV applications and describe the resulting procedures and requirements in the different timeframes up to 2020;
- Identifying how UAVs can fit into the ATM system of 2020 and what activities have to be achieved, especially from the UAV point of view (research roadmap);
- Identifying existing certification requirements, and process and suggest an optimum certification blueprint for human resources and, as far as is required, UAV-related technologies;
- Identifying how UAV can benefit from SWIM and what activities have to be taken to achieve the benefit;
- Identifying the safety issues related to UAVs and developing high-level safety objectives and requirements;
- Identifying the potential airport types for UAV operations and describing the operational impact.

Description of work

The work within INOUI is divided into seven Work Packages (WP):

1. Identification of the future ATM environment and UAV applications
   WP 1 sets the scene for all further work in this project. Existing know-how from, for example, EUROCONTROL, SESAR and international organisations like ICAO will be analysed and ideas and plans existing today will be projected into the future. This comprises inter alia the assumed operational concepts or technological concepts in use. Having done this the related requirements will be captured in a dedicated workshop.
2. Assess the impact of the future ATM system on UAVs
   WP 2 will analyse and define how UAV systems will be integrated in the 2020 ATM architecture in terms of technological concepts and requirements. The available, planned or envisaged technologies identified for either UAVs or ATM systems will be assessed for their ability to fulfil the operational concept and the related operational requirements for different UAV applications. Furthermore, it is the intention to complete a roadmap with regard to the availability of technology or the requirement for development up to 2020.

3. Assess the requirements on the UAV-related technology and humans resources.

   WP 3 will investigate procedures and requirements on certification and licensing of personnel dealing with UAVs and will classify UAV operators' working environments, based on those for pilots and controllers. If required, INOUI will also support certification and licensing issues for technology.

4. Assess how situational awareness can be assured.

   WP 4 aims to analyse and define how UAV systems will be integrated in the 2020 ATM architecture, focusing on the common operating picture. In this step INOUI will identify how situational awareness can be assured by studying the differences between the 'traditional' users of ATM systems and the 'new' users, the UAV-users. This study will be two-pronged: the information and communications layer, and the applications layer.

5. Assess and identify safety issues.

   Within WP 5, a safety assessment cycle from system/model definition, via hazard identification to the definition of safety requirements will be carried out.

6. Identify challenges for airports with regard to UAVs.

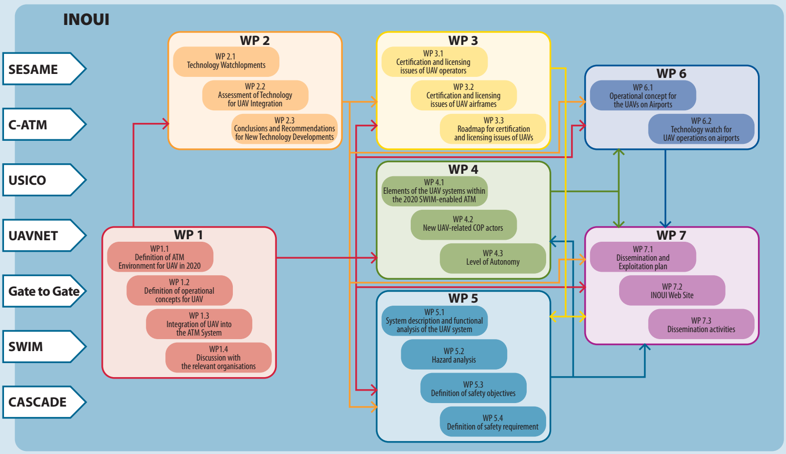
   WP 6 focuses on the operational and technological perspective from the airport point of view by defining an operational concept for the UAV operations at airports of 2020 and beyond. The technologies under development will be assessed with regard to their capability to enable airport operations to facilitate the integration of UAVs.

7. Dissemination and exploitation

   The INOUI project plans an extensive programme of dissemination activities (WP 7), ranging from the organisation of a web page up to participation in panels, workshops and dissemination forums of other projects.

Results

INOUI is the European R&D community's attempt to resolve the question of the UAV integration in 2020 ATM. INOUI outcomes will establish a framework for their operation in Europe, serving as a booster for the European UAV industry. INOUI will define an operational concept, propose



Work Packages and interdependencies

operational procedures and assess the technologies in order to facilitate the UAV integration in the airspace and airport paradigm foreseen by 2020 and beyond.

Another main result of INOUI is the support for maintaining safety levels when introducing UAVs into a 2020 environment, even with air traffic expected to be three times greater than what it is currently.

Acronym:	INOUI	
Name of proposal:	INnovative Operational UAV Integration	
Contract number:	TREN/07/FP6AE/S07.69061/037191	
Instrument:	STP	
Total cost:	4 305 719 €	
EU contribution:	2 317 414 €	
Call:	FP6-2005-TREN-4-Aero	
Starting date:	01.06.2007	
Ending date:	31.05.2009	
Duration:	24 months	
Objective:	Capacity	
Research domain:	Ground Based ATM	
Coordinator:	Mr Baumann Achim	
	DFS Deutsche Flugsicherung GmbH	
	AM DFS- campus 10	
	DE 63225 Langen	
E-mail:	achim.baumann@dfs.de	
Tel:	+49 (0)6103 707 4904	
Fax:	+49 (0)6103 707 4995	
EC Officer:	C. North	
Partners:	Ingeniería de Sistemas para la Defensa de España, S.A	ES
	Boeing Resarch and Technology Europe	ES
	Fundación Instituto de Investigación INNAXIS	ES
	Rheinmetall Defence Electronics GmbH	DE
	ONERA	FR

EP3

Single European sky implementation support through validation

Background

The European Commission initiated EP3 (Episode 3) to undertake a detailed first assessment of SESAR.

EP3 will assess a significant part of the SESAR gate-to-gate operational ATM concept during a three-year period. EP3 will deliver validated operational services and environment definitions (OSEDs) together with the associated performance justification, to SESAR stakeholders. During their life cycle, these activities will be fully integrated into the SESAR programme's development phase (2007-2013), governed by the SESAR joint undertaking.

Objectives

EP3's scientific and technical objectives are to:

- provide evidence that the SESAR operational concept is 'safe in principle', or otherwise;
- define a performance validation framework based on SESAR performance targets;
- provide evidence of the performance of the operational concept against these targets;
- provide evidence of the operational viability of the SESAR target concept, or otherwise;
- provide evidence of the technical viability of the SESAR target concept, or otherwise;
- consolidate and detail the SESAR operational concept in accordance with the assessment results.

Description of work

The European Commission and EUROCONTROL launched the 'industry-led' SESAR programme in April 2006, and Commissioner Barrot set the following goals:

- Safety: increase 10 times
- Capacity: increase 3 times
- ATM costs: reduce by 50%
- Environmental impact: reduce by 10%.

SESAR will deliver its concept of operations covering strategic and tactical planning, air traffic control, airport and airspace user operations in 2007.

EP3 will focus the assessment by using ICAO key performance areas and the European Operational Concept Validation Process methodology. The project has constructed validation areas that group the SESAR concept elements in accordance with its mode of operation to assess the expected benefits and its acceptability by human actors.

Sequences of classical and innovative assessment tools will be used, including:

- Expert groups providing initial qualitative assessment against selected KPA in relation to operability, safety and human factors whilst also developing validation scenarios;
- Gaming exercises providing human assessment of strategic decision-making processes feeding fast-time simulation and analytical modelling;
- Fast-time modelling performance assessment on KPA, and filtering scenarios and options to be evaluated by real-time simulation and trade-off activities:

– Real-time simulation providing qualitative operational assessments, which will be valuable for developing the concept and building common understanding.

All assessments will be consolidated in a top-level system model for trade-off and reporting.

EP3's 26 partners (a majority of which participated in SESAR) cover all ATM technical and system aspects including flow and traffic management, air traffic control, airspace user and airport operations.

Assessment activity will exploit the partners' validation capabilities throughout Europe in a European validation infrastructure during two validation cycles, which will cover a generic first assessment followed by local specific validation activities.

EP3 will produce a full assessment of the SESAR Concept of Operations by 2010.

Results

EP3 will deliver operational services and environment definition documents (OSED), which will detail the SESAR Concept of Operation and be validated by the project's assessment process. A final delivery will involve education and dissemination to cover the many stakeholders not directly involved in SESAR but who need its output for implementation decisions.

Key results from EP3 will enable SESAR decision-makers to take implementation decisions based on performance assessment and operator acceptance of the proposed SESAR Concept of Operation.

Acronym:	EP3
Name of proposal:	Single European sky implementation support through validation
Contract number:	TREN/07/FP6AE/S07.70057.037106
Instrument:	IP
Total cost:	33 379 219 €
EU contribution:	17 402 543 €
Call:	FP6-2005-TREN-4-Aero
Starting date:	18.04.2007
Ending date:	16.08.2010
Duration:	40 months
Objective:	Capacity
Research domain:	Ground Based ATM
Website:	http://www.ep3.eurocontrol.int

Coordinator: Mr Leplae Philippe
EUROCONTROL
Centre de Bois des Bordes
BP15
FR 91222 Bretigny sur Orge

E-mail: philippe.leplae@eurocontrol.int
Tel: +33 (0)1 69 88 75 51
Fax: +33 (0)1 69 88 69 51
EC Officer: C. North

Partners:

The European Organisation for the Safety of Air Navigation	BE
Entidad Pública Empresarial Aeropuertos Españoles y Navegación Aérea	ES
Airbus France	FR
Deutsche Flugsicherung GmbH	DE
Nats En Route Ltd	UK
Deutsches Zentrum für Luft- und Raumfahrt	DE
Nationaal Lucht- en Ruimtevaartlaboratorium	NL
Direction des Services de la Navigation Aérienne	FR
ENAV s.p.a.	IT
Ingeniería y Economía del Transporte, S.A	ES
ISA Software	FR
ISDEFE	ES
LUFTFARTSVERKET	SE
Neometsys	FR
SELEX Sistemi Integrati	IT
SICTA	IT
Smiths Aerospace	US

Thales Avionics	FR
Thales ATM	FR
Queens University of Belfast	UK
Civil Aviation Authority of China Air Traffic Management Bureau	CN
Civil Aviation Authority of China Centre of Aviation Safety Technology	CN
AustroControl	AT
HungaroControl	HU
Letove prevadzkove sluzby Slovenskej republiky (Slovakia)	SK
Luchtverkeersleiding Nederland	NL

STAR

Secure aTm cdmA software-defined Radio

Background

ATM (Air Traffic Management) systems will run short of communication capacity between 2010 and 2015 depending on the considered geographical area (e.g. northwestern France, which is a dense air-traffic area, will be among the first ATC-saturated ones).

Depending on the forecast scenarios, it appears that current and planned analogue and even digital VHF systems (VDL mode 2, 3 or 4) will only support capacity growth until 2015 at most in Europe before being saturated. It is feared that ATC problems could arise earlier (from 2010 on) in high-density traffic areas creating severe traffic congestion and increasing safety risks.

At European level, ICAO in the ACP workgroup has initiated an analysis and first selection of potential radio solutions.

The UMTS 3GPP Wideband CDMA standard has been identified officially as a candidate for the future ATC radio system by the Working Group C of the Aeronautical Communications Panel belonging to ICAO.

Objectives

The STAR project's scientific and technological objectives can be summarised as follows:

1. to develop a secure wideband ATM communications system based on UMTS protocols,
2. to develop a representative trial network permitting the set-up of an air-ground link by airborne equipment in wideband communication mode,
3. to perform research on and to develop a prototype multi-mode (SDR) avionics baseband platform, which is able to support both wideband communications and the existing VHF analogue audio format,
4. to estimate the capacity and QoS improvements offered by a wideband communications system with regards to the 8.33 kHz and VDL-mode2 systems,
5. to validate and verify a secure wideband communications system by 2008 in lab and flight trials,
6. to carry out the preparatory standardisation and regulatory activities required for an effective wideband-based ATM system deployment,
7. to promote the system with dissemination towards the relevant stakeholders.

Description of work

The STAR project will study and validate a secure, scalable, wideband UMTS/3GPP communication system at RF frequencies, including the avionics modem and necessary ground communication infrastructure for a future air-traffic communication system (part of ATM) with VHF audio capability through SDR re-configurability.

Innovation in the STAR programme will mainly be on the following items:

1. Software Defined Radio (RF + modem)

   STAR is aiming at proving the advantages of a SDR concept for avionics ATM purposes regarding modulations (legacy analogue voice and digital wideband 3GPP) and frequencies (at VHF for voice and at RF band for wideband CDMA) showing the backward compatibility of this concept with legacy and forward compatibility with other possibly future standards.

2. Adaptation of the UMTS protocols (down to the physical layer) to allow their use in the avionic ATM/ATC radio taking into account its specificities (Doppler, delays due to cell size, etc.).

The validation of the ATM SDR concept will be carried out as follows:

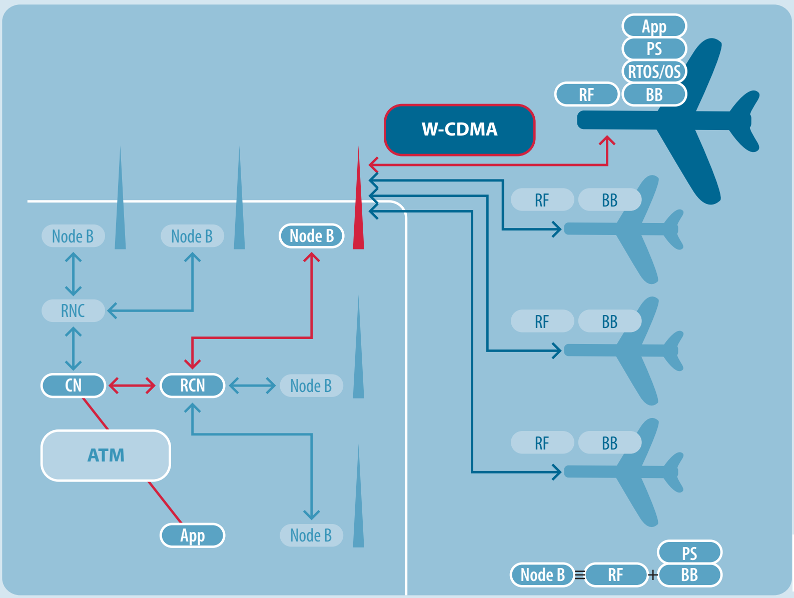
1. In lab trials emulating the complete system (airborne and ground equipment), using channel simulators, traffic load generation and jamming, at VHF for legacy analogue voice and digital wideband modulation, and at RF band for CDMA waveforms.

2. Through flight trials in order to confirm the lab tests results at VHF for legacy analogue voice and at RF band for CDMA waveforms.

Results

The main project deliverables are:

– SDR state of the art (open literature),
– Traffic classes definition and specification,
– Security requirement specifications,
– Legacy systems requirements,
– Wideband air interface requirement definition (R1 and 2),
– Frequency band allocation report,
– Avionics SDR RF/modem architecture specification,
– STAR network architecture (R1 and 2),
– Capacity evaluation results,
– Avionics SDR subsystems implementation and validation report,
– Avionics SDR platform,
– Ground subsystem implementation and validation,
– STAR system integration report,
– Laboratory tests results,
– Acquired and post-processed air flight-test results,
– Study results abstracts for presentation to standardisation bodies,



Acronym:	STAR
Name of proposal:	Secure aTm cdmA software-defined Radio
Contract number:	AST4-CT-2005-030824
Instrument:	STP
Total cost:	5 204 567 €
EU contribution:	2 692 768 €
Call:	FP6-2005-Aero-1
Starting date:	01.06.2006
Ending date:	01.12.2008
Duration:	30 months
Objective:	Capacity
Research domain:	Airborne ATM
Website:	http://www.ist-star.eu
Coordinator:	Mr Bernard Meuriche Thales Communications 160 boulevard de Valmy FR 92704 Colombes
E-mail:	bernard.meuriche@fr.thalesgroup.com
Tel:	+33 (0)1 46 13 35 42
Fax:	+33 (0)1 41 30 29 79
EC Officer:	J.L. Marchand

Partners:	Agilent Technologies Belgium SA/NV	BE
	Ericsson Telecomunicazioni SpA	IT
	IMST GmbH	DE
	Green Hills Software BV	NL
	UNIVERSIDAD POLITECNICA DE MADRID	ES
	ERCOM	FR
	DFS Deutsche Flugsicherung GmbH	DE
	Stichting Nationaal Lucht- en Ruimtevaartlaboratorium	NL

EASN II

European Aeronautics Science Network Phase II

Background

The European Aeronautics Science Network, EASN, was set up by six partners from five European universities and one research establishment. Its goal was to establish an open, unique European platform in order to structure, support and upgrade the research activities of the European aeronautic universities as well as facilitating their role in realising the European Research Area. Before EASN was launched, the contribution of these universities in realising Europe's present research objectives in aeronautics and developing long-term research goals and associated strategies had been limited to the fragmented individual university contributions. The weakness of this fragmented approach was in direct contradiction with the high level and potential of these individual universities on the one side and the very well organised associations of the other aeronautics stakeholders on the other. EASN II aims to exploit the tools created during the first phase of the project in order to further facilitate the communication and co-operation between the European academic community and finally establish a non-profit association which will ensure the continuation of the European Aeronautics Science Network.

Objectives

The main objectives of EASN II are:

- To take the fragmented and multiplied efforts in the research activities of European aeronautic universities and organise and network them according to their technological disciplines;
- To restructure the existing EASN regional structure, so as to achieve the integration of universities from the 12 new Member States;
- To facilitate and foster the mobility of researchers in Europe.

The strategic objectives addressed by EASN II are:

- Promotion of upstream and innovative research and development of breakthrough technologies, which represent the prerequisite for achieving the strategic target of Europe's technological leadership in aeronautics, by developing incubator mechanisms;
- Realisation of the European Research Area;
- Development of an EU research strategy for universities in the aeronautical sector, in accordance with and complementary to the strategies of the respective industrial and research establishment associations;
- Support of the integration of the new Member States' universities within the European aeronautics research community;
- Facilitating the links between SMEs and universities;
- Facilitating the coupling of aeronautics research and aeronautical engineering education;
- Dissemination of knowledge and exploitation of scientific and technological results;
- Stimulation of international co-operation.

Description of work

By exploiting the current EASN Thematic and Regional structure, EASN II aims to further stimulate and promote upstream research in European aeronautics. Communication routes to and from universities in the 12 new Member States will be established and a new tool, namely the National Contact Points, will be introduced in order to further increase the efficiency of the network.

The EASN Interest Groups (IG) will be expanded and further developed to cover the complete scientific and technological areas in aeronautics. Links between industrial research centres and IGs will facilitate the exploitation of the IGs by the European aeronautics industry. The workshops of the EASN IGs will contribute to the information flow, suggestions and discussions of ideas on innovative research, breakthrough technologies, harmonisation of research activities, and the development of ideas and plans for fostering collaboration and human mobility.

Furthermore, a new updated and more user-friendly EASN website will be set up which will facilitate the exchange of knowledge and promote collaboration between EASN members. Finally, the EASN association will be established after analytically formulating the aims of the association, identifying the founding members, formulating the statutes and finally organising an awareness campaign to make the existence of the EASN association known.

Results

The main expected results of the EASN II project are:

- The concept of the scientific and technological pan-European IGs, which was successfully developed and validated for a limited number of technological areas in the framework of the first EASN phase, will be further developed and exploited to cover the whole scientific and technological area of the 2020 Vision for aeronautics and beyond. IGs will become the representatives of the industry to take its views into account. Related IGs will be networked within major technological and scientific areas of aeronautical research, in accordance with the ASTERA/ACARE Taxonomy in order to cover the complete scientific and technological area related to aeronautics (second networking level). These networks will be cross-linked, so as to provide a unique research structure which includes the European aeronautic universities (third networking level).
- The thematic scientific and technological structure of EASN described above will serve as the infrastructure and also the incubator mechanism which will facilitate, organise and promote upstream the innovative research and development of breakthrough technologies.
- The exploitation of regional and thematic EASN structures as well as the links created with the industrial sector.
- The establishment of a permanent and self-funded university association for aeronautical research.

Acronym:	EASN II	
Name of proposal:	European Aeronautics Science Network Phase II	
Contract number:	ASA5-CT-2006-044667	
Instrument:	SSA	
Total cost:	319 500 €	
EU contribution:	319 500 €	
Call:	FP6-2005-Aero-1	
Starting date:	01.11.2006	
Ending date:	30.04.2008	
Duration:	18 months	
Objective:	Competitiveness	
Research domain:	Aerodynamics	
Website:	http://www.EASN.net	
Coordinator:	Prof. Pantelakis Spiros	
	University of Patras, Laboratory of Technology and Strength of Materials	
	Panepistimioupolis, Rion	
	GR 26500 Patras	
E-mail:	pantelak@mech.upatras.gr	
Tel:	+30 (0)2610 991027	
Fax:	+30 (0)2610 997190	
EC Officer:	D. Knoerzer	
Partners:	TU Braunschweig	DE
	ENSMA	FR
	Cransfield University	UK
	Warsaw University of Technology	PL

USE HAAS

Study on high-altitude aircraft and airships (HAAS) deployed for specific aeronautical and space applications

Background

The USE HAAS proposal develops an EU research strategy in the technology sector of high-altitude aircraft and airships (HAAS). HAAS are designed to fly above controlled airspace up to the stratosphere. From such a high altitude, they are expected to provide important aeronautical missions and applications. When hovering in geo-stationary flight they will also provide satellite equivalent services such as regional Earth system observations and communication services with a terrestrial footprint of 600 km in diameter. In order to provide such services HAAS must carry out long-endurance flights of weeks or months, which introduces new concepts for multi-mission applications, given existing legal unmanned aircraft air traffic management regulations. More than a hundred potential USE HAAS stakeholders and end-users took part in the two workshops and working group meetings, and shared the challenge of creating the HAAS sector by preparing the Strategic Research Agenda (SRA) for the sector. The executive summary of the project also includes analysis of existing and developmental HAAS unmanned aircraft, which will be used for potential deployment to provide important missions and applications.

Objectives

The objectives are:

1. to analyse the worldwide state of the art including HAAS aeronautical uses;
2. to develop tentative research objectives for HAAS deployment;
3. to discuss objectives in workshops and working groups to prepare a SRA for the HAAS sector;
4. to disseminate recommendations based on the objectives;
5. to issue the final report including the conclusions and the impact on regulations;
6. to make recommendations for coordinating the activities in this sector, and for defining and disseminating a technological roadmap and a SRA for the HAAS sector based upon the inputs given by the end-users and any potential industrial partner during the workshops and working group meetings.

Hydrogen-Fuel Cell Propelled Aircraft

Solar-Battery-Electric Propelled Airplane

Turbofan Propelled Aircraft

Description of work

Analysis of the working group meetings shows an impressive contribution to the USE HAAS consortium work and its objectives. It specifically highlights the preparation of the HAAS SRA and the creation of the HAAS sector.

The first workshop was organised to disseminate the planned project activities to the new HAAS sector, and to involve EU stakeholders and HAAS platform developers from the USA, Russia, Japan and Korea. The second workshop summarised the current HAAS state of the art and the draft version of the SRA was presented.

The European aeronautical industry, including the air transport industry, is large, important and complex. It was, therefore, entirely appropriate that the work done on this project should include the development of the HAAS sector's SRA. The HAAS SRA consists of three volumes: i) Summary; ii) R&D needs; iii) Missions and applications.

Results

The main achievement of the USE HAAS project was to provide the HAAS sector with a Strategic Research Agenda that includes the R&D needs for developing the HAAS platform, and prospective HAAS missions and applications. There is a need to establish a forum to follow up the activities of the HAAS sector and implement the recommendations of the HAAS SRA, and promote legalisation of needed regulations in order to deploy civilian HAAS unmanned aircraft. Such a forum could be a HAAS observation platform (HAASOP) to include major HAAS stakeholders, relevant industries, research institutes and end-users.

The surprisingly large number of active participants in the two workshops and working group meetings (136) represents an adequate spread from industry and potential end-users, research institutions, public authorities and stakeholders. Many of them were encouraged to implement the HAAS SRA R&D needs and develop a regulatory ATM (air traffic management) to deploy civilian HAAS for different missions and applications. The first meeting of the suggested HAASOP took place on 16 October 2006 and a mandate was given to implement these recommendations.

The deliverables are published on the project website.

Acronym:	USE HAAS	
Name of proposal:	Study on high-altitude aircraft and airships (HAAS) deployed for specific aeronautical and space applications	
Contract number:	ASA4-CT-2005-516081	
Instrument:	SSA	
Total cost:	435 882 €	
EU contribution:	435 882 €	
Call:	FP6-2002-Aero-2	
Starting date:	01.03.2005	
Ending date:	31.08.2006	
Duration:	18 months	
Objective:	Support Actions	
Website:	http://www.usehaas.org	
Coordinator:	Prof. Arie Lavie	
	CTI – Creative Technologies Israel Ltd	
	49 Dagan St.	
	IL 93856 Jerusalem	
E-mail:	arlavie@zahav.net.il	
Tel:	+972 (0)2 64 52 086	
Fax:	+972 (0)2 64 52 489	
EC Officer:	R. Denos	
Partners:	Royal Military Academy	BE
	DLR	DE
	University of York	UK
	Israel Aircraft Industries	IL
	University of Liege (Centre Spatial de Liege)	BE

VEATAL

Validation of an Experimental Airship Transportation for Aerospace Logistics

Background

The 20th century started with the conquest of the atmosphere by aeroplanes and ended with orbiting the earth and moon. The 21st century can foresee the conquest of air cargo transportation by airships in the new economic paradigm of globalisation.

The intensification of transporting goods worldwide requires:
– payloads, which are heavier, larger, indivisible and pre-mounted, still needing to be transported;
– delivery to be achieved at any time, in any place, in all weather, infrastructure-free;
– the carrier to be 'mission versatile' and if active in airspace, to be able to move/hover, lift/descend, be ecological and autonomous.

Objectives

During the early part of the last century, airships were able to tour the world endlessly with 100 tons of payload. This project challenges the new century to 'retro-innovate' in order to provide transport solutions for cumbersome payloads and break the present limit of two tons.

To reach this challenge, the preliminary objectives are:
– to organise conferences/workshops relating to the transportation of cumbersome and indivisible payloads (specially in the aerospace domain) as well as participating and presenting papers during other conferences;
– to demonstrate via the media the feasibility of this transport technology, performing an experimental airship flight with a 4-ton aerospace payload if possible;
– to simulate all the operations required for a transcontinental airship flight, covering all the requirements of the European aerospace industry.

These objectives can be realised by:
– a group of logisticians making an inventory of their needs and handling methods in special transportation;
– a roadmap of airship technology innovations;
– an industrial and R&D consortium for larger prototypes and industrialisation;
– an international training centre, based in Europe, for teaching pilots to fly airships;
– co-operative work on the airship theme, carried out by universities specialising in aerospace and technology.

Description of work

The first part of the work will consist of reviewing the state of the art in aerostatic matters, and illustrating aerostation past history and achievements to provide the background necessary to sustain the architecture of the conference.

Semiosphere, assisted by the Troisel and Supaero teams, will provide the conditions and constraints attached to any satellite payload transportation along with a comparative review of the transportation systems.

Troisel will provide material and illustrations of the lift and transport limits they face in their day-to-day operations with the assistance of logisticians from different walks of industry.

Thermoplane and Compagnie des Aérostats des Pyrénées will then demonstrate the type of contribution which will solve the exposed needs, how the tonnage limit can be broken with illustrations of the existing Russian prototype and how navigating to launching sites will be realised (supported by an animated simulation), while Troisel will investigate how the technology investment (as a roadmap) will be beneficial to the economic systems at large.

These demonstrations will constitute the core of the presentations during the conferences to which experts in the logistic fields will be invited to present their requirements.

Conferences should take place in France, Russia, Beijing and Brussels in order to cover a large spectrum of the stakeholders' issues.

Results

It is expected that VEATAL will achieve a thorough assessment of the requirements linked to the retro-innovation of airships for transportation in terms of complementary interoperable transportation.

A modern airship technology development roadmap will have been drawn up, and hopefully an industrial consortium will be implemented, along with a training centre.

A thermoplane airship

Acronym:	VEATAL
Name of proposal:	Validation of an Experimental Airship Transportation for Aerospace Logistics
Contract number:	ASA4-CT-2006-016093
Instrument:	SSA
Total cost:	278 000 €
EU contribution:	278 000 €
Call:	FP6-2002-Aero-2
Starting date:	01.10.2006
Ending date:	31.03.2008
Duration:	18 months
Objective:	Support Actions
Website:	http://www.veatal.eu
Coordinator:	Dr Gronoff Christian Semiosphere 30 bis rue de l'ancien chateau FR 31670 Labege (Toulouse)
E-mail:	semiosphere@wanadoo.fr
Tel:	+33 (0)5 62 24 41 69
Fax:	+33 (0)5 62 24 00 71
EC Officer:	R. Denos

Partners:	Thermoplane, KB	RU
	Compagnie des Aérostats des Pyrénées	FR
	Troisel S.A.	FR

AeroSME VI

Support for European aeronautical SMEs (Phase VI)

Background

AeroSME VI is another project in the series of successful Specific Support Actions for aeronautics. Running since 1999, AeroSME is providing information and support to encourage and facilitate the participation of European aeronautical small and medium-sized enterprises (SMEs) in R&TD projects funded by the EU.

The improvement of the communication flow and exchange of information with the larger companies and other stakeholders in the aeronautics sector, e.g. universities and research establishments, has resulted in a wider access for SMEs to the industry-led research proposals. Along with other support actions, AeroSME has contributed to an increase in the participation of SMEs from 5.3% in the Fifth Framework Programme (FP5) to 11.9% in the third call of FP6. However, it is obvious that continuous support is still needed to achieve the 15% SME participation targeted for FP7.

Objectives

The objectives of the project are:
– to support aeronautical SMEs in advancing their technology base and their competitiveness through participation in European R&TD projects to improve and maintain the competitiveness of the European aeronautical supply chain;
– to promote SME participation in the EU Framework Programmes by providing the necessary support and information services. AeroSME VI is focused on the first call of FP7 and will start the preparation of the second call;
– to stimulate international co-operation by supporting and coordinating a reliable network between SMEs, industry, research institutes, universities and other entities;
– to support the aerospace sector of the new and candidate Member States in joining the European aerospace community;
– to stimulate the exchange of information and views among the various

Aero SME Home page

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tiers of the supply chain by providing a communication platform, not only for SMEs but also for large enterprises and research organisations which usually have little direct access to the SME community.

Description of work

AeroSME is a support action co-ordinated by ASD, the AeroSpace and Defence Industries Association of Europe (formerly AECMA) representing the aerospace industry in Europe in all matters of common interest. Due to the privileged communication channels with large companies (represented in the Industrial Management Groups – IMG4), research establishments, universities, and national and regional associations, AeroSME provides a proactive interface between SMEs and the aeronautic-related bodies and represents a point of reference for SME issues. The coverage of all 33 countries associated with FP7 ensures a truly pan-European approach.

Building on acquired expertise, AeroSME VI continues to provide tailored services in FP7 such as the helpdesk, the website, the internet SME database and newsletters. Specific actions are undertaken in co-operation with IMG4 to facilitate the integration of SMEs in the large collaborative proposals to be submitted in the first aeronautics call in FP7, e.g. the workshop including one-to-one meetings between interested SMEs and project coordinators. Workshops addressed at aeronautical SMEs are organised to raise awareness on European research issues and the industry's future needs, as well as facilitating contacts with large companies in the supply chain.

Results

Since its beginnings, AeroSME has continuously widened its range of activities. Today, AeroSME is an effective communication platform for all players in the aeronautics community, including those who are not represented by the large national/European industrial associations or the major national aeronautical research establishments. The project provides a single point of contact for all inquiries on both EU research and supply chain issues, and for networking in the aerospace sector.

AeroSME has constantly adapted its services to the needs of SMEs in the respective Framework Programmes. Based on an analysis of the SME role in FP6 projects and the new requirements for FP7, AeroSME will provide an advanced FP7 SME support scheme. It will offer the services and activities necessary to cope with the new FP7 rules, to provide the continuously required support to SMEs and to attract and take care of new SME users.

Along with other EC supporting actions, AeroSME will aim to increase the percentage participation of SMEs in the first calls of FP7. The relationship with IMG4 will facilitate the access of SMEs to information on research strategies and proposal preparation activities, which are not usually available to smaller companies.

Acronym:	AeroSME VI
Name of proposal:	Support for European aeronautical SMEs (Phase VI)
Contract number:	ASA5-CT-2006-036587
Instrument:	SSA
Total cost:	320 324 €
EU contribution:	320 324 €
Call:	FP6-2002-Aero-2
Starting date:	01.12.2006
Ending date:	30.11.2007
Duration:	12 months
Objective:	Support Actions
Website:	http://www.aerosme.com
Coordinator:	Ms Chiarini Paola ASD - AeroSpace and Defence Industries Association of Europe Monsanto Building, 270, Avenue de Tervuren BE 1150 Brussels
E-mail:	paola.chiarini@asd-europe.org
Tel:	+32 (0)2 775 82 98
Fax:	+32 (0)2 775 81 11
EC Officer:	R. Denos

Partners:	ASD	BE
	ASD	BE

ECARE+

European Communities Aeronautics Research Plus

Background

The participation of research-intensive SMEs in EC-funded research has always been a challenge in the area of aeronautics, considering the high level of structuring achieved by the supply chain in this particular field. However, the new instruments implemented by the Sixth Framework Programme (FP6), with the objective of structuring the European Research Area, have been considered by many SMEs to be a major hindrance on the road to participation, making it an even greater challenge than during FP5.

Objectives

This proposal follows up on the ECARE project (2003-2005), which was funded under FP5, and is planned as an amplification of the tasks resulting from the first project. The main objective is to greatly improve on the involvement of research-intensive aeronautical SMEs into EC-funded research (on collaborative projects), following a method adapted from the ECARE project, with its identified best practices and the lessons learnt:
– A core group of 8 partners, including 6 aeronautical regional clusters and benefiting from the support of an already established group of 11 other clusters, will further expand in order to involve up to 30 regions.
– Information seminars on FP6 and FP7 opportunities will be organised and SME capabilities will be assessed in order to expand the already existing database of companies to 300 entries. Partner search functionalities will be installed on the project's website.
– SME capabilities will be relayed to the large collaborative projects' coordinators after fine-tuning by ECARE+.

The ongoing collaboration with AeroSME and SCRATCH will be maintained and increased. Dialogue will be established with regional governments or programmes as well as with the aeronautical companies in charge of the large collaborative projects' coordination.

Description of work

In the first phase, ECARE+ will expand its core group from what it was at the end of the previous ECARE project (17 clusters) to 30 clusters. Common tools and methods will be discussed and implemented. People in the regional points of contact will be trained for the subsequent project activities, allowing the ECARE+ Group to become fully operational regarding the project activities and be effective relays to the SMEs in their region.

In the second phase, regional sessions will be organised in the 30 ECARE+ regions, with the aim of preparing SMEs for the first call for proposal of FP7 in the field of aeronautics. The ECARE+ sessions will present the opportunities of the first FP7 calls and the ECARE+ method, which will support participation of SMEs in large collaborative projects.

Once the information is disseminated during the regional sessions, the ECARE+ contact points will assess the technological capacities of SMEs and their willingness to bring a benefit to large collaborative projects. The ECARE+ database will be expanded from 200 to 300 entries and will be updated for each call during the life of the project. Small groups of SMEs will be identified and forwarded to the coordinator of each large collaborative project.

During this process, much emphasis will be put on ECARE+ fostering partnerships between SMEs from different regions, with the aim of establishing trans-national clusters for research and business.

ECARE+ will work in close collaboration with other EC-funded support measures in the field of aeronautics, such as AeroSME and SCRATCH.

Results

ECARE+ will foster partnerships between:
- European aeronautics clusters
- SMEs from different clusters
- SMEs and large companies in the framework of FP7's large collaborative projects.

ECARE+ will organize 20 information seminars, or regional sessions, and will expand its SME database to include up to 350 SMEs.

Acronym:	ECARE+	
Name of proposal:	European Communities Aeronautics Research Plus	
Contract number:	ASA4-CT-2005-016087	
Instrument:	SSA	
Total cost:	535 000 €	
EU contribution:	535 000 €	
Call:	FP6-2002-Aero-2	
Starting date:	01.02.2006	
Ending date:	31.07.2008	
Duration:	30 months	
Objective:	Support Actions	
Website:	http://www.ecare-sme.org	
Coordinator:	Ms Menant Violaine European Federation of High Tech SMEs Washingtonstraat 40 BE 1050 Brussels	
E-mail:	menant@hitech-sme.com	
Tel:	+33 (0)1 45 23 54 93	
Fax:	+33 (0)1 45 23 11 89	
EC Officer:	R. Denos	
Partners:	ANRT	FR
	Aerospace Wales Forum	UK
	Comité Richelieu	FR
	Linköping University	SE
	HEGAN	ES
	CeTIM	DE
	Technapoli	IT

AEROCHINA

Promoting scientific co-operation between Europe and China in the field of multiphysics modelling, simulation, experimentation and design methods in aeronautics

Background

Numerous codes, models, design optimisations and experimental tools have been developed and used until recently, in both Europe and China, and have proven to be of significant value in many industrial applications, but not when dealing explicitly with combined multidisciplinary issues. So far, the correct use of such single discipline codes has been limited to a specific range of applications. There is still a lack of initial information on available methods, codes and experiments related to combined multidisciplinary problems in aeronautics in Europe and China.

The aim of AEROCHINA is to identify and implement future collaboration between Europe and China by finding a solution to the multidisciplinary design problems in aeronautics. This will be achieved by studies aiming to collect, store and disseminate the existing knowledge in Europe and China in the field of multiphysics modelling, simulation, experimentation and design in aeronautics.

The combined disciplines to be considered include, among others, fluids, structures, chemistry and thermal flows with applications in aero elasticity, aero/vibro-acoustics, aero heating, combustion and turbulence. New experiments and modern diagnostic measurement techniques will be investigated and identified for future rigorous multidisciplinary validation purposes.

Objectives

The aim of AEROCHINA is to foster the co-operation between a number of industrial, university and research organisations in the aeronautics sector in Europe and China in the field of mathematical modelling, computer simulation and code validation, experimental testing and design methods for the solution of multiphysic problems of interest in the aeronautics sector. The physical disciplines (combined or not) considered in AEROCHINA which are of interest to European and Chinese partners are aerodynamics, structures and materials, fluid dynamics, aero acoustics and aero elasticity.

Description of work

The project structure is divided into five Work Packages (WP).

Work in WP1 focuses on the collective assessment and report on the strategy to be followed for the development of the project objectives. The technical specifications of the web-based Communication System are also defined in WP1. Additional work includes the initial specification of the data collection and quality assessment procedures, and the dissemination and exploitation plans.

The Communication System is developed in WP2. Work focuses on the development of the web structure, the data storage and the communication procedures. The development and management of the multidisciplinary database is also part of the activities in WP2.

WP3 focuses on the state-of-the-art review and collection of existing multidisciplinary mathematical models, numerical and experimental methods, simulation results and test results. The data collected is stored in the database within the Communication System.

WP4 focuses on the definition of RTD activities which will require further joint RTD work in Europe and China for analysis and design optimisation of the multiphysics problems. Both scientific and industrial aspects are considered. Specific RTD activities that are ready for a joint proposal in the Seventh Framework Programme are also being defined.

The organisation of a kick-off conference and one workshop in Europe, which is aiming at both internal and external dissemination of the information compiled in AEROCHINA, will be carried out in WP5.

Results

The web-based communication tools and the project database are the basic tools that have been used for the identification and storage of the different mathematical formulae and computational/experimental approaches for solving multidisciplinary problems in aeronautics. Some time has also been invested in the compilation and storage of data from experimental tests to be used as a reference for validating the methods and software for multidisciplinary applications in aeronautics.

In addition, a set of six working groups related to the different multidisciplinary test cases considered in the project has been created and their corresponding activity has already started. The idea behind this is to put together, inside each multidisciplinary working group, the specialists of each discipline in order to deal with the important problem of the interfaces between the disciplines giving the experts of one discipline the opportunity to be aware and open-minded when considering the impacts of their discipline on another one.

Two major dissemination events have been organised in connection with AEROCHINA:

- West-East High Speed Flow Field 2005 Conference
- AEROCHINA China-Europe Open Seminar.

Both events have centralised most of the activities of AEROCHINA partners.

Acronym:	AEROCHINA
Name of proposal:	Promoting scientific co-operation between Europe and China in the field of multiphysics modelling, simulation, experimentation and design methods in aeronautics
Contract number:	ASA5-CT-2006-030750
Instrument:	SSA
Total cost:	200 000 €
EU contribution:	200 000 €
Call:	FP6-2002-Aero-2
Starting date:	01.10.2005
Ending date:	31.03.2007
Duration:	19 months
Objective:	Support Actions
Website:	http://www.cimne.com/aerochina/
Coordinator:	Prof. Bugeda Gabriel CIMNE Edifici C1, Campus Nord UPC; Gran Capità s/n ES 08034 Barcelona
E-mail:	bugeda@cimne.upc.edu
Tel:	+34 (0)93 401 64 94
Fax:	+34 (0)93 401 65 17
EC Officer:	D. Knoerzer

Partners:	Dassault	FR
	EADS-CRC	FR
	EADS-M/DE	DE
	Airbus	ES
	INUSTI-UNIV.PROV	FR
	INIRIA	FR
	DLR	DE
	ERCOFTAC	BE
	University of Birmingham	UK
	IFTR	PL
	INGENIA	ES
	ACTRI/AVIC1	CN

RTD Directorate H

European Commission
DG RTD H3
CDMA
21 rue du Champ de Mars
1049 Brussels
Belgium

H: Transport

Director	András Siegler Tel.: +32 (0)2 29 80182 andras.siegler@ec.europa.eu	 CDMA 4/45 Fax: +32 (0)2 29 92111
Assistant	Christina Kaltsounidou-Kennedie Tel.: +32 (0)2 29 52676/56009 christina.kaltsounidis@ec.europa.eu	 CDMA 4/32 Fax: +32 (0)2 29 92111

H.3 Aeronautics

Head of Unit	Liam Breslin Tel.: +32 (0)2 29 50477 liam.breslin@ec.europa.eu	 CDMA 4/167 Fax: +32 (0)2 29 66757
Project Officer	Johan Blondelle Tel.: +32 (0)2 29 64080 johan.blondelle@ec.europa.eu	 CDMA 4/160 Fax: +32 (0)2 29 66757
Project Officer	Marco Brusati Tel.: +32 (0)2 29 94848 marco.brusati@ec.europa.eu	 CDMA 4/169 Fax: +32 (0)2 29 66757
Project Officer	Daniel Chiron Tel.: +32 (0)2 29 52503 daniel.chiron@ec.europa.eu	 CDMA 4/134 Fax: +32 (0)2 29 66757
Project Officer	Rémy Dénos Tel.: +32 (0)2 29 86481 remy.denos@ec.europa.eu	 CDMA 4/137 Fax: +32 (0)2 29 66757
Project Officer	Dietrich Knoerzer Tel.: +32 (0)2 29 61607 dietrich.knoerzer@ec.europa.eu	 CDMA 4/161 Fax: +32 (0)2 29 66757
Project Officer	Per Kruppa Tel.: +32 (0)2 29 65820 per.kruppa@ec.europa.eu	 CDMA 4/162 Fax: +32 (0)2 29 66757

Project Officer
Jean-Luc Marchand
Tel.: +32 (0)2 29 86619 CDMA 4/138
jean-luc.marchand@ec.europa.eu Fax: +32 (0)2 29 66757

Project Officer
José Manuel Martin Hernandez
Tel.: +32 (0)2 29 57413 CDMA 4/163
jose.martin-hernandez@ec.europa.eu Fax: +32 (0)2 29 66757

Project Officer
Pablo Perez-Illana
Tel.: +32 (0)2 29 84928 CDMA 4/127
pablo.perez-illana@ec.europa.eu Fax: +32 (0)2 29 66757

Project Officer
Andrzej Podsadowski
Tel.: +32 (0)2 29 80433 CDMA 4/133
andrzej.podsadowski@ec.europa.eu Fax: +32 (0)2 29 66757

Project Officer
Hans Josef von den Driesch
Tel.: +32 (0)2 29 60609 CDMA 4/172
hans-josef.von-den-driesch@ec.europa.eu Fax: +32 (0)2 29 66757

Secretary
Mark Arlestrand
Tel.: +32 (0)2 29 60606 CDMA 4/164
mark.arlestrand@ec.europa.eu Fax: +32 (0)2 29 66757

Secretary
Thomas Schizas
Tel.: +32 (0)2 29 64081 CDMA 4/167
thomas.schizas@ec.europa.eu Fax: +32 (0)2 29 66757

Secretary
Krystyna Sitkowska
Tel.: +32 (0)2 29 88322 CDMA 4/171
krystyna.sitkowska@ec.europa.eu Fax: +32 (0)2 29 66757

IT/Budget
Matthew Joseph Cosgrave
Tel.: +32 (0)2 29 60970 CDMA 4/170
matthew-joseph.cosgrave@ec.europa.eu Fax: +32 (0)2 29 66757

Secretary
Jessica de Lannoy Home
Tel.: +32 (0)2 29 57679 CDMA 4/164
jessica.de-lannoy-home@ec.europa.eu Fax: +32 (0)2 29 66757

TREN Unit F.2

European Commission
DG TREN F02
DM24 5/
24 rue de Mot
1049 Brussels
Belgium

F2: Single sky & modernisation of air traffic control

Head of Unit	Luc Tytgat Tel.: +32 (0)2 29 68430 luc.tytgat@ec.europa.eu	DM24 05/083 Fax: +32 (0)2 29 84349
Project Officer	Morten Jensen Tel.: +32 (0)2 29 64620 morten.jensen@ec.europa.eu	DM24 5/068 Fax: +32 (0)2 29 68353
Project Officer	Christopher North Tel.: +32 (0)2 29 68336 christopher.north@ec.europa.eu	DM24 5/033 Fax: +32 (0)2 29 68353
Project Officer	Elisabeth Martin Tel.: +32 (0)2 29 57798 elisabeth.martin@ec.europa.eu	DM24 5/055 Fax: +32 (0)2 29 68353
Secretary	Sylvie de Boeck Tel.: +32 (0)2 29 52105 sylvie.de-boeck@ec.europa.eu	DM24 5/077 Fax: +32 (0)2 29 68353
Secretary	Sagrario Rosado Tel.: +32 (0)2 29 87611 sagrario.rosado@ec.europa.eu	DM24 05/059 Fax: +32 (0)2 29 68353

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ALBANIA
Mr AGOLLI Edmond
Ministry of Education and Science of Albania
Directorate of Scientific Research (DSR)
Street Durresi, 23
Tirana
eagolli@mash.gov.al

AUSTRIA
Dipl.-Ing. ROHOWETZ Hans
FFG-Austrian Research Promotion Agency
EIP
Sensengasse 1
A-1090 Vienna
+43-5-7755-4303
hans.rohowetz@ffg.at
http://www.ffg.at

BELGIUM
FIASSE Pierre
UWE (Union Wallonne des Entreprises)
Chemin du Stockoy, 3
B-1300 Wavre
+32-10-471949
pierre.fiasse@uwe.be
http://www.ncpwallonie.be/

BONNIJNS Alexandre
BEA (Brussels Enterprise Agency)
Tour & Taxis, Avenue du Port 86c B 211
B-1000 Brussels
+32-2-4220045
abo@abe.irisnet.be
http://www.abe.irisnet.be/

VAN DINTER Pascale
STIS (Scientific and Technical Information Service)
Boulevard de l'Empereur, 4
B-1000 Brussels
+32-2-5195642
pascale.vandinter@stis.fgov.be
http://eurofed.stis.fgov.be/

DE RIDDER Luc
IWT (Instituut voor de aanmoediging van innovatie door Wetenschap & Technologie in Vlaanderen)
Bischoffseimlaan, 25
B-1000 Brussels
+32-2-7881566
ldr@iwt.be
http://www.iwt.be/

BULGARIA

Mr MILANOV Evgeni
Bulgarian Academy of Sciences Bulgarian Ship Hydrodynamics Centre
Asparuhovo
9000 Varna
+359-5-2370506
e.milanov@bshc.bg
http://www.bshc.bg

Mr MARKOV Iasen
Ministry of Transport Coordination of Programmes and Projects Directorate
9 Diakon Ignatii
1000 Sofia
+359-2-9409502
imarkov@mt.government.bg
http://www.mt.government.bg

Mrs DIMOVA Biliana
Technical University
8 Kliment Ohridski Blvd.
1756 Sofia
+359-2-9652678
dimova@tu-sofia.bg
http://www.tu-sofia.bg

Mr DOLCHINKOV Radostin
Burgas Free University
Centre for Informatics, Engineering and Natural Sciences
62 San Stefano Str.
8001 Bourgas
+359-5-6827680
rado@bfu.bg
http://www.bfu.bg

Mr MARINOV Mitko
Rousse University «Angel Kanchev»
Auto-Transport Faculty
8 Studentska Str.
7017 Rousse
+359-8-2888609
mdmarinov@ru.acad.bg
http://www.ru.acad.bg

SWITZERLAND
Dr TAUER Andy
Euresearch
Effingerstrasse 19
3001 Bern P.O. Box 7924
+41-31-3806007
andy.tauer@euresearch.ch
http://www.euresearch.ch

CYPRUS
Mr. SPANOS Mathaios
Research Promotion Foundation
P.O. Box 23422 Nicosia
+357-22660292
mspanos@research.org.cy
http://www.research.org.cy/

CZECH REPUBLIC
Ing SKARKA Martin
Academy of Sciences of the Czech Republic
Technology Centre (TC)
Technology centre AS CR, Rozvojová 136
165023 Praha 6
+42-02-34006113
skarka@tc.cz

GERMANY
FISENI Felix
TÜV Rheinland Consulting GmbH
Research Management, Nationale Kontaktstelle Verkehr
Am Grauen Stein 33x
51101 Köln
+49-221-8064156
felix.fiseni@de.tuv.com
http://www.nks-verkehr.eu/

Dr ROMAHN Stephan
PT-Luftfahrtforschung c/o DLR
Nationale Kontaktstelle
Königswinterer Str. 522-524
53227 Bonn
+49-228-447673
stephan.romahn@dlr.de
http://www.dlr.de/PT-LF/eukontakt/eukontak.html

Mr DOERR David
TÜV Rheinland Consulting GmbH
Research Management, Nationale Kontaktstelle Verkehr
Am Grauen Stein 33x
51101 Köln
+49-221-8064156
david.doerr@de.tuv.com
http://www.nks-verkehr.eu/

Mr BENTZINGER Peter
PT-Luftfahrtforschung c/o DLR
Nationale Kontaktstelle
Königswinterer Str. 522-524
53227 Bonn
+49-228-447672
peter.bentzinger@dlr.de
http://www.dlr.de/PT-LF/eukontakt/eukontak.html

DENMARK

Ms ESPEGÅRD HASSEL Nina
EuroCenter
Danish Agency for Technology and Innovation
Bredgade 40
1260 Copenhagen K
+45-35446293
neha@fist.dk
http://www.dasti.dk

ESTONIA

Ms HABICHT Maria
ARCHIMEDES FOUNDATION
EU INNOVATION CENTRE
Väike-Turu 8
51013 Tartu
+372-7-300327
mari@ibs.ee

SPAIN

Phd. MONCLUS GONZALEZ Jesús
CDTI
Cid, 4
E-28001 Madrid
+34-91-5815562/66
jmonclus@cdti.es
http://www.cdti.es/

Prof. GARCIA BENITEZ Francisco
Universidad Superior de Ingenieros
Ingeniería e Infraestructuras de Transportes
Camino de los Descubrimientos
E-41092 Sevilla
+34-95 448 73 15
benitez@esi.us.es

FINLAND

Ms NIEMI Anne
Ministry of Transport and Communications
Administration and Specialist Unit
FI-00023 Government
00023 Helsinki P.O.Box 31
+358-9-16028478
anne.niemi@mintc.fi

FRANCE

Mr DECOSTER Pierre
Ministère du transport / DRAST
CLORA / RST
8, avenue des arts
B-1210 Bruxelles
+32-25068874
decoster@clora.net
http://www.clora.net

Mr MACÉ Christian
Ministère des transports, de l'Equipement, du Tourisme et de la Mer / CETMEF
DTELE/DRDE
151, Quai du Rancy
94381 Bonneuil sur Marne BP 12
+33-1-45135340
christian-ph.mace@equipement.gouv.fr
http://www.cetmef.equipement.gouv.fr

Mr KAËPPELIN Louis
École Nationale des Ponts et Chaussées - ENPC
CLORA / RST
8, avenue des arts
B-1210 Bruxelles
+32-2-5068875
kaeppelin@clora.net
http://www.clora.net

Mr SCHÖNFELD Thilo
Aerospace Valley
2, avenue Edouard Belin
31400 Toulouse
+33-5-61148030
schoenfeld@aerospace-valley.com
http://www.aerospace-valley.com

UNITED KINGDOM

Ms RICHARDS Gill
GR Aero Ltd
12 The Mount, Aspley Guise
MK17 8AE Milton Keynes
+44-870-1910117
gill.richards.dti@btinternet.com
http://www.fp7uk.dti.gov.uk

Ms MCKENZIE Finella
National Physical Laboratory (NPL)
11 Park Road, Rottingdean
BN2 7HL Brighton
+44-1273-390512
Finella.McKenzie@virgin.net
http://www.fp7uk.dti.gov.uk

Mr FUNNELL Cliff
Sustainable Surface Transport (Land, rail, waterbourne)
70 Downview Road
PO22 0EE Barnham
+44-870-1910117
transrtd@fp7uk.co.uk
http://www.fp7uk.dti.gov.uk

GREECE

Dr. TZITZINOU Cathrine
PRAXIS/HELP FORWARD
4, Zalokosta str.
106 71 Athens
+30-210-3607690
katerina@help-forward.gr
http://www.help-forward.gr/

Mr. CHRISTOFILOPOULOS Epaminondas
PRAXIS/HELP FORWARD
1, Square Morihovou
546 25 Thessaloniki
+30-2310-552791
epaminondas@help-forward.gr
http://www.help-forward.gr/

CROATIA

JELICIC Damir
Ministry of Science, Education and Sports
Department for European Integrations
Trg hrvatskih velikana 6
10000 Zagreb
+385-1-4594457
damir.jelicic@mzos.hr
http://www.mzos.hr

HUNGARY

Ms JÁRAY GYÖNGY Katalin
National Office for Research and Technology
Department for Bilateral and Attache Affairs
Neumann János u. 1/c
1117 Budapest
+36-1-4842535
katalin.jaray@nkth.gov.hu

IRELAND
Mr FLYNN Bob
Enterprise Ireland
Michael Street
Limerick
+353-61-408867
bob.flynn@enterprise-ireland.com
http://www.enterprise-ireland.com

ISRAEL
Ms GOLDSTEIN Orly
ISERD-Israeli Directorate for EU Framework Programme
29 Hamered St
IL-61500 Tel Aviv POB 50436
+972-3-5118122
orly@iserd.org.il

ICELAND
Ms VALSDOTTIR Rebekka
RANNIS
Laugavegi 13
101 Reykjavik
+354-5155800
rebekka@rannis.is

THORDARSON Skúli
Vegsyn ehf.
Klettabergi 62
221 Hafnarfirdi
+354-8467253
skuli@vegsyn.is

ITALY
BOZZOLI Sabrina
APRE - Agenzia per la Promozione della Ricerca Europea
Piazzale Marconi 25
00144 Roma
+39-06-5911817
bozzoli@apre.it

CECCARELLI Annalisa
APRE - Agenzia per la Promozione della Ricerca Europea
Piazzale Marconi 25
00144 Roma
+39-06-5911817
bozzoli@apre.it

LITHUANIA
Mr LAPIENIS Saulius
Agency for International Science and Technology Development Programmes
A. Gostauto 12-219
1108 Vilnius
+370-5-2127434
saulius.lapienis@tpa.lt
http://www.tpa.lt

LUXEMBOURG
Mr FERRING Marc
LUXINNOVATION EIG - National Agency for Innovation and Research
7, rue Alcide de Gasperi
L-1615 Luxembourg
B.P. 1372
+352-43-62631
marc.ferring@luxinnovation.lu
http://www.luxinnovation.lu

Mrs MICHEL Hélène
LUXINNOVATION EIG - National Agency for Innovation and Research
7, rue Alcide de Gasperi
L-1615 Luxembourg B.P. 1372
+352-43-62631
helene.michel@luxinnovation.lu
http://www.luxinnovation.lu

LATVIA
Dr KALNINS Kaspars
Riga, Technical University
Institute of Materials and Structures
Kalku 1
LV-1658 Riga
+371-26-751614
kasisk@latnet.lv

MONTENEGRO
Ph.D VUJADINOVIC Radoje
University of Montenegro
Faculty of Mechanical Engineering
Cetinjski put bb
81000 Podgorica
+381 67 544 766
radojev@cg.yu
http://www.ucg.cg.ac.yu/index_en.htm

MACEDONIA, THE FORMER YUGOSLAV REPUBLIC OF
Mr. LEPAVCOV Andrej
Institute OHRID
Ul. Dimitrie Tucovic 24
1000 Skopje
+389-2-3224547
alepavcov@oi.org.mk

MALTA
Dr ZAMMIT-MANGION David
University of Malta
Department of Microelectronics, University of Malta
MSD 06 Msida
+356-23402072
dzmang@eng.um.edu.mt
http://www.mcst.org.mt

Dr WARRINGTON Brian
Malta Council for Science and Technology
Malta Council for Science and Technology, Villa Bighi,
CSP 12 Kalkara
+356-2360-2130
brian.warrington@gov.mt
http://www.mcst.org.mt

THE NETHERLANDS
Ir BURGWAL, VAN DER Erik
SenterNovem
Juliana van Stolberglaan 3
2509 AC The Hague PO Box 93144
+31-70-3735250
e.van.de.burgwal@egl.nl
http://www.egl.nl

Ir SOEDE Matthijs
SenterNovem
EG-Liaison
Juliana van Stolberglaan 3
2509 AC The Hague PO Box 93144
+31-70-3735250
m.soede@egl.nl
http://www.egl.nl

NORWAY
Mr OSMUNDSVÅG Knut Helge
Research Council of Norway
Division for Innovation
St. Hanshaugen
0131 Oslo POB 2700
+47-22-037000
kho@rcn.no

Mr THORSHAUG Niels Peter
Research Council of Norway
EU RTD Office
St. Hanshaugen
0131 Oslo POB 2700
+47-22-037000
npt@rcn.no

Mr STRANDLI Øystein
The Research Council of Norway
St. Hanshaugen
0131 OSLO PO Box 2700
+47-22-037000
ost@rcn.no

POLAND
TUREK Zbigniew
The Institute of Fundamental Technological Research PAS
National Contact Point for Research Programms of the European Union
Swietokrzyska 21 str.
00-049 Warsaw
+48-22-8287483 ext .159
zbigniew.turek@kpk.gov.pl
http://www.kpk.gov.pl

PYCZAK Mikolaj
The Institute of Fundamental Technological Research PAS
National Contact Point for Research Programms of the European Union
Swietokrzyska 21 str.
00-049 Warsaw
+48-22-8287483 ext .159
mikolaj.pyczak@kpk.gov.pl
http://www.kpk.gov.pl

PORTUGAL
Mr SERINA Luís
Ministry of Science, Technology and Higher Education
Av. 5 de Outubro, No 85 - 7
1050-050 Lisbon
+351-21-7828303
luis.serina@grices.mctes.pt
http://www.grices.mctes.pt

Mr RODRIGUES Vasco
GRICES (Office for International Relations in Science and Higher Education)
DSAC (Unit for European Affairs)
Av. 5 de Outubro, 85,5
1050-050 Lisbon
+351-21-7828367
vasco.rodrigues@grices.mctes.pt
http://www.grices.mctes.pt

ROMANIA

Mrs PADUROIU Beatrice
Ministry of European Integration
Management of the EU Structural Funds21-25, Mendeleev Street
010362 Bucharest
+40-21-3183065
beatrice.paduroiu@mct.ro
http://www.mct.ro

Dr RACHERU Anca
Romanian Space Agency
Management of the EU Structural Funds21-25, Mendeleev Street
010362 Bucharest
+40-21-3168722
anca.racheru@rosa.ro
http://www.rosa.ro

SERBIA

Ms MILOSEVIC Nada
Ministry of Science and Environmental Protection
Njegoseva 12
11000 Belgrade
+381-11-3616529
nada.milosevic@nauka.sr.gov.yu

Mr. MELNIKOV Vladimir
JSC
Unit of Advanced Research and Technology
Rizhskaya pl., 3
107996 Moscow
+7-495-2623295
cntisecretar@mail.ru
http://www.rzd.ru

Prof. PAVLOV Leonid
JSC
Rizhskaya pl., 3
107996 Moscow
+7-495-2623295
cntisecretar@mail.ru
http://www.rzd.ru

SWEDEN

WALLGREN Christine
VINNOVA
Mäster Samuelsgatan 56
10158 Stockholm
+46-8-4733009
christine.wallgren@vinnova.se

ALATALO Juha
VINNOVA/Europaprogrammen
Mäster Samuelsgatan 56
10158 Stockholm
+46-8-4546458
juha.alatalo@vinnova.se

SLOVENIA

Dr FEDOR Cerne
Ministry of Transport
Transport Policy Unit
Langusova 4
1000 Ljubljana
+386-1-4788319
fedor.cerne@gov.si

SLOVAKIA

doc.Ing.PhD. FABIAN Peter
University of Zilina
CETRA- Centre for Transport Research
Univerzitná 1
010 26 Zilina
+421-41-5135012
Peter.Fabian@fri.utc.sk, fabian@rekt.utc.sk
http://www.utc.sk/cetra/

TURKEY

Mr KORU Aziz
TUBITAK
FPs National Coordination Office
Atatürk Bulvari No:221
6100 Ankara
+90-312-4272302
ncptransport@tubitak.gov.tr

Mr OZAN Gürcan
TUBITAK
FPs National Coordination Office
Atatürk Bulvari No:221
6100 Ankara
+90-312-4272302
ncptransport@tubitak.gov.tr

SOUTH AFRICA

Mr MOKONYAMA Mathetha
Council for Scientific and Industrial Research
Private Bag x 395
0001 Pretoria
+27-83-4575648
mmokonyama@csir.co.za
http://www.csir.co.za

Dr PARKER Kamallunddien
Advanced Manufacturing Technology Strategy
Manufacturing Technology
Private Bag x 395
0001 Pretoria
+27-82-4158548
Kparker@csir.co.za
http://www.csir.co.za

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The aim of this publication is to provide information on research projects that have been financed in the Sixth Framework Programme (FP6) within the field of Aeronautics. While Volume 1 of the project synopsis covered the project selected in the first calls for proposals, this second volume covers the last calls.

Similar to Volume 1, the projects are grouped in the following categories:

- Strengthening competitiveness
- Improving environmental impact with regard to emissions and noise
- Improving aircraft safety and security
- Increasing the operational capacity of the air transport system.

The background, objectives, description of work and expected results of each project are presented here. The contact details of the coordinators and the partnership are also given. Comprehensive index lists by acronym, by partner and by instrument have been provided to ease your search.

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