European Aeronautics Science Network

The European Aeronautics Science Network Association

Endorsed projects for the 5th FP7 call

Presented by: Michael Papadopoulos

European Aeronautics Science Network

Projects overview

EM-CRACK	Aircraft Health Monitoring by exploiting Fracture-Induced Emitions of Electromagnetic Radiation
GENUMAS	Geometric Numerical Simulator for Aircraft Safety
CORSAIR	New solutions for manufacturing and repair of Ni alloys components
ALSYS	Composite Aircraft Active Lightning-strike Protection System
SULTRAMAT	Surface engineering for ultra high temperature Nb based alloys for the aerospace sector
PARAD^{2}IS	Parameters of defects detected in composites by shearography
AISHA+	Aircraft integrated structural health assessment +
VIVID	Virtual assessment of low-velocity impact damage in composite airframes
QICOM	Quantitative inspection of complex composite aeronautic parts using advanced X-ray techniques
CJ	Innovative Aerostructures Connections – ”Composite Joints of Aerostructures”
SAB-P	Smart based air power system
HIPACT	Design of novel aircraft structures resistant to high velocity impact
IASS	Improving the aircraft safety by self healing structure and protecting nanofillers
NICS	Development of novel methods of laminar flow control on a swept wing
ATMAS	Development of the future ATM concept based on 4D navigation/planning capabilities, common data pool and advanced CDM process.
Uplane	The concept of unmanned transport aircraft – feasibility assessment taking into account safety issues, possibility of joint usage of the airspace (including the upper one), certification.
IN-LIGHT-eWINDOW	Development of innovative light blocking electro and thermo chromic coatings for energy efficient windows

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GENUMAS: Geometric Numerical Simulator for Aircraft Safety

Coordinated by: ***University of Zagreb***

Prof. dr. sc. Zdravko Terze ***(zdravko.terze@fsb.hr)***

Core Partnership:

Univ. Zagreb (Croatia), Univ. Liege (Belgium), Politecnico di Milano (Italy), Univ. Duisburg-Essen (Germany), Univ. Cranfield (UK), Politecnico di Torino (Italy), TsAGI (Moscow, Russia), DINAMIKA (Russia), EASN (SME, Belgium), CASSIDIAN Air Systems (Spain) , AWPARC (SME, Italy) - In negotiation.

- **Activity in Work Programme:**

  Ensuring customer satisfaction and safety, Protection of aircraft and passengers, Improving cost efficiency, The greening of air transport

- **Area in Work Programme:**

  Aircraft safety, Operational safety, Aircraft development cost

- **Topic in Work Programme :**

  Systems and equipment, Design systems and tools

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- **Project content and goals:**

  - design a reliable computational environment for the coupled simulation of complex landing and take-off accidental scenarios;

  - exploit novel geometric mathematical models and computational algorithms (algorithms that operate in the non-linear spaces (i.e. manifolds), instead of ‘standard’ vector spaces, and allow for modeling of ‘geometrically exact’ structural entities and more robust integration algorithms);

  - enable efficient and stable integration synthesis of the flight physics model, structural numerical model, landing gear dynamics and control algorithms.

- **Expected impact:**

  Expected impact of the novel and more accurate computational models and flight simulation procedures:

  - increased level of safety of fixed-wing aircraft and rotorcraft flight operations;

  - design of more cost effective flight scenarios and greening of air transport;

  - improvement of level of overall operation safety and protection of aircraft and passengers.

Partners needed to complete the consortium

- Industrial partners (end-users) active in design of flight simulation procedures

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CORSAIR: Coldspray Radical Solutions for Aeronautic Improved Repairs

Coordinated by: ***Dr. Simone Vezzù (Veneto Nanotech scpa, ITALY)***

Core Partnership:

Universities and Research Organizations (3):

Veneto Nanotech scpa (ITALY) ; Politecnico di Milano (ITALY) ; University of Juan Rey Carlos III (SPAIN)

Industrial Partners (5):

AVIO spa (ITALY); EADS-IW (GERMANY) ; CGT* (GERMANY) ; LPW (UK); TWI (UK)

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- **Activity in Work Programme:** ACTIVITY 7.1.1. THE GREENING OF AIR TRANSPORT
- **Area in Work Programme:** Area 7.1.1.2. Ecological production and maintenance
- **Topic in Work Programme :** *AAT.2012.1.2-2. Maintenance and disposal*

or (to be defined)

- **Activity in Work Programme:** ACTIVITY 7.1.4. IMPROVING COST EFFICIENCY
- **Area in Work Programme:** Area 7.1.4.2. Aircraft operational cost
- **Topic in Work Programme :** *AAT.2012.4.2-6. Maintenance and repair*

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- **Project content and goals:**

– *Use of Cold Spray Technology as low temperature and high efficiency repair technology for aeronautic components and structures.*

– *First Focus in components and frames in light alloys: Al, Mg and Ti alloys.*

– *Design and Development of a portable unit in order to provide quick and high-performances in-situ repairs.*

– *Second Focus in repair of Ni alloys components.*

- **Expected impact:**

– **Improving the cost-efficiency** and **time-efficiency** *by the implementation of a high-performance and high-efficiency repair technology: (1) increase the capability to* ***re-use of components*** *by repair. (2) increase the* ***life-time of components*** *by high-performances protective repairs. (3) possibility to define and realize* ***cost-effective in-situ*** *repairs.*

– **Greening of air transport** *by increasing both the full recyclability and full lifetime of components and by substituting actually processes by using a eco-friendly repair technology (Cold Spray)*

Partners needed to complete the consortium

- ***One/Two*** *industrial partners involved in production of aeronautic components and/or structures (some agreements were actually in discussion even if for instance no official agreements have been received by other industrial partners).*
- *One research organization (in this sense there are several "sheet of interest" and the partner could be quickly selected when the core consortium will be completed)*

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ALSYS: Composite Aircraft Active Lightning-strike Protection System

Coordinated by: *Prof. Igor R Rybalchenko, National Aerospace University "Kharkiv Aviation Institute" (KhAI)*

Project will be presented in more detail during ETNA brokerage event

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AISHA+: Aircraft integrated structural health assessment

Coordinated by: ***Katholieke Universiteit Leuven - Belgium***

AISHA + SHM + aNDT

- **Activity in Work Programme:**
  - 7.1.4. IMPROVING **COST EFFICIENCY**
- **Area in Work Programme:**
  - 7.1.4.2. Aircraft operational cost
- **Topic in Work Programme :**
  - AAT.2012.4.2-2. Aerostructures

- **Activity in Work Programme:**
  - 7.1.3. ENSURING CUSTOMER SATISFACTION AND **SAFETY**
- **Area in Work Programme:**
  - 7.1.3.3. Aircraft safety
- **Topic in Work Programme :**
  - AAT.2012.3.3-1. Aerostructures

- **Activity in Work Programme:**
  - 7.1.1 THE **GREENING** OF AIR TRANSPORT
- **Area in Work Programme:**
  - 7.1.1.1. Green aircraft + 7.1.1.2. Ecological production and maintenance
- **Topic in Work Programme :**
  - AAT.2012.1.1-2. Aerostructures
  - AAT.2012.1.2-2. **Maintenance** and disposal

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- **Project content and goals:**

– The “plus” in the title “AISHA+” refers to an extended approach, i.e. **structural health monitoring (SHM)** will partially be combined with **advanced** or traditional **non-destructive testing**. There is a tendency to believe that SHM will finally replace traditional scheduled non-destructive testing. But a combination of SHM and advanced NDT would make more sense in some cases – especially on short term.

– The basic concept of the project is the implementation of diverse **innovative non-destructive techniques** to detect damage (fatigue, impact, corrosion) in selected and **relevant full-scale aircraft parts** (metal, composites) proposed by maintenance companies and manufacturers. The use of guided **ultrasonic** waves (non-linear ultrasonics, time-of-flight, full-field imaging) will play the major role also in this project, but other technologies, such as **electrochemical** and **electromechanical impedance** monitoring will be more and more applied. Finally, the focus is the creation of robust sensor networks while **avoiding of complex on-board systems**.

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- **Expected impact:**

– It is the intention to use the positive experiences that were obtained within the former **AISHAII** project (e.g. a floorbeam sensor was **certified and implemented in an operational airliner)** and to give it a new dimension by stronger focusing on **final implementation** at the highest technological readiness level (TLR) possible. SHM sensors should be performed as **minor modifications** whenever possible to reduce the time to market.

Partners needed to complete the consortium

- Companies or departments with practical experience in **maintenance, repair and overhaul** (MRO) to find **relevant full-scale parts** for development of structural health monitoring (**SHM**) systems

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VIVID: virtual assessment of low-velocity impact damage in composite airframes

Coordinated by: ***University of Parma (IT), Prof. Alessandro Pirondi***
Core Partnership: *Politecnico di Milano (IT), LMT Cachan (FR), Lublin University of Technology (PL), University of Patras (EL), Bercella srl (IT), EASN (BE), SAMTECH (BE), LATECOERE (FR),*

- **Activity in Work Programme:**

7.1.3 ENSURING CUSTOMER SATISFACTION AND SAFETY;

7.1.4IMPROVING COST EFFICIENCY

- **Area in Work Programme:**

7.1.3.3. AIRCRAFT SAFETY

7.1.4.1. AIRCRAFT DEVELOPMENT COST

- **Topic in Work Programme:**

AAT.2012.3.3-1. Aerostructures

AAT.2012.4.1-1. Design systems and tools

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- **Project content and goals:** the project is aimed at developing and validating experimentally advanced modeling tools for the **virtual assessment** of the airframe with respect to **low-velocity impact damage tolerance.** Typical example: impact from tools falling during maintenance.

1. In order to provide a good usage of these advanced capabilities, **correct values for model parameters** should be used. This can be done thanks to a large numerical tests campaign, to be compared to a corresponding experimental test campaign for validation.
2. A distinctive point of VIVID is to **implement new models into an existent commercial finite element software** developed by a project partner. This allows to make the developments durable in a European software and to solve problems with a complexity level that cannot be reached with the academic in-house finite element codes.
3. **Fatigue crack and damage growth capabilities** will also be developed. Fatigue prediction in composites is clearly becoming a hot topic for the aerospace industry.
4. **Efficient optimization methods** available by project partners could be used to design composite structures in order to minimize the occurrence of damage, or to optimize composite structures from an experimental data base of damage scenarios that will be developed in VIVID.

Expected impact: ***Aircraft Safety, Development and Operation Cost, Environment***

- to **reduce uncertainties** regarding the safety-critical decision of inspecting the airframe;
- to be able to **precisely predict the scenario of damage tolerance** of the design adopted and improve it exploring virtually several different materials and design solutions reducing the need of demanding experimental campaigns.
- to **define more precisely inspection intervals**, maintenance procedure, life extension or disposal at the design stage and during service improving both scheduled and unscheduled maintenance, avoiding unnecessary inspections and extending allowable damage limits, which means in turn a less grounded aircraft.
- to **reduce direct operation costs** (reduction of fuel consumption due to lower weight, which impacts also the Greening of Air Transport).
- to reduce purchase costs due to **lower development cost** because of the physically-based nature of damage models that allows a less demanding experimental plan to transfer damage tolerance information from coupon to structure.

Cross-fertilization in other industrial sectors

- aircraft engines, automotive, train, shipbuilding, mechatronics.

Partners needed to complete the consortium

- the Consortium possesses already a good degree of complementarity between the partners, however we are open to possible suggestions

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QICOM: quantitative inspection of complex composite aeronautic parts using advanced X-ray techniques

Mission statement: **"…to take the next big step in quality control and development of new advanced composite components for the aircraft of the future."**

Coordinated by: University of Applied Sciences Upper Austria
Core Partnership: CTU, UPAT, KUL, EADS, LAC, AIR, VG, FACC, CEA, FHG, EASN (no further partners are needed)

Areas in Work Programme:
7.1.1.1.; 7.1.1.2. ; 7.1.3.3. ; 7.1.4.1. ; 7.1.4.2.

Topics in Work Programme:
AAT.2012.1.1-2 ; AAT.2012.1.1-3; AAT.2012.1.2-2; AAT.2012.3.3-1; AAT.2012.4.1-2; AAT.2012.4.1-5; AAT.2012.4.2-2.

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QICOM: high level goals

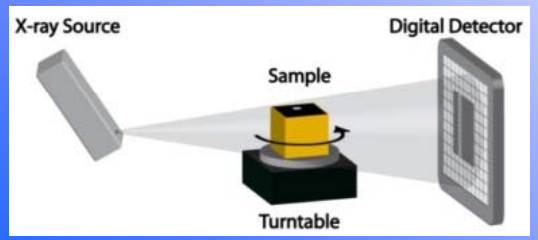
Escalate and replace commonly used **NDT techniques** (e.g. ultrasonic inspections, micro cuts) by using X-ray computed tomography in aeronautics

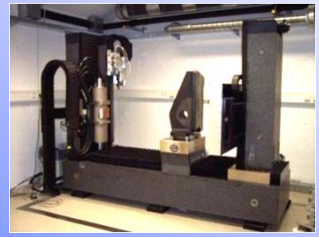
Develop and apply **advanced X-ray computed tomography techniques** for characterizing aeronautic composites and components

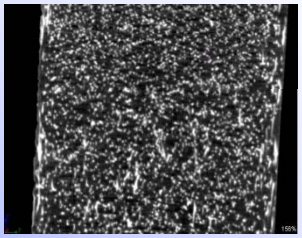
Provide highly detailed, **qualitative and quantitative 3D characterizations of inner and outer structures**

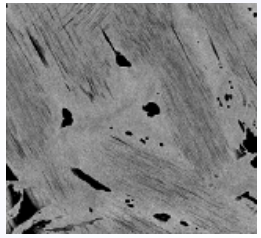
Advanced application specific **simulation and modeling of composites materials and parts**.

➔ **CHARACTERIZATION OF ADVANCED COMPOSITE COMPONENTS USING X-RAY COMPUTED TOMOGRAPHY**









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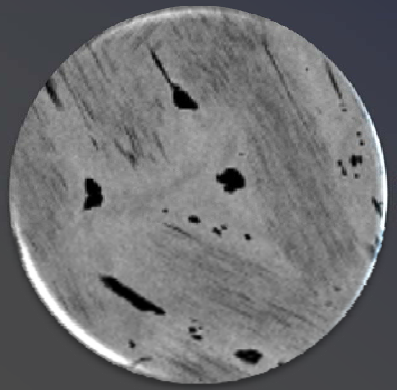
QICOM: targeted outline and main objectives

Characterization of **advanced composites**…

- Carbon-fiber-reinforced polymer,
- Ceramic matrix composites,
- Glass fiber-reinforced plastic,
- Carbon fiber-reinforced carbon, etc.

…using **mobile X-ray computed tomography** together with…

- Quality control of large scale and complex aeronautic components
- Using novel scanning geometries



...**advanced X-ray computed tomography techniques**…

- High resolution X-ray computed tomography
- Precise porosity evaluation,
- Inner structure characterization,
- Characterization of impact damage and delamination,
- Analysis on metal CFRP hybrid structure,
- Characterization of high density inclusions

…to provide **feedback** for **material development** and **component design**

- Modeling and simulation of composites
- Development of tailored components
- Feedback loop to the design office for the construction of new components

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SAB-P: Smart based air power system

Coordinated by: Dr. Pantelis Nikolakopoulos
University of Patras
Department of Mechanical Engineering and Aeronautics
Machine Design Laboratory
Phone: +30 2610 969 421
Fax: +30 2610 997 207
e-mail: pnikolak@mech.upatras.gr

- **Activity in Work Programme**: *7.1.6: Pioneering the air transport of the future*
- **Area in Work Programme:** *7.1.6.3: Promising pioneering breakthrough technologies and concepts for aeronautics and air transport.*
- **Topic in Work Programme :** *AAT.2012.6.3-1. Breakthrough and emerging technologies; AAT.2012.6.3-2. Radical new concepts for air transport*

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- **Project content and goals:**

- Actively Assisted Take off - Landing
- Air Stream as an Auxiliary Power Source during landing and takeoff
- Induced lift and drag as performance benefits
- Array of fans as a source of active assistance for take off and landing
- Assessment of Airport Design Implications

- **Expected impact:**

- Lower Fuel Consumption due to adapted aircraft design
- Higher Safety Standards (e.g. Influence of shear winds, Assistance on flame-out landings etc.)
- Advantages in airport operating conditions (e.g. Snow, low level fog)

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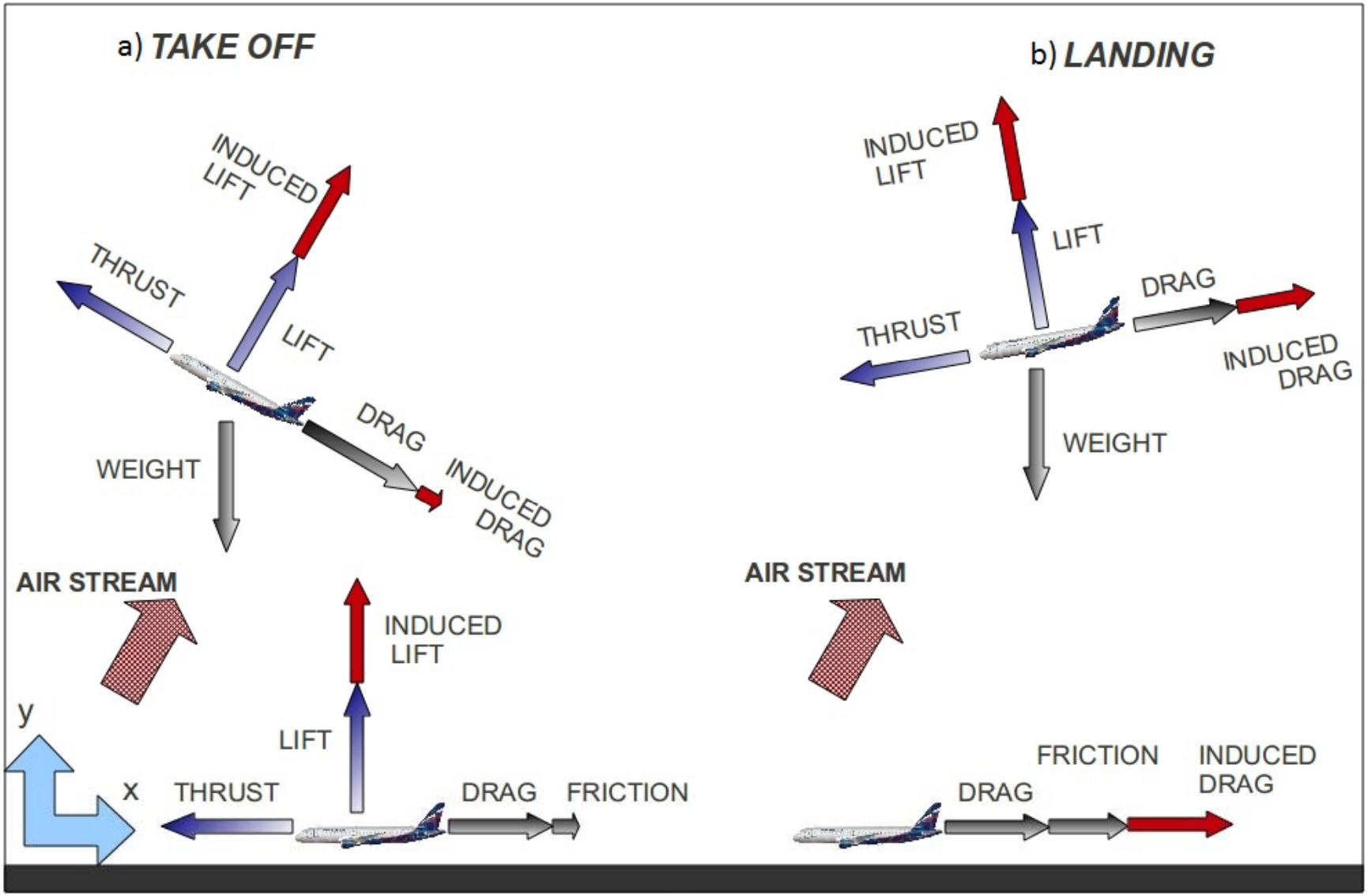

Partners needed to complete the consortium

- Academic Partner or SME with expertise in avionics
- Academic Partner or SME with expertise in airport logistics
- Academic Partner or SME with expertise in airport operations

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HIPACT: Design of novel aircraft structures resistant to HIgh velocity imPACT

Coordinated by: Swerea SICOMP AB (Sweden)
Core Partnership: Imperial College, DLR,
Other Partners: NLR, ONERA, Poli. di Milano, U. of Patras; U. of Liverpool, Cranfield U, EADS IW, SONACA, Airbus, Piaggio Aero, ESI, Saab Aviation, Uniresearch

- **Activity in Work Programme: 7.1 Aeronautics and Air Transport**
- **Area in Work Programme:** 7.1.3.3 Aircraft Safety, 7.1.1.1 Green Aircraft, 7.1.4.1 Aircraft Development Cost, 7.1.4.2 Aircraft Operational Cost
- **Topic in Work Programme :** AAT.2012.3.3-1. Aerostructures, AAT.2012.1.1-2. Aerostructures, AAT.2012.4.1-2. Aerostructures, AAT.2012.4.2-2. Aerostructures

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Project content and goals

- Focused on bird and hail impact on fuselage and leading edges of wings
- Develop novel composite aircraft structures resistant to high velocity impact.
- Novel composite materials and innovative structural design concepts
- Development of improved simulation methods for high velocity impact
- Efficient test programme for development & validation of the design methods

Expected impact

- Increase the weight efficiency of representative leading edge component for wings or tails subjected to high velocity impact by 40 % compared to component of conventional design
- Allow corresponding increases in passenger safety and/or in fuel efficiency of future aircraft

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IASS: Improving the aircraft safety by self healing structure and protecting nanofillers

Coordinated by: Liberata Guadagno, University of Salerno (Department of Industrial Engineering); lguadagno@unisa.it

- **Activity in Work Programme:** ACTIVITY 7.1.4. IMPROVING COST EFFICIENCY
- **Area in Work Programme:** AREA 7.1.4.2. Aircraft operational cost
- **Topic in Work Programme :** AAT.2012.3.4.2 –Maintenance

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IASS Consortium

Participant number	Participant organization name	Organization short name	Country
1 (Coordinator)	Università degli Studi di Salerno	UNISA	Italy
2	EASN- for Dissemination	EASN	Belgium
3	University of Patras	LTSM-UP	Greece
4	VZLU, a.s.	VZLU	Czech Republic
5	Alenia Aeronautica	ALA	Italy
6	Italian Aerospace Research Centre	CIRA	Italy
7	Martin-Luther-University Halle-Wittenberg	MLU	Germany
8	Easy Industrial Solution	EIS	Spain
9	MATERIA Nova asbl – Research Center	MN	Belgium
10	NANO4 S.A. (SME)	NANO 4	Belgium

- **IASS - Target of the project**

The aim of this project is the formulation, preparation and characterization of self-healing thermosetting composites containing dispersed protective nanofillers.

-The project will specifically target composites tailored for multifunctional applications such as lightning strike protection, impact damage and flame resistance.

- These composites will find primary use in the aerospace arena.

The IASS objectives can be summarized by the following items:

- The multifunctional composite systems will be developed with the aim of overcoming the following drawbacks of the composite materials:

- Reduced electrical conductivity;
- poor impact damage resistance (impact damage may significantly affect the integrity of the composite structure);
- poor flame resistance;

The thermosetting material will be projected considering compatibility criteria so that to integrate different functions into a material capable of bearing mechanical loads and serves as a structural material element

Expected impact:

The Proposal will contribute to the following objectives for technology readiness by 2020:

- Reduction of accident rate by 80%;
- Reduction of aircraft operating costs by 50% through:

  a) reduction in fuel consumption due to Development of new cost-effective lightweight materials,

  b) reduction of aircraft operating costs - (An aircraft with inherent self-healing abilities could help to significantly extend the inspection intervals, thereby increasing aircraft availability. Alternatively, existing inspection intervals could be maintained with significantly thinner structures, thereby saving airframe weight and hence reduce fuel burn, in-service cost and the environmental impact).

ATMAS: ATM Advanced System

Coordinated by: Bruno Lamiscarre, ENAC, France

- **Project consortium: almost complete**
  - **Universities: 4,** ENAC (coordinator), Belgrade Univ., Braunschweig Technological Univ., Technion, Patras Univ. To be confirmed: none
  - **Research establishments: 4 or 5,** TSAGI, ONERA, CRIDA , INNAXIS, To be confirmed: NLR
  - **SMEs: 2,** Monitor soft, M3systems.
  - **Number of Industrial partners: 2 or 3,** AIRBUS/Prosky, CAPGEMINI, To be confirmed: EADS-IW
  - **EASN**

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Objectives:

- to **develop a holistic** approach to air transport management system
- to develop and **prove the feasibility** of a resilient, self adapting management system for air transport
- to take into account **legacy systems and human centered** organization of ATM (self adapting don't mean full automation)

Results:

- Resilient and self-adapting algorithms for en-route, TMA, Airport (Air side and land side), Airline operations management
- Probabilistic proof of safety and performance wrt to KPAs

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UPlane: “Unmanned Plane”

Concept development and feasibility assessment for integration of Unmanned Transport Aircraft into the future Air Transportation System

Coordinated by: Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)
Amina Malik
Air Transportation Systems
Blohmstrasse 18
21079 Hamburg
Tel: +49-40-42878-4196
Fax: +49 42878-2976
email: amina.malik@dlr.de

Core Partnership: DLR (Germany) and TsAGI (Russia)

- **Activity in Work Programme:** Cross-cutting activities for implementation of the sub-theme programme
- **Topic in Work Programme :AAT.2012.7-25.** Assessment of the potential insertion of unmanned aerial system in the air transport system

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- **Project content and goals:**
  - Radical concept development by utilizing and integrating breakthrough technologies
  - Overall system architecture including operational scenario, configuration, technology screening, cost assessment and certification
  - Integration of Unmanned Transport Aircraft into future ATM system considering ATC and flow management communication network and procedures
  - Human factors of Remote Pilot and ATC Controllers, i.e. liabilities, responsibilities & training
  - Ground based control (GCS, ergonomics,..) and Air – Ground communication and Surveillance
  - Onboard automation and control, i.e. FCS, navigation, data links, collision avoidance, vehicle health monitoring

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- **Expected impact:**

– Strengthening the collaboration and research network between Europe and Russia

– Proof of concept for Vision 2050, where unmanned aircraft will share the airspace with manned aircraft , causing a step change in aeronautics

– Current technology screening and readiness with development of futuristic technological concepts for execution of the Unmanned Transport System

– Safety and Certification Standards (Compliance with current standards and development of new standards for Unmanned Transport System)

Partners needed to complete the consortium

Confirmed Partners

- EASN Endorsed Project
- DLR, Germany
- TsAGI, Russia
- Two Russian SME Partners, Monitor Soft and NIK – Samara (ATM/ATC)

Potential Partners

- Research Establishments e.g. NLR, ONERA, …
- Industry/SME with experience in avionics /automation /control /communication /navigation, e.g. EADS IW, Thales, …
- Academia/Industry/SME/ with experience in Unmanned Aerial Systems, e.g. Cranfield University, Alenia, Schiebel, …
- Air Navigation Service Provider, e.g. EUROCONTROL, DFS, …
- Certification Authorities, EASA
- …

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SULTRAMAT: SURFACE ENGINEERING FOR ULTRA HIGH TEMPERATURE Nb-BASED ALLOYS FOR THE AEROSPACE SECTOR

Coordinated by: P. Tsakiropoulos – N. Michailidis (nmichail@eng.auth.gr)

Core Partnership: ***Partners expressed initial interest:***

Universities / Research Centers	Industries
Sheffield University, UK	MTU Aero Engines, Germany
Aristotle University of Thessaloniki, Greece	SNECMA, Safran group, France
ONERA, French National Aerospace Research Center, France	Honeywell Turbo Technologies, France
Fraunhofer PCCM, Greece	Indestructible Paint Limited, UK
University of Patras, Greece	Monitor Coating Limited, UK
Fraunhofer IPT, Germany	KCS Europe GmbH, Germany – Confirmed
Universidad Carlos III de Madrid, Spain	
University of Nancy	
… others	

- **Activity in Work Programme: 7.1.4. IMPROVING COST EFFICIENCY**
- **Area in Work Programme: 7.1.4.1. Aircraft development cost**
- **Topic in Work Programme: AAT.2012.4.1-2. Aerostructures**

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- **Project content and goals:**

  Increase of operating temperatures in gas turbine blades >1300^{o}C

  Development of Nb-Si based alloys

  Development of appropriate coatings for protection against oxidation

  Full characterization of the oxidized coating systems

  Industrial implementation of alloys and coatings

- **Expected impact:**

  To increase gas turbine operational and cost efficiency

  To improve reliability and safety

Partners needed to complete the consortium

- The consortium is almost complete.
- We will evaluate the participation of further Industrial and Academic / Research Institutions, fitting to project and willing to participate.

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Updated information about the EASN endorsed projects and contacts can be found on the EASN website (www.EASN.net)