

## Editorial

### A WORD FROM THE NEW DIRECTOR GENERAL

I was elected Director General during the Council session held in London on 29 November 2007. Now, at the start of 2008, when we view **the Centenary celebrations** for powered flight in Britain and in other European nations, I firstly want to take advantage of this editorial to thank again the members of the Board for having expressed their trust in me. I wish also to pay tribute to all our predecessors who, in the early nineties, created the Confederation of European Aerospace Societies, and to those who recently conducted its conversion into a more solid organisation, the Council of European Aerospace Societies – CEAS – whose Legal Statutes were officially declared on 1<sup>st</sup> January 2007. During its first year of life, thanks to the determination and efficiency of Sir Colin Terry, the main lines to be followed were rapidly mapped out and today our present President, Dr Georges Bridel, has already demonstrated his vision and strong will to continue the development process. I am particularly pleased to be in a position that allows me to help him.

Due to the fact that CEAS is now made up of ten National Societies, and hopefully several more in the future, the DG has to be the central and focal point for information and communication in order to articulate presidency and vice-presidencies operations, and to support the Technical Committees via the two Branch chairmen.

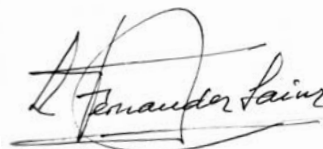
A main duty for the CEAS DG is to reach the goals set after each Trustees Board Council, optimizing the use of the resources available, having in mind the ultimate objective of our Strategic Plan which is to make CEAS more valuable to its Member Societies by expanding aerospace endeavours into the future and facilitating the networking activities pointed out in the Statutes: Conferences (next, Manchester in 2009), Events, Awards, Publications, Technical Committees.

Of paramount concern for the DG are the E-Financial State, the budget management and the search for resources, with the help of the Financial Vice-President. Another aim is to establish the necessary administrative procedures for a better, quicker and more efficient functioning.

In an uncertain and quickly changing international scenario the CEAS DG has to be attentive to opportunities, in order to consolidate and grow, in the following areas:

- The world market driving the future aerospace and aviation business into its next century.
- The growth of demands for civil air travel and the limiting constraints for the future – research possibilities, environmental issues, ...
- The security ongoing challenge and the concerns about the terrorist threat.

**Let's move positively forward in a true European spirit!**



*Leandro B. FERNANDEZ SÁINZ*  
DG of the CEAS



Leandro B.  
Fernandez Sáinz

CEAS

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## ABOUT THE 6<sup>TH</sup> BOARD MEETING HELD IN ATHENS

*The 6<sup>th</sup> board meeting was held on Friday 18 April in Greece, the new CEAS Member, in the Cultural Centre-Club House University of Athens, "Costis Paqlamas Building" - 48, Akadimias & Sina Str.*

The President and the members of the CEAS Board wish to express here their warmest thanks to the HAES (Hellenic Aeronautical Engineers Society) for the excellent way in which the meeting was hosted as well as for the superb dinner which was offered on 17 April evening.

- At 9:00, the President Georges Bridel delivered the traditional welcome message.
- The minutes and actions from the London's meeting – 29 November 2007 – were reviewed in detail, which allowed to clear up most of the remaining discrepancies and to re-activate all still pending actions.

### • THE CEAS DELIVERABLES

After a long debate, the CEAS Deliverables list could be finalised, which henceforth will be our "Fundamental Charter". A really significant step forward!

## CEAS Deliverables

### - KNOWLEDGE TRANSFER:

- A well-founded structure for Technical Committees

### - HIGH LEVEL EUROPEAN CONFERENCES:

- Programme of Technical pan-European events dealing with specific disciplines and the broader technical aspects
- Political and Technical bi-annual Conference ("European Air&Space Conference")

### - YOUNG PEOPLE'S FOCUS

### - PUBLICATIONS

- Position / Discussion Papers on Key Issues
- Professional Scientific and Technical Journals
- Periodic Newsletter on CEAS activities

### - RELATIONSHIPS AT A EUROPEAN LEVEL

- Inputs into EC Framework Research Programmes
- Inputs into the European Parliament on technical-political issues
- An input into other European Institutions

### - PROFESSIONAL RECOGNITION WORLDWIDE

### - HONOURS AND AWARDS

- Annual Gold Medal to recognise outstanding achievement
- Medals in technical areas to recognise achievement



*President Georges Bridel takes advantage of the coffee break to find a solution to unblock a conflicting situation...with success.*

### • ACTIONS RELATED TO THE RECRUITMENT OF NEW CEAS MEMBER SOCIETIES

Dr Ulf Olsson reported that no results were obtained yet since the London's meeting but that all engaged actions are still under active management: Portugal, Poland, Czech Republic, Russian Society, Ukrainian Body. The President of the Finnish Society of Aeronautical Engineers, our new Member (the 10th one) will attend the next board meeting.

### • FINANCES

- The Director General, Dr Leandro B. Fernandez Sáinz, informed of the opening of a CEAS bank account within the framework of the Asociacion de Ingenieros Aeronauticos de Espana (AIAE), so that now, all invoices preliminarily accepted by the relevant authorities can be paid.
- The 2008 budget was approved. It will cover: (i) the general functioning of the Council; (ii) the Award; (iii) the Quarterly Bulletin (four 16-page issues); (iv) the actions undertaken by Mr Alain Garcia to initiate the process of creation of a technical publication.
- Possible financial support from the European Commission: President Georges Bridel made the necessary arrangements for being able to submit in due time to the EC our formal request completely filled in according to the Rules.



*In front of his PC, Peter Brandt preparing an intervention about the MOU related to the future CEAS scientific publications. On his left, Ulf Olsson.*



*From left to right : Antonio Martin-Carrillo Dominguez; Triantafillos (Akis) Tsitinidis; Keith Mans; Ulf Olsson ; Jean-Marc Garot; Georges Bridel; Alain Garcia; Sir Colin Terry ; Pieter Kluit; Jean-Pierre Sanfourche ; Franco Persiani; Christophe Hermans ; Wilhelm Kordulla ; Constantinos Stavriniadis; Leandro B. Fernandez Sáinz;*

### ● THE MANCHESTER'S CEAS TECHNICAL CONFERENCE

This event, expected to give the CEAS a quite important impulse – and in addition some significant financial resources, will be led by the Royal Aeronautical Society (RAeS). It will take place in Manchester, 26 to 29 October 2009. All necessary actions will be taken with a view to getting EU financial support.

### ● PUBLICATIONS

The draft agreement between CEAS and DLR, ONERA and ESA was lengthly discussed. At last, it clearly appeared that as regards the CEAS publications, three levels should be distinguished:

- (i) a Scientific Journal devoted to the results of high scientific works conducted by PhD researchers of European Research Establishments and Academia (the papers published may include mathematical developments as required);
- (ii) a Technical Review aerospace engineers oriented, with articles covering design, engineering, system studies, manufacturing, testing, ...;
- (iii) a periodic Letter aiming at giving visibility on CEAS activities.

Regarding point (iii), Mr Sanfourche stated that as early as the publications (i) and (ii) would exist, he would replace the present 16 – page Quarterly Bulletin by a 4 to 6 – page Monthly Letter.

Taking into consideration the agreement finally reached, Dr Georges Bridel took the action to rewrite the above mentioned agreement, limiting it to the category(i) publication.

The decision was officially taken to authorize the launch of this scientific publication, with the financial support of DLR, ONERA and ESA: in principle, 6 issues per year, 60 pages in four colour high gloss print on 135grammes/square metre paper.

Authorization was also given to Mr Garcia, regarding his initiative aiming at creating a technical publication(category (ii)).

### ● AERONAUTICS BRANCH CHAIRMAN STATUS REPORT

Mr Alain Garcia made a very detailed reporting: Technical Committees status, the Aero-acoustic committee case (conference in Bilbao in next October), technical publications, request for administrative and finance support.

- Technical Committees status: letters of nomination, way of functioning, creation of an Aeronautics Branch Management Team (ABMT), reporting methodology.

- Technical publications: following the above mentioned statements, an action plan is being in course of development, with the objective to issue the Number One at the very beginning of 2009.

### ● CEAS WEBSITE

The CEAS Website was presented by Dr Antonio Martin-Carrillo Dominguez.

### ● YOUNG PEOPLE'S FOCUS

Jean-Pierre Sanfourche will establish in the coming days contacts with the ECATA (European Consortium for Advanced Training in Aeronautics) the Head Office of which is located in Toulouse within ISAE/SUPAERO.

### ● PROGRAMME COORDINATION COMMITTEE (PCC)

Until the successor of Gérard Fouilloux is designated, Jean-Pierre Sanfourche will perform the necessary coordination tasks, in particular through the Bulletin, in close liaison with the Event Coordinator of each Society.

### ● NEXT COUNCIL MEETINGS:

- Cologne, 5 September.
- Noordwijk, ESA/Estec, 5 December; dinner on 4 December evening at HUIS TER DUIN.

## CEAS AWARD 2009: Dr Fichtmüller



*Dr Carl Peter Fichtmüller*

Discussion of the CEAS Award took place on 17 April at 17:00. It has been decided that the Award for 2009 will be presented to Dr Carl Peter Fichtmüller, for his successful leadership in Messerschmitt Bölkow Blohm GmbH and as advocate of the European aerospace sector as well as a respected voice in the European industry and defence policy community. Dr Fichtmüller has significantly contributed to the consolidation, integration and positioning of the European aerospace sector. Born in 1936 in Hanover, he joined the MBB company in

1969. He became President of the MBB Aircraft Division in 1983, including military aircraft and helicopters. In 1989 and 1990, he also headed the MBB Dynamics Division, finally becoming Chief Operating Officer of MBB in 1992. After 27 years, he left MBB in 1992 to take up new responsibilities in the the European Association of Aerospace Industries (AECMA, now ASD) in Brussels, where he served as the General Secretary until 2001 and as the Head of the Policy Commission for some more years. Dr Fichtmüller has also been a member of the supervisory boards of Panavia, Eurofighter, Eurocopter and Euromissile.

The CEAS Award has been created to reward persons who have made outstanding contributions of European recognition to the advancement of aerospace in Europe. Taking the form of a medal and a scroll, it is presented annually.

## PERSONALITY INTERVIEW

Jean-Pierre Sanfourche, Editor-in-Chief of the CEAS Bulletin, has interviewed François JOUAILLEC

### François Jouaillec



François Jouaillec has spent most of his career in the research and technology programs management. After graduation from Ecole Polytechnique and Ecole Nationale Supérieure des Techniques Avancées in 1976, he joined the French ministry of defense to develop several research programs in the area of unconventional ships and

submarines. At the Office National d'Etudes et de Recherches Aérospatiales (ONERA), he coordinated the military research activities and was director of the "Centre d'Etudes et de Recherches de Toulouse" (CERT) between 1992 and 1999. He then served as director for strategic affairs and business development at ONERA Headquarters. He is now the director general of Aerospace Valley, the "pole de compétitivité" related to aeronautics, space and embedded systems based in Toulouse.

François Jouaillec has taught mechanical sciences in several schools of engineering including Ecole Polytechnique, and is involved in various professional organizations and committees related to aviation and technology. He has been distinguished as Chevalier de la Légion d'Honneur, Chevalier de l'Ordre National du Mérite, Chevalier des Palmes Académiques. He is a member of AIAA and senior member of AAAF.

### **1. Could you briefly summarize the present situation of Aerospace Valley, its latest developments, its major short and mid-term objectives?**

Among the so called "world class" clusters selected by the French government in 2005, Aerospace Valley has reached a significant level of achievement, as an efficient gathering of industry, research and training organizations in the aerospace and embedded systems area, within the South West of France.

- More than 140 collaborative research projects have been defined and selected internally, and then promoted to the most appropriate public/ private partnerships at the regional, national or European level. More than one hundred of these projects have already started, representing more than one thousand participations.

- The cluster has also contributed to the emergence of around 30 non R&D projects, concerning infrastructure, economic development or training facilities and programs.

- We operate a variety of professional services to our 540 corporate members including aerospace economic information, group promotion in the major aerospace events, assistance in intellectual property and normalization. Future projects include a shared sourcing portal for SMEs.

### **2. How are you going to manage, within France, the working liaisons with the new Aerospace Competitiveness Poles of Ile-de-France and Alpes Côte d'Azur Regions?**

Like most developed countries possessing a strong aerospace industry, the French assets are not scattered all over the coun-

try but rather concentrated in a limited number of regions, mainly the South West, Ile de France and Provence Alpes Côte d'Azur, and more recently two aerospace clusters have been established in these regions. The three clusters have immediately set up strong links under the guidance of Aerospace Valley, to guarantee the most efficient use of private and public resources at the national scale. As an example we conduct periodic reviews of our projects together. We also expect to share and diffuse the best practices and coordinate our international initiatives. One should keep in mind that clusters, with regard to the French policy, are essentially networks with limited permanent staff and should remain so. This is why a close connection between them is highly beneficial.

### **3. What are the similar Competitiveness Poles within the European Union?**

The situation varies a lot from one country to another. Some clusters are very much guided by a regional government and act more or less like a regional development agency, some others are very much business oriented especially for their SME members to find new market opportunities worldwide. The French clusters, to my opinion, are in an intermediate position with a strong emphasis on technology.

### **4. What are your working relationships with them?**

I was personally quite impressed by the number of solicitations that we received immediately to organize bilateral cooperation with a number of aerospace clusters all over Europe. At the Vienna Aeronautics Days in 2006, we have rather proposed to create a light forum of multilateral cooperation between aerospace clusters, in order to diffuse the best practices and act together as a contributor to the aerospace sector issues in Europe. This forum called "Wings for Regions" (W4R) is being proposed in the 7<sup>th</sup> FP. Of course we also conduct several bilateral discussions, with or without

a formal agreement, on selected topics.

### **5. Do you entertain working relationships with the European Institutions, the European Commission in particular?**

Probably not enough, even if we are the official NCP (national contact point) for aeronautics within the larger "transportation" NCP. We distribute the information about FP 7 opportunities and organize dedicated events, we also provide a first level assistance to project promoters. W4R could create the opportunity to strengthen our links with the European Institutions. Connections with the JTIs Clean Sky and ARTEMIS are expanding. Aero SME / Scratch is also a very efficient tool that clusters can use to the benefit of their members.

### **6. As you may observe, the CEAS is getting a growing importance: in which manner would you like that we develop fruitful links between Aerospace Valley and us?**

I will give a personal answer since we have not really put this issue on the discussion table of Aerospace Valley so far. As a former member of AAAF board, I am quite satisfied to measure the progress, step by step, which leads to a structured and visible European association of aerospace professionals. I appreciated the quality of the first CEAS conference in Berlin, for instance, expecting to be able to host a next edition in Toulouse. The clusters already participate actively in the regional chapters of their national professional association, and this regional life links them to CEAS in some sense to expand in the future. Finally as an association of corporate members, let me mention that we are also connected to our national industrial association GIFAS, and through this link, to our European industrial association ASD. All these links should be as simple as possible, ensuring an efficient flow of information, and avoiding useless administrative complexity.

## THE ROYAL AERONAUTICAL SOCIETY CONFERENCE 2008



### CONFERENCE FIRST DAY OFF TO A "FLYING START"!

22 – 24 April 2008

No. 4 Hamilton Place, London W1J 7BQ

This Conference, supported by CEAS, lasted three days.

#### **DAY 1 – TUESDAY 22ND APRIL 2008: CAMPAIGN MANAGEMENT – WHERE DO WE STAND?**

Well over 100 delegates from 6 Countries were welcomed to the first day of the Royal Aeronautical Society Annual Conference by Keith Mans, Chief Executive, Royal

Aeronautical Society and Captain Dave Rowland, President Elect, Royal Aeronautical Society. The subjects dealt with during the different sessions are mentioned hereafter:

#### **SESSION 1: PREPARATION & SEEDING THE GROUND**

The topics dealt with were: Crisis Management, Campaign Management: a Think Tank View, Generating and Preparing Forces for Operations.

#### **SESSION 2: SITUATIONAL AWARENESS**

The topics dealt with were: Intelligence Operations, Assuring Situational Awareness to Support EU Operations, Network Capabilities, A View on the Information Management Challenges Facing ISR in the Battlespace.

**SESSION 3: EXECUTION & CONTROL**

The topics dealt with were: Operational Execution, Virtual Leadership, Making the Headlines, So What About the next 100 Years ?

**DAY 2 – WEDNESDAY 23<sup>RD</sup> APRIL 2008: ENABLING THE FUTURE – THE TECHNOLOGY DIMENSION?**

Well over 140 delegates were welcomed to the second day of the Conference by Chairman of Session 1, Terry Knibb, Learned Society Board, Royal Aeronautical Society. The main thrust of the day’s proceedings focused on the technological development which will continue to be vital in driving the aerospace and aviation business into its next century. The sessions explored the premise that environmental issues are now to the fore but so are security concerns over the terrorist threat and asked whether research is being focused in the right areas and are Governments doing enough to show leadership and underpin that leadership with funding?

**SESSION 1 – AEROSPACE - THE FUTURE**

The topics dealt with were: ACARE Strategic Agenda, The Whole Supply Chain, Europe’s Combined Aeronautics Research Efforts.

**SESSION 2 – TECHNOLOGY STRATEGY AND CREATION**

The presentations discussed the following areas of interest : The National Aerospace Technology Strategy, UK Innovation & Technology, Ministry of Defence Science & Technology Strategy and Policy, the Aerospace & Defence Knowledge Transfer Network.

The final session of the day - Delivering the Technologies – comprised three presentations: Research in the Supply Chain, Boeing V22 Osprey, Collaboration & Competition – the Whole World Platform View.

**DAY 3 – THURSDAY 24<sup>TH</sup> APRIL 2008: THE FUTURE OF CIVIL AIR TRANSPORT OPERATIONS – TODAY’S PRIORITIES FOR TOMORROW’S GAIN**

In the first session of the day, delegates heard about security challenges to the industry, the issues of sustainable aviation and also the tough economic environment which is shaping the industry. In the second session of the morning, politics, regulations and safety were discussed. The audience also heard of the political side of the air transport and the environment debate, and of the new US-EU Open Skies liberalisation and its potential effects on the industry.

In the afternoon, the conference continued with sessions looking at new business models.

In the fourth session of the day, the focus was on the infrastructure of airports – a crucial and now highly visible part of the industry which is under great pressure at the moment. With security queues now causing stress for travellers, one presentation focused on a concept for an ‘integrated security portal’, where a moving walkway could get passengers moving through terminals efficiently and safely. Heathrow’s future was also discussed, with Lord Soley of Hammersmith, Campaign Director.

The conference concluded with a spirited and thought-provoking debate ‘This House agrees that Aviation is Good for the World’ with the Rt Hon Brian Wilson, Chairman of Flying Matters as the proposer, and John Vidal, Environment Editor, The Guardian, opposing the motion. Both sides made important points and the passionate question and answer session raised useful issues. In particular one theme that both sides seemed to have common ground on, was that the industry not only needed to do more, but also needed to communicate its achievements and technological advances in sustainable aviation better and ‘speak as one voice’.

**TWO PANEL DISCUSSIONS PARTICULARLY IMPORTANT TOOK PLACE:**

**MEETING THE ENVIRONMENTAL CHALLENGE**

*Chairman: Keith Mans, Chief Executive, Royal Aeronautical Society*

Highly Fuel-Efficient & Greener Aviation – Organising a Step Jump towards ACARE Goals  
Dr Raj Nangia, Consultant, Nangia Aero Research

The Propulsion System – What Options Do We Have?  
Alan Newby Chief Engineer Advanced Projects  
Civil Aerospace, Rolls Royce plc

Environmentally Optimised Aircraft Design  
Prof Ian Poll, Professor of Aerospace Engineering, Cranfield Aerospace

Optimising the Air Transport System – Gains Possible Through Operational Developments  
Ted Eliff, Chief Scientist, EUROCONTROL Experimental Centre

Q&A Session

**SECURITY: THE ONGOING CHALLENGE**

*Chairman: Prof Keith Hayward, Head of Research, Royal Aeronautical Society*

Security and Resilience: How Government and Industry Can Work Together  
Derek Marshall, Director, Aerospace Defence and Homeland Security, SBAC

Aviation Checkpoint Screening  
Andrew McClumpha, Associate, Transport Infrastructure Safety & Security Group, Booz Allen Hamilton

Capabilities & Technologies Required for Homeland Security  
Jon Wills, NS&R Programmes Director, BAE Systems

Panel-led Debate & Discussion

Q&A Session

For getting further information, it is possible to purchase post-conference CD proceedings. Please contact [Hinal.Patel@raes.org.uk](mailto:Hinal.Patel@raes.org.uk)



## COLLABORATION AND COMPETITION - THE WHOLE PLATFORM VIEW



*This paper presents Collaboration and Competition in Technology Development from the perspective of the Airframer who delivers the whole Platform. It is based on personal experience as engineering manager of both product and research programme.*

### COLLABORATION IN TECHNOLOGY DEVELOPMENT

#### Introduction

- Theme of talk
  - ▶ Based on experience as customer of research programmes as well as managing them (particularly NGCW)
  - ▶ Balance of collaboration and competition and what it means to the 'airframer'



Collaboration is a key ingredient for successful technology development. It involves establishing a project and more importantly a partnership to jointly develop technology capability. It can be done proactively where partners are carefully selected or reactively where opportunities present themselves. Partner selection is important and must be done systematically, meeting clear requirements. Technical capabi-

#### Collaboration in Technology Development (1)

- What does it mean
  - ▶ Establishing a project and partnership to jointly develop technology or capability
- How do we do it
  - ▶ Proactive and reactive
  - ▶ Partner selection
    - Location
    - Technical capability
    - Future product



#### Collaboration in Technology Development (2)

- What are the benefits ?
  - ▶ Added value from working together
  - ▶ Sharing risk
  - ▶ Mutual benefit from separate exploitation routes
  - ▶ Sharing cost
  - ▶ Enabling funding
  - ▶ Sparking off each other
  - ▶ More than the sum of the parts
  - ▶ Prepares the supply chain
- What are the risks ?
  - ▶ Management overhead
  - ▶ Lack of ownership and direction
  - ▶ IP leakage



lity where a partner has a specific capability or back ground to contribute will be an important factor. On-going partnership development where there are mutual benefits based on future exploitation opportunities will also influence partner selection. Location and hence access to local funding opportunities is yet another criteria for selection.

The benefits from collaboration are substantial. There is added value from working together where the result is more than the sum of the parts, and shared working can act as a catalyst for innovation and new ideas. Risks associated with technology development can be shared. There can be mutual benefits from different and separate exploitation routes. Obviously the costs can be shared, and collaboration can enable external funding from government bodies. For the prime partnerships with the supply chain can prepare the subcontractors for future product developments.

However there are risks to collaboration. There will inevitably be a management overhead greater than in a simple customer/supplier relationship. There can be a lack of ownership and direction within a group of partners as opposed to a supply chain.

Probably the most often risk is due to the potential leakage of intellectual property (IP) particularly. These risks can largely be mitigated by their proper management at the outset of the project. The management overhead can be offset by the external support, which can also provide the “glue” between the partners. Collaboration Agreements are necessary not only to cover the project management but most importantly the management and ownership of IP.

Overall, collaboration is a positive contributor to technology development; however the framework for the partnership must be established and agreed at the outset and successful collaboration depends on a positive mindset within the partner.

## COMPETITION

### Competition

- Within the Market
  - ▶ Can drive the supply chain
  - ▶ Can enable an industry-wide standard
  - ▶ May be suppliers to both
    - IP leakage
    - Product strategy leakage –
    - intelligence
- Between Partner
  - ▶ ‘race’ is good
  - ▶ Lack of openness is bad
  - ▶ Management overhead
- Between technologies
  - ▶ Multiple solutions
  - ▶ Trade studies
  - ▶ Decision making
  - ▶ Increases costs
  - ▶ Lowers product risk



Market driven competition has both benefits and risks to technology development. It can drive suppliers to maintain and improve their position in the supply chain by improving their products and processes alongside the primes. It can also enable industry-wide standardisation where there are suppliers to more than one prime. However there are challenges as well. There is a risk of IP and sensitive product strategy leakage.

Between partners in project, competition can produce some positive benefits from the “race” to develop better technology, however it can introduce a lack of openness between partners and hence a further management overhead.

Finally there can be competition between technologies to meet the overall product/customer needs. Ideally in technology projects there are multiple technology solutions being pursued through trade studies. This enables critical decisions to be made and will reduce product risks. Inevitably there can be an increase in cost to follow multiple paths, however this should be mitigated by the improved solutions delivered.

## THE WHOLE PLATFORM - THE END GAME

The technology solutions may be different for components, eg fuselage and wing. There is not necessarily a “one size fits all”.

### Whole Platform – the end game

- Requirements can be different
  - ▶ Cabin, Wing/Empennage,
- Technology
  - ▶ Not ‘one size fits all’
  - ▶ Transfer/progressive exploitation
- Roles
  - ▶ Integrator and Architect
  - ▶ Supply chain managers
  - ▶ People development a challenge
- High value
- High risk
- High barriers to entry



Body ETDU



However the whole platform aspect can enable a progressive technology exploitation - as a technology is increasingly used in successive products.

With increasing activity in the supply chain, either as partners in technology development or as suppliers/partners for product development, the role of the “airframer” – the whole platform - is changing. Increasingly he is becoming the architect and integrator as opposed to the developer.

He is defining the architecture and the platform level requirements and validating their delivery.

He is becoming a supply chain manager and people development becomes a challenge. It is a high value operation with high risks and high barriers to entry.

### Summary

- Competition and Collaboration are both necessary and valuable
- The risks must be managed
- The Whole platform is the route to exploitation
- The role of the prime is changing

Body ETDU



*The present paper was presented by Jenny Body, Airbus, on the occasion of the RAeS Conference 2008, during the session “Delivering the Technologies” chaired by Professor Ric Parker, Director of Research and Technology, Rolls-Royce plc.*



# TECHNOLOGY DEMONSTRATION STUDY ON SENSE & AVOID TECHNOLOGIES FOR LONG ENDURANCE UNMANNED AERIAL VEHICLES

## General background

*This project, launched by the European Defence Agency (EDA) on 21 June 2005, was one of the two technology areas selected from an initial list of more than 10 critical technologies of interest to the Participating Member States for demonstration studies funded by the Agency. The contract was awarded in February 2006 to a consortium composed of SAGEM DS as prime contractor with Onera, Espelsa and TNO as co-contractors. The 16.5 - month study started in March 2006 was completed in November 2007. Its results provide significant advance to the feasibility of a Sense & Avoid demonstrator by delivering an extensive and detailed insight into the following elements:*

- *mapping of the applicable regulations;*
- *definition of requirements for Sense & Avoid systems of Long Endurance Unmanned Aerial Vehicles (LE-UAV);*
- *definition of potential solutions based on the requirements established by the experts;*
- *testing the proposed technical solutions by means of simulations;*
- *assessment of the impact of the implementation of the proposed potential solutions on the future use of LE UAV, the Air Traffic Management (ATM) procedures and safety considerations.*

## APPROACH USED

To achieve study aims, a two-way study approach was applied by the contractors, a combination of system and technological approaches, in order to establish a first realistic set of requirements, necessary to define and compare the different candidate solutions. This approach provided fully comprehensive short and mid-term combined technical solutions for the S&A problem (figure 1).

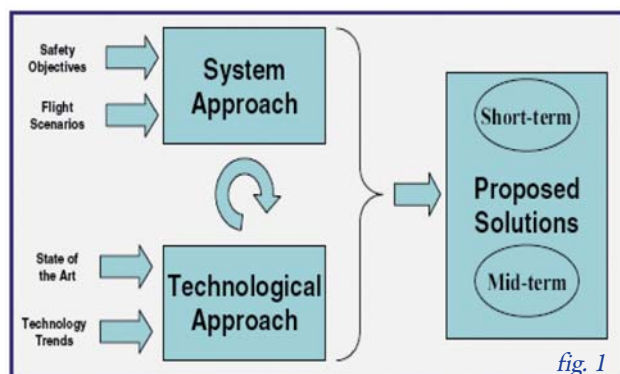


fig. 1

As no data were available from regulatory bodies, the contractors used its knowledge of the use of the airspace by manned aircraft and UAVs, combined with results of studies dealing with the insertion of UAVs in non-segregated airspace, in order to define safety objectives and establish quantitative requirements for the sense and avoid system.

## THE ESSENTIAL RESULTS, IN BRIEF

The study has demonstrated the feasibility of a mid-air collision avoidance system for the LE UAV within a 6-8 years timeframe, so that following its certification, this system may be available in 2013-2015.

### 1. Mapping of regulations

The manned aviation regulatory frame remains the relevant regulatory basis. The most recent document is the EUROCONTROL specification for the use of military UAVs as operational air traffic outside segregated airspace which has been approved for publication in October 2007.

### 2. Requirements and architecture

A set of realistic quantitative requirements were established. The proposed sense and avoid architecture, combining automatic and Man-in-the-Loop elements, is sketched in figure 2.

### 3. Potential solutions

Avoid function is the ability to detect and forecast conflictive situations and make decisions intended to solve the conflictive situations, reached when the distance between the UAV

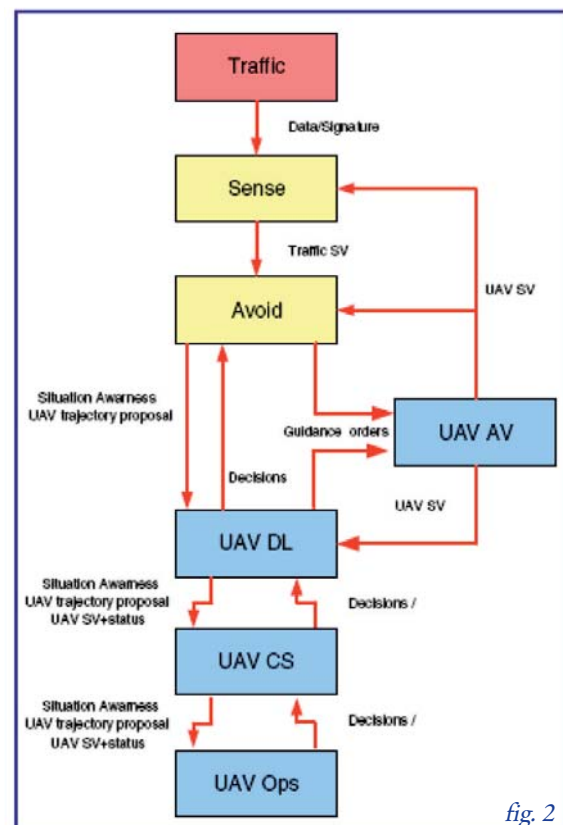


fig. 2

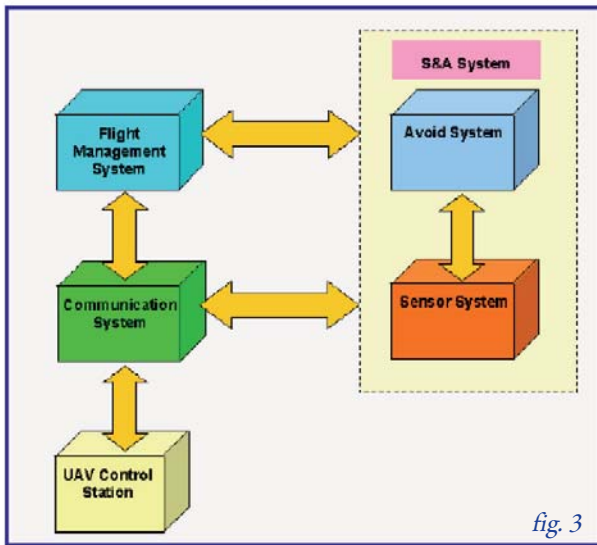


fig. 3

and other airspace user is lower than the predefined safety distance. To perform that task, avoid function receives information from the sense function. The proposed S&A system is an onboard one, interchanging information with the other LE UAV systems and with pilot-in-command (figure 3). Concerning the sense function, the short-term solution is mainly based on EO (Electro Optical)/IR (InfraRed) sensors, complemented with a radar and a transponder interrogator. At mid-term horizon, laser and radar technological improvements will lead to further advances. At long-term horizon, the reduction of the number of sensors will improve the reliability of the whole system since less electronics is required.

#### 4. Simulations and flight tests

Simulations provided the performance assessment of the proposed solutions when flight tests contributed to the characterisation of sensors.

#### 5. UAV integration impact on ATM

It seems that the present ATM environment is able to manage the introduction of LE UAVs. Many situations can be managed in the same way as for manned aviation or with limited adaptations. Some propositions have also been made to ease the introduction of UAVs in non-segregated airspace.

#### ABOUT THE FUTURE USE OF LE UAVS

- The UAVs not fitted with a S&A system will most probably require the use of a chase aircraft with a UAV operator onboard to maintain a visual surveillance of other aircraft.
- The primary goal of using a S&A system is to not anymore require the use of a chase aircraft and to allow really using LE UAVs for "Dull, Dirty and Dangerous" (D3) missions.

#### PROPOSED WAY FORWARD

The following efforts are proposed to realise the recommendations of the study:

- insertion of UAVs into the general air traffic may be achieved only by the involvement and close cooperation of all the stakeholders (manned aviation regulatory authorities, standardization working groups, airspace users, etc.);
- regulatory framework for UAV traffic insertion should be tackled in a very short time to provide unrestricted use of UAVs in conjunction with other airspace users;
- taking into account the great number of stakeholders and issues to be solved – definition of safety requirements, modifications of regulations, technology/engineering works, system certifications, standardization – close coordination and controlled actions are required.

### EUROPEAN DEFENCE AGENCY

The European Defence Agency (EDA), an Agency of the European Union, was established by the Council on 12 July 2004. It is designed to "support the Council and the Member States in their effort to improve European defence capabilities in the field of crisis management and to sustain the ESDP (European Security and Defence Policy) as it stands now and develop in the future".

The Agency is ascribed four functions, relating to:

- defence capabilities development;
- armaments cooperation;
- the European defence technological and industrial base and defence equipment market;
- Research & Technology development.

- Mr Javier Solana, EU High Representative, is Head of the EDA and chairman of its Steering Board, the decision-making body composed of the 26 participating Member States (all EU MS except Denmark) Defence Ministers and of the European Commission Representative. This Steering Board acts under the Council's authority and within the framework of guidelines issued by the Council.

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J.-P. S. – From information provided by the  
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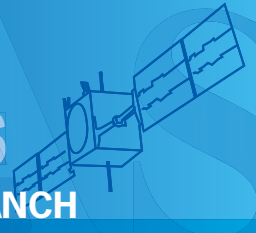
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## THE WORD FROM EUROSPACE

by Jean-Jacques Tortora



Jean-Jacques Tortora is Secretary General of EUROSPACE.

The next ESA council at ministerial level is a major milestone for the European space industry as many major ESA ongoing programmes will soon reach termination in all the Agency's core activities. This presses for the decision of new missions with the ambition to take up new challenges in order to consolidate the positions of Europe in space.

What is at stake is the sovereignty of Europe through its capacity to access and operate freely into space. This requires to secure the European infrastructures like launchers or space situation awareness capabilities, as well as to ensure the availability of space technologies with the appropriate maturity, the required level of non dependence, and at competitive conditions for risk free implementation in commercial or institutional programs. This can only be achieved with the appropriate funding level and with more commitment of all stakeholders to the coordination of activities.

The contribution of space systems to the monitoring of climate change is unquestionable and here comes the opportunity for Europe to tackle this issue. There is no doubt that GMES (Global Monitoring Environmental System) is an adequate framework to accommodate such initiatives. It would thus be appropriate for the ESA Council to exert its best efforts to motivate the European Commission to put in place the effective financing means to ensure the elaboration of the sustainable space infrastructures necessary to secure the continuity of the relevant data.

Space technologies offer genuine solutions to a number of arising European Union policies. Industry is eager to play its role in this framework by proposing solutions, participating in markets assessment and taking part in the elaboration and in the operations of future systems and services. On their side, European Governments and institutions must facilitate the development of new public services as well as to organise the potential demand for such systems.

The future of space exploration also needs to be addressed, and member States must determine the political will of Europe to fly – or not – European astronauts with European

vehicles. ESA shall then be tasked to position its overall exploration plan within the international cooperation framework, with the required level of autonomy.

The competitiveness that European space industry demonstrates on the commercial market greatly benefits to the European institutions. Today, it has become one of the conditions of the autonomy of Europe in space. Support to competitiveness is therefore an essential step for the future implementation of European strategies and it must be an objective for itself to be pursued by ESA.

ESA programme planning must be ambitious. But more than this, it must be stimulating for European industry which looks forward to challenging missions.

### ASD-EUROSPACE

The Space group in ASD

Eurospace is the professional association of the space industry. As such, it is the reference body for consultation and dialogue within the industry, the main focus being space policy and strategy.

Its members are the main European space systems manufacturers and launch services providers. The membership covers 13 European countries, with national representation balancing the importance of each nation's space segment.

In 2004, Eurospace became the Space Group of ASD (AeroSpace and Defence industries association of Europe), representing space interests.

Active Working Groups and Panels:

- Policy Committee
- ECCS - Eurospace is the space industry standardisation body
- EEE Electronic parts and components
- Security & Defence
- GMES (Earth Observation)
- Navigation (Galileo)
- Research and Technology- Eurospace is the official industry representative to the European Space Technology Harmonisation process and ESTMP
- Space Industry Markets
- IPR and legal affairs

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## TerraSAR-X, A NATIONAL GERMAN RADAR MISSION REALISED IN PUBLIC – PRIVATE-PARTNERSHIP

by Dr Rolf Werninghaus, DLR, Bonn (rolf.werninghaus@dlr.de)

### General background

**On 15 June 2007, the TerraSAR-X satellite was successfully launched from Baikonur on a Russian-Ukrainian DNEPR-1 launch vehicle. TerraSAR-X is a German radar satellite that provides high-resolution, high-quality X-band Radar data for scientific research as well as commercial applications.**

– TerraSAR-X is the first space project in Germany that has been realised in a public-private-partnership (PPP), with considerable financial contribution by industry. The partnership model is based on a cooperation agreement that was signed by the German Aerospace Centre (DLR) and EADS Astrium GmbH on 25 March 2002. The objective is for equal partners to cooperate, with each making an equitable contribution towards a joint project in order to meet their own needs. Going beyond the traditional process of awarding government-funded contracts, this approach is based on a cooperative project management. Having different objectives, both sides contribute their resources, jointly implementing the project and utilising its results afterwards. The advantage of this approach is that it permits meeting scientific goals while supporting industrial marketing needs at the same time. In this way, investments are secured which a single partner would be unable to provide on its own.

– Under the partnership agreement, EADS Astrium GmbH has been awarded a contract by DLR to develop, build and launch the satellite. For its part, DLR develops the satellite's operating system as well as its instrument-calibration and payload ground segment for receiving, processing, archiving, calibrating and distributing the radar data. In addition, the DLR is responsible for satellite operation over a period of five years.

– EADS Astrium undertook to set up a distribution system and commercialise the TerraSAR-X data and products through its fully-owned subsidiary Infoterra GmbH.

– In return for the exclusive right to commercialise TerraSAR-X data, EADS Astrium GmbH agreed to contribute to the development cost of the satellite. In addition, EADS Astrium GmbH contributes a sales-dependent share of the operating cost for the satellite during its operational phase and invest considerable sums in marketing the satellite's data.

– In general, TerraSAR-X will serve two main goals: (i) The first goal is to provide the strongly supportive scientific community with multi-mode X-band SAR data. The broad spectrum of scientific application areas include Hydrology, Geology, Climatology, Oceanography, Environmental Monitoring and Disaster Monitoring as well as Cartography (DEM Generation) and interferometry. Representing the

federal government, the DLR will be the sole owner of the TerraSAR-X data and coordinate their scientific utilisation.

(ii) The second goal is the establishment of a commercial EO-Market in Europe, i.e. the development of a sustainable EO-business so that follow-on systems can be completely financed by industry from the profit. Taking into account the expected business development, the PPP-agreement is aiming at:

- the self-sustainability of the business;
  - the implementation and operation of a follow-on system TerraSAR-X2 by industry;
  - scientific exploitation rights for DLR also for TerraSAR-X2.
- If the business develops as foreseen today, EADS Astrium GmbH will finance a follow-on system after the satellite's service life has ended, thus securing the continuity of the business.

### The TerraSAR-X Satellite

The TerraSAR-X features an advanced high-resolution X-band Synthetic Aperture Radar (SAR) with day/night and



all weather capability based on the active phased array technology which allows the operation in different imaging modes (Spotlight-, Stripmap- and ScanSAR) with two polarizations in

various combinations. It combines the ability to acquire high resolution images (down to 1 m resolution) for detailed analysis as well as wide swath images (up to 100 km wide swaths) for overview applications. Switching between modes can be done very fast and in an extremely flexible manner. In addition, the experimental Dual Receive Antenna (DRA) mode enables the use of interesting new features like Along Track Interferometry (e.g. for velocity measurements), full polarimetric data acquisition and the enhancement of the stripmap azimuth resolution.

In addition to the SAR-instrument, two Secondary Payloads fly on the Terra-SAR spacecraft:

- (i) the Laser Communication Terminal (LCT), a Technology Demonstrator for an inter-satellite communication link developed by TESAT/Backnang in contract to DLR;
- (ii) the Tracking, Occultation and Ranging instrument package (TOR), a dual-frequency GPS tracking receiver and a laser reflector set for high-precision orbit determination and occultation measurements provided by the Geoforschungszentrum Postdam (GFZ) and the University of Texas, Center for Space Research.

**The TerraSAR-X Ground Segment**

The TerraSAR-X Ground Segment is the central element for controlling and operating the TerraSAR-X satellite, calibrating its SAR instrument, and archiving the SAR-data as well as generating and distributing the basic data products. The overall ground Segment and service infrastructure consists of two major parts:

- the ground segment, provided by DLR;
- the commercial exploitation and service infrastructure (TSXX) developed by Infoterra.

The DLR Ground Segment is based on existing national infrastructure as much as possible and was optimized for flexible response to scientific and commercial user requests and fast images product turn-around times. It is composed of three major elements:

- the Mission Operation Segment (MOS) provided by the German Operation Centre (GSOC);
- the Instrument Operation and Calibration Segment (IOCS) provided by the Microwaves and Radar Institute (IHR);
- the Payload Ground Segment (PGS) provided by the German Remote Sensing Data Centre (DFD) and the DLR Remote Sensing Technology Institute (IMF).

The scientific exploitation of the TerraSAR-X data is coordinated by DLR, which is the point of contact for all science users. Commercial customers, on the other hand, will have to contact Infoterra for access to TerraSAR-X data. In addition to the baseline station in Neustrelitz, Infoterra will set up additional receiving stations for so-called Direct Access Customers (DACs) respectively Direct Access Partners (DAPs). These Direct Access Stations are foreseen to extend the baseline receiving station concept.

**The TerraSAR-X Mission**



fig. 1

Launch on 15 June 2007 (figure 1): a Sun-synchronous Dawn Dusk Orbit with a 11-day repeat period was selected as a good compromise between radar performance and order to acquisition time and revisit time. Once in orbit the satellite has been taken over by the DLR Mission Control Centre in Oberpfaffenhofen. Only four days after launch the first SAR image was successfully processed.

As shown in the image, a 30km x 60 km area in Russia, western to Volgograd has been imaged in the stripmap mode HH polarization.

The successful processing of the first image (figure 2) demonstrates the outstanding functional capability of the satellite on the one hand and the operability of the ground

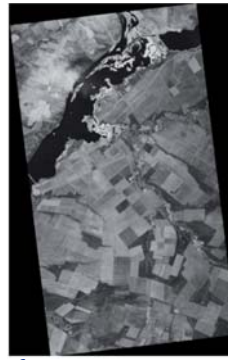


fig. 2

segment on the other hand. The entire processing chain including order input, scheduling, commanding, data acquisition, on ground data reception, SAR processing and archiving of the images has been verified.

In the meantime, the commissioning phase of 5-month duration has been successfully completed and **the satellite has become operational on 7 January 2008**. Since then, thousands

of high-quality images have been acquired, processed and delivered to the customers. All three image products – Spotlight, Stripmap, ScanSAR – have been released and the image performance is of exceptional quality. This includes the highest resolution 300 MHz product, multi-polarization images as well as interferometric data.

The following example (figure 3) shows an overlay of three TerraSAR-X images of the island Sylt, taken on 22, 24, and 27 October 2007. Areas that have changed in between the data taken appear in blue or green, especially in the sea areas, that have changed due to the tides.

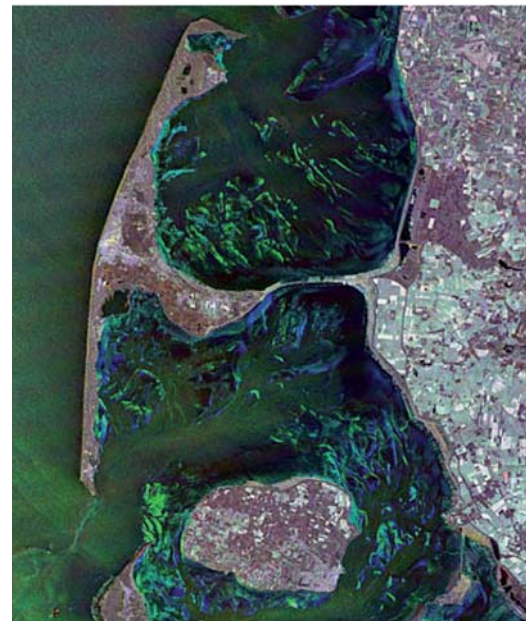


fig. 3

The second example (figure 4) shows the pyramids of Giza on the West bank of the Nile on the fringe of the Egyptian Desert, about 20 km from Cairo city centre. In the pictures the three large pyramids can clearly be seen on the outskirts of the small town of Giza, with the Great Pyramid standing out as the most prominent one. The smaller pyramids come out equally well on the radar image.

Structures in the desert sand can be seen to the South of the pyramids. This opens up archaeological options and constitutes yet another application for TerraSAR-X data. The image has been acquired on 2 July 2007 in High-Resolution Spotlight Mode. The original resolution is 1 m (reduced image).



fig. 4

## THE SERIES OF WONDERFUL ESA'S SUCCESSFUL MISSIONS IS CONTINUING!

### ● 20 FEBRUARY 2008: AFTER DELIVERING COLUMBUS,ALANTIS BACK ON EARTH

On this STS-122 mission, the shuttle spent nearly 13 days in space, including 9 days docked to the International Space Station (ISS) to conduct the delivery of Europe's first permanent human outpost in orbit: the 7 m long 12.8 tonne Columbus module, a state-of-the-art multidisciplinary laboratory.

### ● 9 MARCH 2008: EUROPE LAUNCHES ITS FIRST RE-SUPPLY SHIP-JULES VERNE ATV TO THE ISS



Jules Verne, the first of ESA's Automated Transfer Vehicles (ATV), a new series of autonomous spaceships designed to re-supply and re-boost the ISS, was successfully launched into low orbit Earth orbit by an Ariane-5 ES at 05:03 CET (Central European Time) from Kourou on 9 March.

### ● 3 APRIL 2008: THE ATV JULES VERNE DOCKS TO THE ISS



The 19-tonne unmanned spaceship manoeuvred from a holding position 39 km behind the 275-tonne space outpost and conducted a 4 hour staged approach with several stops at reference

points for checks. It autonomously computed its own position through relative GPS and in close range it used videometers pointed at laser reflectors on the ISS to determine its distance and orientation relative to its target. Final approach was at a relative velocity of 7cm/s and with an accuracy better than 10cm!

### ● 27 APRIL: GIOVE-B IS SUCCESSFULLY LAUNCHED

A further step towards the deployment of Europe's Galileo global navigation system was taken on 27 April 2008 at 00:16 CEST when the GIOVE-B satellite was lofted into a medium altitude orbit around the Earth by a Soyuz/Fregat rocket departing from Baikonur by launch operator Starsem. Two years after GIOVE-A mission, GIOVE-B will continue the demonstration of critical technologies necessary for Galileo.



Built by a European industrial team led by Astrium GmbH and Thales Alenia Space, this 500 kg satellite carries two rubidium atomic clocks, a Passive Hydrogen Maser (stability better than 1 nanosecond per day), a radiation monitoring payload, a laser-reflector and signal generation units.

## The Council of European Aerospace Societies - CEAS -

### The CEAS: an International Non-Profit Association

**Located:** Belgium - Rue du trône 98 - 1050 Brussels

[www.ceas.org](http://www.ceas.org)

The CEAS aims to develop a framework within which the major aerospace societies in Europe can work more closely together. The Member Societies: AAAF (France), AIAE (Spain), AIDAA (Italy), DGLR (Germany), FTF (Sweden), HAES (Greece), NVvL (Netherlands), RAeS (United Kingdom), SVFW (Switzerland). Following its establishment as a legal entity conferred under Belgium Law, this new organisation began its operations on 1<sup>st</sup> January 2007.

The basic mission of the Association is to add value at a European level to the wide range of services provided by the constituent Member Societies, allowing for greater dialogue between the latter and the European institutions, industry, governments and academia. The Council is governed by a Board of Trustees, with representatives of each of the Member Societies.

### The officers of the Board, for the year 2008 are:

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## Among the Main Coming Events

### 2008

- **9-11 June:** Avignon (France). International Symposium: On-Board Energy Materials – [secr.exec@aaaf.asso.fr](mailto:secr.exec@aaaf.asso.fr) – [www.aaaf.asso.fr](http://www.aaaf.asso.fr)
- **30 June-5 July:** 8<sup>th</sup> World Congress on Computational Methods in Applied Sciences and Engineering.  
Venice (Italy) [www.iacm-eccomascongress2008.org](http://www.iacm-eccomascongress2008.org)
- **8-11 July:** Prague (Tch. Rep) 5<sup>th</sup> International Symposium: Anti-Missile Defence – [secr.exec@aaaf.asso.fr](mailto:secr.exec@aaaf.asso.fr) – [www.aaaf.asso.fr](http://www.aaaf.asso.fr)
- **14-20 July:** Farnborough International Airshow
- **22-24 July:** 2008 International Powered Lift Conference London, RAeS [conference@raes.org.uk](mailto:conference@raes.org.uk) – [www.aerosociety.com/conference](http://www.aerosociety.com/conference)
- **3-5 September:** Braunschweig (Germany). Conference on Buckling and Postbuckling Behaviour of Composite Laminated Shell Structures and COCOMAT Workshop.  
[geschaftsstelle@dglr.de](mailto:geschaftsstelle@dglr.de) [www.cocomat.de](http://www.cocomat.de)
- **3-5 September:** Bremen (Germany)- To moon and Beyond - [www.beyondmoon.de](http://www.beyondmoon.de)
- **16-19 September:** Liverpool (UK). 34<sup>th</sup> International Symposium: Rotorcraft Forum – [conference@raes.org.uk](mailto:conference@raes.org.uk) – [www.raes.org.uk/conference](http://www.raes.org.uk/conference)
- **23-25 September:** Darmstadt (Germany). Annual Aeronautics and Astronautics Conference, DGLR – [geschaftsstelle@dglr.de](mailto:geschaftsstelle@dglr.de) [www.dlrk2008.dglr.de](http://www.dlrk2008.dglr.de)
- **24-25 September:** Training for Advanced Technology Aircraft - Annual RAeS Flight Crew Training Conference - London - [conference@raes.org.uk](mailto:conference@raes.org.uk)
- **26 Sept-3 Oct.:** Glasgow (UK)- IAF Studet Conference - [www.iafastro.com](http://www.iafastro.com) – [www.aerosociety.com/conference](http://www.aerosociety.com/conference)
- **7 October:** Greener by Design Forum - London, RAeS - [conference@raes.org.uk](mailto:conference@raes.org.uk) [www.aerosociety.com/conference](http://www.aerosociety.com/conference)
- **9-11 October:** Friedrichshafen, Germ., 7<sup>th</sup> International Airship Convention 2008 – [geschaftsstelle@dglr.de](mailto:geschaftsstelle@dglr.de) – [www.airshipconvention2008.org](http://www.airshipconvention2008.org)
- **13-17 October:** 6<sup>th</sup> Aerothermodynamics Symposium for Space Vehicle Design. ONERA, Chalais-Meudon (France).
- **14-15 October:** Bonn (Germany) - International Symposium on Precision Approach and Performance Based Navigation (ISPA 2008). [www.dgon.de](http://www.dgon.de)
- **14-16 October:** Liverpool (UK) Conference: Designing the next Generation of Civil Aircraft Structures (CEAS/Str.&Mat. Group) [conference@raes.org.uk](mailto:conference@raes.org.uk) – [www.aerosociety.com/conference](http://www.aerosociety.com/conference)

- **22-24 October:** Hamburg (Germany). International Meeting, Aviation Product Support – [geschaftsstelle@dglr.de](mailto:geschaftsstelle@dglr.de) – [www.imapp2008.org](http://www.imapp2008.org)
- **27-29 October:** London, UK, CEAS/Aerodynamics Group Conference: The Aerodynamics of Novel Configurations – [conference@raes.org.uk](mailto:conference@raes.org.uk) – [www.aerosociety.com/conference](http://www.aerosociety.com/conference)
- **11-13 November:** NLR, Amsterdam (NL): SETP/SFTE Flight Test Safety Workshop Europe
- **12-13 November:** Military Flight Simulation: Present Capabilities and Future Potential – Flight Simulation Group Conference – London, RAeS [conference@raes.org.uk](mailto:conference@raes.org.uk) [www.aerosociety.com/conference](http://www.aerosociety.com/conference) – November UAV Conference London, RAeS [conference@raes.org.uk](mailto:conference@raes.org.uk) – [www.aerosociety.com/conference](http://www.aerosociety.com/conference)

### 2009

- **21-23 April:** RAeS Annual Conference & Exhibition Aerospace 2009 – London, RAeS – [conference@raes.org.uk](mailto:conference@raes.org.uk) [www.aerosociety.com/conference](http://www.aerosociety.com/conference)
- **25-29 May:** Rotterdam, on board "SS Rotterdam": Symposium organised by the International Committee on Aeronautical Fatigue (ICAF)
- **29 June-3 July:** Milan – 20<sup>th</sup> Nal Congress of AIDAA
- **8-10 September:** Aachen (Germany) – German National Aeronautics and Astronautics Congress- [www.dlrk2009.dglr.de](http://www.dlrk2009.dglr.de)
- **22-24 September:** Hamburg (Germany) 35<sup>th</sup> Rotorcraft Forum [geschaftsstelle@dglr.de](mailto:geschaftsstelle@dglr.de)
- **26-29 October:** Manchester (UK), CEAS European Air & Space Conference 2009

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