The Quarterly Bulletin of the

CEAS

COUNCIL OF EUROPEAN AEROSPACE SOCIETIES

3AF – AIAE – AIDAA – CzAeS – DGLR – FTF – HAES – NVvL – PSAA – RAAA – RAeS – SVFW – TsAGI – VKI

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THE SUCCESSFUL LINKÖPING CONFERENCE OF SEPTEMBER 2013 FIRMLY ESTABLISHED THE CEAS CONFERENCE AS ONE OF THE MOST IMPORTANT EVENTS AMONG THE COMMUNITY OF EUROPEAN AIR AND SPACE PROFESSIONALS

WHAT IS THE CEAS ?

The Council of European Aerospace Societies (CEAS) is an International Non-Profit Association, with the aim to develop a framework within which the major Aerospace Societies in Europe can work together.
It presently comprises 15 Member Societies: 3AF (France), AIAE (Spain), AIDAA (Italy), CzAeS (Czech Republic), DGLR (Germany), FTF (Sweden), HAES (Greece), NVvL (Netherlands), PSAS (Poland), RAAA (Romania), RAeS (United Kingdom), SVFW (Switzerland), TsAGI (Russia), VKI ((Von Karman Institute, Belgium) and EUROAVIA.
Following its establishment as a legal entity conferred under Belgium Law, this association began its operations on January 1st, 2007.
Its basic mission 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, governments, aerospace and defence industries and academia.
The CEAS is governed by a Board of Trustees, with representatives of each of the Member Societies.
Its Head Office is located in Belgium:
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- A well-found structure for Technical Committees

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- Technical pan-European events dealing with specific disciplines and the broader technical aspects
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Publications:
- Position/Discussion papers on key issues
- CEAS Aeronautical Journal
- CEAS Space Journal
- CEAS Quarterly Bulletin
- Aerospace Events Calendar – www.aerospace-events.eu

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- European Commission
- European Parliament
- ASD (AeroSpace and Defence Industries Association of Europe), EASA (European Aviation Safety Agency), EDA (European Defence Agency), ESA (European Space Agency), EUROCONTROL
- Other European organisations

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- Annual CEAS Gold Medal to recognize outstanding achievement
- Medals in technical areas to recognize achievement

Young Professional Aerospace Forum

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- General Functions: President, Director General, Finance, External Relations & Publications, Awards and Membership.

- Two Technical Branches:
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  – Space Branch

Each of these two Branches, composed of specialized Technical Committees, is placed under the authority of a dedicated Chairman.

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EDITORIAL

ABOUT THE SUCCESSFUL LINKÖPING CONFERENCE

Jean-Pierre Sanfourche
Editor-in-Chief

The successful CEAS2013 European Air & Space Conference held in Linköping (Sweden) on 16 to 19 September was an indisputable success, this is the reason why I have taken the initiative to publish herein in their integrity the keynote speeches which were delivered by the personalities who graced our event with their active participation.
The opening session included in particular two presentations from the European Commission: by Rudolph Strohmeier, DG Research & Innovation, about the preparation of the next Framework Programme 'Horizon 2000', and by Giuseppe Pagnano, who summarized the status of Clean Sky 1 Programme and the main lines of Clean Sky 2 Programme which is presently undertaken.
For the first time we have dedicated a significant place to Aerospace Defence affairs in the agenda. This initial attempt was very much appreciated and it is my conviction that the future organisers should pursue and enhance it. As a matter of fact, the necessity to rapidly progress towards a well coordinated European Defence is an obviousness, which should encourage our CEAS to strongly support all programmes, projects and action plans oriented in that direction.
In Linköping, two main subjects were dealt with: Future Combat Air Systems and Missile Defence.
A complete day, animated by CEAS President David Marshall, was dedicated to Education and Training with the aim to discuss on how to prepare for getting the well educated and motivated aerospace community we need to build in order to reach the ambitious 2050 goals. Opened by the keynote speeches from Dietrich Knörzer, Directorate General for Research and Innovation in Aeronautics at the European Commission, and from Aldert Kamp, Director of Education in Aerospace Engineering at TU Delft, this day allowed through a number of working meetings to make emerged a clear Proposal for an Action Plan.
And during the three days of the Conference, about 160 technical papers were presented, covering most of the main topics of Aeronautics and Space: their abstracts are gathered together in a book including the coordinates of the authors. As a short illustration of the researches being led within Europe, the EREA's (association of European Research Establishments in Aeronautics) presentation made by its president Rolf Henke is herein reproduced.
Considering the importance of the attendance on the one hand, and the variety and density of the presentations on the other hand, it can be said that Linköping Conference firmly established the CEAS biennial Conference as one of the most important events among the community of European Air and Space professionals.

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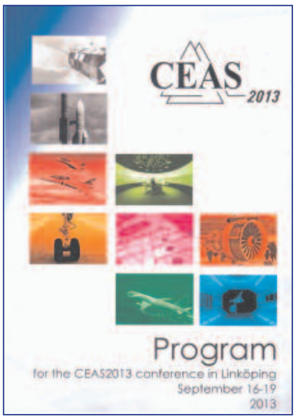

• FIRST DAY – 16 September 2013

– WELCOME ADDRESSES: Roland Karlsson, Chairman FTF and Chairman of CEAS 2013 Organizing Committee - David Marshall, CEAS President - Petter Krus, Chairman of CEAS 2013 Programme Committee - Paul Lindvall, Linköping Municipality - Helen Dannetun, Vice Chancelor, Linköping University – Dan Jangblad, Vice President, SaaB AB.

– KEYNOTES: Rolf Strohmeier, European Commission: 'Horizon 2020' – Giusepe Pagnano, European Commission: Clean Sky 1 and 2 – Constantinos Stavrinidis, ESA: Clean Space.

– Air Power Session:

Keynotes: General Johan Svensson, Swedish Armed Forces (Sweden): Future Swedish Air Force within the context of Global Swedish Armed Forces – Engineer-in-Chief (Col.) Philippe Koffi, Armament Procurement Agency (France): A French Vision of Future Combat Aviation – Jan Palmkvist, Saab AB: Gripen Next Generation Fighter.

Technical presentations: David Marshall, CEAS President: Safeguarding the European Combat Aircraft Industry – Thierry Prunier, Dassault Aviation (France): 'nEUROn', the promising Europe's UCAV Demonstrator – Guido Kurth, MBDA: Meteor missile's propulsion system – Luc Dini and Michel Dechanet, Thales Air Systems SA: Missile Defence Challenges in Europe – Pawel Ziencik, ITWL (Poland): the Air Force Institute of Technology of Poland.

– Technical Session Part One:

- Green technology: Ultra Low Emissions – Space Avionics: Sensing and Navigation
- Recent Advances in Aircraft Actuation Systems and Components
- Flight Operations: ATM – UAS Traffic Insertion and UAS Operation
- Manufacturing - Structural Design
- Environment & Aerospace – Clean Space: Green Rocket Propellant
- Aircraft Design: Methods and Tools – Propulsion in Aircraft Design
- Aeronautics: Stability and Control – Experimental Aero. – Wind tunnel and Flight Testing
- Computational Methods in Aerospace Engineering

• SECOND DAY – 17 SEPTEMBER 2013

– Education Session:

KEYNOTES: David Marshall, CEAS President: Introduction – Dietrich Knörzer, EC DG Research and Innovation in Aeronautics: Education and Training, an Investment in Europe's Future – Aldert Kamp, TU Delft: Educating Tomorrow's Innovative Engineers.

TECHNICAL WORKSHOPS:

- Outreach, careers advice and skills training
- Space Engineering Competences and Academic Education
- EWADE (European workshop on Aircraft Design Education): general Presentation by Founders and Hosts – Teaching and Research Activities in Aircraft Design – Aircraft Design Studies

– Technical Session Part Two

- EREA (association of European Research Establishments in Aeronautics) Session
- Flight Operations: Trajectory and Flight Optimization – Operational Value and Trajectories
- Structural Design: Analysis, Materials and Manufacturing
- Design Engineering : Collaborative Design, Modelling & Simulation – Methods and Tools
- Aeronautics: Aeroacoustics, Aeroelasticity, Unsteady Aerodynamics, Active Flow Control, Aerodynamic Modelling & Simulation, Computational Methods
- Avionics: sensing and Navigation
- Propulsion: Gas Turbine Modelling & Simulation – cores, Combustion Chambers Modelling & Simulation
- Space: Clean Space, De-Orbiting and Space Debris – Life Cycle Assessment

• Third Day – 18 September 2013

KEYNOTES: Mike McCann, GKN – Christer Fuglesang, ESA Astronaut

Education (Cont'd and end)

- EWADE: collaboration, Methods and Tools – Round Table: next EWADE and EWADE's role in CEAS
- Education Session Summary, by David Marshall

Technical Presentations Part Three

- GARTEUR (Group for Aeronautical Research and Technology in Europe)
- Aerodynamics: Design & Applied Aerodynamics – Modelling & Simulation
- Aeronautics: Modelling and Simulation – Architecture, Sensors and other – Stability and Control – Innovative Aircraft Design
- Flight Operations: Human Machine Interface - Logistics, Maintenance and support
- Space: Clean Space, Rockets & Environment – Systems – Propulsion and Exploration

'HORIZON 2020' • EUROPE'S INITIATIVE FOR RESEARCH AND INNOVATION IN EUROPE

By Rudolf Strohmeier, DG Research and Innovation, European Commission

Rudolf Strohmeier

"Ladies and gentlemen,
First of all, let me thank the organisers of the conference in particular the CEAS president, Mr David Marshall, for inviting me to speak at this 4th European Air & Space Conference of the Council of European Aerospace Societies (CEAS) in Linköping. In my view, it is very important to gather the scientific and technical community periodically to share knowledge and ideas, in particular for the younger researchers from whom the future leading research and innovation ideas will emerge and prepare the European aerospace of tomorrow. Therefore to dedicate the 2nd day to education is a laudable effort.

In this moment we are in a significant transition in European research and technological developments. The large and successful 7th Research Framework Programme comes to its end this year and the new EU Framework Programme for Research and Innovation Horizon 2020 will officially start in 2014.

In my presentation, I would like to take shortly stock of the achievements of FP7, in particular in aeronautics and Air Transport, and then to inform you about the main features, the new aspects and the state of play of the preparation of the next Framework Programme Horizon 2020, and about aviation within its "Smart, Green and Integrated Transport" Societal Challenge.

As the slide of EUROSTAT (Figure 1) demonstrates that the production of the high-tech industries could recover after the financial crisis much better than the total manufacturing industries and specially the low-tech manufacturers, Europe, therefore, has to make all efforts in maintaining or sometimes regaining its competitive positions on a globalised market, in particular increasingly for high-tech products such as those of aeronautics and space. This is one of the main reasons why the Commission has incorporated Innovation in the Framework Programme Horizon 2020. It is the key to transform technologies and knowledge faster into advanced more competitive products.

It is common sense today that the investment in R&D is part of the solution to exit from the economic crises (Figure 2). Therefore, it is no surprise that several of the Member States that are most affected by the economic crisis can be found in the lower part of the graph showing the average R&D

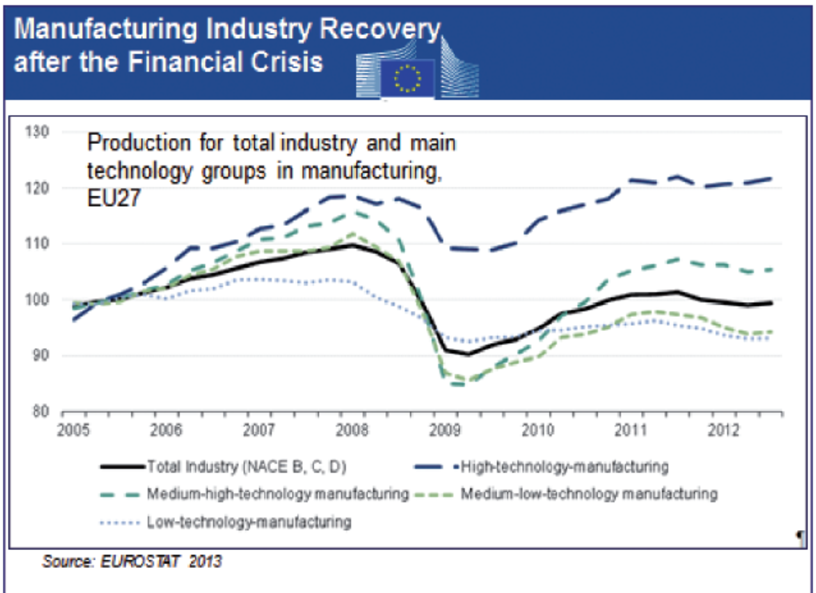

Fig. 1

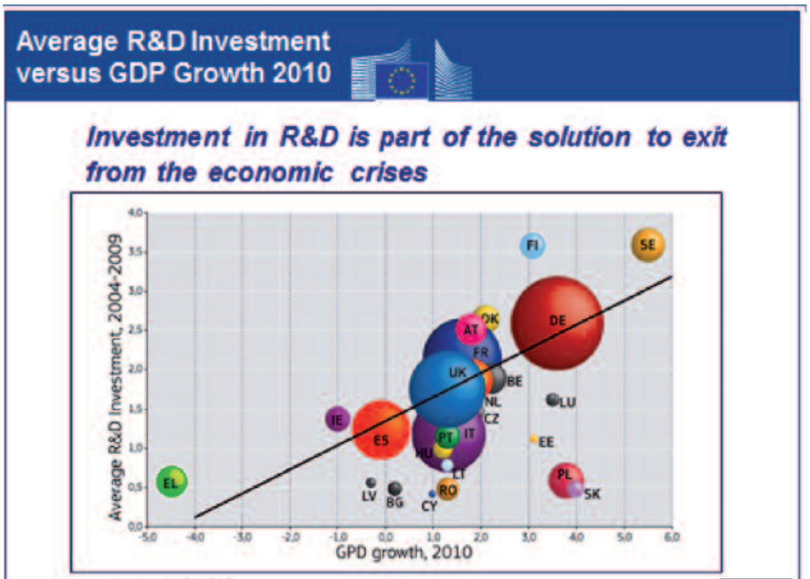

Fig. 2

Fig. 3

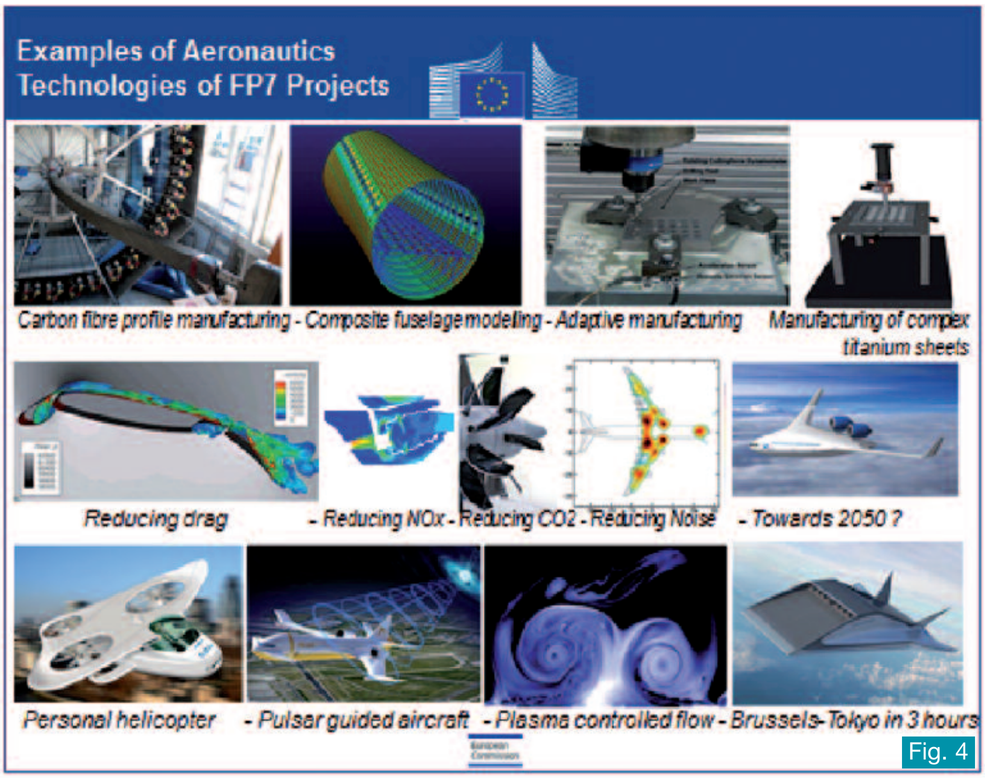

Fig. 4

investments as you see from this slide.

At the European level our response has been since quite some years to put an increasing effort in research and technological developments notably through a significant contribution from the EU Research Framework Programmes.

As you are certainly aware, the European research and joint technological developments in Aviation started already nearly 25 years ago within the early EU Research Framework Programmes. Jointly remarkable progress has been achieved in critical technologies that contributed to the success of the Europe's Aeronautics products. This slide shows that EU-level research projects have significantly contributed to the technology readiness for Europe's flagship aircraft - the Airbus A380 (Figure 3). It covers all technology areas from composites materials, advanced on-board systems up to design tools for aerodynamics. By the way, this is the favourite Aeronautics poster of our Commissioner, as it clearly shows that joint European efforts can really move and achieve something.

You can find numerous other success stories the European research projects have contributed to, e. g. for aero-engines, small aircrafts, advanced design tools, etc. – not all are as big and spectacular as the A380.

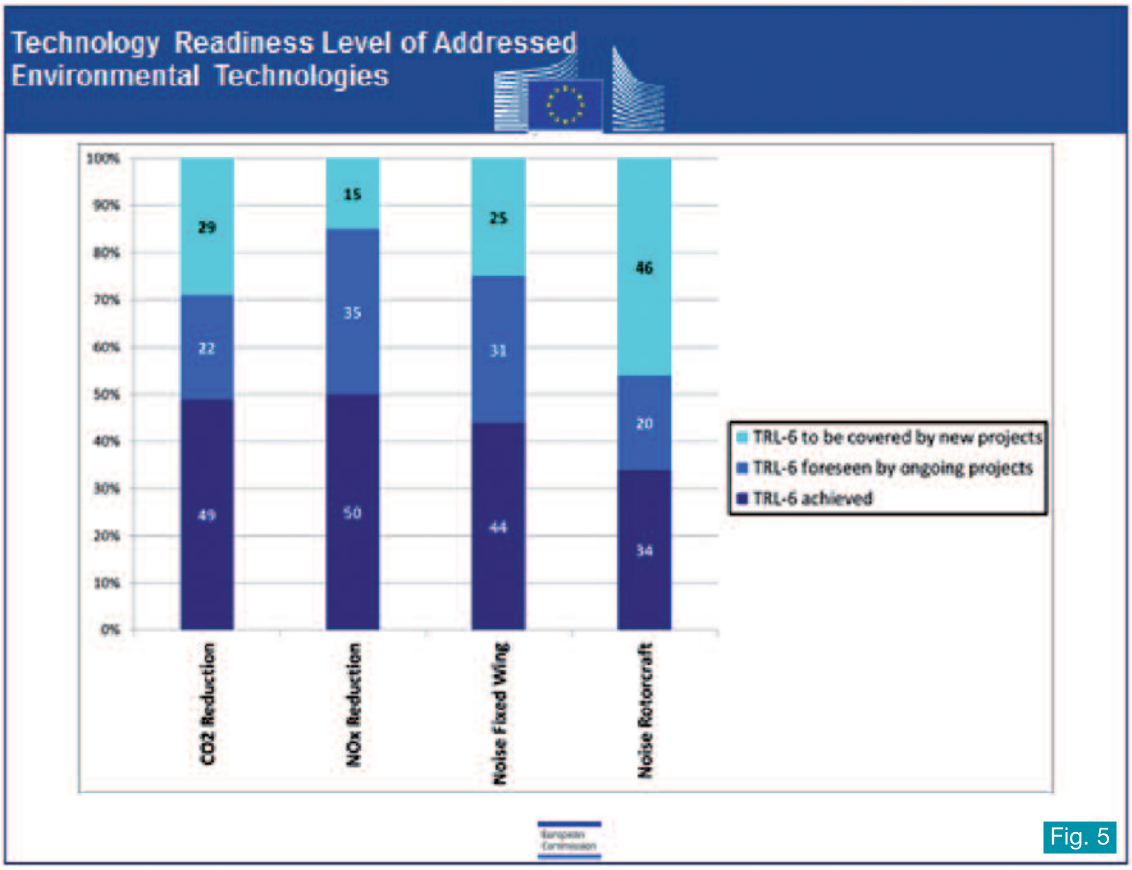

Fig. 5

With more than 1.0 billion Euros of EU funding invested in research and technology development, the achievements of the Aeronautics & Air Transport (AAT) programme of FP7 are equally numerous and significant (Figure 4). Of course, the primary output is the maturation of a wide range of technologies for aeronautics and air transport but also progress has been achieved towards a number of common goals developed in the Vision 2020 for European Aeronautics, jointly developed by all aviation stakeholders in ACARE, the Advisory Council of Aviation Research in Europe.

In view of the Vision 2020 goals for societies' needs and for the global leadership, the FP7 projects addressed advanced manufacturing technologies ensuring competitiveness, tackled fluid dynamic problems leading to reduced fuel consumption, noise and emissions and looked into the future with novel concepts and their related technologies for the air transport of tomorrow.
With the Joint Technology Initiative 'Clean Sky' a new instrument was born in FP7 as a public private partnership. In large demonstration platforms of the key aeronautics areas Clean Sky aims for achieving a high technology-readiness-level of critical aircraft components and technologies. The co-ordinating Scientific Officer of Clean Sky, Giuseppe Pagnano, will give you a closer inside view later this morning.
In parallel we have asked the experts to assess the potential on on-going and past efforts to reach Technology Readiness Level 6 before 2020 (Figure 5). Evaluated in 2011, the slide indicates the expected achievements of the environmental goals as emission and noise reduction. Provided the effort is sustained, we are thus on a good track to reach most of the ambitious environmental objectives of the Vision 2020. Of course the industrial sectors need then effectively to take up these technologies for them to have an actual impact.
The new Framework Programme includes sky research as well as the translation of knowledge to large demonstration

action. Horizon 2020 will be based therefore on three priorities: The Excellence of Science, the Industrial Leadership on a more and more globalised market, and the tackling of the societal Challenges that Europe is facing today and in future. I can tell you that my colleagues and myself are currently very busy preparing already the first WP of Horizon 2020. However, there are still some implementation modalities under negotiation, but we are confident that the process can be finalised this autumn and that we can launch the

first Calls for Proposals just before the end of this year.
Better inter-linkages and coordination of the European research and innovation programmes and means to stimulate the whole innovation chain "from idea to the market" is a key priority for Horizon 2020. It is designed to trigger sustainable growth, create new jobs, and address societal challenges considered beyond the scope and resources of any one country to tackle. Horizon 2020 will continue to bring benefits to science and society, but it will also feature a number of changes and improvements including, a comprehensive take on the innovation ecosystem, from "research to retail". Indeed, to maximise the impact of Union level actions, support will be provided to the full spectrum of research and innovation activities.
Horizon 2020 will bring some changes compared with the previous Framework Programmes. First, it will integrate three support initiatives for research and innovation of the European Union. The coupling of research towards innovation in all its different needs is probably the most important change. It will focus on the key societal challenges as e. g. transport – that means mobility of the citizens – including aviation instead of technologies. Finally it aims for simplified access procedures for the involved stakeholders, including a reduction of TTG to 8 months.
Horizon 2020 will support a broad range of coordinated activities to address “Grand Societal Challenges” – among them the challenge of “Smart, green and integrated transport” with a provisional budget of more than 6 billion Euros. This budget will be concentrated to fund research that require trans-European cooperation to address today's most pressing transport challenges, including the ones of aviation:

– making the European Aviation sector more competitive,
– decreasing its environmental impact, in particular noise and emission,
– continuing to enhance the already very high levels of safety,
– contributing to seamless mobility when using air transport; this means looking at travels from door to door. As most of us know, going to and from an airport is often the biggest hurdle for an air trip in Europe.

As before, the goals for aviation in Horizon are fully in line with Europe’s vision for Aviation ‘Flightpath 2050’.
The steadily growing global air transport (Figure 6) means not only a promising business case for the aircraft manufactures of Europe, US and several emerging economies as Brazil, China or Russia, but it also brings a number of global challenges such as safety, environmental impacts, energy supply or air traffic capacity.
In order to tackle these challenges the researchers and engineers need to develop suitable technologies and innovations to counterweight the anticipated growth without creating too much negative impact for the society. For example, there is the challenging ambition that the global air traffic growth should become neutral in its CO_2 emissions as from 2020.
We are working in the perspective of publishing the first Horizon 2020 Work Programme before the end of this year. We shall ask for proposals to contribute to very ambitious objectives for Aviation, which should be familiar to you from the new Europe’s Vision for Aviation “Flightpath 2050” such as to keep our leadership in design, manufacturing and system integration so that jobs are kept in Europe. We are also targeting decrease of CO_2 emission by 75% between 2000 and 2050. We want to pursue our efforts on safety aiming at less than 1 accident per 10 million flights in 2050. With the same time horizon, we would also aim to be able to travel in 4 hours door to door for 90% of the connections within Europe. I am sure that each of

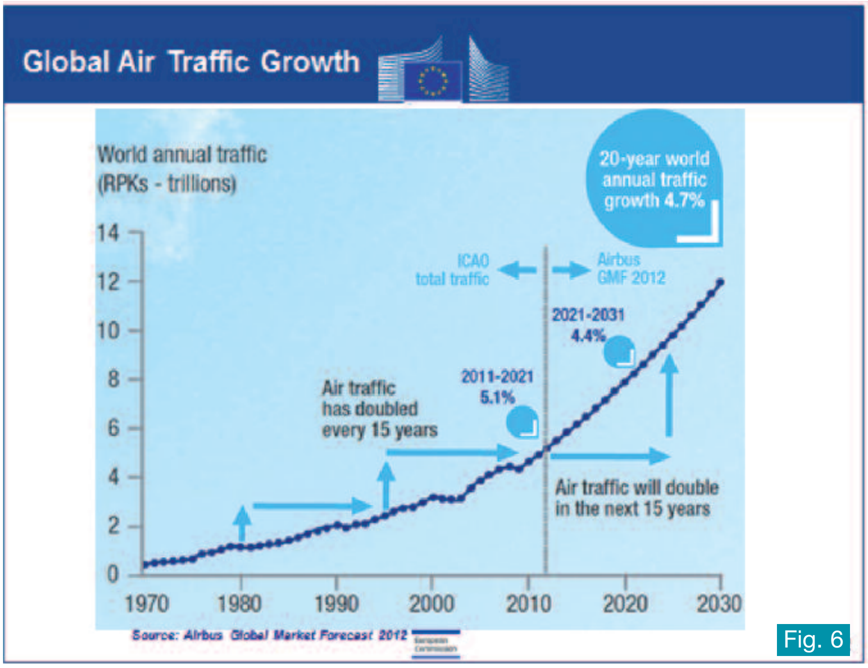

Fig. 6

you can understand from your own personal travel experiences that there is a lot to do in this field.

Now, let me say some words about the preparation of Horizon 2020 Public Private Partnerships, in which I have been personally very much involved and which also includes the proposal for the Clean Sky 2 Joint Undertaking. Securing European industry competitive position implies that new technologies and practices address the societal challenges in the sector, in particular reducing the environmental footprint of air transport. Therefore in the Commission we strongly support the Clean Sky ambitious environmental objectives and work hand in hand with all key stakeholders in aviation, industry and academia, to prepare the successful set-up of Clean Sky 2 (Figure 7). A draft legislative proposal has been adopted by the Commission on 10th July as part of an important Innovation Investment package with a total budget of Euros 22 billion and will today be presented to the Council Research working Group.

This package contains the Commission proposal for setting up five Joint Technology Initiatives in the areas where Europe has or should gain the technological leadership and where Public-Private Partnerships can be important engines to cover the value chains getting longer and longer in Europe. In some areas – aeronautics, pharmaceuticals, ICT – they build on the existing successful partnerships. In other areas, like bio-based economy, it sets up a totally new Public-Private Partnership at the European level. We hope that these major EU-level investments in research and innovation will be ready to be launched at the beginning of 2014, when Horizon 2020 starts.

Clean Sky can play an important role in accepting the tool of a PPP as the air transport sector is probably the only one where our political masters have a concrete idea how a value chain looks like today.

Finally, let me say a few words about this CEAS conference.

I am impressed to see the very dense programme with many technical sessions and presentations - a number of which originating from EU funded research - and many young scientists participating, among those are the leaders of tomorrow's European aviation.

At the same time, the current European landscape of dissemination of scientific knowledge relevant to aviation is quite fragmented even if we have very good and committed associations organising conferences and editing scientific publications such as CEAS. Even for me it is the second major European aeronautics conference within three months to attend.

Through the FP7 support action E-CAERO (Figure 8) we have asked a number of main scientific associations to reflect about this issue to converge towards a better structured landscape and making larger impacts. We have the obligation to give our talented scientists and engineers a stimulating environment, which can give maximum impact to their communication and scientific publications and provide them with solid curriculum-vitae, well recognised in Europe and worldwide.

I have learnt that already good progress has been made over last three years and I sincerely hope that in the next years we will see significant changes in the European land-

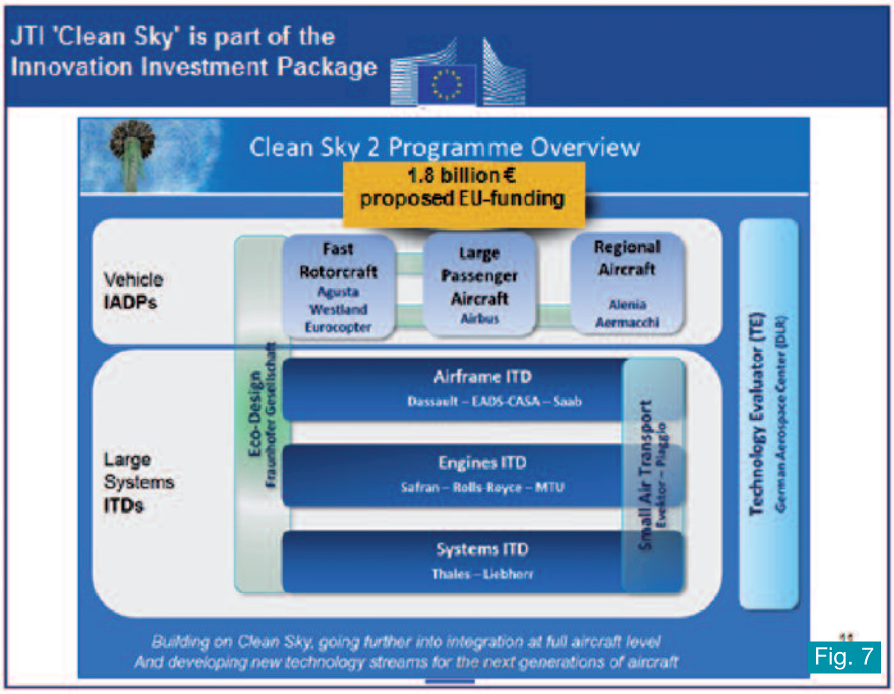

Fig. 7

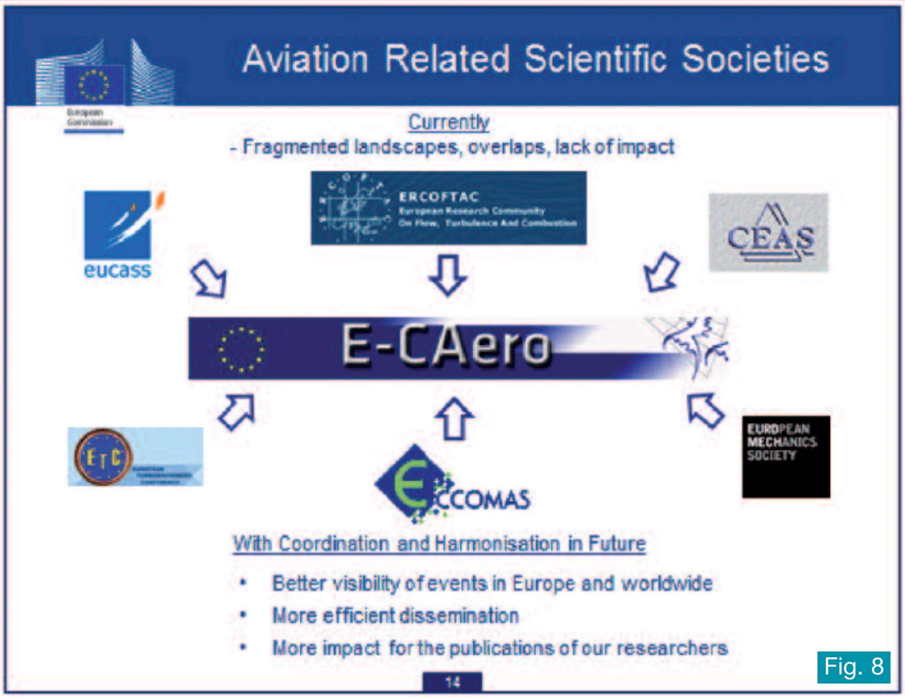

Fig. 8

scape of aeronautics conferences allowing establish Europe as the world-leading place for disseminating relevant scientific knowledge. I would like to thank CEAS and its member organisations for their active participation in this process of E-CAERO and encourage all to continue.

Let me conclude – FP7 was a successful programme, specially for the stakeholders of aeronautics and air transport. With Horizon 2020 the European Union will have the largest ever Framework Programme for research and innovation, designed to make its contribution to overcome the economic crisis in Europe.
The Transport Challenge, including the Public-Private Partnerships like Clean Sky, SESAR and others, represents a significant part of Horizon 2020.
Clean Sky, SESAR and collaborative research with the appropriate allocation of resources will be able to cover the entire range of necessary research and innovation activities for aviation. I am confident that jointly we can make the implementation of Horizon 2020 a big success for Europe.
Finally, I would like to thank CEAS and the organisers of FTF, the Swedish Aerospace Association for inviting the European Commission. I wish you all a successful conference here in Linköping with interesting technical presentations and fruitful discussions. ”

CLEAN SKY

By Giuseppe Pagnano, Coordinating Project Officer

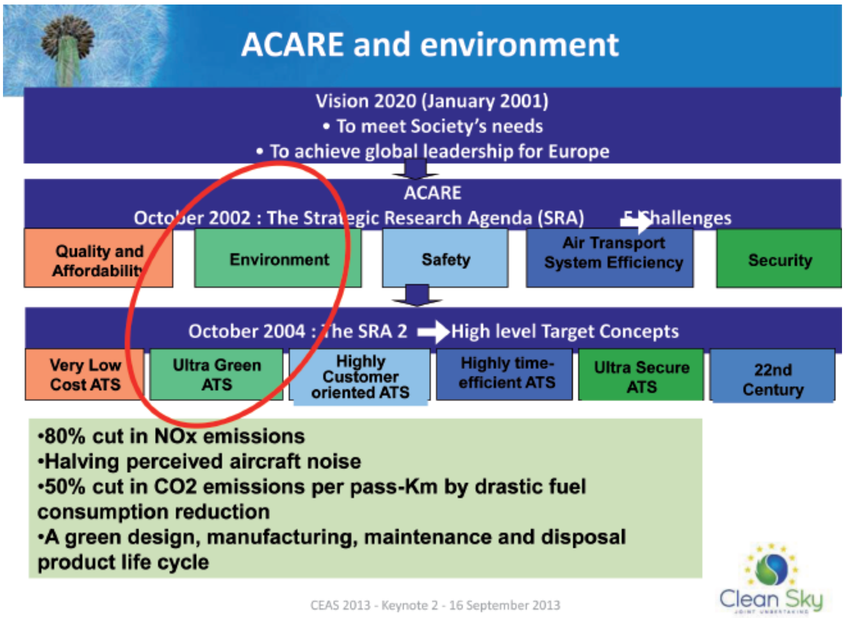

Fig. 1

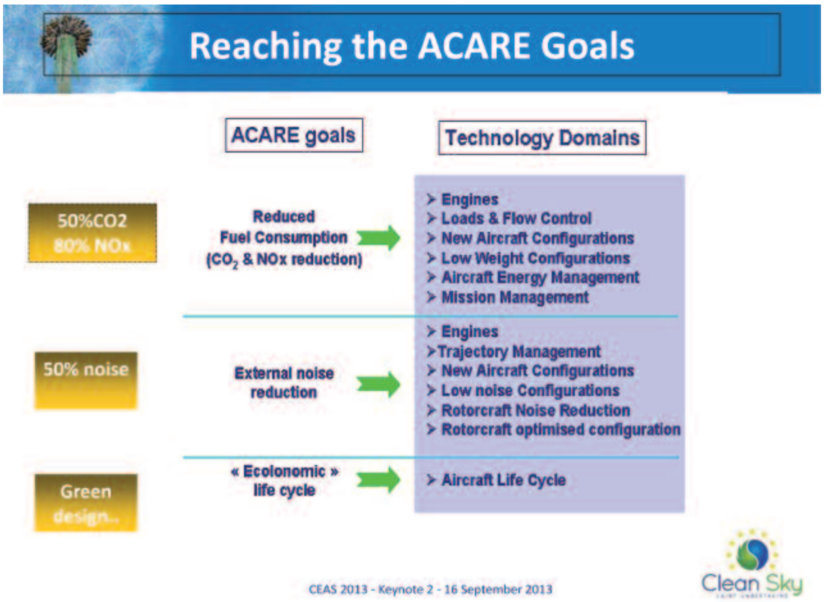

Fig. 2

Fig. 3

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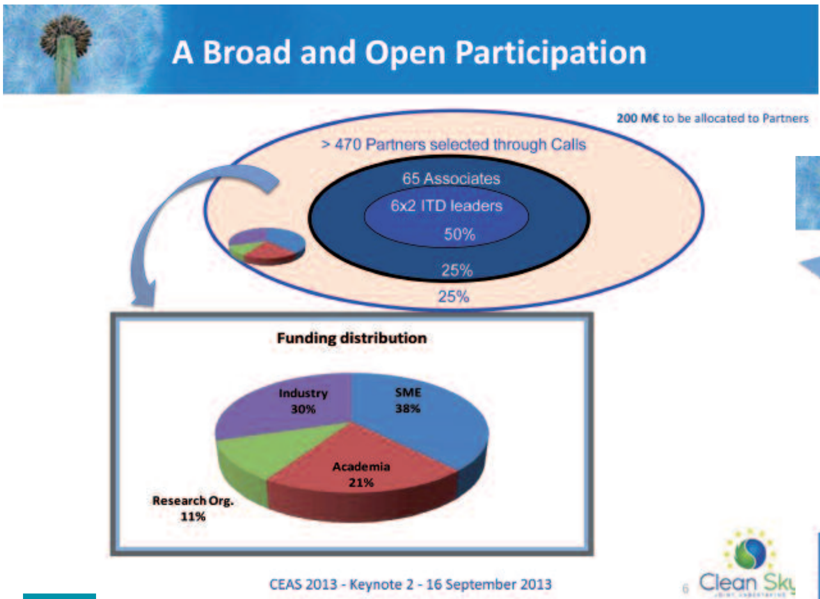

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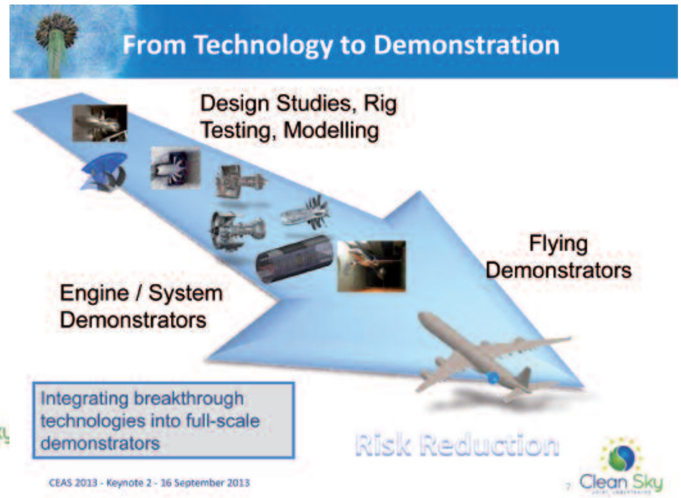

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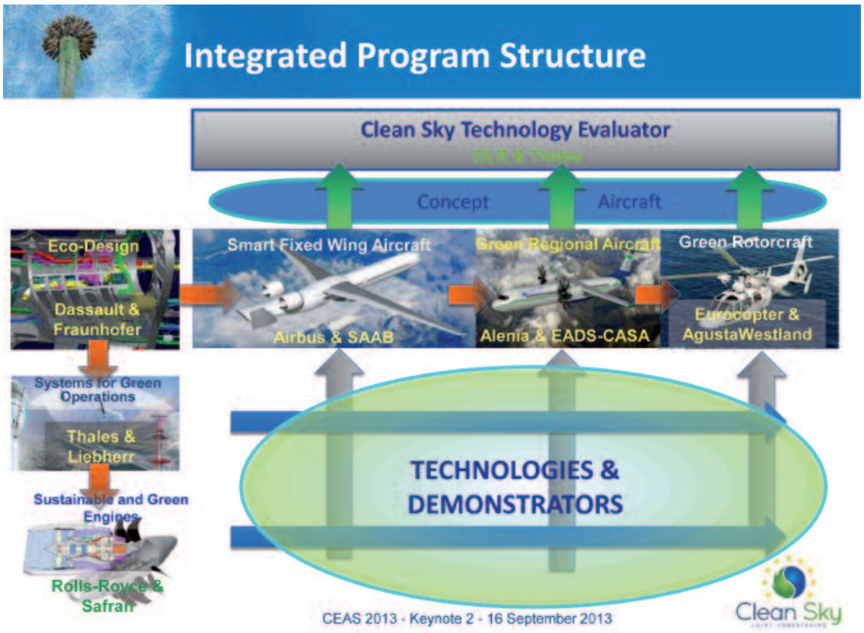

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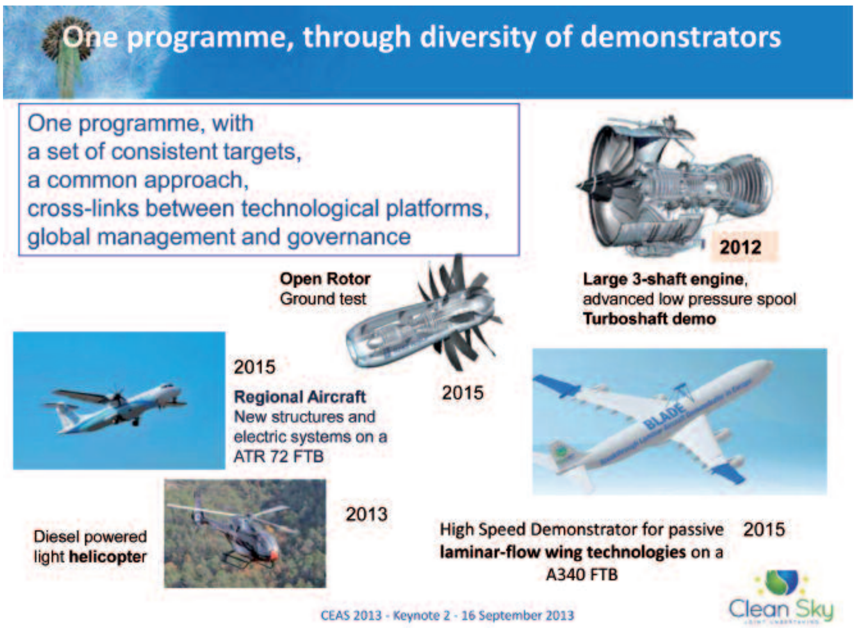

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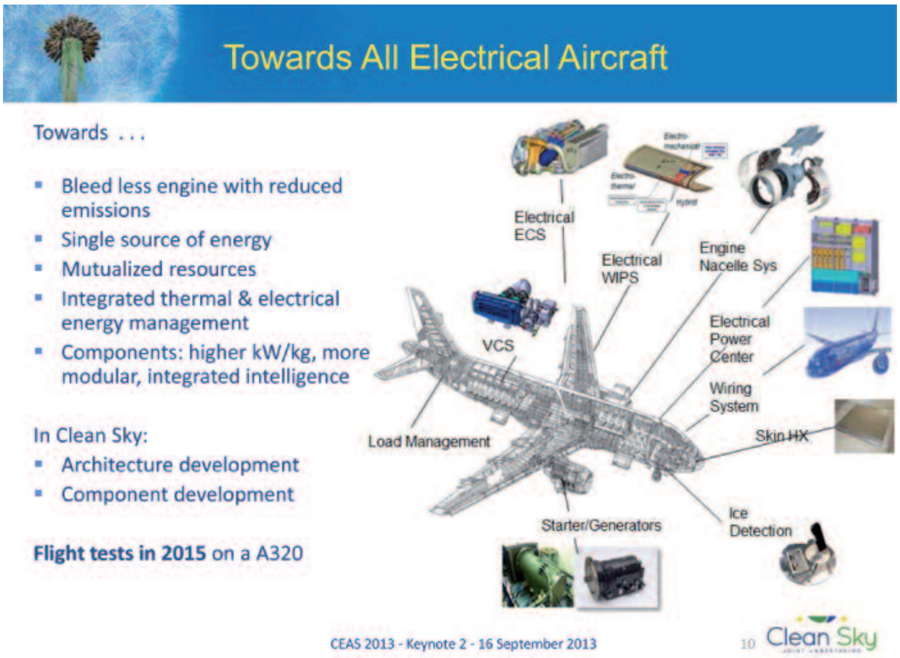

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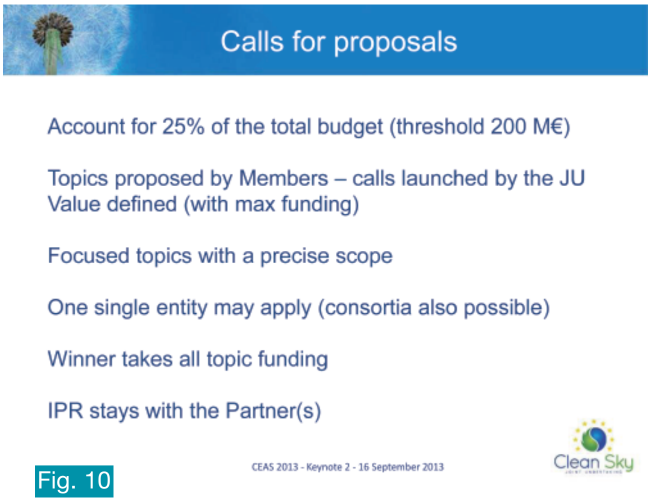

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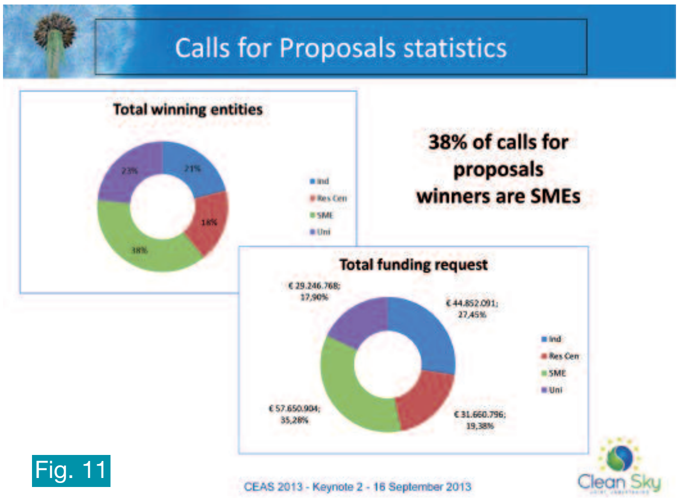
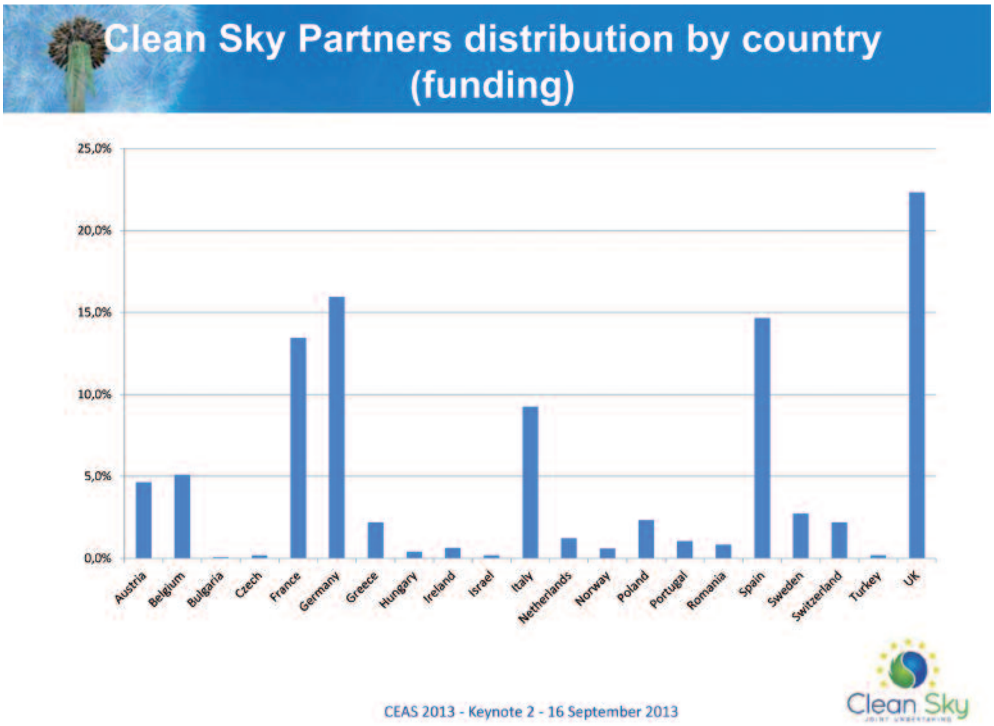


Fig. 11



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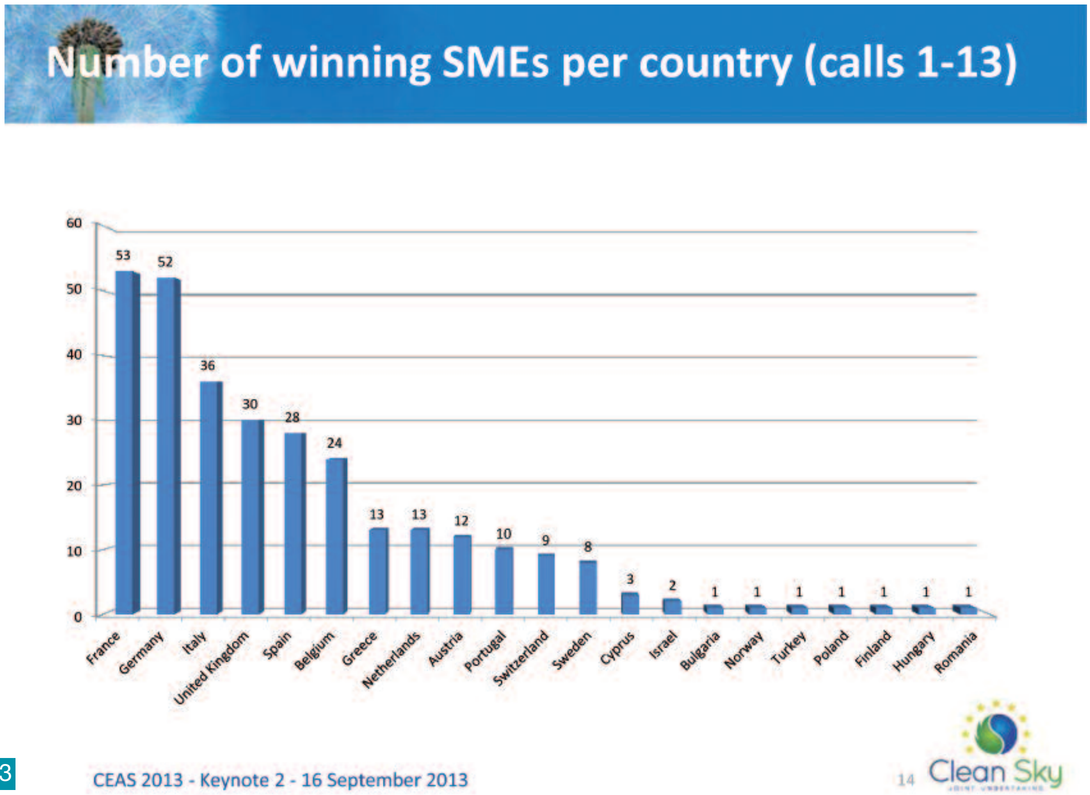


Fig. 13

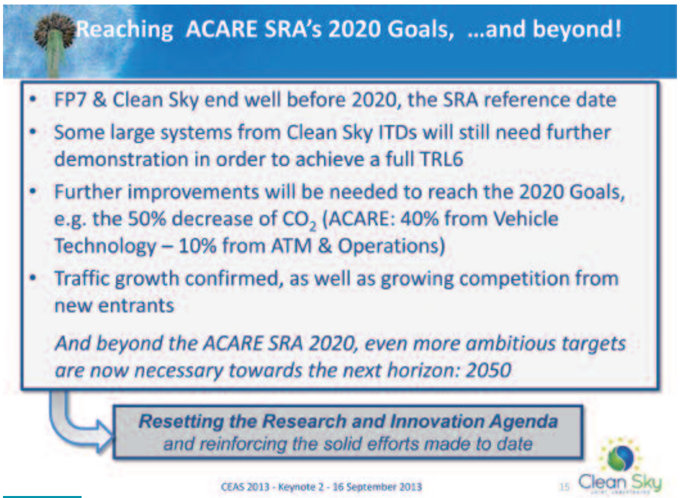


Fig. 14

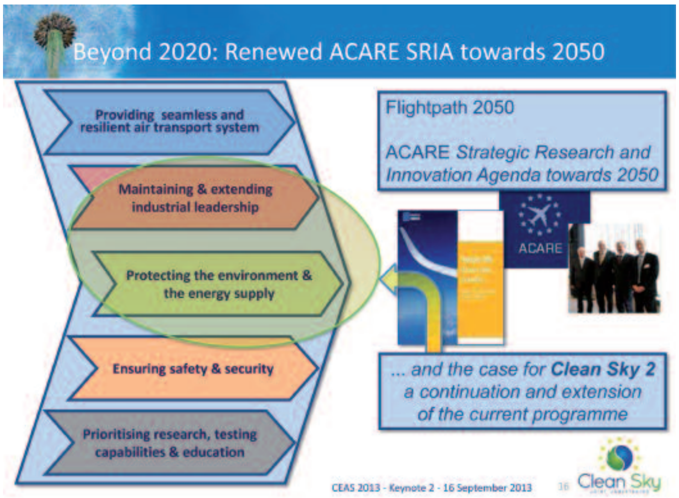


Fig. 15

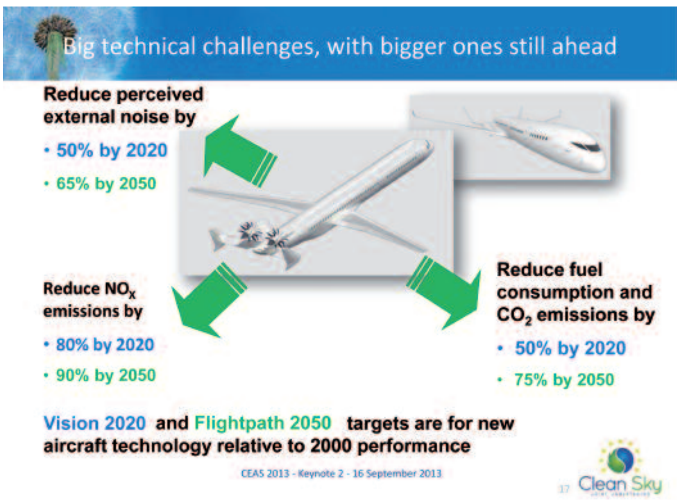


Fig. 16

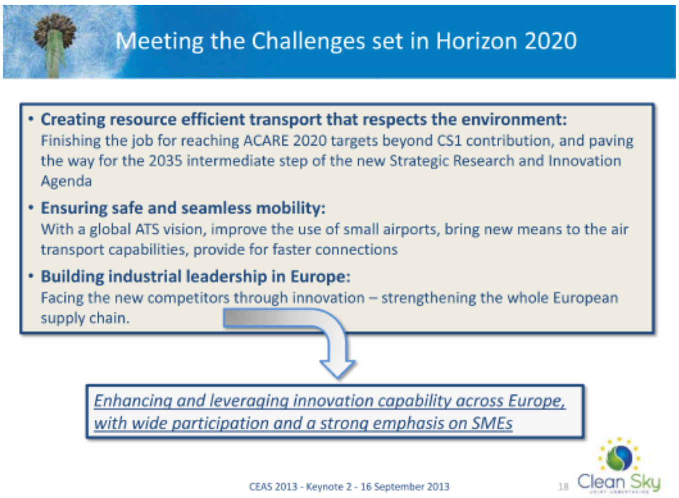


Fig. 17

Fig. 18

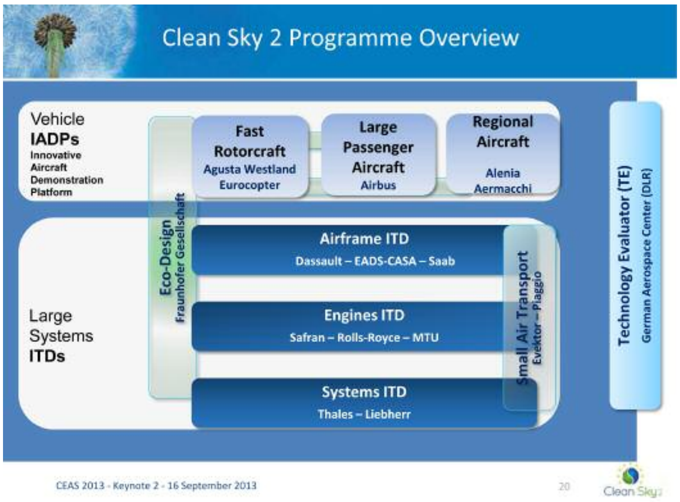


Fig. 19

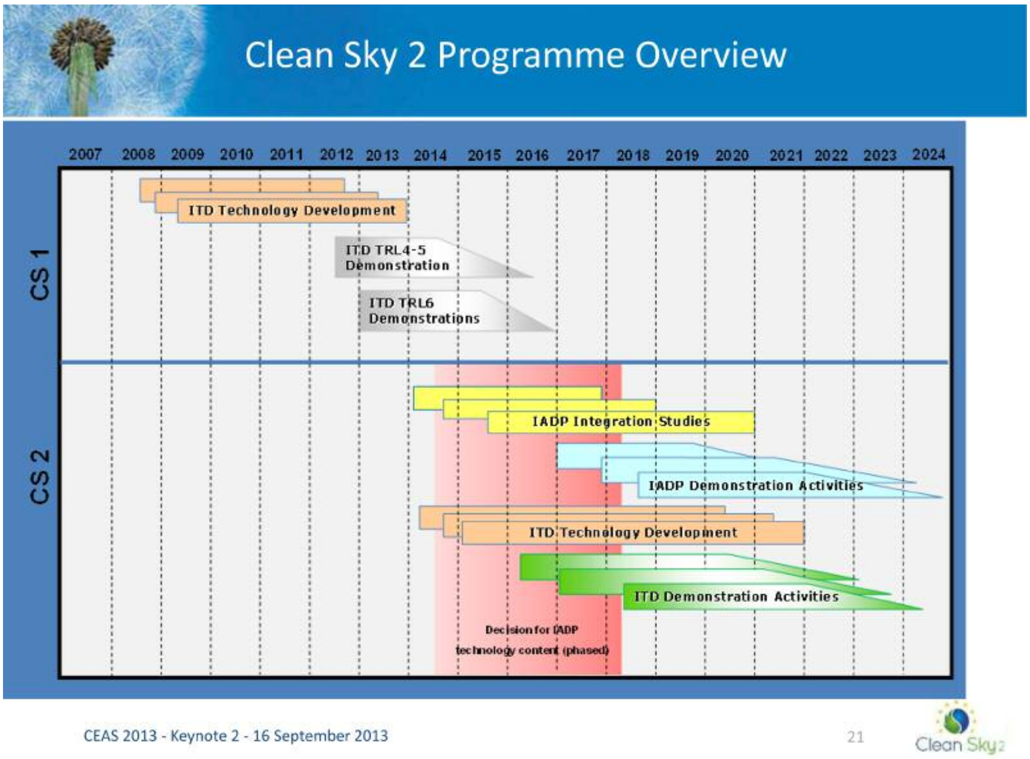


Fig. 20

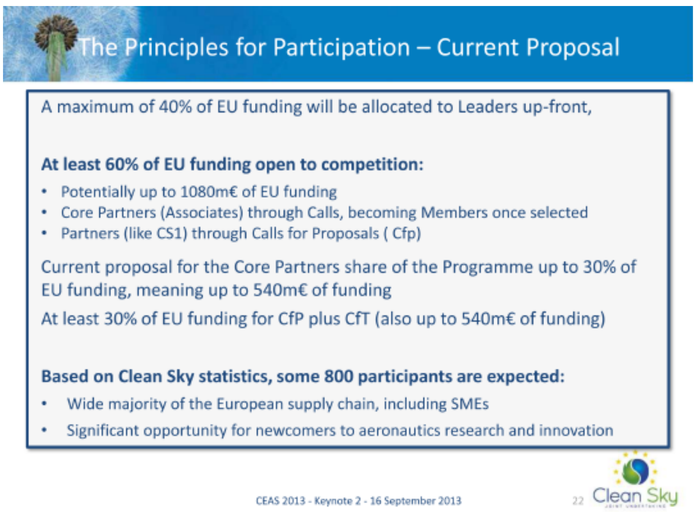


Fig. 21

Fig. 22

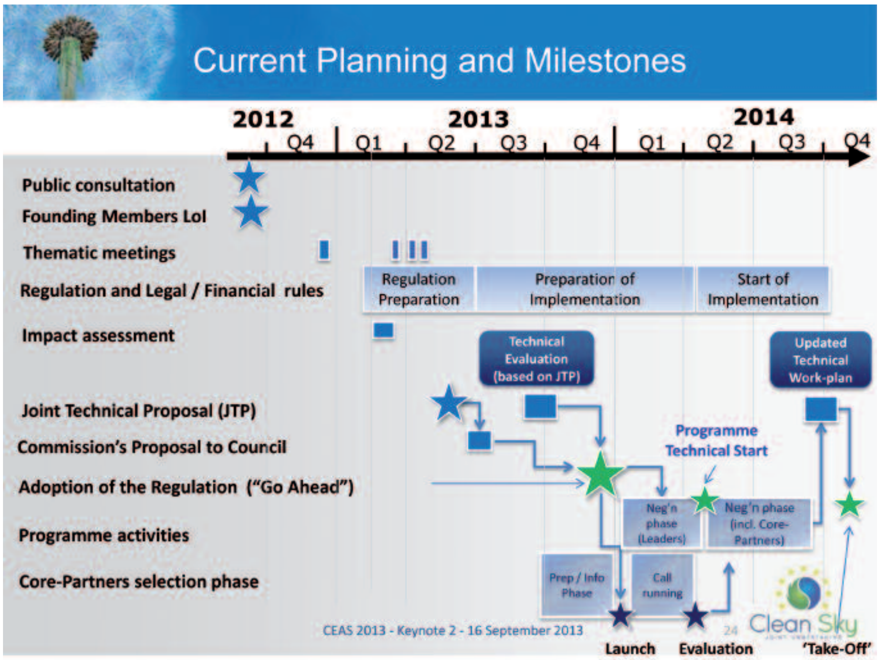


Fig. 23

Fig. 24

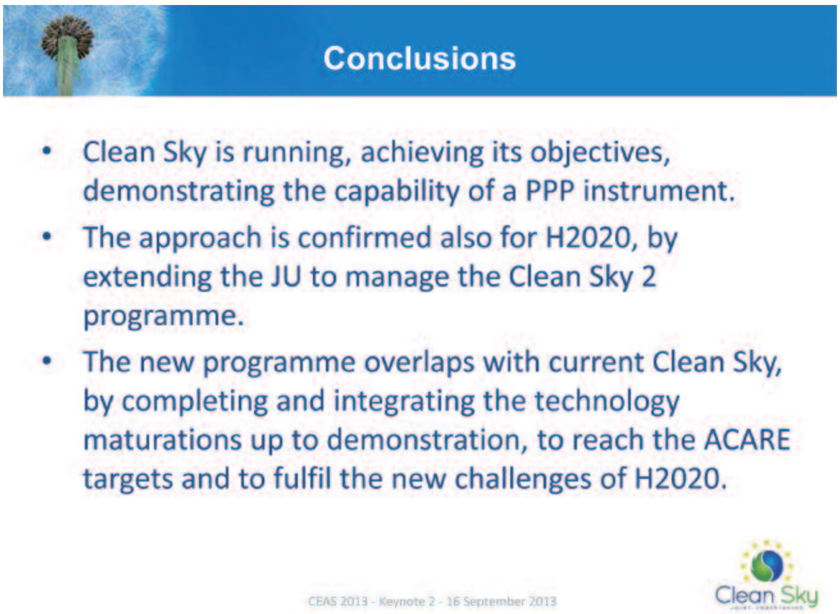


Fig. 25

SAFEGUARDING THE EUROPEAN COMBAT AIRCRAFT INDUSTRY FUTURE: PROGRESS TO DATE

Académie de l'Air et de l'Espace
Air and Space Academy

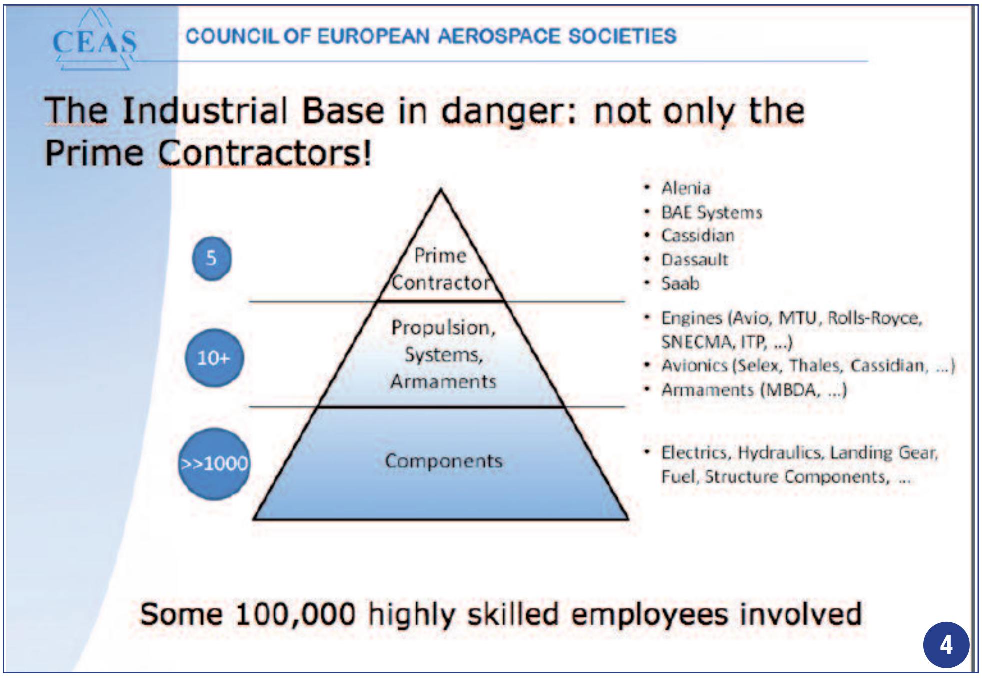
David Marshall

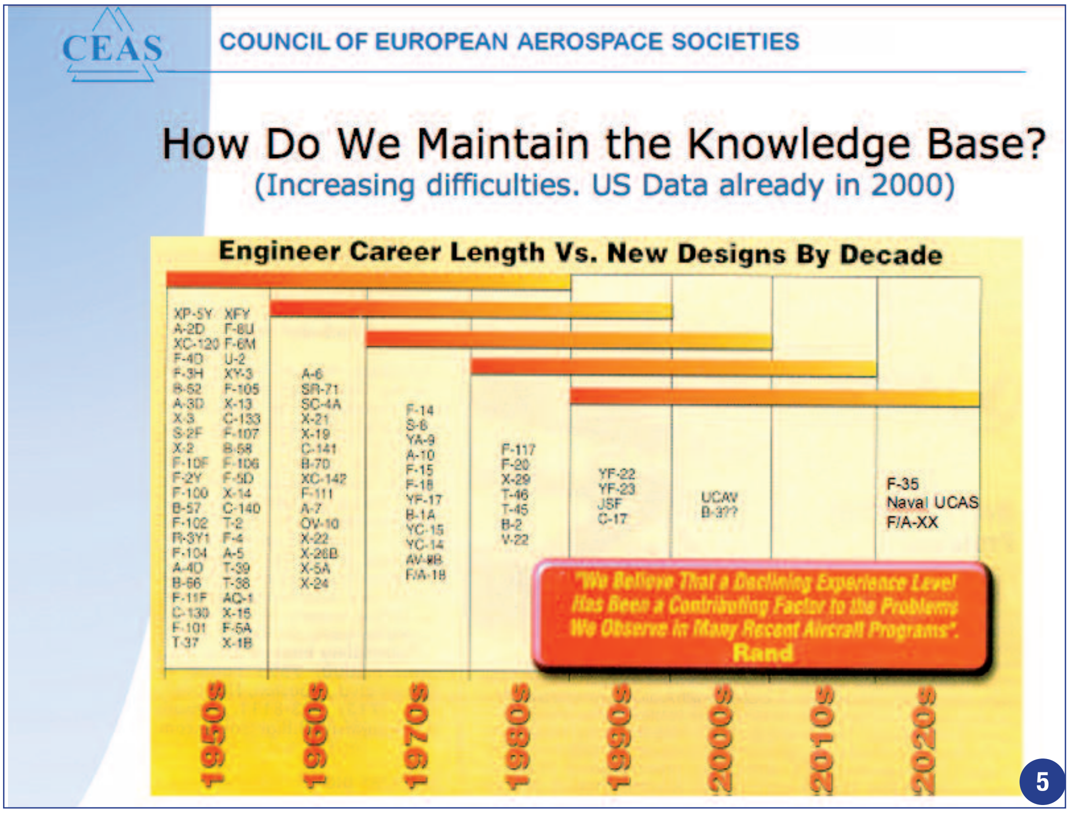
The Air and Space Academy, in cooperation with the CEAS, organised on 16 May 2013 at Ecole Militaire in Paris a Forum to deal with the theme:

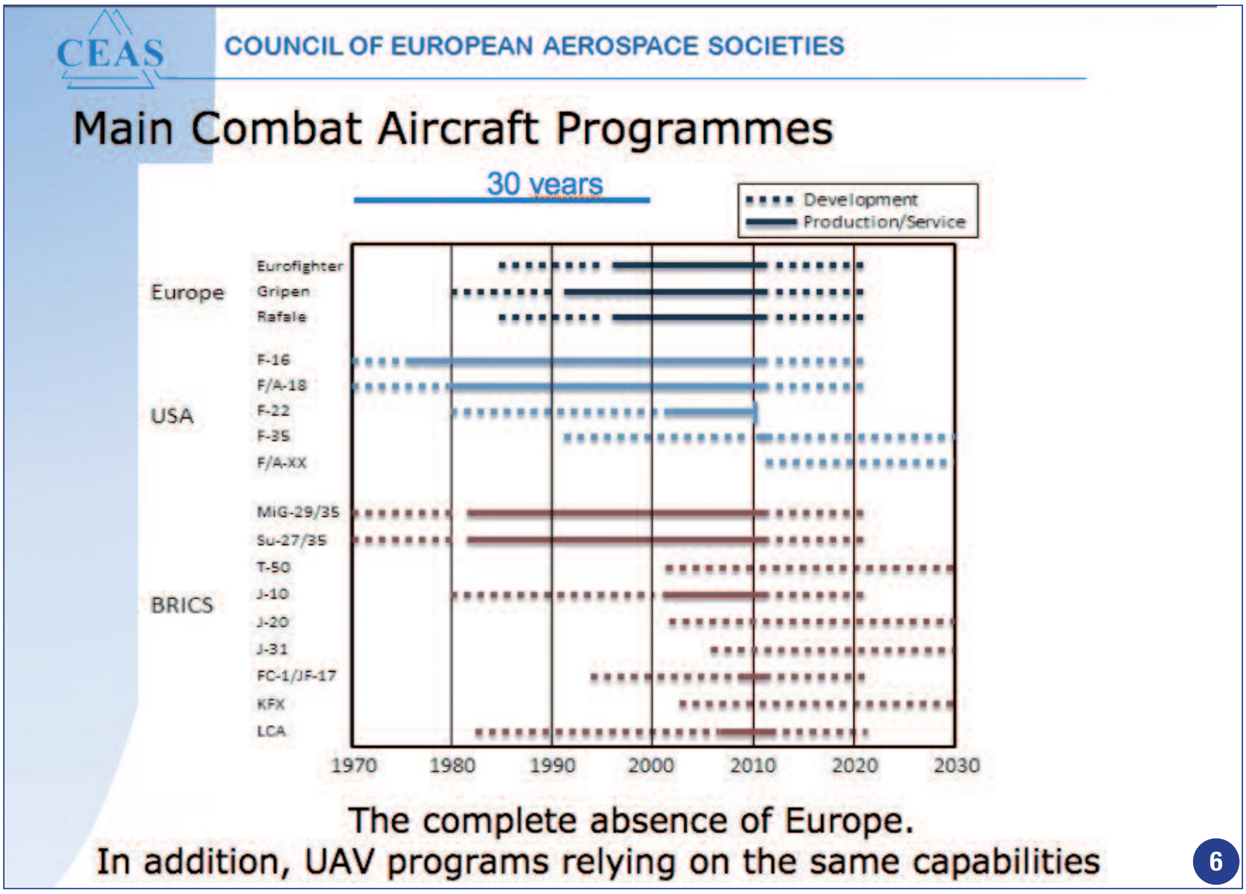
"Safeguarding the European Combat Aircraft industry future: what must be done now?"

The main conclusions which emerged from this event have been presented by CEAS President David Marshall, as an introduction of the Air Power Day.


CEAS
COUNCIL OF EUROPEAN AEROSPACE SOCIETIES
The Key Messages, valid since 2011
1. Air warfare scenarios without advanced combat aircraft are no longer feasible (manned and unmanned)
2. Air Power independence relies strongly on industrial capabilities, design, development, production
3. A strong European Industrial Base is also mandatory to Support Operations and Upgrades: to instantly & independently serve unexpected requirements
4. The Combat Aircraft Industry is a driving force for advanced technologies and qualified employment and impacts the civil sector
3

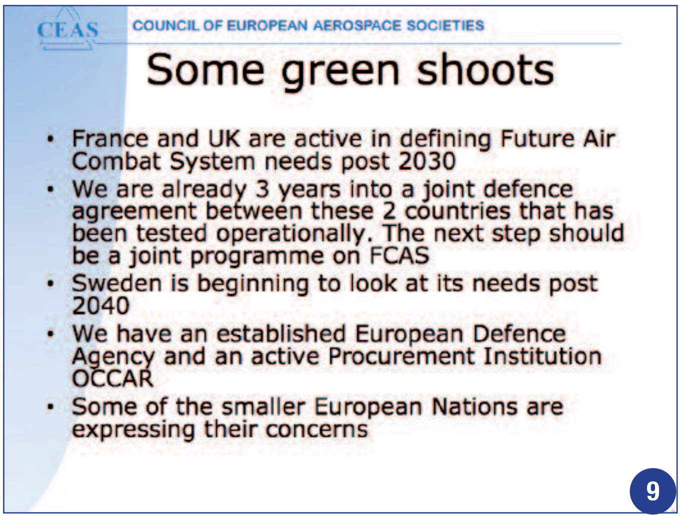

CEAS
COUNCIL OF EUROPEAN AEROSPACE SOCIETIES
The Industrial Base in danger: not only the Prime Contractors!
5
10+
>>1000
Prime Contractor
Propulsion, Systems, Armaments
Components
• Alenia
• BAE Systems
• Cassidian
• Dassault
• Saab
• Engines (Avio, MTU, Rolls-Royce, SNECMA, ITP, ...)
• Avionics (Selex, Thales, Cassidian, ...)
• Armaments (MBDA, ...)
• Electrics, Hydraulics, Landing Gear, Fuel, Structure Components, ...
Some 100,000 highly skilled employees involved
4

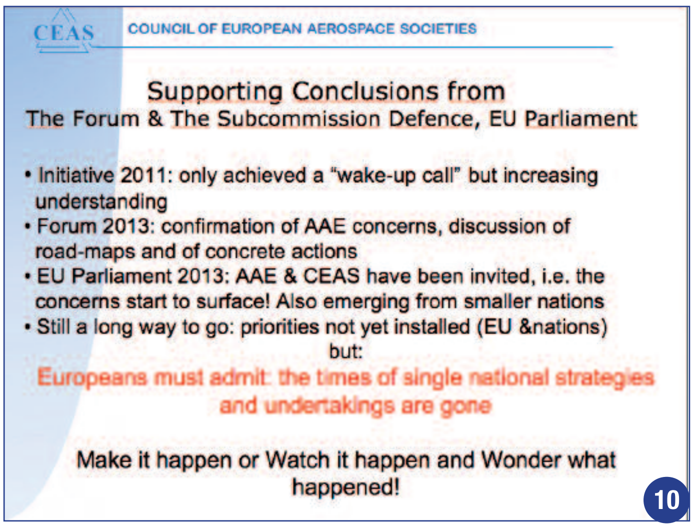

CEAS
COUNCIL OF EUROPEAN AEROSPACE SOCIETIES
How Do We Maintain the Knowledge Base?
(Increasing difficulties. US Data already in 2000)
Engineer Career Length Vs. New Designs By Decade
XP-5Y XFY
A-2D F-8U
XC-120 F-6M
F-4D U-2
F-3H XY-3
B-52 F-105
A-3D X-13
X-3 C-133
S-2F F-107
X-2 B-58
F-10F F-106
F-2Y F-5D
F-100 X-14
B-57 C-140
F-102 T-2
R-3Y1 F-4
F-104 A-5
A-4D T-39
B-66 T-38
F-11F AQ-1
C-130 X-15
F-101 F-5A
T-37 X-1B
A-6
SR-71
SC-4A
X-21
X-19
C-141
B-70
XC-142
F-111
A-7
OV-10
X-22
X-26B
X-5A
X-24
F-14
S-6
YA-9
A-10
F-15
F-18
YF-17
B-1A
YC-15
YC-14
AV-8B
F/A-18
F-117
F-20
X-29
T-46
T-45
B-2
V-22
YF-22
YF-23
JSF
C-17
UCAV
B-3??
F-35
Naval UCAS
F/A-XX
"We Believe That a Declining Experience Level Has Been a Contributing Factor to the Problems We Observe in Many Recent Aircraft Programs".
Rand
1950s
1960s
1970s
1980s
1990s
2000s
2010s
2020s
5


CEAS
COUNCIL OF EUROPEAN AEROSPACE SOCIETIES
Main Combat Aircraft Programmes
30 years
Development
Production/Service
Europe
Eurofighter
Gripen
Rafale
USA
F-16
F/A-18
F-22
F-35
F/A-XX
BRICS
MiG-29/35
Su-27/35
T-50
J-10
J-20
J-31
FC-1/JF-17
KFX
LCA
1970
1980
1990
2000
2010
2020
2030
The complete absence of Europe.
In addition, UAV programs relying on the same capabilities
6


CEAS
COUNCIL OF EUROPEAN AEROSPACE SOCIETIES
Combat a/c emerging outside Europe*
JSF/F-35
J-UCAS
J-20
KFX
TFX
J-31
F/A-XX
T-50
JSF/J-UCAS: US
J-20/J31: China
T-50: Russia
KFX: Korea, Indonesia
TFX: Turkey
* Mostly manned, but also umanned (UCAS)
In addition:an increasing number of UAV Programmes
(also missing in Europe)
7


CEAS
COUNCIL OF EUROPEAN AEROSPACE SOCIETIES
Ways to Maintain Capabilities
• European manufacturers can no longer maintain combat a/c capability alone on a national base.
• No single government will commission any new combat aircraft program to its industry: too much investment, too little market
We obviously must think European, but
How?
• Maintaining complete capability needs a consolidated approach:
- Full program every 30 years
- Operational & Technology Demonstrator every 15 years
- Requirements & needs in one basket, one road-map, one technology strategy, programs t.b.d. Use of Institutions such as EDA
•Impossible? : only if the political will fails to materialise against short term national interests.
8


CEAS
COUNCIL OF EUROPEAN AEROSPACE SOCIETIES
Some green shoots
• France and UK are active in defining Future Air Combat System needs post 2030
• We are already 3 years into a joint defence agreement between these 2 countries that has been tested operationally. The next step should be a joint programme on FCAS
• Sweden is beginning to look at its needs post 2040
• We have an established European Defence Agency and an active Procurement Institution OCCAR
• Some of the smaller European Nations are expressing their concerns
9


CEAS
COUNCIL OF EUROPEAN AEROSPACE SOCIETIES
Supporting Conclusions from
The Forum & The Subcommission Defence, EU Parliament
• Initiative 2011: only achieved a "wake-up call" but increasing understanding
• Forum 2013: confirmation of AAE concerns, discussion of road-maps and of concrete actions
• EU Parliament 2013: AAE & CEAS have been invited, i.e. the concerns start to surface! Also emerging from smaller nations
• Still a long way to go: priorities not yet installed (EU &nations)
but:
Europeans must admit: the times of single national strategies and undertakings are gone
Make it happen or Watch it happen and Wonder what happened!
10

A FRENCH VISION OF FUTURE COMBAT AVIATION

The subject was dealt with by Engineer - in - Chief (ICA) Philippe Koffi, DGA (Armament Procurement Agency, France)

ICA Philippe Koffi has managed the 'nEUROn' Project. In 2011, he joined the Strategy Directorate, where he is in charge of the preparation of future combat aeronautics and is particularly involved in the preparation and the implementation of the Anglo-French UCAS roadmap within the scope of the Lancaster House Treaty signed in 2010.

The paper here below published is a summarized report written by Jean-Pierre Sanfourche, of Philippe Koffi's presentation

Abstract

Within the 2030-2035 time frame, first delivered Rafale aircrafts will be retired from service duty and there will be in France a capability need for a Future Combat Air System (FCAS). It was emphasized by current French concept studies that a force mix, made of both upgraded Rafale and Unmanned Combat Air Systems (UCAS), could bring an optimized trade-off between operational capabilities, life- cycle costs and technology risks and would provide France with cutting edge combat air capability.

In order to meet these long term objectives as well as shorter ones like the today or tomorrow operational contract of the French Air force and like the industrial skills sustainment jeopardize by the end of the major Rafale developments and by the military budget cuts, two R&D roadmaps have been set up by French DGA. One is dedicated to the Rafale upgrades and one is dedicated to the FCAS (Future Combat Air System) preparation and development.

Within the scope of the FCAS roadmap, the French priority is the launch in 2014 of the Anglo-French Future Combat Air System Demonstration Programme (FCAS DP); which is aimed at being a very important and structuring project of the European Combat Air Sector for the next ten years.

KEY MILESTONES IN THE COMBAT AIR SECTOR

The diagramme presented in Figure 1 emphasizes the French Combat Air Fleet size as forecasted over the next 4 decades.

First there is a fleet of so-called old fighters – M2000-5, M2000D, and MF1. Most of them will be retired from service duty by the end of the decade, but it is highly likely that there will be a retrofit of a part of that fleet, in particular the M2000D. The retrofitted aircraft would be available in 2020 and would be definitely retired within the 2030 timeframe.

Then there is the *Rafale* aircraft fleet with 2 forecasted major upgrades: a F4 upgrade, which qualification is expected by the early 2020s and a MLU, which qualification is expected by the late 2020s.

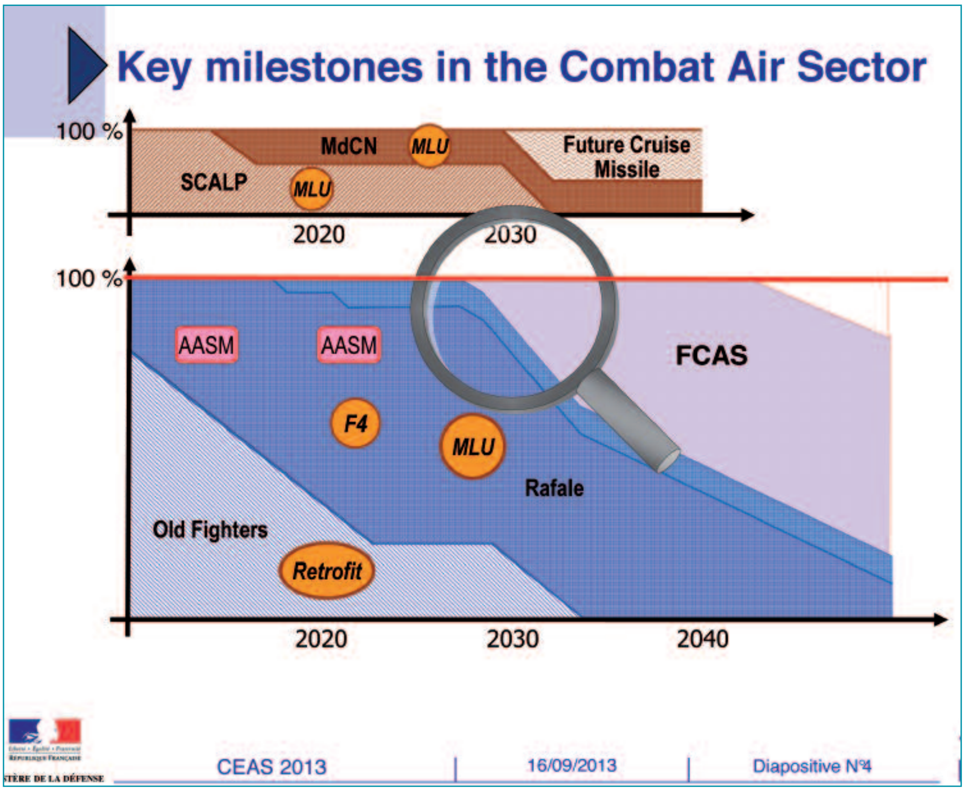


Figure 1. Key milestones in the Combat Air sector

It has also to be mentioned AASM (Armement Air-sol Modulaire • French Air-to-Ground Modular Weapon), and its upgrades over the next 10 years including the integration of a laser seeker and of airburst capabilities as well as the development heavier or lighter versions.
On the diagram, it can be noticed that within the 2030 timeframe the combat air fleet is impacted both by the final retirement of retrofitted old fighters and by the retirement of the first delivered *Rafale*, which are impacted by the life duration limit. And then it is raised a capability need for a FCAS.
Moreover Cruise Missiles, as major assets, are part of the broad Combat Air sector's picture, SCALP/Storm Shadow shall be retrofitted within the 2020 timeframe but will be retired from service duty at about the end of the next decade. So here again there is a capability need for a Future Cruise Missile.
Conclusion is that for the 2020 timeframe, there is a unique opportunity to achieve a global optimisation of main combat air assets and in particular between FCAS and a Future Cruise Missile.

FCAS OPTIONS

The Future Combat Air System (FCAS) is not a single component but a combination of one or several components - manned or unmanned.
For the last 10 years, French concept studies have been launched to identify the best combination (i.e. the combination providing the highest operational capabilities for the lowest life-cycle costs). There are 2 major FCAS options (Figure 2): first option a combination made of single component and that component is so-called *Rafale* NG+. The latter is a *Rafale* with significant airframe upgrades including LO (Low observability) and range upgrades and with significant mission system upgrades. Here there would be many commonalities with the so-called MLU. But Rafale MLU is a retrofit of existing aircraft while *Rafale* NG+ is based on the purchase of new aircraft to overcome the decrease of the *Rafale* fleet. And the unmanned component would be more or less high intensity UCAV.
For both options it has to be kept in mind that FCAS would be operated aside with *Rafale* F4.

RAFALE AIRCRAFT R&D AND R&T

The aim of Research & Development programmes in the Combat Air Sector is of course to prepare future *Rafale* upgrades as well as the Future combat Air System.
France aims at developing the 5th and 6th generation aircraft technologies. French view is that within the 2030 timeframe, combat air systems will have to be more survivable because it is likely that today high intensity threats will be only the tomorrow medium intensity threats. Systems will also be more autonomous. That sounds obvious as far as UCAS is concerned, but it is also true when dealing with manned systems, where some tasks that are today allocated to the pilot will be allocated to the machine in the future. And it will be allowed by a better tactical situation awareness provided by advanced sensors. Last but not least, within that timeframe, the combat air systems will take benefit of networking and of multiplatform collaborative modes.

FR R&T is divided in 2 roadmaps

FCAS roadmap bears the development of the so-called common technologies: 'common technologies' because they can be applied either on an upgraded Rafale or on a UCAS. However having in mind that UCAS represents in many domains the highest technical challenges, that roadmap is driven by UCAS need but with the objective to get

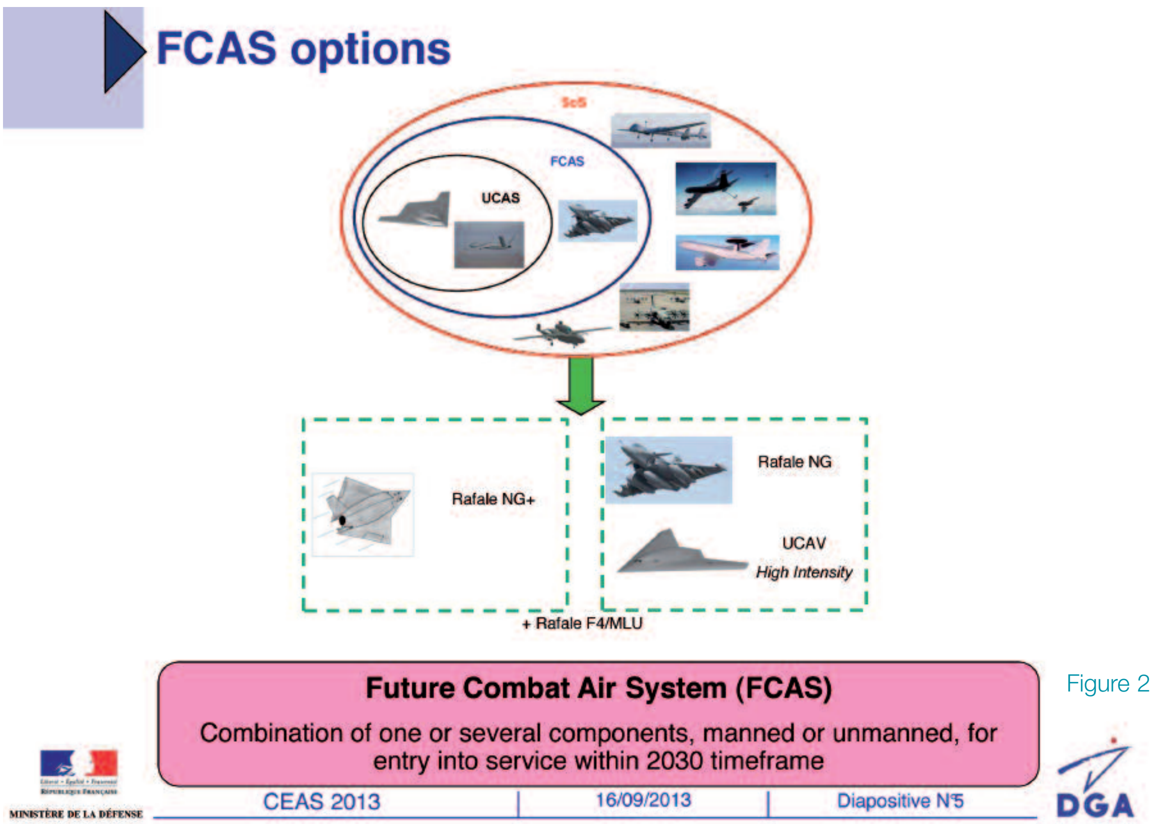


Figure 2. FCAS options

Figure 3. METEOR launch from a Rafale aircraft

the widest range of application. Moreover FCAS will be highly likely launched in cooperation so thru that roadmap DGA (Direction Générale de l'Armement, France) makes it best to enhance and structure the European cooperation. Therefore most studies of that roadmap have been launched and will be launched in cooperation.

On the other hand the *Rafale* roadmap bears the development of technologies really dedicated to the Rafale aircraft. For instance those related to the nose cone radar or to air-to-air modes. Here the objective is to keep improving the operational capability of the aircraft in a changing environment and to keep controlling the ownership costs. The objective is to maintain the technology advantage of the aircraft on the export market. Hence most studies are launched on a national basis.

France is also very careful to sustaining skills and technologies deemed necessary for sovereignty and for the airborne nuclear capability.

Last but not least despite the economic downturn, DGA does not yield to the general slump and really wants to provide France with a cutting edge combat air capability.

RAFALE UPGRADES

– WHAT ARE THE DRIVERS?

A review carried out in 2011 allowed to get a shared view of current operational capabilities of the aircraft and also of the needed upgrades necessary to meet the operational requirements at 2020+ time horizon. A lot of lessons were besides learned from military operations conducted in the past years: SERPENTAIRE in Afghanistan (2006-2012), HARMATTAN in Libya (2011) and more recently SERVAL in Mali (2013), showing that a constant seeking is required for versatility, Day One capabilities and interoperability.

– THE MAIN UPGRADES

For F3-R Version

The necessary upgrades mainly concern: (i) Day One capability and in particular the integration of the Beyond Visual Range Air-to-Air METEOR missile (Figure 3); (ii) targets identification and designation improvement thanks to the new Laser Designation Pod (PDL – NG); (iii)) improvement of the decision loop and of interoperability thanks to "free text" Line 16, IFF mode 5 and SAASM (Selective Availability Anti Spoofing Module receiver); (iv) operational capabilities sustainment including buddy-refuelling pod and the Automatic Ground Collision Avoidance System (A-GCAS). Particular attention has to be brought to industrial skills sustainment.

For F4 Version

The necessary upgrades mainly concern: (i) Day One capability with in particular improvements for operations in dense environments; (ii) targets identification and designation improvement thanks to the new RBE2 AESA (Active Electronically Scan Arrays) modes - detection and tracking of moving ground targets (GMTT/GMTI), HR SAR (High Resolution Synthetic Aperture Radar) and to the helmet-mounted display; (iii) increase of strike capabilities through the integration of upgraded existing weapons; (iv) improvement of decision loop, communications and interoperability.

Main MLU Upgrades

MLU capability goals and industrial challenges will be highly dependent on the FCAS down selected option, the latter going to have a major impact on Rafale survivability and priority targets requirements. But some candidate upgrades have been already identified:

- New mission system EMTI (Equipment Modulaire de Traitement de l'Information – Modular Information Processing Equipment) architecture, including Rafale/UCAS cooperation;
- Major EW (Electronic Warfare) system - SPECTRA - upgrade;
- Major radar RBE2 AESA upgrade;
- New Generation Cockpit development and integration (Figure 4);
- Future Cruise Missile integration;
- Post-ASPMA (Air-Sol Moyenne Portée Améliorée – Enhanced Mid Range Air-to-Ground Missile) integration.

UCAS REQUIREMENTS AND CONCEPTS

- UCAS IN A MIXED FORCE

UCAS is only one asset among others to carry out air-to-ground attack missions. And it is even one asset among other existing assets like cruise missiles, combat aircraft, attack helicopter and armed ISR UAV. It means that within the scope of very high budget constraints, a UCAS programme will be launched only if it can be demonstrated a breakthrough in operational capabilities.

On Figure 5 main components characteristics are dis-

Figure 4. New generation cockpit

played. We can see that there are common characteristics, the so-called ‘cores’, and there are boundaries.

UCAS is commonly compared to manned combat aircraft and to cruise missile. UCAS shares with cruise missile the ability to operate in dangerous and dirty environment but UCAS is a reusable asset. On the other hand, UCAS shares with the combat aircraft the ability to operate in high intensity environment, but UCAS is expected to achieve a breakthrough in terms of ownership costs. Indeed most of operators training will be made by simulation and will offer peacetime and training costs savings.

Last but not least UCAS is a persistent asset. Persistence in contested airspace is a key enabler because it will provide us with the ability to carry out new missions or existing missions in a different way.

- UCAS PRIORITY MISSIONS

A set of 8 priority missions for UCAS has been defined.

First there are 5 priorities mission vignettes (Figure 6), which are about recce and air-to-ground attack within a high intensity environment: SEAD (Suppression of Enemy Air Defence) missions, Air Field Attacks, Strategic Air Operations, Air interdiction missions.

There is a brand new mission which is called Armed Recce and which is enabled by the survivability and persistence performances of the air vehicle. That kind of mission is carried out 2 or 3 weeks after the launch of an operation, when all long range and very long range threats have already been destroyed. Here the vehicle will persist in the deep and will detect, track, fix and engage removable ground targets as well as medium and short range threats.

As a priority 2 (Figure 7), there are Close Air Support missions within a medium environment. These missions will emphasize speed and persistence characteristics of the platform.

And as priority 3 (figure 7), there is an air-to-surface attack mission but also an air-to-air CAP (Combat Air Patrol) mission. Due to OODA (Observe, Orientate, Decide and Act) loop constraints, the full range of air-to-air missions is not considered as a priority or even a candidate for UCAS within the 2030 timeframe. However CAP mission is a kind of dull mission where it could be taken benefit from persistence and from the lack of pilot on board. Moreover within that mission most of the missile launches or strikes are performed on BVR (Beyond Visual Range) modes and therefore it will decrease OODA constraints.

Anyway, from this set of 8 mission vignettes and from a related list of threats we have produced a UCAS CONUSE document and a set of UCAS requirements.

- KEY UCAS CHARACTERISTICS

Concerning airframe, the main characteristics are: (i) speed, reach and persistence; (ii) high survivability (VLO – Very Low Observability, EW- Electronic Warfare, threat avoidance); (iii) weapon bay integration of a large range of armaments (Modular Air-to-Ground Weapons, SDB (Small Diameter Bomb), Meteor, …); (iv) autonomous air-to-air refuelling.

As regards engine, are to be noted: low fuel consumption, very low observation possibility, reliability, safety and robustness.

And the mission system is particularly rich: (i) an innovative avionics, with its open modular architecture, autonomous mission management; (ii) the multi-sensor architecture allowing optimal sensor management and data fusion; (iii) the multi-function array offering very and ultra high resolution SAR capabilities; (iv) infrared targeting, surveillance and situational awareness; and (v) optionally, carrier integration and storage.

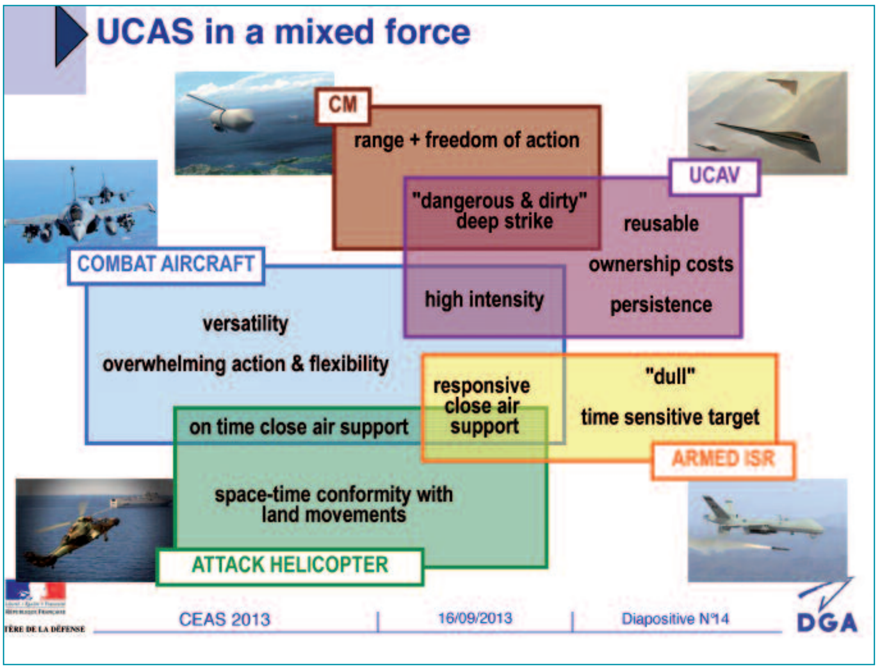


Figure 5. Unmanned Combat Air System in a mixed force

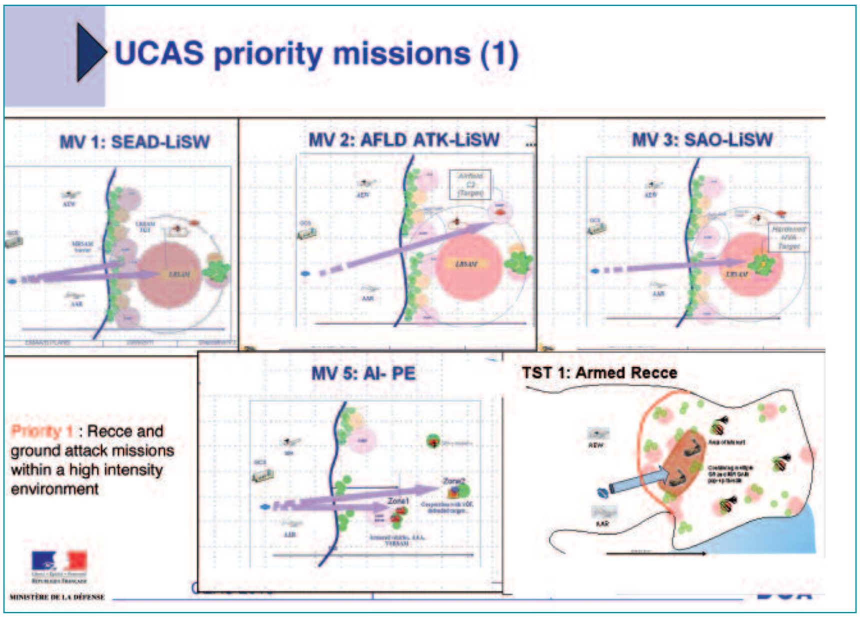


Figure 6. UCAS priority missions 1

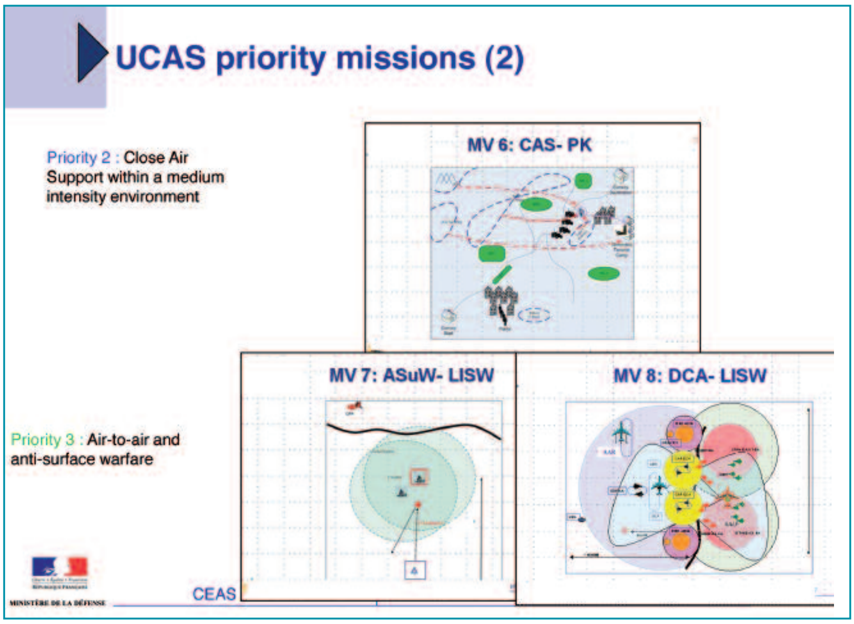


Figure 7. UCAS priority missions 2 and 3

THE ANGLO-FRENCH FUTURE COMBAT AIR SYSTEM DEMONSTRATION PROGRAMME

– STRONG CONVERGENCES

A number of strong convergences exist between the UK and France regarding the FCAS preparation. As a matter of fact, UK and France have got similar skills and the same technology level in military aeronautics, they have a shared 2030+ Vision of industry and capacity needs, including FCAS capability needs within the 2030 timeframe, and also have a strong political will to enhance their co-operation in that sector, as expressed in the Lancaster House Treaty of 2 November 2010.

– A JOINT FCAS TECHNOLOGY AND INDUSTRY ROADMAP

This roadmap going from the Soi (Statement of intent) in 2012 up to the effective FCAS IOC in 2030 can be schematized as follows (Figure 8):

FCAS DP shall meet 2020 pre-requisites: the maturation of technologies for UCAS operating in a high threat/high intensity environment, the maturation of UCAS concept of use and integration within a system of system, and the structuring of co-operation between industry and government. Three dimensions are then to be covered: technology, operations and industry.

Successfully conducted, the FCAS DP will allow the UK and France to be able to deliver a new Combat Air capability in 2030.

The FCAS DP perimeter from 2014 to 2020+ comprises three dimensions: industry, operational, technology (Figure 9).

CONCLUSION

There are two European cooperation frameworks bearing different milestones, stakes and objectives.

– First the legacy fighter roadmap

Unfortunately it is highly polluted by export competition and there is no major opportunity for cooperation at sys-

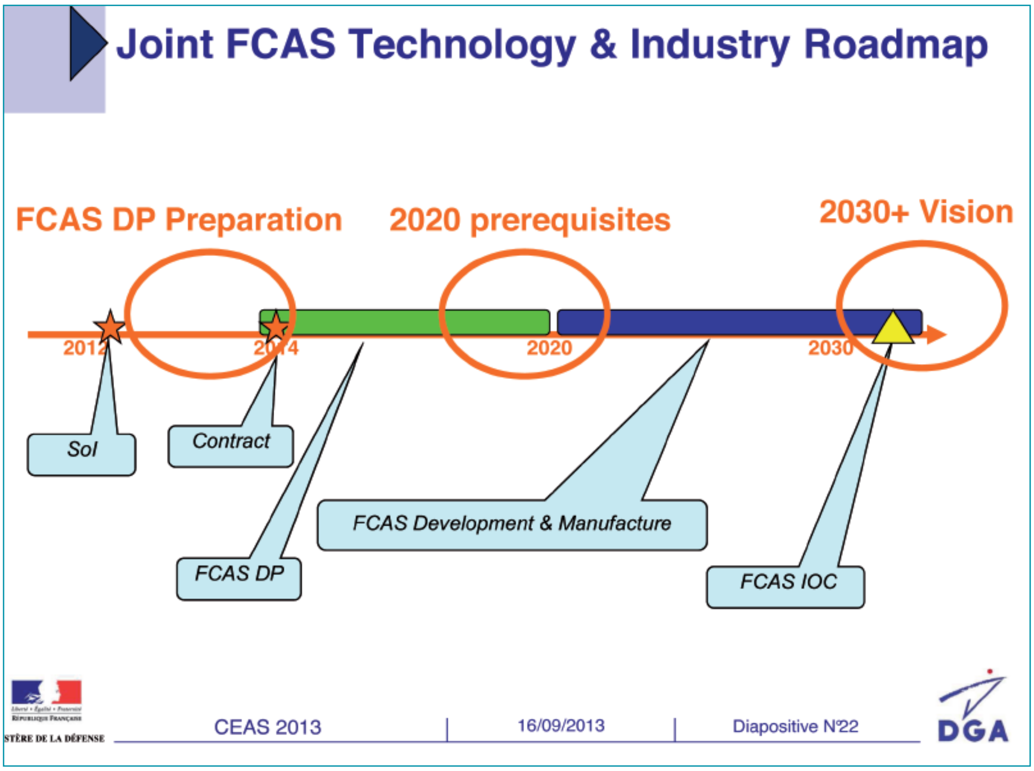


Figure 8. Joint FCAS Technology & Industry Roadmap

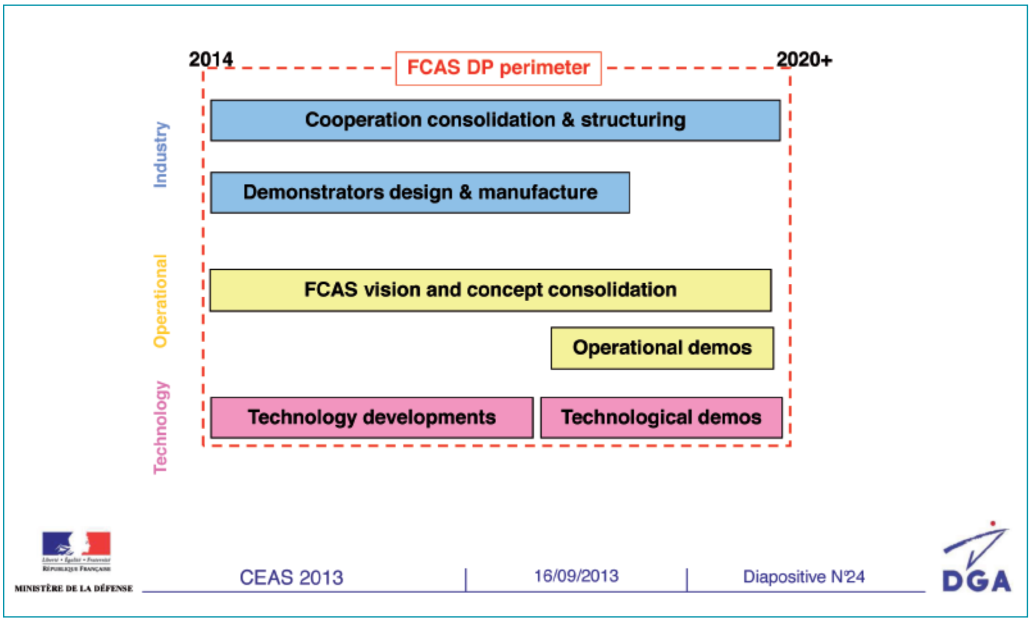


Figure 9. FCAS DP Perimeter

tem level within the next 10 or 15 years. But it does not mean at all that nothing can be done. European nations have to be pragmatic and a cooperation at system of system level could be promoted. Indeed there are opportunities for harmonization of standards, concepts and organisation. This could allow for instance the launch of joint training programmes. It could also be envisaged to enhance interoperability between European assets in order to increase operational capabilities in operations.

– Second the FCAS roadmap

Here the field of opportunities for European cooperation at system level looks much larger, and even more if it is decided to launch a UCAS programme because there would not be any strong interference with the Joint Strike Fighter JSF. However in the past fully multilateral cooperations have proven not to be very successful and even more when they were initiated from scratch.

Therefore here it is proposed to rely on the existing Anglo-French core of cooperation. This core is still young and has to be consolidated and matured within few coming years. But then it is highly likely that there will be opportunities for cooperation extension.

It will give time to get, at European level, a shared European vision for Combat Aeronautics. Such a shared vision is a key for a successful cooperation.

NEURON: THE PROMISING EUROPE'S UCAV DEMONSTRATOR

By Thierry Prunier

Thierry Prunier was director of the nEUROn programme, Dassault Aviation

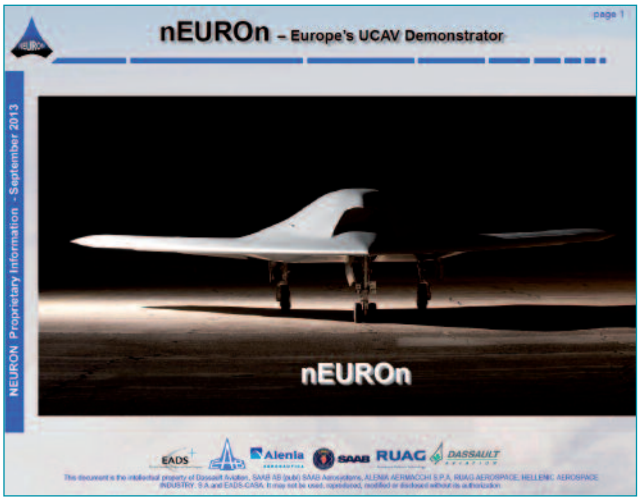


Figure 1

HISTORICAL BACKGROUND

It was at the 2003 International Paris Air Show (Le Bourget) that the French Government appointed Dassault Aviation prime contractor for the 'nEUROn' UCAV technology demonstration programme. The latter represented an innovative approach to industrial cooperation providing European design offices with the means to develop their strategic skills in the years ahead.

PROGRAMME OBJECTIVES AND TECHNOLOGICAL CHALLENGES

'nEUROn' is a technology demonstrator whose objective is to demonstrate the validity of command and control technologies in a stealth unmanned vehicle the size of a combat aircraft, with all necessary back-up modes providing the required safety. It is to be considered as an R&T programme with five main aims: (i) development of a stealth platform in terms of both radar and infrared signature; (ii) feasibility of air-to-ground missions with ground station inserted within a C3I network; (iii) possibility for air-to-ground weapon delivery from internal bay with tempo constraints; (iv) automatic detection and recognition of re-locatable ground targets with airborne optical sensor; (v) search from cost breaking-through technologies (airframe, avionics, COTS-Components On The Shelves).

The major technological challenges relate to the aircraft's shape (aerodynamics, absence of vertical stabiliser, radar absorbers, internal weapon bay), the important role of software, its insertion into airspace and the sophisticated algorithms, required to give decision-making power to the machine whilst keeping the human element in the mission loop.

A SKILLS-BASED PROGRAMME

Partners were selected on the basis of excellence and areas of competence, competitiveness as well as their government's financial commitment. In this way Dassault Aviation put together a team made up of industrial partners (subcontractors) from six countries (Figure 2): EADS-CASA (Spain), Saab (Sweden), Thales (France), Alenia (Italy), HAI (Greece) and Ruag (Switzerland).

Through its role as prime contractor Dassault Aviation is promoting excellence in European industry by developing capabilities in the area of stealth unmanned air systems, know-how for next generation European combat aircraft and experience in managing international co-operation programmes (definition of innovative and cost-efficient co-operation schemes for tomorrow's projects).

The sharing of technological road maps between the partners was as indicated Figure 3.

A European cooperation project on such a scale calls for a

Figure 2

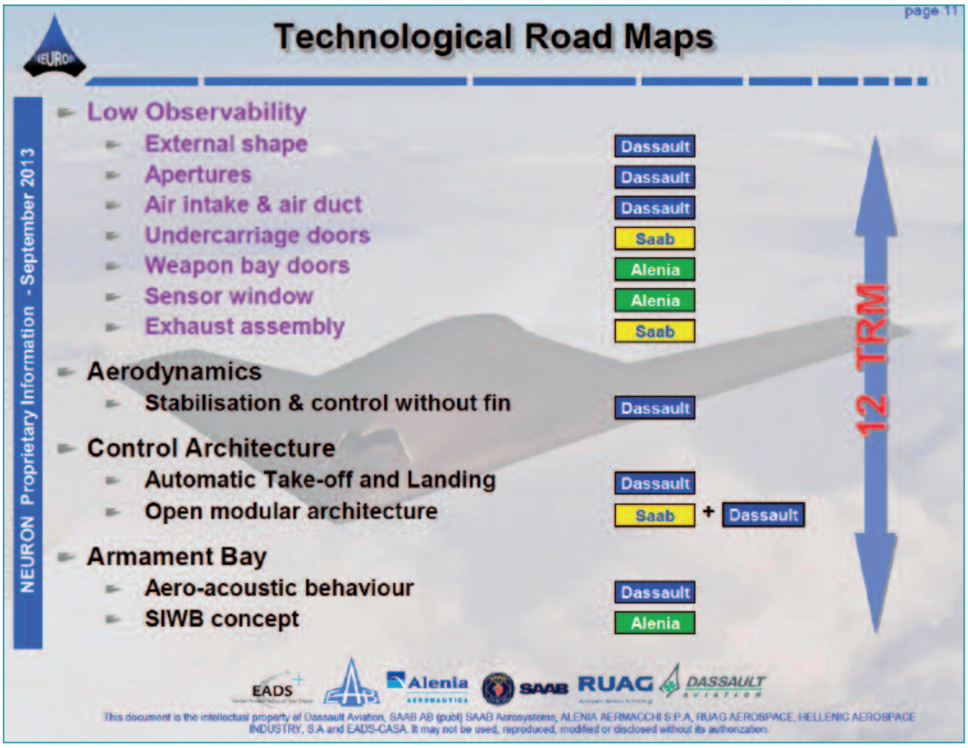


Figure 3

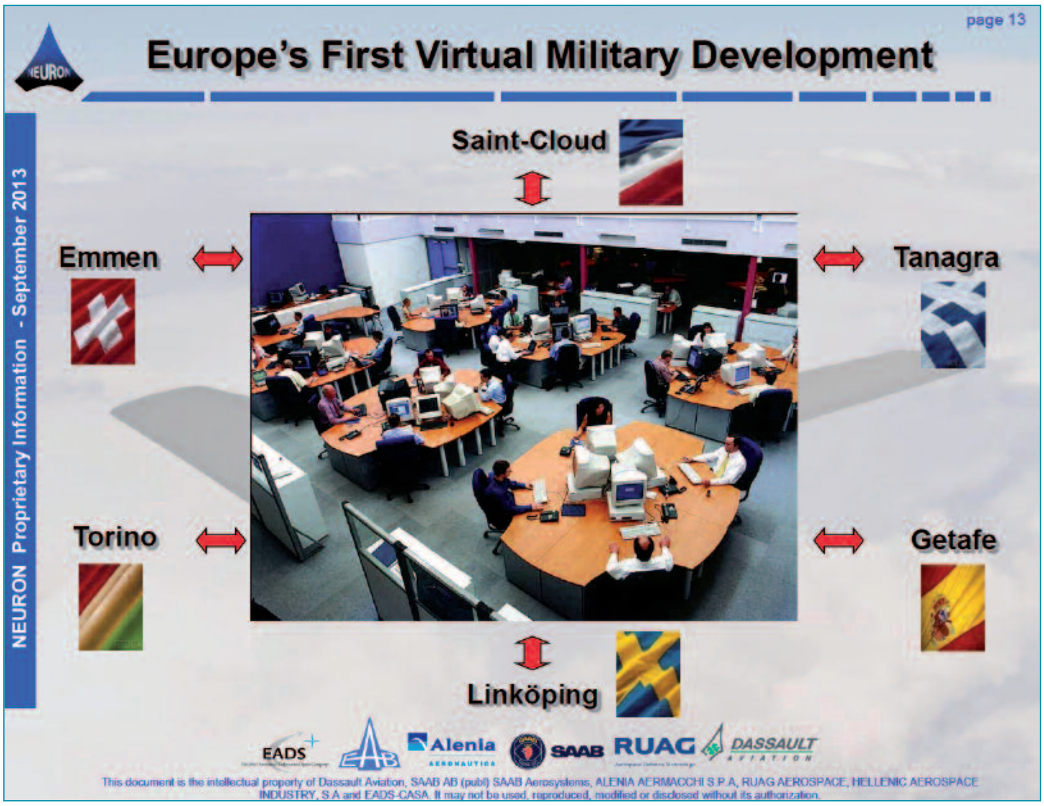


Figure 4

PLM (Product Lifecycle Management) environment. The 'nEUROn' is therefore following on the footsteps of the Falcon 7X in becoming the first military aircraft in the world to be designed and developed on a 'virtual plateau' (Figure 4).

nEUROn's GENERAL DESCRIPTION

The nEUROn System, the air vehicle itself, the engine-exhaust assembly and the overall concept are given here after: Figures 5 to 8.

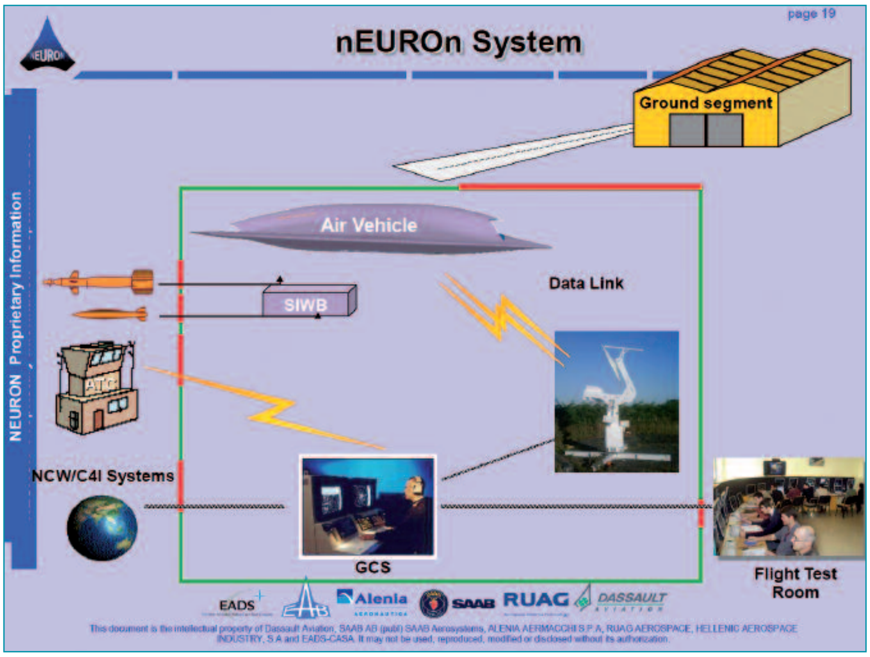


Figure 5

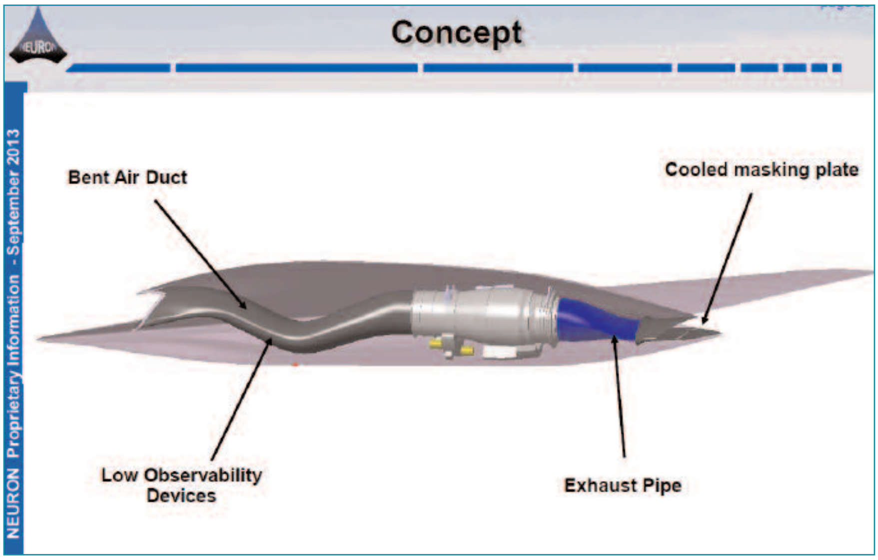


Figure 6

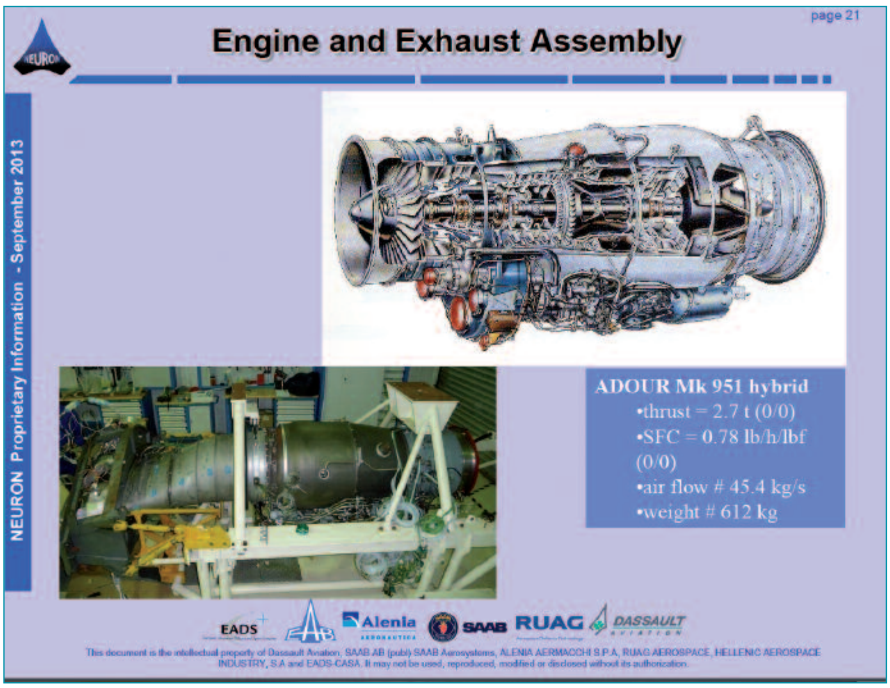


Figure 7

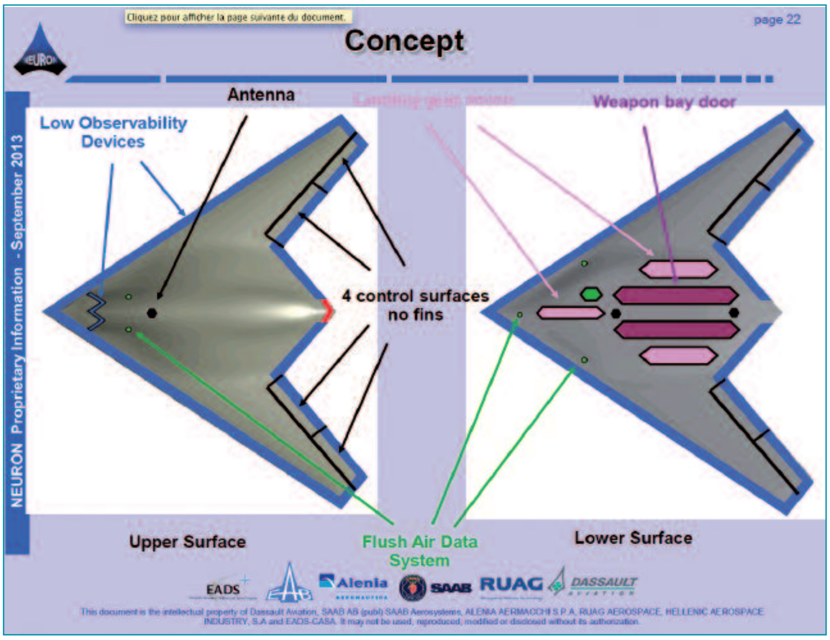


Figure 8

nEUROn's CONFIGURATION DATA

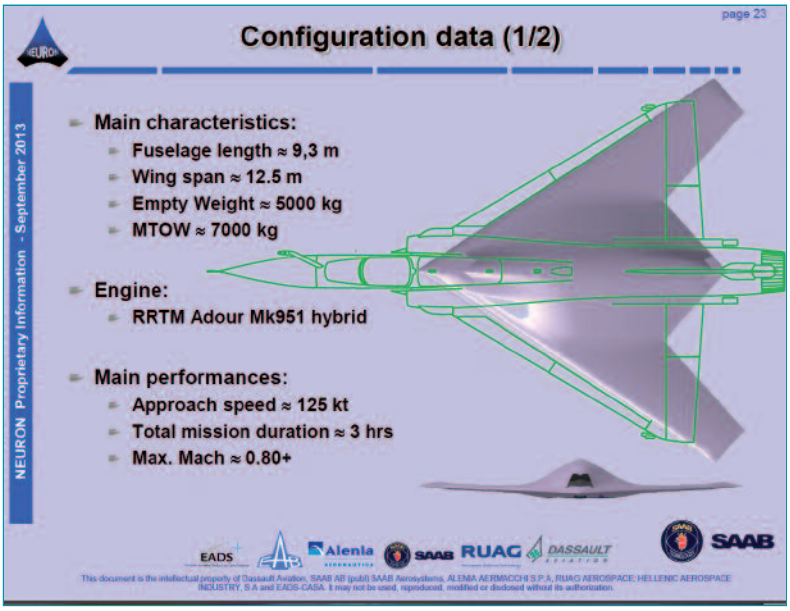


Figure 9

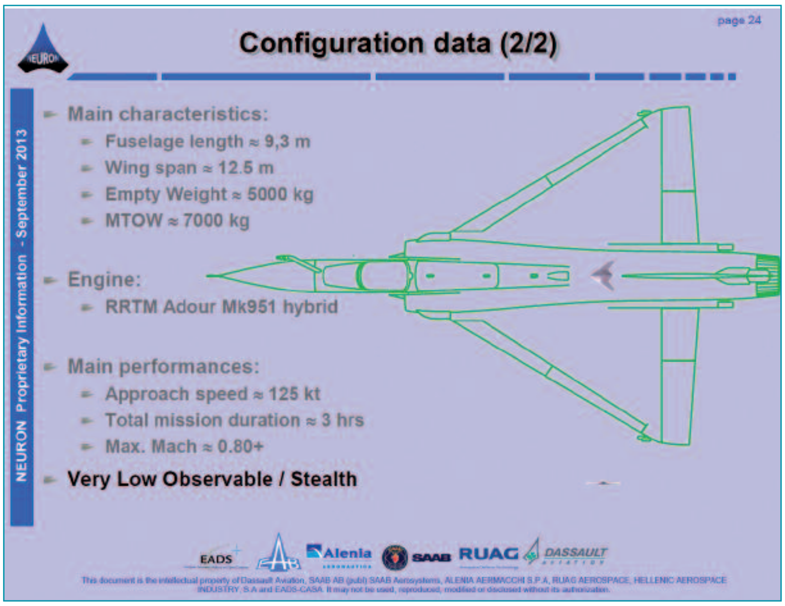


Figure 10

GROUND TESTS BEFORE FIRST FLIGHT

Figure 11

Electrical, hydraulic, landing gear, braking, fuel and venting tests, carried out in normal and also in degraded conditions, demonstrated that the aircraft systems function correctly. Vibration tests helped determine the structure's eigen modes and confirm that there is no risk of flutter in flight. Parallel tests were carried out on the ground station and on the communication systems between the ground segment and the air segment. Engine (Adour) run-up tests with the specific nozzle were also satisfactory (Figure 11).
Allowed to taxi, the nEUROn executed accelerations-stops on the runway of Istres Flight Test Centre, gradually increasing speed until the nose lifted up (Figure 12).

NEARING FIRST FLIGHT

Figure 12

The ground station operator does not fly the UCAV by remote control: he only has control and monitoring over a set flight plan can trigger it to taxi and can order it to stop. The air vehicle is guided entirely through the established flight plan by the flight control system. As in the case when opening a flight envelope, taxiing tests are executed one step at a time so that at any moment it is possible to return to a safe situation. They achieved a speed of 20 kt on the taxiway, and 140 kt on the runway. Before proceeding with the first take-off a few final proof tests were needed: mechanical resistance of the structure and verification that the aircraft is not affected by radar emissions around the site of Istres. In order to obtain the First Flight Permit a safety file had to be compiled containing the different proofs that the UAV met airworthiness requirements: these proofs (50 forms + 400 documents) were passed on to DGA (French Armament Procurement Agency) gradually and the latter, after analysis, issued the Flight Permit on 28 November 2012.

FIRST FLIGHT: ISTRES – 1ST DECEMBER 2012

On Saturday 1st December 2012 at 07:55, the engine was ignited and nEUROn began taxiing to the top of the runway. The accompanying Rafale took off and flew into place to escort the nEUROn.
08:20 (Figure 13) – brakes off, acceleration and take-off – the aircraft, very stable, soars skyward and follows its flight plan perfectly.
After 25 minutes flight, it makes a perfect landing. All air segment and ground segment systems functioned perfectly. The flight area covered is: 200 kt – 7,000 feet – 1.3 g. Localisation: pinpoint accuracy.

Figure 13

POST-FIRST FLIGHT TESTS

The aircraft radar signature was measured in February-March-April 2013 at the DGA Solange measurements base in Rennes (France). These tests have confirmed that the stealth goals have been met (Figures 14 et 15).
From mid-2013 on, tests are being devoted to opening up the flight envelope and finalising development of the nEUROn in Istres.
In 2014, the nEUROn capabilities will be demonstrated in

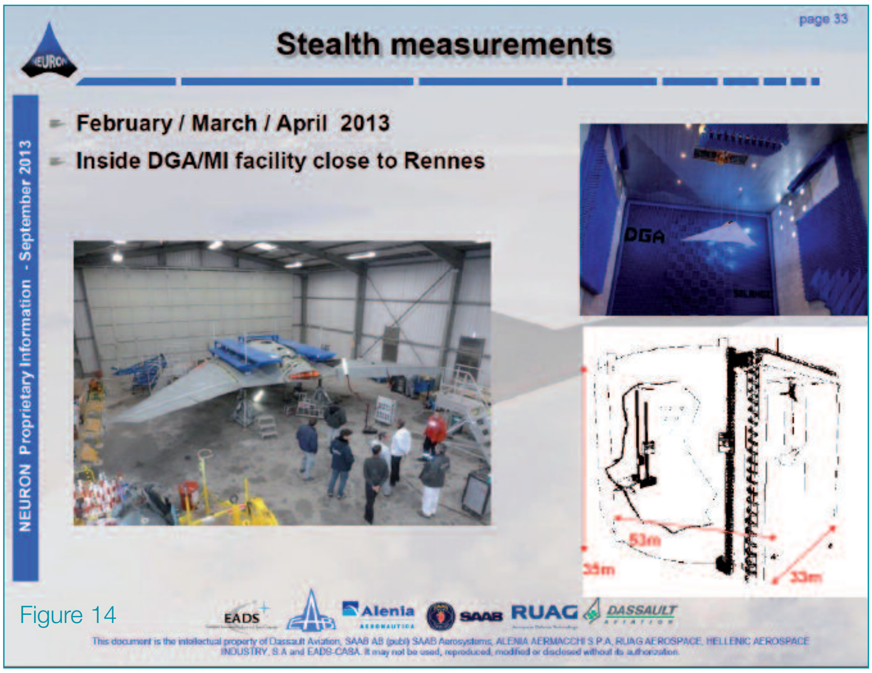


Figure 14

flight: first in Istres, then, after road transfer, in Vidsel (Sweden), and then in Perdasdefogu (Italy). Bombs will be fired from the bay, attacks simulated in liaison with a command centre, radar and infrared signatures identified in-flight ad nEUROn's stealth during operational flight verified through confrontation with different operational radars (Rafale, ground-to-air battery, etc).

In particular two autonomy scenarios will be tested – (i) GCS Supervised Autonomous mode – (ii) as well as the autonomous attack.

CONCLUSION

The nEUROn can be seen as a laboratory for European co-operation, a flying test bench for demonstrating key technologies to be used for European Flight Combat Air Systems and a team for granting European technological autonomy.

It is only a technology demonstrator but which comes in the nick of time to push the Anglo-French Initiative to define an operational demonstrator that may fly in 2020.

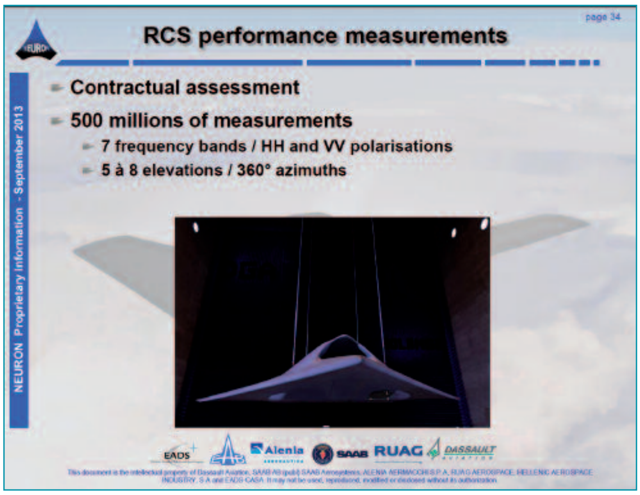
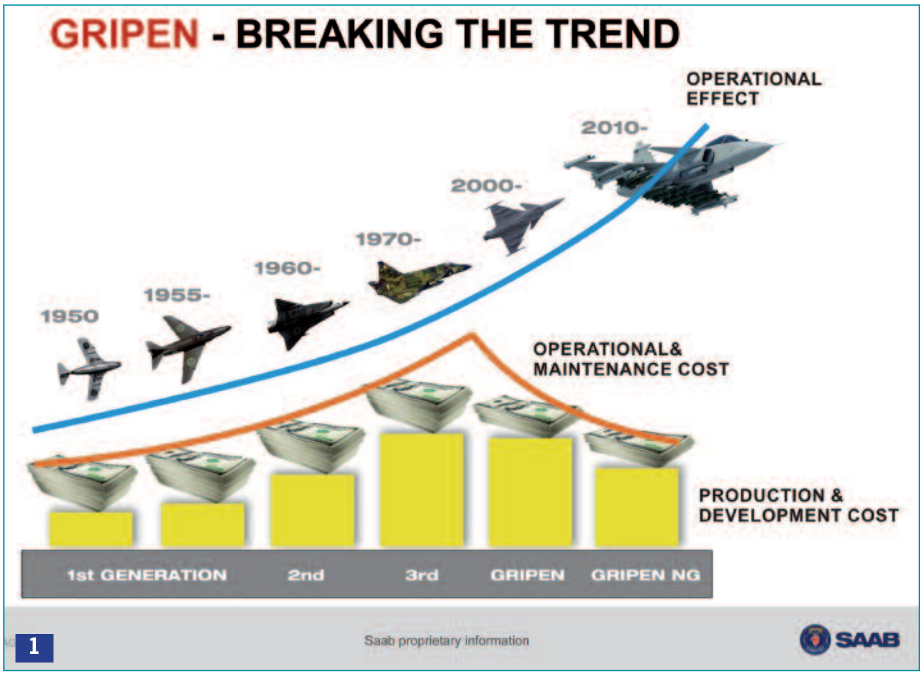


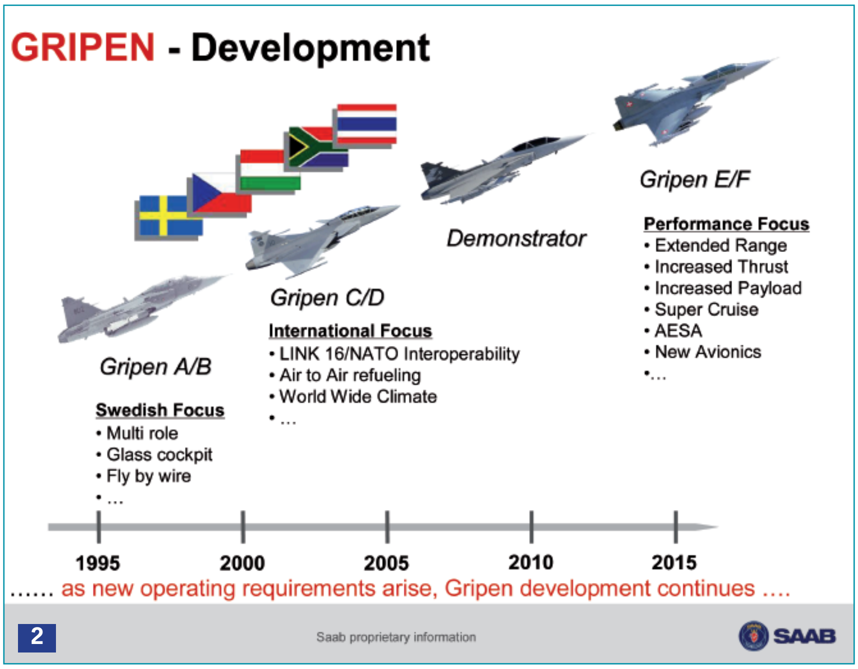
Figure 15

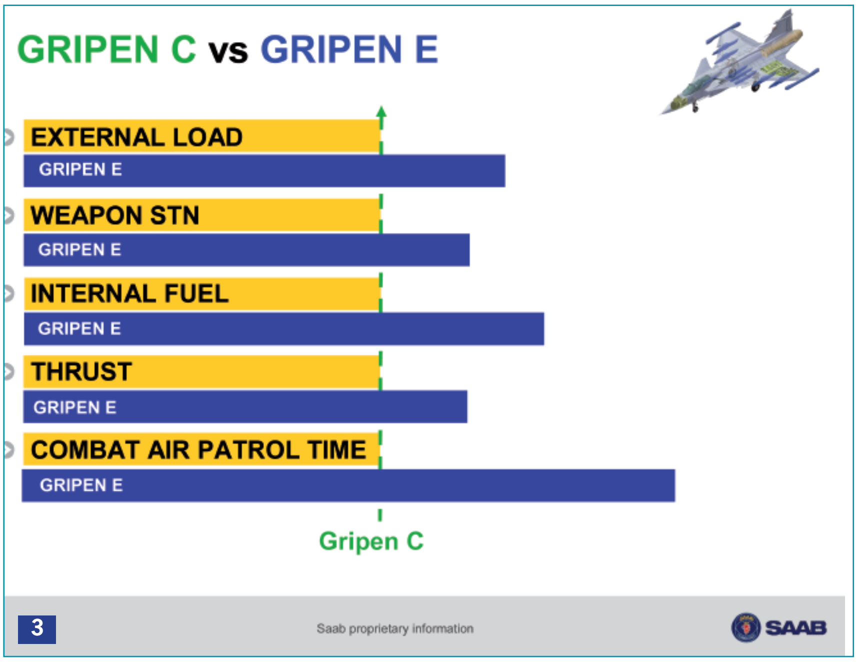
GRIPEN NEXT GENERATION FIGHTER

By Jan Palmkvist, Director Product Management- Business Area Aeronautics Saab AB

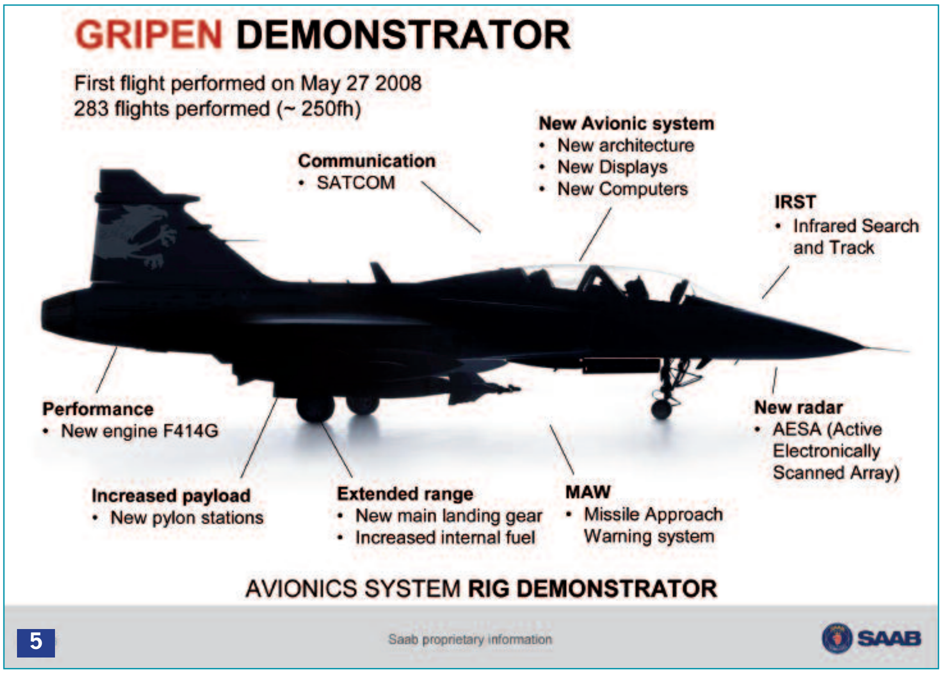
The slides presented by Jan Palmkvist provided a very complete information about the Next Generation Gripen. They are here after reproduced: figures 1 to 17.

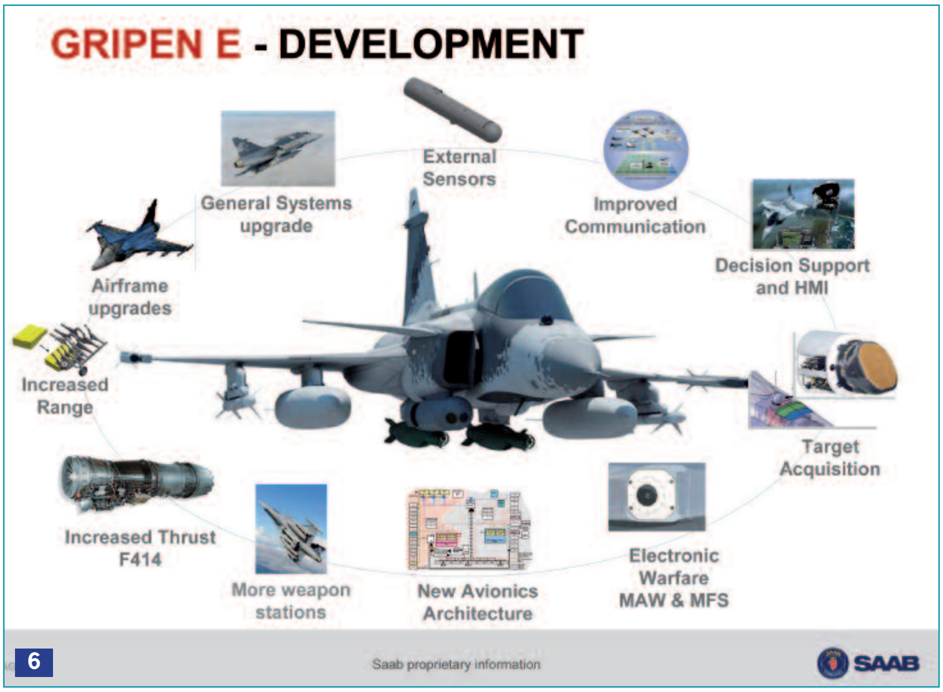


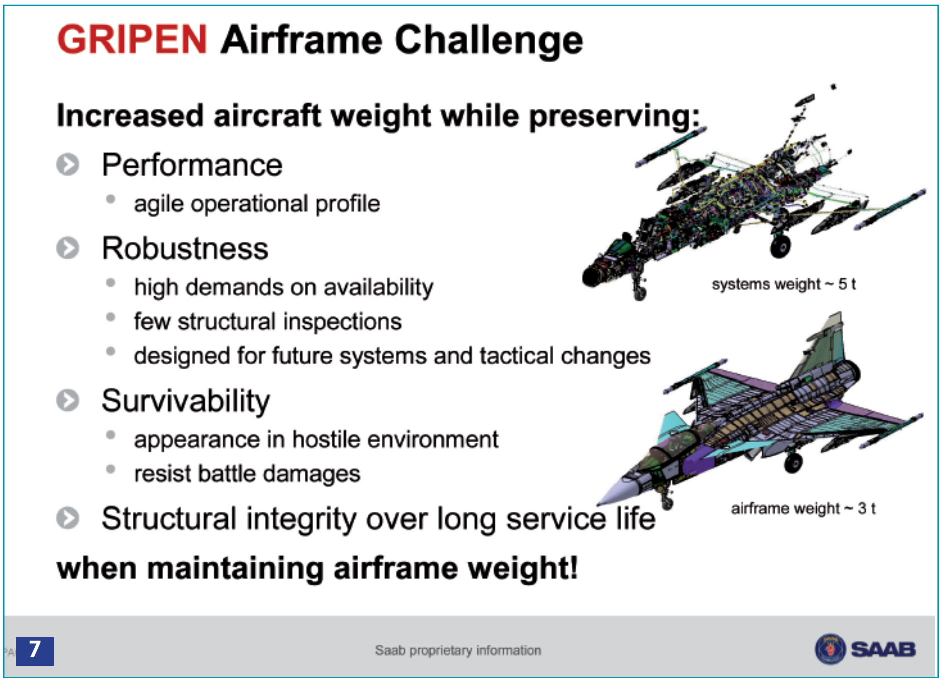

GRIPEN - Development
Gripen E/F
Performance Focus
• Extended Range
• Increased Thrust
• Increased Payload
• Super Cruise
• AESA
• New Avionics
•…
Demonstrator
Gripen C/D
International Focus
• LINK 16/NATO Interoperability
• Air to Air refueling
• World Wide Climate
• …
Gripen A/B
Swedish Focus
• Multi role
• Glass cockpit
• Fly by wire
• …
1995
2000
2005
2010
2015
...... as new operating requirements arise, Gripen development continues ....
2
Saab proprietary information
SAAB

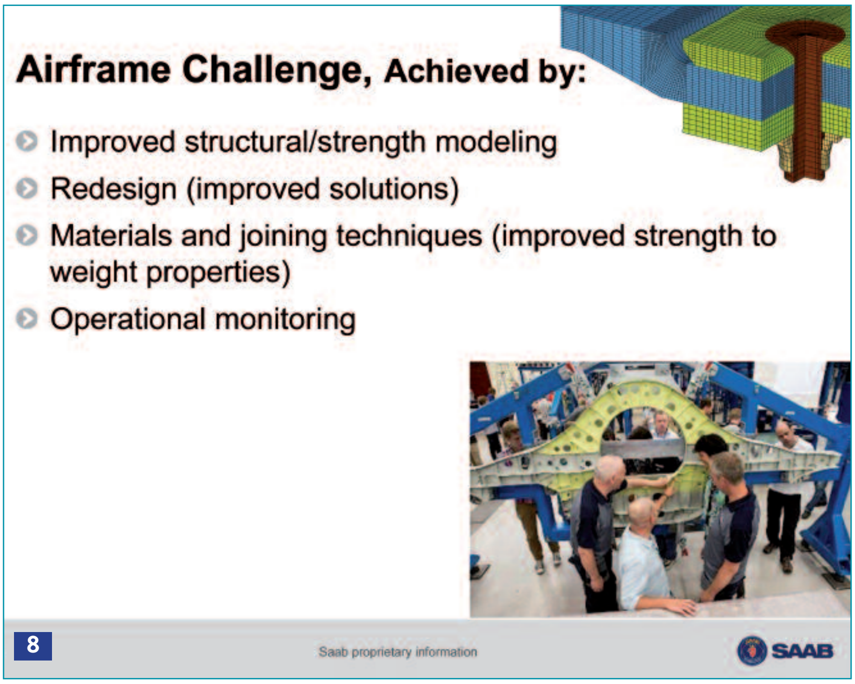

GRIPEN C vs GRIPEN E
EXTERNAL LOAD
GRIPEN E
WEAPON STN
GRIPEN E
INTERNAL FUEL
GRIPEN E
THRUST
GRIPEN E
COMBAT AIR PATROL TIME
GRIPEN E
Gripen C
3
Saab proprietary information
SAAB

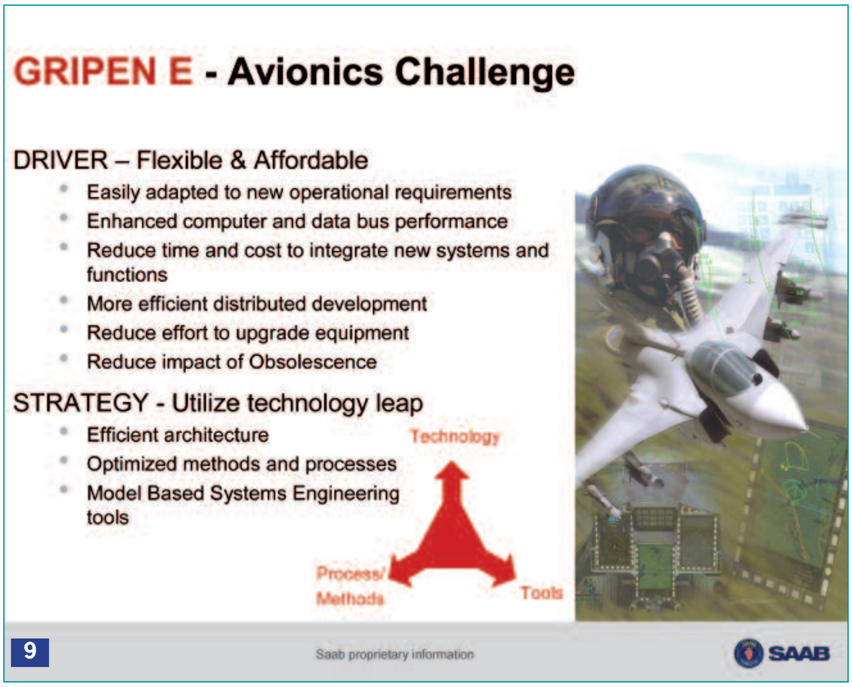

GRIPEN DEMONSTRATOR
SUMMARY
Great potential for further Gripen development proven
Major increase in range
Increased capability to carry payload
Increased flight performance
Technology
More powerful and cost effective engine
AESA-radar
New avionic system
Significant risk reduction for full size development programme
Reduced cost and development time more than 50%
New development process/method
MBD for Airframe development and Production
MBSE för Systems development
4
Saab proprietary information
SAAB

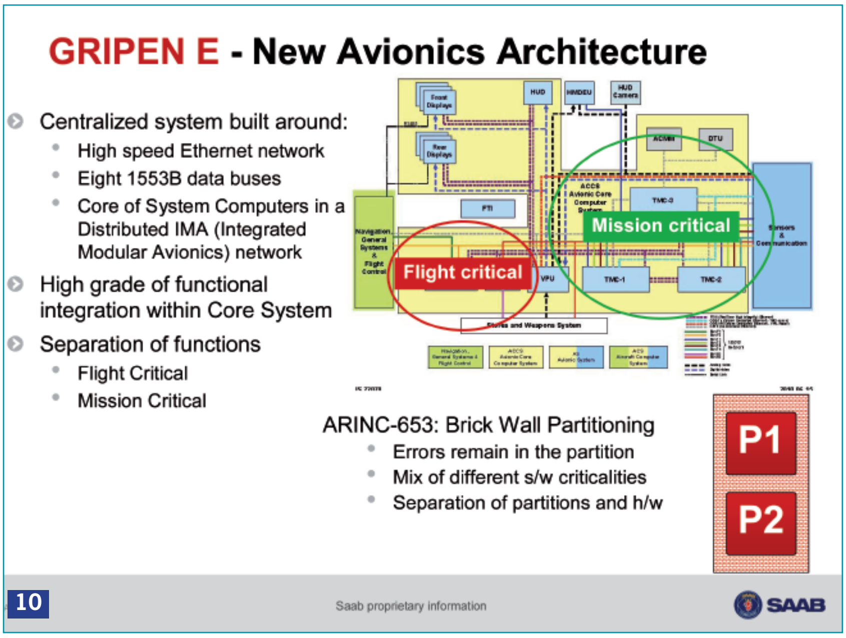

GRIPEN DEMONSTRATOR
First flight performed on May 27 2008
283 flights performed (~ 250fh)
Communication
• SATCOM
New Avionic system
• New architecture
• New Displays
• New Computers
IRST
• Infrared Search and Track
Performance
• New engine F414G
New radar
• AESA (Active Electronically Scanned Array)
Increased payload
• New pylon stations
Extended range
• New main landing gear
• Increased internal fuel
MAW
• Missile Approach Warning system
AVIONICS SYSTEM RIG DEMONSTRATOR
5
Saab proprietary information
SAAB

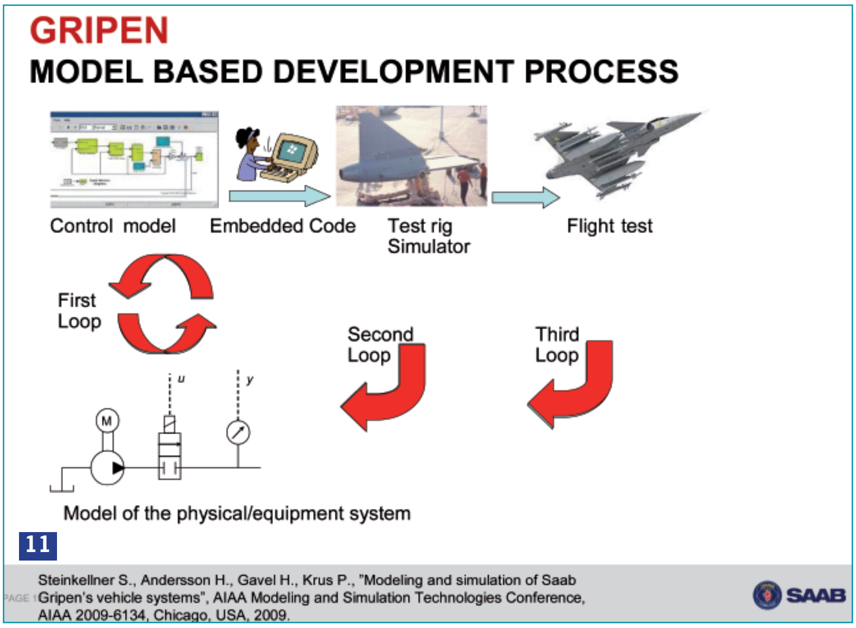

GRIPEN E - DEVELOPMENT
External Sensors
General Systems upgrade
Improved Communication
Decision Support and HMI
Airframe upgrades
Increased Range
Target Acquisition
Increased Thrust F414
More weapon stations
New Avionics Architecture
Electronic Warfare MAW & MFS
6
Saab proprietary information
SAAB


GRIPEN Airframe Challenge
Increased aircraft weight while preserving:
Performance
• agile operational profile
Robustness
• high demands on availability
• few structural inspections
• designed for future systems and tactical changes
Survivability
• appearance in hostile environment
• resist battle damages
Structural integrity over long service life
when maintaining airframe weight!
systems weight ~ 5 t
airframe weight ~ 3 t
7
Saab proprietary information
SAAB

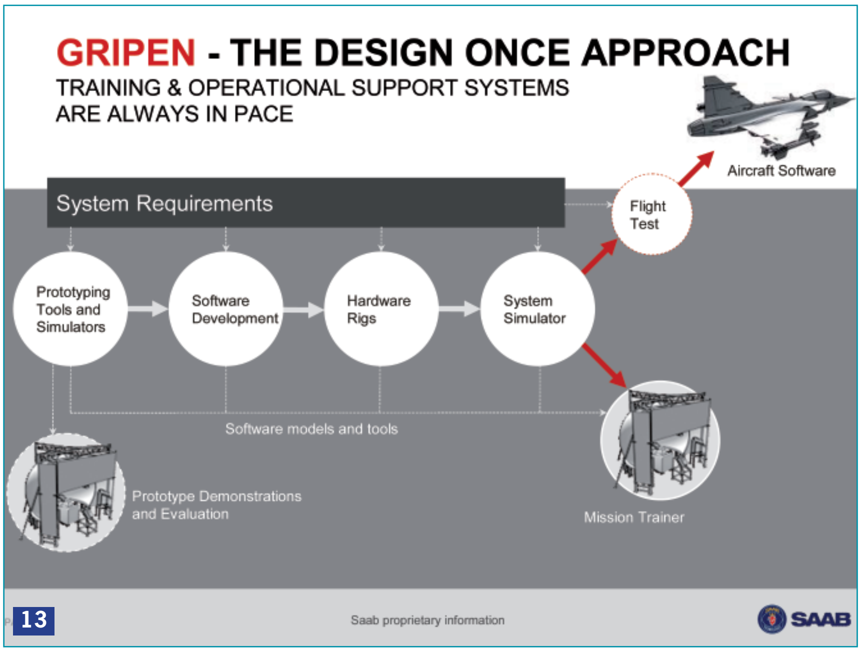

Airframe Challenge, Achieved by:
Improved structural/strength modeling
Redesign (improved solutions)
Materials and joining techniques (improved strength to weight properties)
Operational monitoring
8
Saab proprietary information
SAAB

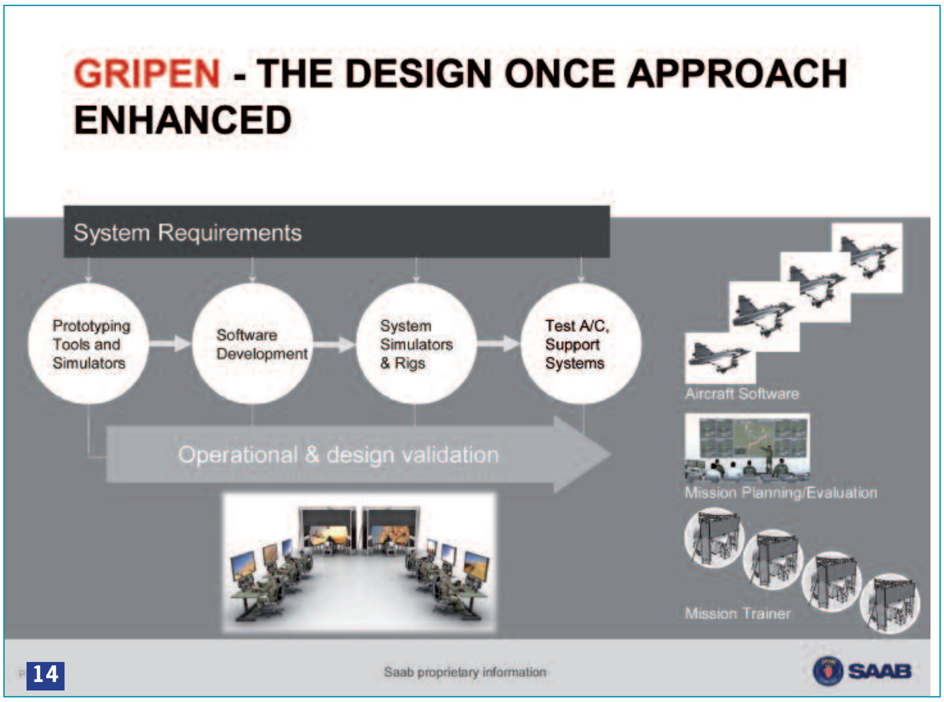

GRIPEN E - Avionics Challenge
DRIVER – Flexible & Affordable
Easily adapted to new operational requirements
Enhanced computer and data bus performance
Reduce time and cost to integrate new systems and functions
More efficient distributed development
Reduce effort to upgrade equipment
Reduce impact of Obsolescence
STRATEGY - Utilize technology leap
Efficient architecture
Optimized methods and processes
Model Based Systems Engineering tools
Technology
Process/ Methods
Tools
9
Saab proprietary information
SAAB


GRIPEN E - New Avionics Architecture
Centralized system built around:
High speed Ethernet network
Eight 1553B data buses
Core of System Computers in a Distributed IMA (Integrated Modular Avionics) network
High grade of functional integration within Core System
Separation of functions
Flight Critical
Mission Critical
Mission critical
Flight critical
ARINC-653: Brick Wall Partitioning
Errors remain in the partition
Mix of different s/w criticalities
Separation of partitions and h/w
P1
P2
10
Saab proprietary information
SAAB


GRIPEN
MODEL BASED DEVELOPMENT PROCESS
Control model
Embedded Code
Test rig
Simulator
Flight test
First
Loop
Second
Loop
Third
Loop
M
u
y
Model of the physical/equipment system
11
Steinkellner S., Andersson H., Gavel H., Krus P., "Modeling and simulation of Saab Gripen's vehicle systems", AIAA Modeling and Simulation Technologies Conference, AIAA 2009-6134, Chicago, USA, 2009.
SAAB


GRIPEN - SIMULATORS & TRAINING
12
Saab proprietary information
SAAB


GRIPEN - THE DESIGN ONCE APPROACH
TRAINING & OPERATIONAL SUPPORT SYSTEMS
ARE ALWAYS IN PACE
Aircraft Software
System Requirements
Flight
Test
Prototyping
Tools and
Simulators
Software
Development
Hardware
Rigs
System
Simulator
Software models and tools
Prototype Demonstrations
and Evaluation
Mission Trainer
13
Saab proprietary information
SAAB


GRIPEN - THE DESIGN ONCE APPROACH ENHANCED
System Requirements
Prototyping Tools and Simulators
Software Development
System Simulators & Rigs
Test A/C, Support Systems
Operational & design validation
Aircraft Software
Mission Planning/Evaluation
Mission Trainer
14
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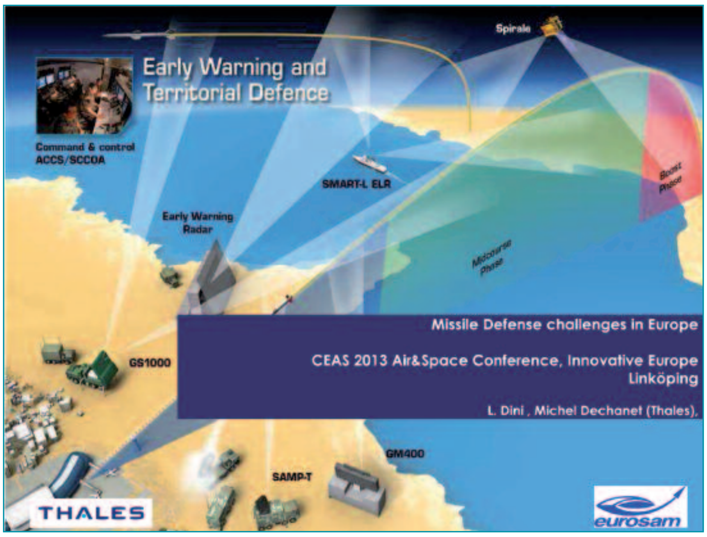
GRIPEN
Gripen development will continue to meet the operational needs of the future
15
Saab proprietary information
SAAB


THE TOP 3 IN MULTINATIONAL AERONAUTICS R&T
JTI Clean Sky (1600M€)
Environmentally friendly aircraft
European Union's largest research project
Saab one of 12 Founding Companies
Neuron (450M€)
Europe's largest multinational military demonstrator
Sweden/Saab Co-project Leader
MidCAS (50M€)
European Defence Agency's largest research project
Sweden/Saab Project Leader
16
Saab proprietary information
SAAB


TECHNOLOGY SPILLOVER EFFECTS ON NATIONAL ECONOMY
"The Gripen Project … is a process which through the years has resulted in considerable spillover effects in addition to the values from a defence perspective." Stefan Fölster, Chief Economist, Confederation of Swedish Enterprise, 2002.
"The JAS 39 Gripen development program has generated (in the Swedish economy) an additional social return to society (a spillover multiplier) on the order of magnitude of at least 1.8 times the original development investment." Gunnar Eliasson, Professor, Royal Insitute of Technology and the RATIO Institute, 2009.
17
SAAB

MISSILE DEFENCE: A CHALLENGE FOR EUROPE WHERE A PROGRESSIVE CAPACITY IS NEEDED TOGETHER WITH TECHNOLOGIES FOR THE FUTURE

This theme was dealt with by Michel Dechanet, from Thales Air Systems SA. The summing up of his lecture, written by Jean-Pierre Sanfourche, is here after presented.



GENERAL BACKGROUND

Europe is participating, within the framework of NATO, in the programme for common development of a system of command aimed at coordinating resources contributing to defence against ballistic missiles.

THE OBJECTIVE FOR EUROPE: TO ENHANCE THE NATO CAPABILITY

The objective is to enhance the NATO capability by gradually completing the US EPAA (European Phased Adaptive Approach) with European assets provided by the European nations as decided in Chicago Summit of 20 May 2012. Interoperability is guaranteed by the NATO Command and Control Systems, whose developments funded by NATO common funding should take into account European concerns. Doing so the NATO missile defence architecture will not only rely on US assets and technologies, which represent a very important effort, but also on the European systems and technologies, which are complementary and existing for some part.

THE PRESENT STATUS, IN SHORT

These systems and technologies already play a valuable and progressive role in the NATO ALTBMD (Active Layered Theatre Ballistic Missile Defence) architecture and will be a part of the future BMD expansion from ALTBMD with additional systems. This includes the surveillance and alert systems (sea based, land based and later on space based – see part on Ballistic Missiles Detection), C2 (Command and Control), and lower layer systems, with their surveillance/multifunction radars and missiles, which are part of the paced capacity priorities. The NATO BMD Interim Capability for the BMC3 is in place and in operations in Ramstein used in particular for the enhancement of the protection of the Turkish airspace.

As a further step, the NATO BMC 3I (I = Interim), is progressing towards an initial operational capability. In particular, it has been adapted to be able to take into account the new NATO command structure. Both the interim BMD capability and the initial operational capability in development are based on the ACCS System, originally developed for Air operations. That System has demonstrated through robust test programme its ability to fulfil its mission. Throughout the progressive integration built between the two Air Defence and Missile Defence systems, the NATO BMC3I will meet the objective of an integrated Air and Missile Defence. It thus will be able to form the basis for any further BMD development. In the meantime, national European components are evolving: the French-Italian SAMP/T system (Sol-Air Moyenne Portée/Terre) comes on the NATO stage. The recent March 2013 ATOC firing jointly performed by Italy and France at Missile Launching Test Centre of Biscarrosse, fully demonstrated the kill capability (third ATBM successful live firing) of the system and its ability to pass real-time information to the NATO C2. Thus, a lower layer capability, making use of European systems like the SAMP/T with the US systems contribution like Patriot or Aegis BMD ships, connected to the NATO BMAC3I, is achievable.

SOME ILLUSTRATRIONS

Mr Michel Dechanet illustrated his lecture with about 30 slides, among which 5 only are reproduced (because of editorial volume constraint): European Phased Adaptive Approach (EPAA) to Developing and Deploying Missile Defence (Figure 1); Europe's contribution to the implementation of NATO operational capacity including BMC 3 (ACCS TMD) and SAMP/T systems (Figure 2); a panorama of European achievements in Active Layered Theatre Ballistic Missile Defence and Missile Defence (Figure 3); the development of a Very Long Range radar demonstrator (Figure 4); the SAMP/T system, now fielded in French Air Force and Italian Esercito, and NATO Integrated (Figure 5).

Mr Michel Dechanet concluded his lecture by evoking the way ahead, proposing different types and a steps for developing NATO-Europe cooperation.

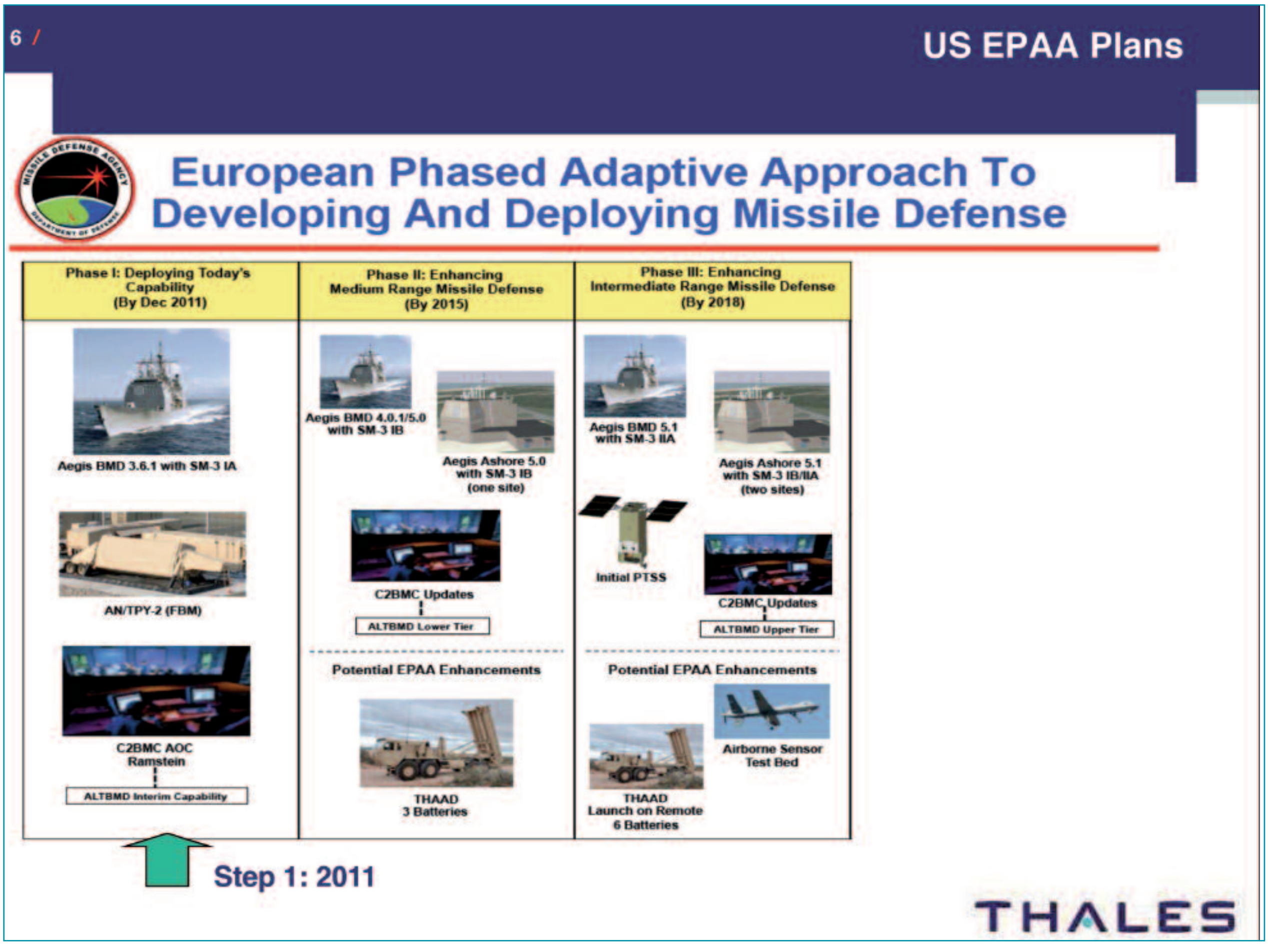


Figure 1

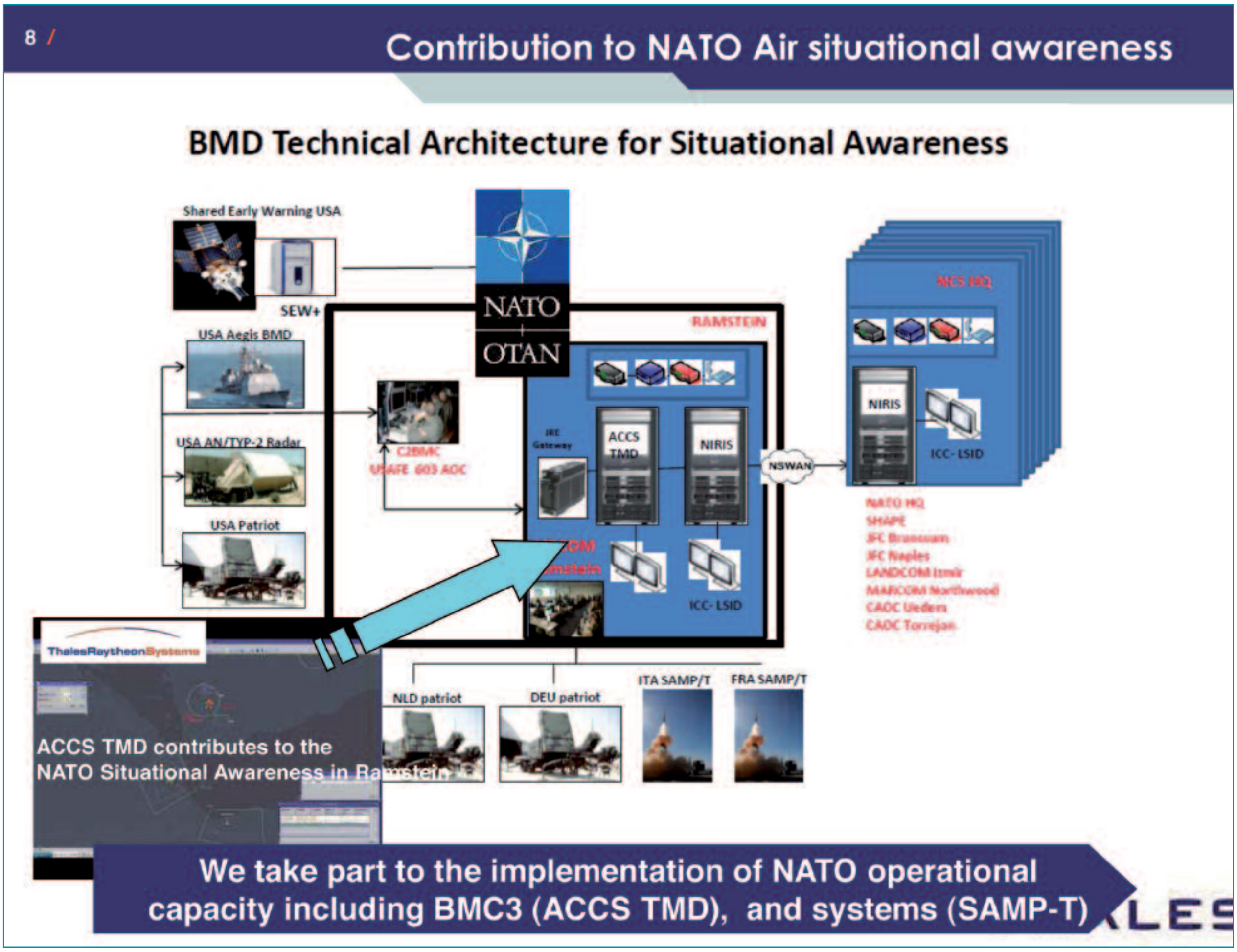


Figure 2

Figure 3

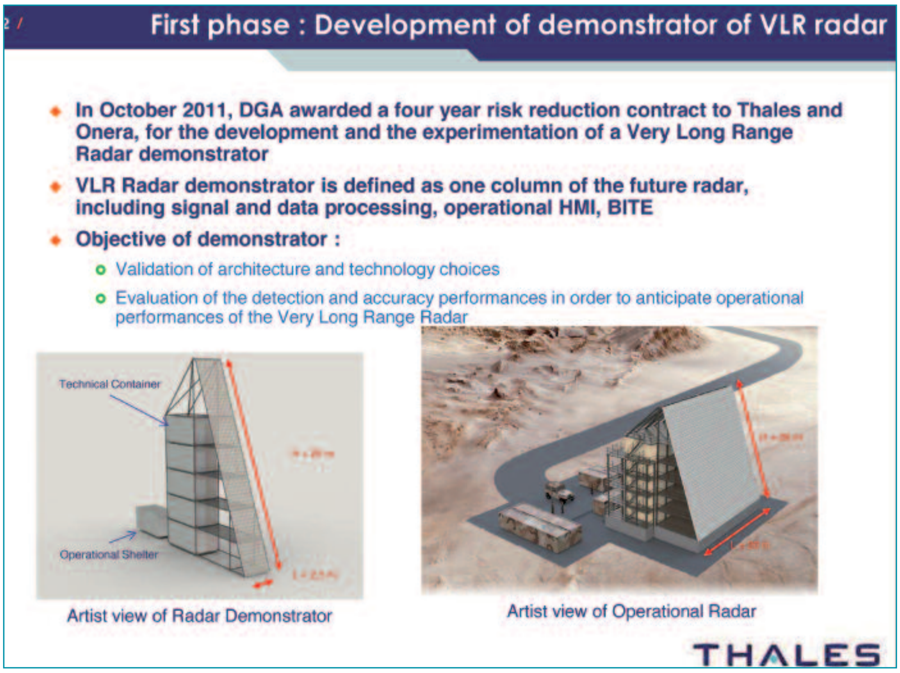


Figure 4

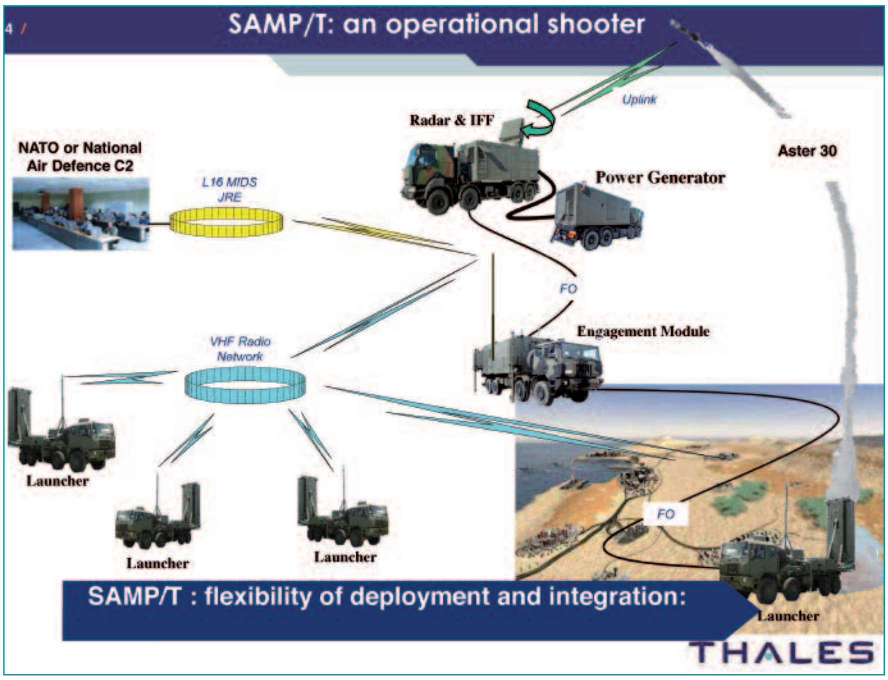


Figure 5

METEOR - EUROPEAN AIR DOMINANCE MISSILE POWERED BY HIGH ENERGY THROTTLEABLE DUCTED ROCKET

By Guido Kurth, Bayern Chemie GmbH, Germany

METEOR, the European 21st century Beyond Visual Range Air to Air Missile (BVRAAM) (Figure 1), came into series production in 2013. METEOR will be the long range air to air weapon for Eurofighter Typhoon, Rafale and Gripen and it is a candidate for the F-35 Lightning II Joint Strike Fighter. Development started 2002 based on common requirements of six European nations (ESP, FRA, GER, IT, SWE, UK). Development is done by an industrial consortium led by MBDA Missile Systems.

Figure 1. Meteor, European Beyond Visual Range Air to Air Missile

Air dominance achieved by METEOR is based on many features. One of the most important is its kinematic performance, being far superior to any other air to air missile system. This is based on the ramjet type propulsion system using a solid propellant. It powers the missile up to the target intercept at high supersonic speed and provides a No-Escape Zone significantly larger than for any other existing MRAAM system. The METEOR propulsion sub-system (PSS) is a Throttleable Ducted Rocket (TDR) with high energy (Boron containing) sustain propellant (Figure 2).
The presenter highlighted key facts of the METEOR programme and important features and advantages of the missile system, explained the functionality of the TDR, and described the overall design and components of the METEOR PSS (on unclassified level), as:

- gas generator case
- sustain propellant cartridge, Boron loaded sustain propellant
- interstage, housing control valve, actuator, actuation electronics and booster SAU/igniter
- ram combustor case with
  - port covers and port cover actuation
  - sustain insulation
  - ceramic sustain nozzle and insulation
  - case loaded boost motor, boost motor propellant
  - nozzle retention ring and environmental seal
- air intakes closed by movable ramp and air duct with bend section / ram combustor interface

In addition Mr Guido Kurth described the principle of the thrust control for the TDR sustain motor. Operation of the TDR motor is verified by ground and flight test as well as by simulation.
He outlined scope and philosophy of ground testing and summarized unclassified information of METEOR flight tests performed up to now. METEOR flight testing started in 2006 and has proven key functionalities of the PSS and aerodynamic control of the asymmetrical airframe, as well as data link, homing and intercept of different targets.

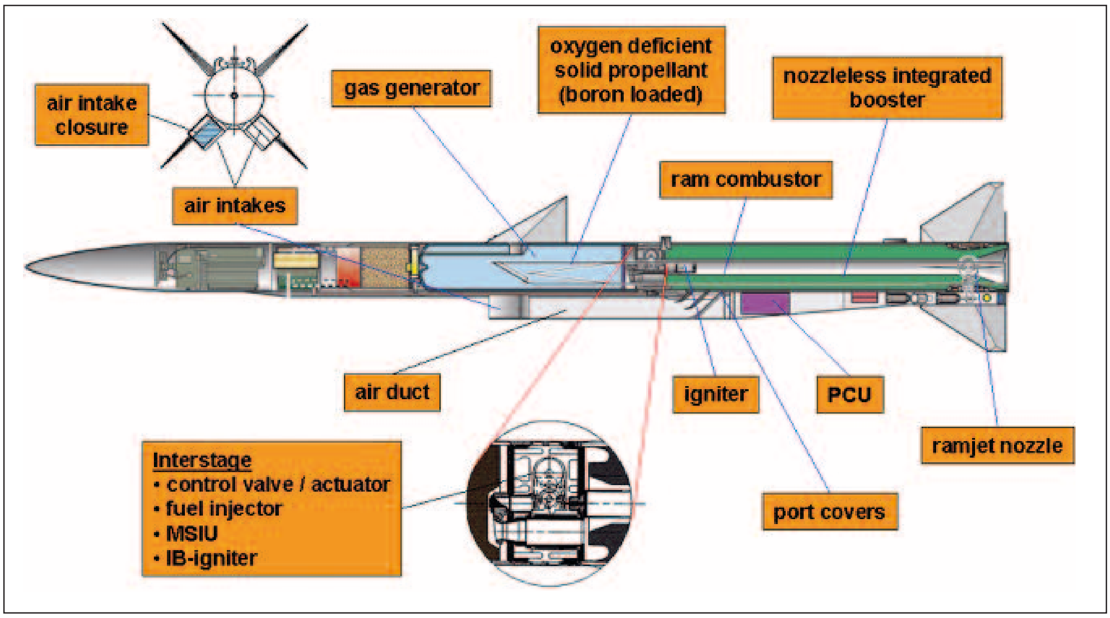


Figure 2. Schematic of the Throttleadle Ducted Rocket

Air Force Institute of Technology of Warsaw

By Pawel Ziencik, M.Sc.
ITWL, Warsaw

Air Force Institute of Technology is a research institute supervised by the Polish Minister of National Defence. Since 1953 AFIT supports operation of aviation technology. Hundreds of scientific studies – research and experimental – constructions of the Institute are used both in the civilian and military aviation, including Polish Armed Forces.

The institute consists of 10 Research & Development Divisions, which act innovatively in following areas:

- Designing and integration of aircraft systems
- Unmanned Aerial Vehicles
- Logistics systems
- Reliability and safety
- Training systems, including e-learning
- Aerial armament
- Airfield pavement and road infrastructure
- Substitutes of fuels, oils and lubricants
- C4ISR systems integration
- Aircraft engines

AFIT adapts helicopters to modern, centric-network battlefield. Open architecture of the Integrated Avionic System allows to use in other developed in AFIT projects such as the Helmet Mounted Display System - CYKLOP and the Helmet Mounted Sighting System – ORION.

The family of Unmanned Aerial Vehicles consists of Unmanned Surveillance Aircraft, jet and propeller aerial targets demonstrators used by the Polish Air Defence Forces, and Vertical takeoff and landing UAV. Unmanned Aerial Vehicles are controlled by autopilot developed at the AFIT.

IT systems developed by AFIT engineers are in use to conduct the analysis and assessment of the Armed Forces Aviation's flight safety and also for IT support of the service of F-16 aircraft implemented into Polish Air Force.

Air Force Institute of Technology conducts both research ground and in-flight testing. Flying laboratory is used among other things to test prototype devices and aircraft appliances.

The institute develops and improves Air Force and Air Defence command systems, simulation training systems for digital battlefield and interactive training systems in the field of aviation technology and air defence.

As regards armament, AFIT developed among others, system for firing non-guided missiles from helicopter.

Well-skilled staff of the Institute carries out researches such as performance evaluation of airfields and roads pavements as well as construction materials. High quality equipment allows the assessment of equality, capacity and surface smoothness. AFIT provides technological supervision for airfield and road pavement building process.

For fuels and lubricants testing, AFIT uses working liquids and liquid fuels laboratories which can carry out, among others, expertises such as: fuels and working liquids quality evaluation, diagnosis of emergency fuel states and lubrication of aircraft engines. An important area of research works is the use of bio-components in petroleum, oil and lubricants used in aviation.

As the result of work on the integration of C4ISR systems AFIT developed Modular solution for the dismounted soldier with infrared imaging system and command subsystem, tactical data link standards depository with the LINK16 functionality emulation and simulation system aboard Polish

F-16 fighter and the system to detect and track the objects on low earth orbits.

Air Force Institute of Technology takes on multilateral cooperation with foreign research institutions, defence industry companies, and institutions dealing with integration in the North Atlantic Pact. Scientific Council which works in AFIT, has the authority to confer postdoctoral degree in the technical sciences with a specialization in "construction and operation of machines". In June 2008 Last President of Poland in Exile – Ryszard Kaczorowski, became the Honorary Member of this Council.

Tuesday – Opening speech for Education Day

By CEAS President David Marshall

"Good morning and welcome to Education day at CEAS 2013

As I said yesterday in my opening remarks for the whole conference this is a new departure for CEAS conferences but is totally in tune with the aerospace community's thinking in looking forward to a 2050 horizon.

You will hear more from our keynote speakers in a moment on the priorities and planned initiatives for European programmes in this field but I think that there is a personal challenge to all of us to find ways of engaging in this vital process. We all have our personal contacts either with children and students. We often are or have been working in situations where clear training needs appear and need to be met.

As you will hear during the morning there are growing examples of good practice in engaging with children throughout their education journey with clear benefits. Training is or should be a through life journey and it will be the combination of education and training that makes the well educated and motivated aerospace community we need to build to reach our ambitious 2050 goals.

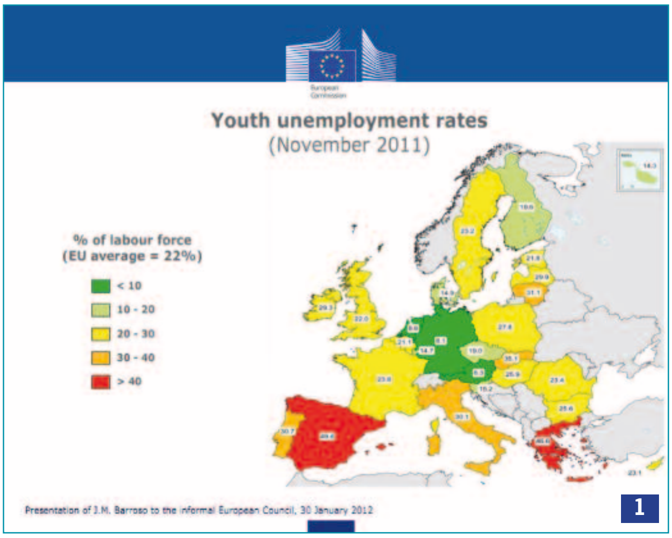
You don't need very much mathematics to calculate that the core of our community for 2050 is now in the education process or will be entering it in the next few years. If we fail them no amount of Innovation elsewhere will deliver our Vision.

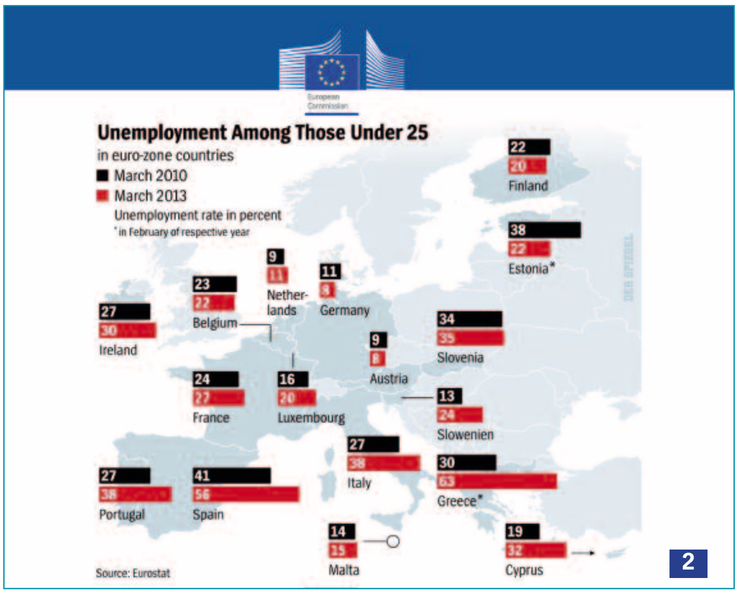
At the end of our breakout sessions we will end with a plenary again to see if we can identify some of the key activities we need to stimulate at a European level to succeed.

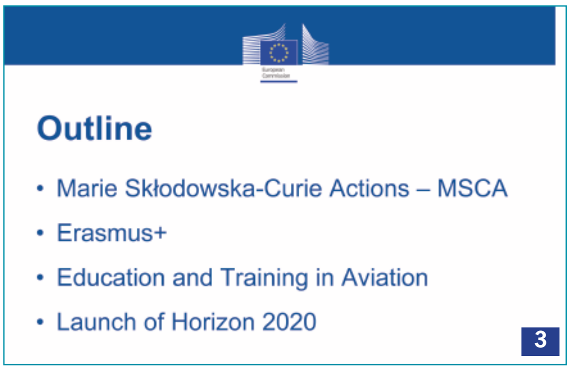
So now to our first keynote speaker…"

Education and training - an investment in Europe's future

by Dietrich Knoerzer, DG
for Research and Innovation Aeronautics







MSCA Objective

Marie Skłodowska-Curie Actions (MSCA)

Main Objective
Ensure the optimum development and dynamic use of Europe's intellectual capital in order to generate new skills and innovation

Rationale
•Encourage new and creative types of **training**
•Identify excellent **talents** in research and innovation world wide
•Make the best **researchers** in Europe and in the world to work together across countries, sectors and disciplines
•Create a whole **new mind-set** in Europe, crucial for entrepreneurship and innovation

4

MSCA in Horizon2020

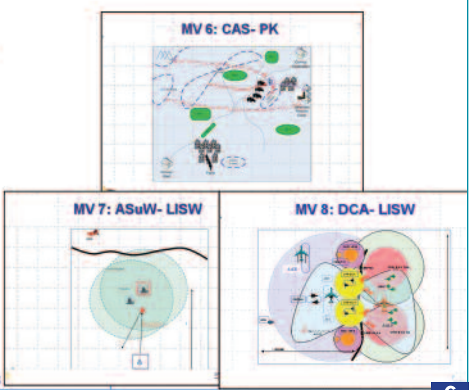
Innovative Training Networks	ITN	Training Networks, European Industrial Doctorates, Joint Doctorates
Individual Fellowships	IF	Support for experienced researchers undertaking international and inter-sector mobility
Research and Innovation Staff Exchange	RISE	International and inter-sector cooperation through the exchange of staff
Co-funding of programmes	COFUND	Co-funding of regional, national and international programmes: - doctoral programmes - fellowship programmes

5

UCAS priority missions (2)

Priority 2 : Close Air Support within a medium intensity environment

Priority 3 : Air-to-air and anti-surface warfare



CEAS

6

Individual Fellowships (IF)

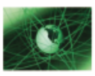
✓ Opportunities for international and inter-sector mobility of ER to facilitate career moves
✓ Enhance competences and creative potential of best researchers, European and non-European willing to work in the EU
✓ Encompass intra-European, incoming, outgoing mobility and re-integration
✓ Possibility of inter-sector secondments

7

Research and Innovation Staff Exchange (RISE)

✓ New type of staff exchange action, to stimulate transfer of knowledge
✓ Flexible inter-sector (within Europe) and international (with 3rd countries) exchanges of highly skilled research and innovation staff
✓ Single eligibility rule for partnership consortia
✓ Based on a common research project






8

COFUND

Co-funding of Regional, National, and International Programmes (COFUND)

- Stimulating regional, national and international programmes to foster excellence
- Spreading the best practices of MSCA
- Extended to doctoral training and exchange of staff
- Building on experience from FP7 COFUND

9

Erasmus+

Main Objectives
•to improve people's skills and ultimately their employability
•to support the modernisation of education and training systems

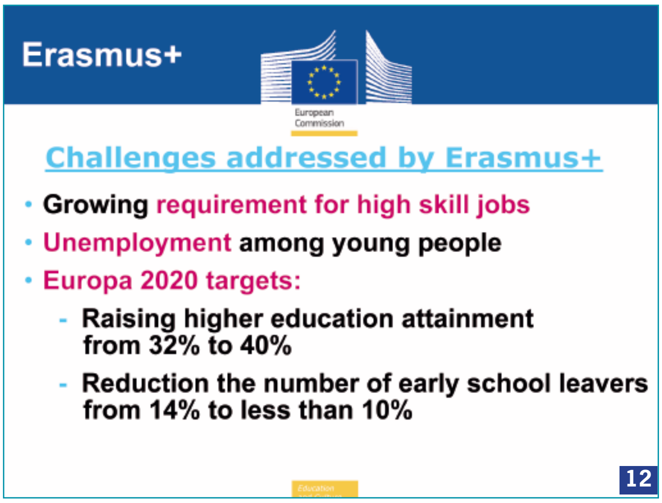
10

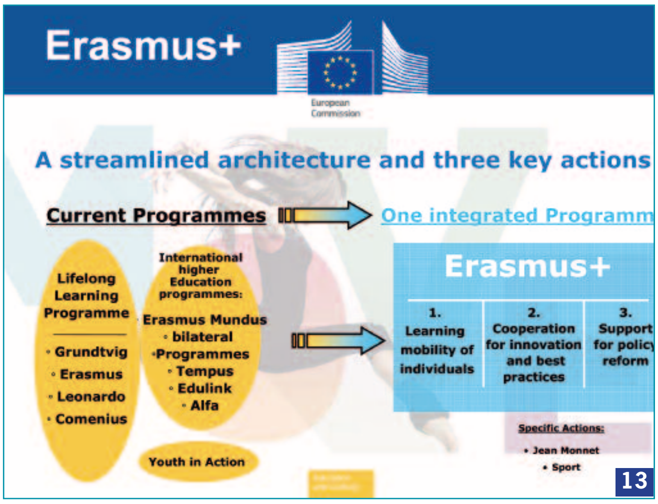
Erasmus+

Erasmus+

- **Budget increase of approximately 70%**
- **Two thirds of budget targets learning mobility**
- **5 million people could study or work abroad**
- **Two key objectives:**
  - **individual mobility**
  - **competitiveness of education sector**

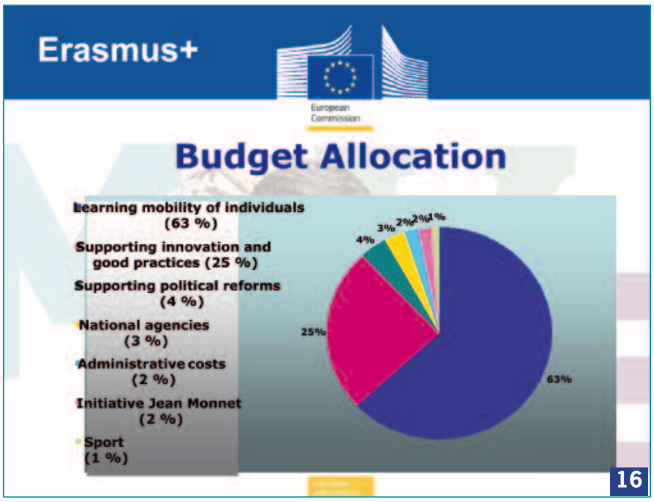
11


Erasmus+
European Commission
Challenges addressed by Erasmus+
• Growing requirement for high skill jobs
• Unemployment among young people
• Europa 2020 targets:
- Raising higher education attainment from 32% to 40%
- Reduction the number of early school leavers from 14% to less than 10%
12


Erasmus+
European Commission
A streamlined architecture and three key actions
Current Programmes
One integrated Programm
Lifelong Learning Programme
· Grundtvig
· Erasmus
· Leonardo
· Comenius
International higher Education programmes:
Erasmus Mundus
· bilateral
·Programmes
· Tempus
· Edulink
· Alfa
Youth in Action
Erasmus+
1. Learning mobility of individuals
2. Cooperation for innovation and best practices
3. Support for policy reform
Specific Actions:
• Jean Monnet
• Sport
13


Erasmus+
European Commission
Individual Opportunity
• Students: nearly 3 million higher education and vocational students would get support
• Master's students: a new loan guarantee scheme
• Youth: 500 000 to benefit from international volunteering opportunities and youth exchanges
• Staff: 1 million teachers, trainers, school leaders and youth workers to teach and learn abroad
14


Erasmus+
European Commission
Cooperation for innovation and good practices
• 23 000 Strategic partnerships between education institutions, youth organisations, training institutions and business
• 400 Knowledge Alliances and Sector Skills Alliances
• IT support platforms and e-Twinning
• 1000 capacity building projects in third countries
15


Erasmus+
European Commission
Budget Allocation
Learning mobility of individuals (63 %)
Supporting innovation and good practices (25 %)
Supporting political reforms (4 %)
National agencies (3 %)
Administrative costs (2 %)
Initiative Jean Monnet (2 %)
Sport (1 %)
63%
25%
4%
3%
2%
2%
1%
16


Erasmus+
European Commission
2. Cooperation for innovation and good practices:
• Strategic Partnerships
• Sector Skills Alliances
(Vocational Education and Training - VET)
• Knowledge Alliances (HEI and companies)
Knowledge Alliances are transnational, structured partnerships between higher education and business.
Knowledge Alliances are open to any discipline, sector and to cross-sectorial cooperation, particularly in emerging fields.
17


Knowledge Alliances
European Commission
Overall objective:
• Strengthen Europe's innovation capacity
• Foster innovation in higher education, enterprises and socio-economic environment
Specific goals:
• Implement innovative ways of teaching, learning and governance
• Stimulate entrepreneurship and entrepreneurial competence of students, academics and company staff
• Facilitate the exchange, flow and co-creation of knowledge
18


Knowledge Alliances
European Commission
Essential features are:
• Partnership:
→ at least 6 partners from 3 participating countries, thereunder at least 2 companies and 2 higher education institutions
→ balanced participation and structured collaboration
• Innovation: in higher education and via higher education in enterprises and in the socio-economic environment. New skills for new needs!
• Impact: Partnership and activities persist beyond project lifetime. Societal and economic relevance and outreach.
19

Knowledge Alliances

European Commission

Essential features are:

- **Partnership:**
  → at least **6 partners from 3 participating countries,** thereunder at least **2 companies and 2 higher education institutions**
  → balanced participation and structured collaboration
- **Innovation:** in higher education and via higher education in enterprises and in the socio-economic environment. New skills for new needs!
- **Impact:** Partnership and activities persist beyond project lifetime. Societal and economic relevance and outreach.

20

2012 Example: *e-nspiration* — Core Partners

Energy Related Multidisciplinary Knowledge Alliance Aiming To Introduce An Innovative Training Programme

http://www.enspiration.eu

MONTAN UNIVERSITÄT
JERNKONTORET — THE SWEDISH STEEL PRODUCERS' ASSOCIATION
ASMET — THE AUSTRIAN SOCIETY FOR METALLURGY AND MATERIALS — ONLINE
Buderus Edelstahl
talkademy.org
institute of materials & machine mechanics — slovak academy of sciences

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2012 Example: *e-nspiration* — Approach

Activities:

- Prototype of training courses
- Establish an international multidisciplinary training program on energy efficiency engineering and management
- Educate innovation drivers in respect of energy relevant engineering and learning methods
- Bring together the professionals from energy intensive industrial sectors, researchers and trainers with engineering students

22

Aviation Research FP's and ACARE

23

The new vision: Flightpath 2050

Responding to society's needs
Securing global leadership for Europe

- Meeting Societal and Market Needs
- Maintaining and Extending Industrial Leadership
- Protecting the Environment and the Energy Supply
- Ensuring Safety and Security
- Prioritising Research, Testing Capabilities & Education

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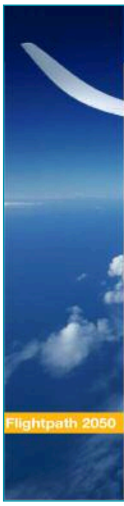
Flightpath 2050: Prioritising Research, Testing Capabilities and Education



- European research and innovation strategies are jointly defined by all stakeholders
- Strategic European aerospace test, simulation and development facilities are identified, maintained and continuously developed
- Networks of multi-disciplinary technology clusters are created
- Students are attracted to careers in aviation. Courses offered by European Universities closely match the needs of the Aviation Industry

25

Strategic Research &Innovation Aganda Volume 1

Education

"**A fully integrated European aviation education** system delivers the **required high-quality workforce** and provides lifelong learning."

"To **attract both students and workers** to the aviation sector

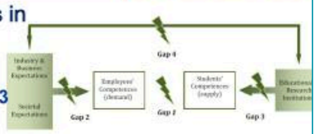
"A network of multi-disciplinary technology clusters is created based on **collaboration between industry, universities and research establishments**"

26

Project EDUCAIR – GA 284899

EDUCAIR

Assessing the educational gaps in aeronautics and air transport
EC contribution: 392000 €
Duration: 21 months until June 2013
5 Universities, 1 Research centre



Objectives:

- **To identify the attraction and repulsion factors** of education in Aviation
- **To estimate the future needs for Aviation Labour force**
- **To assess the Gaps of Competences and Skills** between the needs and the Educational Offer
- **To recommend improvements** in the current educational offers

Universiteit Antwerpen — TUDelft — NLR

27

Educating Tomorrow's Innovative Engineers to maintain Europe's leadership in aerospace

By Aldert Kamp, Director of Education Aerospace Enginering at TU Delft

"We face great challenges: an exponential growth in air transport, the depletion of oil, global warming, noise pollution, better safety. Europe wants to maintain its competitive and leading position in aviation, aeronautics and spaceflight, by conquering these challenges. Are we ready for that? The challenges may be comparable to the Moon race in the sixties. That attracted thousands of young people to our aerospace sector. Solving world problems attracts students to engineering studies. But are we sure we can attract sufficient young people? Are they driven and inspired to create the technologies for the next generation of air transport and space missions? The challenges we are facing require creative people who can develop incremental as well as disruptive innovations. Are we sure we are ready to educate young generations of aerospace engineers with the innovative power we need?

Following the vision of ACARE, the Advisory Council for Aeronautics Research in Europe, an independent Think Tank of experts, **we need increasing numbers of highly performing students, attracted to careers in aerospace**. We need university courses that are academically challenging. That match the needs of industry and research. We need standard three-cycle programme structures and common accreditation criteria all over Europe. We need a European industrial community that engages with the students, attracts them when they are teeners, coaches them during their studies, and provides them interesting career opportunities. And we need a mentality of lifelong learning.

We also have to educate tomorrow's generations of engineers to be more creative and innovative than today's engineers. That is not the same as excellent Grade Point Average (GPA)'s for academically challenging courses. To conquer the challenge of designing a zero-emission airplane, or the search for life in the oceans under a kilometers thick ice sheet on an icy moon of Jupiter, engineers need a deep and up-to-date working knowledge of fundamental and aerospace engineering sciences. But that is not enough: they also need creativity, practical experience, technical prowess, knowledge of non-engineering disciplines, the ability to cooperate in international multidisciplinary teams, the ability to take risks.

Do you think that Europe's education in aerospace engineering is ready to maintain leadership in Aviation? We need increasing numbers. But the workforce in aerospace is ageing. The pipeline of aerospace engineers is threatened because fewer students choose the STEM areas. We need academically challenging courses. But the naked truth is that many students who come to university, searching for the excitement of aernautics and spaceflight, find something else: In an era of internet and laptops, they often find an education system that was developed during the heyday of manual switchboards and keypunches. Worldwide, many students, who are the first generation of "digital natives", "Homo Zappiens" as we call them in Delft, are disappointed by the old-fashioned low-tech educational systems. In the world of global collaboration and teamwork, they often find universities with individuals, learning alone. In the world of appealing projects and cool products, they often find a death march of naked math and science. Taught in impersonal lecture halls. Transferring information through rote memorisation. With an ever increasing emphasis on science and less on engineering. Taught by staff who is selected for their academic excellence, but has little or no practical engineering experience. These factors are embarrassing and repulsive.

We need more training in creativity, collaborating, multidisciplinary thinking, taking risks, and so on. Seldom do I see those skills integrated in aerospace engineering education. They are often called "soft skills". But if we want to maintain leadership and competitiveness these are the most important engineering skills. What I see is that, regardless how much they are needed to make our students creative and innovative, the training of such skills is often rejected as being too soft by the hard-core "rigorous" engineering professors. Don't you think that educating these skills calls for a different model of pedagogy, one which is less focussed on scramming facts into students' heads?

Our world has changed drastically since the seventies and eighties. But it seems that many educational systems are stuck in a rut. We live in a global knowledge economy. A newly flattened world as Thomas Friedman tells us in his book "The World is Flat". The production of new knowledge is shifting from single to multiple institutions, from national to international domains. It puts emphasis on the combination of technical expertise, creativity and communication. We live in a finger-tip society. Information that was limited in availability and amount, is now characterised by flux and glut. Big data is transforming the scope and scale of our education. The value of explicit information is therefore rapidly dropping. Today the real value is what you can do with what you know. We also live in a world where the workplace has changed: organisations have been flattened from top-down management to cross-functional teams. Leadership-by-influence is the norm, no longer by authority. Why is it that we live in a New Creative World of Work but many of us still educate our engineers in a Cold-War curriculum? Is it may be because experts are afraid loosing expert territory? That would be a silly academic NIMBY problem: changing curricula is fine, but don't touch my course. Or is it because educational institutions are deeply and inherently conservative?

Let us not forget **the new generation learns differently from my generation**. Too many universities ignore the changing needs and desires of the young generation. I am pretty sure that the traditional "spoon-feeding" universities won't be able to attract the innovative and creative student. If we really want to maintain our leadership we have to break the conservatism in the educational systems. This will be a real challenge for Europe.

I have attended conferences in Western Europe, Russia and the States on engineering education. Where CEO's and Heads of technical business like Astrium, Airbus, Boeing, Rolls Royce, ASML, Shell were asked what qualities they want most in new employees. None of them ever mentioned expert engineering knowledge as being a problem. By far number one is the ability to apply theory to new problems. It is the single most desirable attribute of the young graduate. Problem solving, critical thinking, asking questions, collaborating in multidisciplinary teams, agility and adaptability, communicating, accessing and analysing information. They are the skills that matter. Tony Wagner, Innovation Education Fellow at Harvard, calls them the "Survival Skills" of the new Knowledge Economy. David Goldberg of Foundry for Innovation in Engineering Education calls them the "Missing Engineering Basics". Without these skills, narrow expert knowledge of aerodynamics, structures, flight mechanics and so on results in publications in Journals of Aerospace Sciences, but not in European leadership in innovative aerospace systems for the future. So what these leaders say is that whatever gap exists between higher education and industry needs, they shall not be in these survival skills or missing engineering basics.

This sets the scene for tomorrow's curricula in Aerospace Engineering. It shall contain the Core subjects of the foundations in aerospace engineering sciences and knowledge about aerodynamics, flight and orbital mechanics, propulsion, dynamics and stability, light-weight structures, materials, operations. It it shall contain the core subjects of engineering and design skills to conceptualise, design, develop and operate aerospace systems, learning how to decompose big problems, how to model in words and diagrams, how to measure, learn to accept failure.

It shall contain the 4C's that are key for an Innovative Europe:

- Critical Thinking and problem solving
- Creativity, imagination and initiative
- Communication, asking questions, language
- Collaboration, working in teams, leadership-by-influence

And it shall contain life-long learning, accessing and analysing information, agility and adaptability, and mobility. And it shall be engaging, compelling and motivating.

Already in the eighties, well before the global knowledge economy, universities in the US had concerns about the innovative power of their graduates. And the worst thing is:

– 30 years later, they still have. In the mid nineties Boeing issued a list of desired attributes engineering graduates should have, and what they actually saw. They are much in line with what I just said. In 2001 MIT Aeronautics & Astronautics and three Swedish universities, including our host Linköping, established the CDIO Initiative, an innovative educational framework for engineering. "Rethinking engineering education". Their vision is about an integrated learning of:

- Technical Knowledge,
- Engineering and Design skills
- Personal Skills like critical thinking, problem solving, and creativity
- Interpersonal Skills like cooperation and communication in international and multi-disciplinary teams

Five members of the PEGASUS network, my home university TU Delft, KTH in Stockholm, Bristol, Politecnico di Milano, Aachen have joined this Initiative. Also the aerospace universities of Liverpool and Queens University Belfast. Worldwide 100 engineering universities, including this Linköping. Please let us learn from their successes. They have reconstructed their curricula to better integrate the Core subjects, the 4 C's and other things I mentioned. I am pretty sure they are in a much better shape to educate engineers for an Innovative Europe than many others.

To demonstrate how a modern curriculum looks like, I will give you the vision of TU Delft Aerospace Engineering on education and the way we implemented it in a nutshell: We have adopted the so-called T-shaped professional. The engineers of the future have to be deep problem solvers in science, engineering, design and management. Who are capable to collaborate with specialists from other disciplines. We have made a rigourous and compelling curriculum. Telling the story how one engineers aircraft and spacecraft. If you were one of our students you would like to be engaged in the engineering and design of aircraft and spacecraft, using labs and workspaces, experiencing what aerospace engineering is about. That's what we made. Almost all courses relate to aircraft and spacecraft. In the Bachelor our students learn how to engineer in a series of six design projects that are complemented with courses on aircraft and spacecraft design. These projects go from the concrete to the abstract, in which students work international teams and acquire design-build-test experiences, practicing their theories on authentic design problems that come from practice, industry or research. Using our labs, making a flight test in our plane. Students thus learn to take calculated risks by trial-and-error, practice critical thinking, problem-solving, creativity, collaborate in open-ended, sometimes incompletely defined problems and projects. Such elements are hallmarks for innovators. In the MSc our students learn a complex high-tech subfield in a relatively short time. To prove they can manage a steep learning curve in a new specialism to create new knowlege. Steep learning curves are important in lifelong learning. In our programme we also require that all our students experience, what I call an "immigration mind-set" at least once in their study. It's about getting a feel of mobility, learning the skill of agility and adaptability. Feeling displaced from the usual, be uncomfortable; worrying about being good enough, doing despite not fully understanding, learning how to make it in a new environment with different values. These aspects empower innovation and creativity.

Ladies and gentleman, if we want to maintain our leadership and competitiveness in aerospace we can't wait and see. The World of Work has changed. The urgency is there. Universities have to change. To rethink the way they operate. We have to get more and better engineers who can develop incremental as well as disruptive innovations in aerospace. Would not it be great if we could use the major challenges in Aerospace Engineering as the "Sputnik moment" to attract more talent to our field: teeners, students and teachers. By outreach actions, events, putting international competitions in the spotlight. Once we have them onboard we have to give them a joyful and engaging learning experience using state-of-the art didactics and techniques. Modern, and more effective. With the rigour of aerospace engineering. That prepares them for the innovative and creative tasks that are waiting for them. With integrated design skills, and integrated personal and interpersonal skills. In which they learn to apply knowledge to real-life problems in a global knowledge economy in multidisciplinary setting in multinational teams. In which they experience an "immigrant mind-set" by studying partly abroad. Only then they are prepared for creativity and innovation, to conquer the challenges of the post-oil aircraft, the global warming, and the search for life on the icy moons of Jupiter.

I don't say Aerospace Engineering education is in a crises. But our target to maintain leadership in aviation and space has very high expectations put on it. If we take this target serious, I urge you on to an open mind and willingness to bring the higher engineering education to the New World of Work. By making use of the best practices in engineering education as for instance in the CDIO network. I think it is a unique opportunity to make this leap forward, together, collaborating in the integrated knowledge triangle of education, research and industries, for an innovative Europe in aerospace. ”

SESSION SUMMARRY • EDUCATING TOMORROW'S INNOVATIVE ENGINEERS

by CEAS President David Marshall

AMONG MAJOR STATEMENTS

- JCB Academy: a very good example of how you can start at school level to get young people prepared for engineering. Strengths: a strong vision statement and collaboration with industry
- DLR_School_lab: link the gap between school and industry. Pupils of all ages can do hands-on experiments. Teachers and university students are involved
- REStARTS: an FP7 project which shows that collaborations between teachers, scientists and pupils preparing resources and activities can be highly successful
- Fly higher: also resources for schools, including competitions and a career advice pack
- Euroavia: a great example of student leadership and how we should trust the people who are future employees to lead their future with industry
- Hamburg Aviation Academy – an interesting model of the Government leading but with full employer and agency involvement
- RAeS: showing the work of the Society Education and Skills work and a way forward
- Flybe Academy: showcasing an industry-led Academy with partnerships with colleges and universities
- Aviation Skills Partnership: Skills for operational outcomes
  - Skills programmes for aviation enabling focus on policy, regulation, frameworks and access and practical skills outcomes

DISCUSSION POINTS

- You have to get very young people interested in science and aeronautics
- The link between industry and schools is essential:
- Scientists and engineers have to understand they should be involved and give time and pay attention to education in schools
- Gender issues: young girls need to be made aware of all the different aspects of aeronautics and aviation, e.g. issues related to society and particular applications may attract them more. Get mothers (parents) involved
- The board of CEAS need to have a vision for how to get young people think about all the different possibilities of future jobs in aeronautics (not just academic/engineers). This vision needs to include how education at schools , universities and industries is organised e.g.:
  - Engineers need to know how young people learn (pedagogical issues)
  - Teachers need to learn how to teach aeronautics (knowledge content and pedagogical issues

PROPOSED ACTION PLAN

- We need to adopt some common language:
  - Aviation, Aeronautics and Space – new term covering all areas
- New areas for focusing effort:
- Operators – outcome focused
- Facilitators
  - Support organisations (Air Traffic, Airports, Launch site)
- Originators – OEM and supply chain (e.g. Airbus Military, SAAB)
- Enablers
- Governments, Commission, Schools, Colleges, Universities,Training Providers, Academies, Research
- We need a mechanism to allow students (prospective employees) to lead how the European industry gets its people to the required outcomes and widen participation– role for organisations such as Euroavia ?
- We need to join the students directly with the employers and allow colleges, universities, research establishments to operate as enablers
- We need to embrace the aviation (operating) industry fully into the skills initiatives (and Space ?). Funding needs to be available to support the initiatives. Governments and Government organisations are enablers
- We need skills programmes to have common frameworks and accreditation to allow people to progress from first aspiration to their chosen career without interruption across borders and cultures, use competence tools
- We need to ensure that we attract the right people to the industry with the right core values and principles (e.g. safety, economic etc)
- We need a mechanism to share best practice across the industry (physical sites and programmes) and outside (e.g. JCB Academy)
- CEAS should establish an Education & Skills Committee to coordinate cross Society activity and to enable Commission funding to be channelled into agreed frameworks with agreed partnerships through agreed partnerships
- The Commission should consider seed funding a pan-CEAS initiative to agree the skills needs of each nation and to coordinate a launch plan

TECHNICAL PRESENTATIONS

In total near 160 technical papers were presented: about 130 in Aeronautics and 30 in Space. The abstracts had been assembled into a book published by Linköping University and distributed to all delegates before the beginning of the Conference.

AERONAUTICS

The topics covered are listed here below:

- GREEN TECHNOLOGY – ULTRA LOW EMISSIONS
- RESEARCH ADVANCES IN AIRCRAFT ACTUATION SYSTEMS AND COMPONENTS (R3ASC)

- FLIGHT OPERATIONS
  - – ATM
  - – UAS Traffic Insertion and UAS Operation
  - – Trajectory and Flight Optimization
  - – Operational Value and Trajectories
  - – Human Machine Interface
  - – Logistics, maintenance and Support

- STRUCTURAL DESIGN
  - – Analysis, Materials and Manufacturing
  - – Analysis, Materials and Manufacturing – Cracks and Damages
  - – Manufacturing, and Hot Temperatures Materials

- AIRCRAFT DESIGN
  - – Methods and Tools
  - – Propulsion in Aircraft Design
  - – Design Engineering, Collaborative Design, Modelling and Simulation
  - – Aircraft Design methods and Tools
  - – Novel Concepts
  - – Innovative Aircraft Design

- AERONAUTICS SCIENCES
  - – Stability and Control
  - – Experimental Aero, Wind Tunnel and Flight Testing
  - – Aeroacoustics, Aeroelasticity, Unsteady Aerodynamics
  - – Active Flow Control
  - – Aerodynamic Modelling and Simulation, Computational Methods
  - – Architecture, Sensors and Other
  - – Stability and Control

- AVIONICS: SENSING AND NAVIGATION

- PROPULSION

– Gas Turbine Modelling and Simulation

– Cores, Combustion Chambers Modelling and Simulation

SPACE

The themes dealt with were:

- SPACE AVIONICS, SENSING AND NAVIGATION

- ENVIRONMENT AND AEROSPACE

- CLEAN SPACE
  - – Green Rocket Propellant
  - – De-Orbiting of Space Debris
  - – Life Cycle Assessment

- SPACE SYSTEMS

- SPACE PROPULSION AND SPACE EXPLORATION

■

EREA AND ASSOCIATION OF EUROPEAN RESEARCH ESTABLISHMENTS IN AERONAUTICS

Professor Dr Rolf Henke, DLR and EREA Chairman, presented the EREA Proposal for a joint Research Initiative (JRI) in Aviation. This proposal, named '**FUTURE SKY**', is reproduced here below.

1

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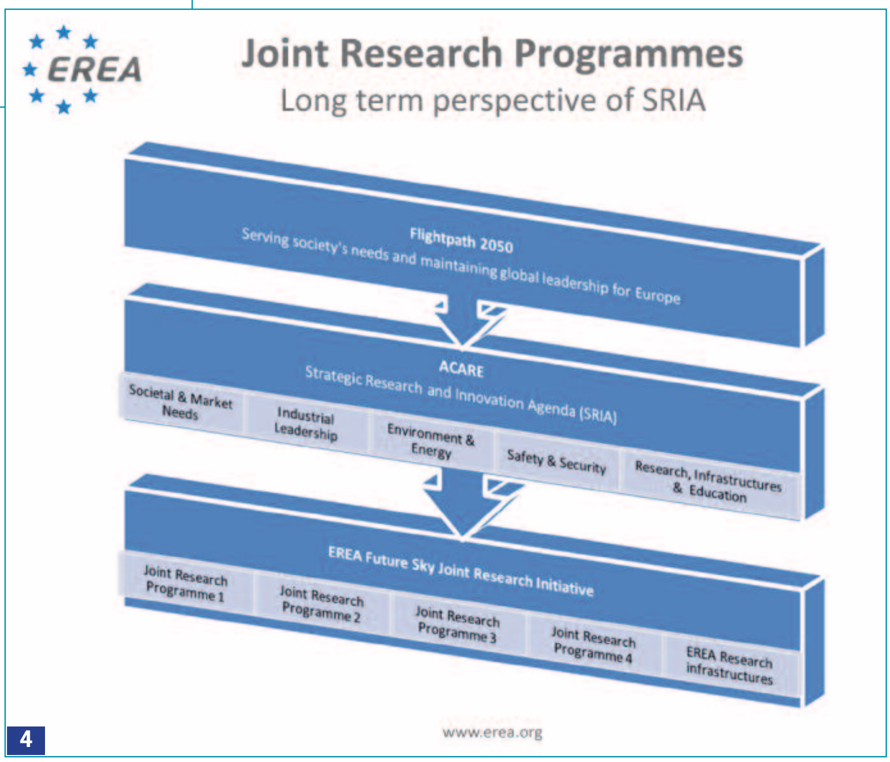

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FutureSky goals
24/7 Air Transport System

- The overall goal of FutureSky will be “24/7”
- This concept describes the full airside mobility, 24 hours a day, 7 days a week, resilient against any impacts e.g. from disruptive events like extreme weather, in line with FlightPath 2050, with interfaces to other sectors (intermodal approach)
  - “24/7” asks for new environmental friendly vehicles, so quiet that they are allowed to operate during night at airports (=> FP2050 goal)
  - Totally new elements of the ATS will be needed, e.g. large UAV for air cargo
  - “24/7” addresses aviation operational issues, including ATM
  - “24/7” addresses intermodal aspects, both specific for aviation and with respect to worldwide day-and-night operations

Status: Whitepaper delivered, EREA is waiting for comments; contacts to industry, academia, EASA, ASD, … underway

5

FutureSky goals

Vision
Define technologies, systems and processes with regards to Flightpath 2050

Knowledge
Develop the knowledge for the next ATS generation including complex testing and validation capabilities
Contribute to the education of future engineers

24/7

Attraction
Make aviation fascinating for the public and attract the young generation

Competetiveness
Analyse and prepare the scientific technological ground for future ATS beyond Clean Sky and SESAR

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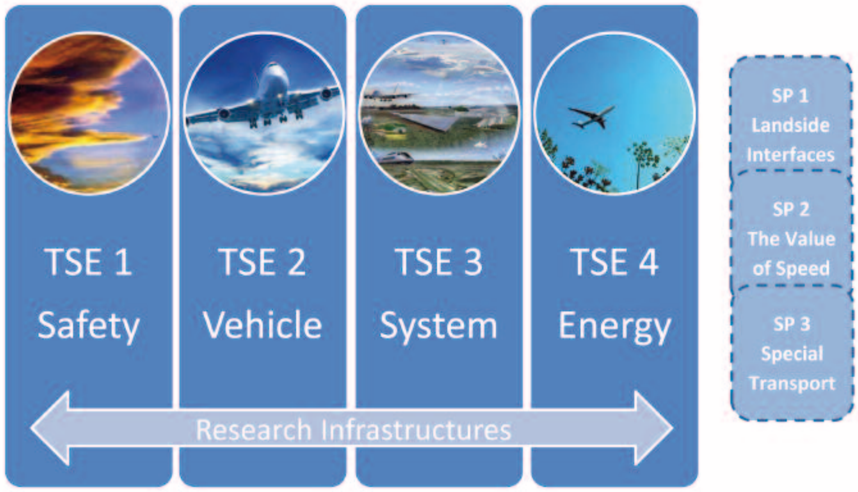
6

Programmatic outline
Enablers and Support Projects for 24/7 ATS



SP = Support Project
TSE = 24/7 Enablers

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TSE 1 on Safety

- **Theme 1 – Towards 10^{-7}**
  - Breakthrough research to address current main accident categories and current main common causal factors of accidents in commercial air transport with the purpose of enabling a direct, specific, and significant risk reduction in the medium term.
- **Theme 2 – Strengthening the capability to manage risk**
  - Methods, models, processes and technologies to enable the aviation system actors to achieve control over the safety risk in the air transport system.
- **Theme 3 – Building ultra-resilient systems and operators**
  - Improvement of Systems and the Human Operator with the specific aim to improve safety performance under unanticipated circumstances.
- **Theme 4 – Building ultra-resilient vehicles**
  - Reducing the effect of external hazards on vehicle integrity as well as reducing the number of fatalities in case of accidents.

Status: Whitepaper delivered, EREA is receiving comments; contacts to EASA, Eurocontrol, ASD, … underway

www.erea.org

Start in 2014 / 2015

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TSE 2 on the vehicle

- The quiet operating air transport vehicles
  - Serviceable from smaller airfields
  - Make use of ultra-quiet engines
  - Use flow control e.g. for maximum lift on short runways
  - Reduce all 3 kinds of noise: source noise, trajectory noise, configuration noise, plus research on noise perception
- Also includes research on the impact of air vehicles by addressing the whole product life cycle
- Addresses the Flightpath 2050 goals on industrial leadership and competitiveness in the long term
- Could serve as a baseline for the next short range aircraft

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TSE 3 on the system

- Address the whole air transport system ATS
- Special focus on the insertion of UAVs in the civil ATS
  - Probably for air cargo as a start.
- Prepare a toolset for different UAS, including night operations e.g. by electrical UAS, etc., in order to provide the vision of a complete 24/7 ATS
- Enable European industry to serve the world market with appropriate products and service

10

TSE 4 on energy

- Addresses the energy system on-board and on-ground
- Innovative propulsion research
- Development of different energy sources:
  - Batteries
  - Fuel cells
  - Enhanced turbines driving electrical engines, etc.
- Look at the complete balance
  - Needs on ground, i.e. at the airport
  - Energy supply
- Use of alternative fuels
  - Including production processes, certification, etc.
- Setting standards according to FP2050
  - On fuels
  - On impact / emissions
  - On logistics

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Support projects
SP 1 & SP 2: TSE Input; SP 3: TSE Output

- **SP 1 – Ground interfaces**
  - Adressing the 4 hour door-to-door goal from Flightpath 2050
  - Fast loading/unloading; turnaround time at the airport,
  - Adaptations in landside and airside of airport processes
  - Provide ideas, solutions and simulations on the interface to the other modes.
- **SP 2 – The value of speed**
  - Incl. supersonic transport
  - Knowledge gained from supersonic research to be transferred into high-tech projects in aerodynamics, propulsion, materials, light weight structures etc.
- **SP 3 – Special transport**
  - Search and Rescue SAR; Off-shore missions
  - Rigging of power poles
  - Pipeline inspections, etc.

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Organisational set-up

- FutureSky aims at further aligning the institutional research programmes of the national research establishments gathered in EREA.
- By further joining research efforts at a European scale, results in aviation research should be achieved that would not have been achieved by individual effort.
- REs are committed to involve third parties in the research activities of FutureSky, so that a proper technology transfer between basic knowledge to industrial application can be ensured.

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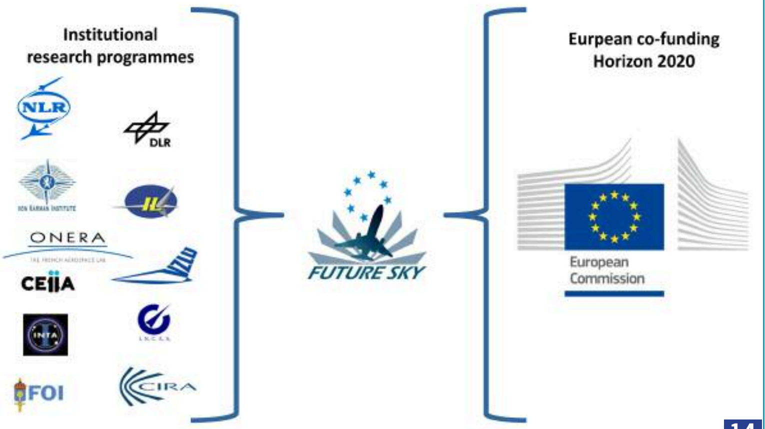
Funding mechanism



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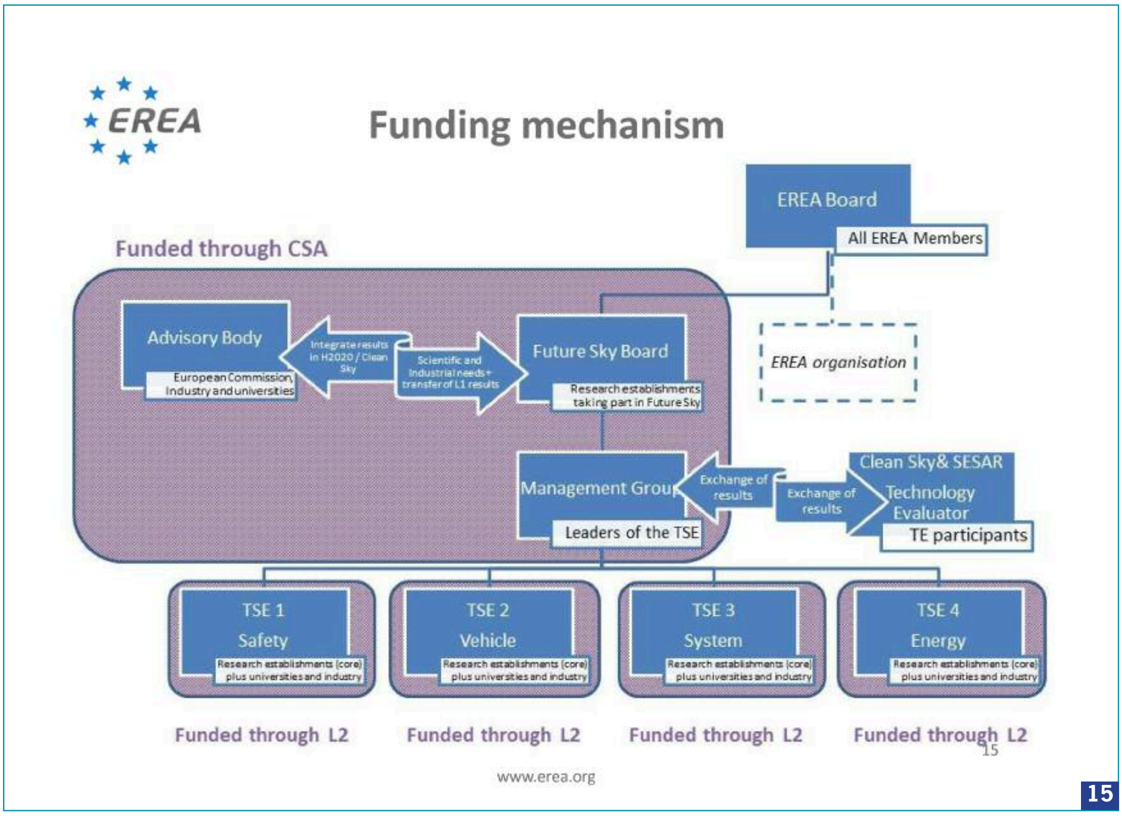

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EREA

Involving Universities and Industry

- **In the FutureSky Advisory Board**
  - University representatives
    - Bring and share fundamental existing knowledge in order to build well addressed and well-structured TSE
  - Industrial representatives
    - Share long term visions and needs in order to better address the scientific steps and tools to be developed in Future Sky (incl. airports, ANSP, ...)
- **In the TSE**
  - Parties interested and committed to the long term objectives of the programme can express their interest in teaming up and forming a consortium
- **Role of EASA, Eurocontrol t.b.d.**

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EREA

Role of the European Commission

- Involved in set-up and operation of FutureSky
- Representative from DG RTD and DG MOVE in Advisory Body
- A project officer from the European Commission will be taken on-board in all the co-funded activities
- TSE based on Commission's work programme
- Commission evaluates the quality of the proposed TSE
- Outcomes of FutureSky could be input for next work programmes

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EREA Association of European Research Establishments in Aeronautics

FUTURE SKY

www.erea.org
contact@erea.org

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GARTEUR SESSION AT CEAS 2013

A special session at CEAS 2013 was devoted to GARTEUR (Group for Aeronautical Research and Technology in EURope). GARTEUR was formed in 1973 and is based on a government-to-government agreement (MoU) between seven European nations with major research and test capabilities in aeronautics.

The GARTEUR session was chaired by Anders Blom, Swedish Defence Research Agency (FOI), member of GARTEUR Council, and all presentations were given by Swedish members of the various GARTEUR groups. In his introduction he noted that France is the GARTEUR chair country for 2013-2014 succeeding Sweden.

Björn Jonsson, Swedish Defence Materiel Administration (FMV) Sweden, member of GARTEUR Council and Executive Committee, gave an overview presentation of the GARTEUR organization, its operational principles and technical activities over the past decades. He also noted that the French chairmanship will focus on two dual use areas: Aviation Security and RPAS (Remotely Piloted Air Systems) with the aim to initiate new collaborative activities in these areas. His presentation is summarized in the following points:

GARTEUR has actively pursued European collaboration in aeronautics R&T for more than 35 years, covering both military and civil aeronautics R&T
Over the years more than 120 collaboration projects (Action Groups) have been performed resulting in more than 170 technical reports. GARTEUR Open Technical Reports are made available on the website.
GARTEUR is a unique forum of aeronautical experts from Industry, Research Establishments and Academia.
GARTEUR is the only framework in Europe for both civil and military Research & Technology for Aeronautics.
A main GARTEUR asset is its unique mechanism for cooperation which provides a straightforward way to increase collaboration on dual use projects. Through the GARTEUR mechanism, both industrial and governmental partners with either civil or military funding can easily work together.
The research activities are well coordinated with the EU and NATO/STO aeronautical research programmes. There are several examples where GARTEUR-ideas have lead to EU-funded projects and also that EU-projects have been followed up by complementing GARTEUR projects.
The GARTEUR technical activities are performed under The Groups of Responsibles (GoR), which are the scientific management bodies and think-tank of GARTEUR, composed of representatives from government departments, research establishments and industry. The activities of these four groups were presented as follows.

GoR - Aerodynamics

Torsten Berglind of FOI Sweden (present chair of GoR Aerodynamics) presented the technical activities of this group with a number of examples. GoR-AD initiates and organizes basic and applied research in aerodynamics, often coupled to other disciplines. Recent and on-going research activities have been and are devoted to:

- Aerodynamics
- Aerothermodynamics
- Aeroacoustics
- Aeroelasticity
- Aerodynamic shape optimization

Example project: AD/AG-46 Highly Integrated Subsonic Air Intakes

Example project: HC/AG-17 Helicopter Rotor Wakes in Presence of Ground Obstacles

- Aerodynamics coupled to Flight Mechanics
- Aerodynamics Systems Integration

The trend towards more multi-disciplinary analysis, emerging from industrial requirements, will increase in the future.

GoR - Structures and Materials

Joachim Schön of FOI Sweden (member of GoR Structures and Materials) presented the technical activities of this group. The activities cover:

- Structures
- Structural dynamics
- Design
- Loads
- Materials
- Computational modelling

Structures research is devoted to computational mechanics, loads & design methodology. Structural dynamics research involves vibrations, responses to shock and transient loads, aero-elasticity and acoustic response. Materials research is related to materials systems including aspects of polymers, metals and composite systems

GoR - Flight Mechanics, Systems and Integration

As the Swedish member of this group could not be present, the session chair Anders Blom presented the activities. The GoR-FM is active in the field of air vehicle systems technology in general, including, but not limited to:

- Safety
- Avionics systems
- Certification
- Multidisciplinary design aspects
- Performance and stability & control

Beyond flight mechanics, the GoR-FM is responsible for subjects concerning flight guidance, air traffic control, sensor technology and systems, human factors and related matters, with reference to both manned and manned aircraft.

GoR – Helicopters

The activities of this GoR were covered in the overview presentation by Björn Jonsson as no representative of this group was present. The GoR-HC initiates, organizes, executes, and monitors basic and applied, computational and experimental aeronautics-oriented research in the following areas and in the context of application to rotorcraft (helicopters and tilt rotor aircraft) vehicle and systems technology:

- Extension of flight envelope / performance
- Safety / survivability
- Environment / public acceptance
- Passenger comfort
- Cost / affordability / time-to-market

In his concluding remarks the session chair Anders Blom pointed out that more information is available on the GARTEUR website www.garteur.org where also open technical reports have been made available.

■

YEAR 2014

28- 30 January	• **3AF** – OPTRO 2014 – Optronics in Defence and Security - Paris • OCDE 2, rue André Pascal – Paris (16e) – www.optro2014.com
05-07 February	• **3AF/SEE/SIA** – ERTS² 2014 – Embedded Real Time Software and Systems - Toulouse (France) – Pierre Baudis Centre – http://www.erts2014.org
04-06 March	• **ATM World Congress** – World ATM Congress 2014 – Madrid (Spain) – IFEMA Feria de Madrid – Partnership CANSO-ATCA - http://www.worldatmcongress.org/
12-14 March	• **3AF/CEAS** – Greener Aviation – Conference – Brussels (Belgium) – Square Meeting Centre Mont des Arts – http://www.greener-aviation2014.com
13-17 April	• **ESA** – ESPC 2014 – 10th European Space Power Conference – Noordwijkerhout (NL) – NH Conference Centre – www.congrexprojects.com/2014-events/14a05
29-30 April	• **ATAG (Air Transport Action Group)** – ATAG Aviation & environment summit – Geneva (Switzerland) – President Wilson Hotel – http://www.envirosummit.aero/
05-07 May	• **ESA** – IWGGMS – 10 – Workshop on Greenhouse Gas Measurements from Space – Noordwijk (NL) – ESA/ESTEC – www.congrexprojects.com/2014-events/14c02/
19-22 May	• **3AF + ESA/CNES/DLR** – Space Propulsion 2014 – Cologne (Germany) – Maritim Hotel köln www.propulsion2014.com
20-22 May	• **ESA** – Sentinel – 2 Workshop – Frascati (Italy) – ESA/ESRIN http://www.seom.esa.int/S2forscience2014
20-22 May	• **ESA** – 5th EMPPS Workshop – Electronic Materials, Processes and Packaging for Space – Noordwijk (NL) – ESA/ESTEC – www.congrexprojects.com/2014-events/14c06/
20-22 May	• **EBAA/NBAA** – EBACE 2014 – 14th Annual European Business Aviation Convention & Exhibition – Geneva (Switzerland) – Palexpo and geneva International Airport – www.ebace.aero/2014/
20-25 May	• **BDLI/Messe Berlin** – ILA Berlin 2014 – Air Show – Berlin (Germany) - Berlin Expo Centre Airport http://www.ila-berlin.de/
26-30 May	• **ESA** – 4S Symposium 2014 – Small Satellites Systems Symposium – Porto Petro, Mallorca (Spain) – Conference Centre – http://www.congrexprojects.com/2014
02-06 June	• **ESA** – GNC 2014 – 9th ESA International Conference on Guidance, Navigation and Control Systems – Porto (Portugal)- Congress Centre – http://www.congrexprojects.com/14a01
04-05 June	• **RAeS** – Flight Simulator Conference – London (UK) – RAeS/HQ – www.aerosociety.com/events
10-11 June	• **SAE Int** – SAE 2014 Design Manufacturing Economics Composites – Madrid (Spain) – NH Parque Avenidas – www.sae.org/events/dtmc/

10-13 June • **ESA** – 9th ESA Roundtable on Micro Nano Technologies (MNT) – Lausanne (Switzerland) – Swiss Tech Convention Centre – http://www.congrexprojects.com/14c03

16-18 June • **ACI Europe/Fraport AG** – ACI Europe General Assembly 2014 – Frankfurt Airport (Germany) www.aci-europe-events.com/

16-20 June • **AIAA/CEAS** – 20th AIAA/CEAS Aeroacoustics Conference – Part of AIAA Aviation Conference 2014 – Atlanta (Georgia), USA. Hyatt Regency Atlanta – http://www.aiaa.org/events

16-20 June • – **AIAA/CEAS** – 20th AIAA/CEAS Aeroacoustics Conference – Part of AIAA Aviation Conference 2014 – Atlanta (Georgia), USA. Hyatt Regency Atlanta – http://www.aiaa.org/events

16-20 June • – **AIAA/3AF** –ANERS 2014 – Aircraft Noise and Emissions Reduction Symposium – Part of AAC 2014 – Atlanta (Georgia), USA – Hyatt regency Atlanta – http://www.aiaa.org/events

17-20 June • **3AF** – MD10 – International Conference: Missile Defence, Challenges in Europe – Mainz (Germany) – Rheingoldsalle Conference Centre – www.3af.fr – lisa.gabaldi@aaaf.asso.fr

19-21 June • **EHS** – EHS 2014 – Hradec Kralové LKHK (Czech Republic) – Airport – www.eurohelishow.com/

14-20 July • **Farnborough International ltd** – Farnborough 2014 – http://www.farnborough.com/

22-24 July • **RAeS** – Applied Aerodynamics Conference 2014 – Bristol (UK) – University Bristol Queen's Building www.aerosociety.com/events

02-05 September • **ERF/CEAS/RAeS** – 40th European Rotorcraft Forum 2014 – Southampton (UK) – Grand Harbour Hotel www.erf2014.com

07-12 September • **ICAS** – 29th Congress of the International Council of Aeronautical Sciences – St-Petersburg (Russia) – Hotel Park Inn by Radisson Pribalt. – Hosted by TsAGI – www.icas2014.com/

07-09 October • **RAeS** – 4th Aircraft Structural Design Conference – Belfast (UK) – Queen's University Belfast – www.aerosociety.com/events

THE CEAS/ASD AEROSPACE EVENTS CALENDAR

The CEAS and ASD have created an innovative tool so-called "CPMIS" (Conference Programming Management Information System), the aim of which is to facilitate the search of the different aerospace events in the world that are programmed at short and mid-term time horizon, and so allowing to optimise the scheduling of future events by avoiding possible overlapping and redundancies, but on the contrary to encourage co-operations and synergies between the actors concerned. Its role is therefore double: information on the one hand, conference programming enabler on the other.
THE ADDRESS IS: http://www.aerospace-events.eu

A search engine selects the events according to specific topics and key words. A graphic display (day, week and months view) eases the access and the view.

- 4 TYPES: Conference, Workshop, Lecture, Air Show
- 6 MAIN CATEGORIES: Aeronautical sciences - Aerospace (for events including all aspects of aviation and space) – Civil Aviation – Air power – Space – Students and Young Professionals.
- 64 SUB – CATEGORIES: aeroacoustics – aeroelasticity – aerodynamics, etc.

AUTOMATIC INSERTION OF NEW EVENTS BY THE ORGANISERS THEMSELVES:

- Go to http://www.aerospace-events.eu
- Click on the "introduction" text
- Redirected on the New Event Form, you have to click on this form and to enter your event related information, validate, click on Save and send.

CONTACTS:

postmaster@aerospace-events.eu is the general address for any question and requests;

– Marc de Champs, responsible for the CPMIS computerized tool management at ASD (AeroSpace and Defence industry associations of Europe): marc.dechamps@asd.europe.org
– Jean-Pierre Sanfourche, CEAS, responsible for the Events Calendar permanent updating and validation: jpsanfourche@dbmail.com