EUROPE'S RESEARCH TACKLES THE GLOBAL CHALLENGES TO AERONAUTICS

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Abstract

Aeronautics and air transport face global challenges, which include increasing environmental concerns, rising air space capacity needs and a global industrial competition. Joint efforts on the European level have the goal to tackle those challenges and to prepare the future perspectives of this for Europe important industry sector. The main goals are presented and typical examples of research measures on European level are given.

1. Introduction

In 2004 the Heads of State of the Member States of the European Union agreed in Lisbon to enhance research and techno-logical development (RTD) in Europe, as RTD is a motor for economic perspective within the increasing globalization of many industrial sectors. The EU Research Framework Programme is the successful joint effort to address future technology needs in Europe. Aeronautics with its high investment in RTD and its strategic importance as a high-tech sector is an important part of those activities.

2. Global Challenges and Needs to Tackle them as of Today

A crude oil price of more than 140 US$ per barrel with little hope of a reduction in price, rising prices for key materials such as steel, titanium, copper and others, food price at record level show that the global resources are not available indefinitely. Global warming and melting ice at the pole areas indicate a climate change that represents a challenge to the entire mankind. There is a global need to tackle those challenges by more efficient use of energy and resources. This requires new technologies and methods and includes the in detail knowledge of processes and their simulation.

2. The Challenges to Aeronautics

World-wide aeronautics and air transport had a significant growth rate in the past despite political and energy crises and the predicted growth rate is believed not to diminish (Fig.1). Today air transport is estimated to contribute about 2 – 3 % of the global greenhouse gases but with an increasing tendency due to its growth rate, which was 36% in the last five years.

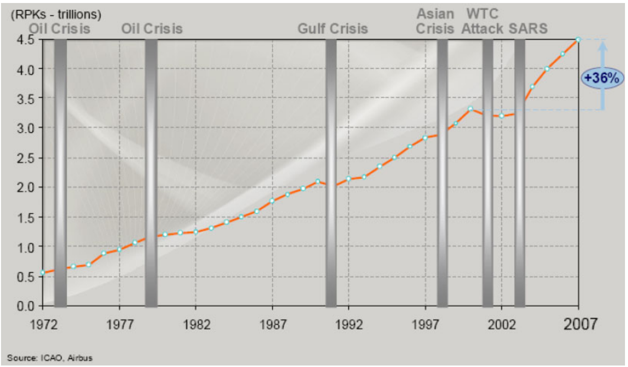

Fig. 1: Development of World Air Transport in the last 35 years (Source: ICAO, Airbus)

By comparing the efforts in CO² reduction of the different transport modes one can observe that from 1990 to 2000 aeronautics made by far the biggest progress, but in comparison with other vehicles used for public transport as railways or busses the production of CO² is still twice as high per passenger-kilometre (Fig. 2). Here a huge effort is needed for further reduction of the fuel consumption, in particular in the view of the high energy prices.

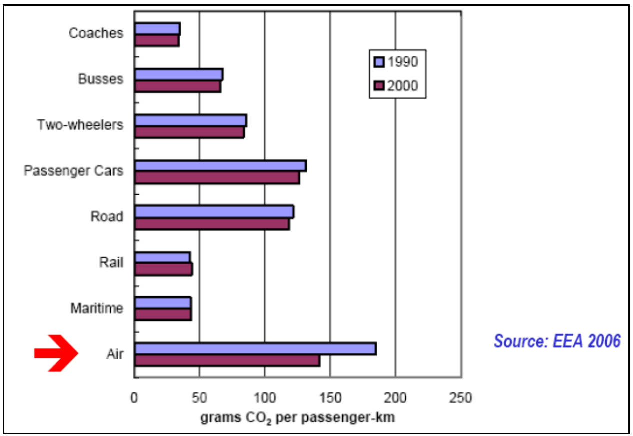

Fig. 2: Comparison of different transport modes related toCO^2 emission per passenger-km (seat-miles)

4. The RTD Policy of Europe

In several high-level meetings the European Union has confirmed that sustainable economic growth requires massive investment in Research and Technological Development (RTD). The EU goal is achieving a similar percentage of R&D effort by 2010 as the big economies USA and Japan that means spending of about 3% of the GDP for R&D. The government of raising economies such as China and Russia also invest massively in RTD.

In Europe the efforts are undertaken on EU level but also on national, regional and private level, creating jointly the European Research Area as a part of the more and more integrating economies. This all happens in the view of an increasing globalisation of the economy; In consequence Europe's RTD policy is open towards international collaboration, demonstrated in the international Fusion project ITER or the 7th Research Framework Programme of the European Union. Not to forget the International Space Station ISS, where the European Space Agency collaborates with the USA, Russia and Japan.

5. The Opportunities of the 7th Framework Programme

In 2007 the EU launched the 7th Research Framework Programme (FP7) as the largest international research collaboration that ever was established: this research initiative of more than 50 Billion Euro for the years 2007 - 2013 is financed by the European Union of the 27 Member States and by eight associated countries (Fig. 3). That means industry and research institutes of 35 countries have an equal access rights to the activities of FP7.

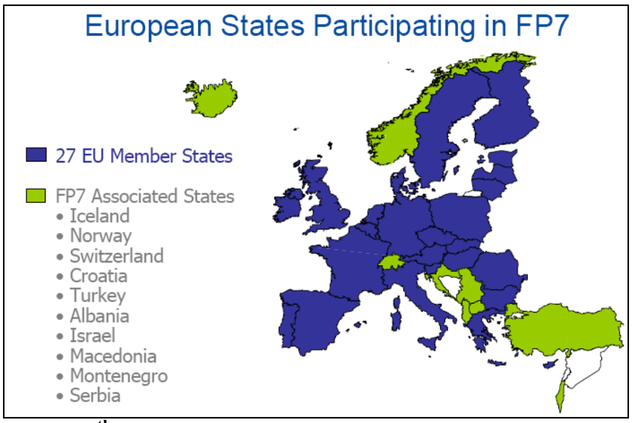

Fig. 3: 7th Research Framework Programme of the EU - 27 Member States of the EU and 8 associated countries contribute to it

FP7 offers not only the large Thematic Programmes for collaborative research in all important areas such as Energy, Environment or Transport (incl. Aeronautics). It has four major programme lines that are explained in the following chapters. Fig. 4 below shows the budget breakdown of FP7.

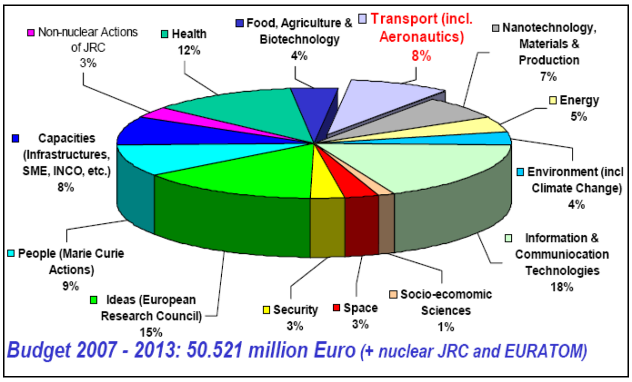

Fig. 4: Budget breakdown of the 7th Research Framework Programme (2007 – 2013)

5.1 'Cooperation' - Collaborative Research for European Excellence

The specific programmes on 'Cooperation' supports all types of research activities carried out by industry and research communities in trans-national cooperation and aims to gain or consolidate leadership in key scientific and technology areas.

FP7 allocates the largest amount of more than 32 billion Euro to the Cooperation programme. The budget will be devoted to supporting cooperation between universities, industry, research centres and public authorities throughout the EU and beyond.

The Cooperation programme comprises ten identified thematic programmes addressing the most important fields of knowledge and technology, where research excellence is particularly important to improve Europe's ability to address its social, economic, public health, environmental and industrial challenges of the future. Many of them tackle technologies that are addressed by this conference. In particular the activities of:

- Biotechnology
- Information & communication technologies
- Nano-sciences, nanotechnologies, materials & new production technologies
- Energy
- Environment (including Climate Change)
- Transport (including Aeronautics)
- Space
- Security

The calls for proposals of 2007 and 2008 took already place in most programmes, but more calls will come for the years 2009 to 2013.

5.2 'Ideas' – The European Research Council

Investigator-driven 'frontier research', within the framework of activities commonly understood as 'basic research', is a key driver of wealth and social progress in modern societies. This upstream research opens new opportunities for scientific and technological advances, and it is instrumental in producing new knowledge leading to future applications and markets.

The objective of the new European Research Council (ERC) is for Specific Programme 'Ideas' to reinforce excellence, dynamism and creativity in European research and improve the attractiveness of Europe for the best researchers from both European and third countries, as well as for industrial research investment, by providing a Europe-wide competitive funding structure.

5.3 'People' - The Mobility Programme

In previous Framework Programmes the 'Training & Mobility' activities – better known as the Marie-Curie-Programme – were very successful in stimulating the international exchange of Europe's young researchers.

In FP7 the 'Marie Curie Actions' have been reinforced in the 'People' Specific Programme. Entirely dedicated to human resources in research, this Specific Programme has a significant overall budget of more than 4,7 billion Euro over a seven year period, which represents a 50% average annual increase over FP6.

Highly trained qualified researchers are a necessary condition to advance science and to underpin innovation, but also an important factor to attract and sustain investments in research by public and private entities. Against the background of growing competition at world level, the development of an open European labour market for researchers free from all forms of discrimination and the diversification of skills and career paths of researchers are crucial to support a beneficial circulation of researchers and their knowledge, both within Europe and in a global setting.

Special measures to encourage young researchers and support early stages of scientific career, as well as measures to reduce the 'brain drain', such as reintegration grants, will be introduced.

It has clearly an additional stimulating effect for young researchers to learn international collaboration as early as possible. In the view of the intensive world-wide collaboration in the Aerospace sector, this is a must for the young research fellows.

5.4 'Capacities' - Research and Innovation Capacities for Europe

The FP7 Capacities programme aims to enhance research and innovation capacities throughout Europe and ensure their optimal use. It has a budget of about four billion Euro to operate amongst others mainly the areas of research infrastructures and research for the benefit of Small and Medium Enterprises (SMEs), which are important contributors to Europe's economy.

The overall objective of the 'Research infrastructures' part of the FP7 Capacities programme is to optimise the use and development of the best research infrastructures existing in Europe. Furthermore, it aims to help to create new research infrastructures of pan-European interest in all fields of science and technology. This includes aeronautics wind tunnel of strategic importance.

5.5 International Collaboration

It is Europe's policy to be in research and technology acquisition as open as possible. Therefore International Cooperation is a key issue of FP7. International research partners from all over the World can participate in projects and RTD activities of FP7. Participants from International Partner Collaboration Countries (IPCC) normally can receive the public co-financing from FP7. Only those from the high income industrial states such as Australia, Canada, Japan or the USA get normally the public co-funding from their national government. Even special research actions with individual countries and FP7 are possible.

6. Aeronautics Tackles the Future

At the end of my keynote address I would like to illustrate the approach of the EU by the example of Aeronautics research, which is in my responsibility.

In 2000 a panel of high-level personalities of Aeronautics developed a *'Vision for 2020'* [1] with challenging goals such as

- The reduction of aircraft CO^2 emissions per passenger kilometre by 50%,
- The reduction of perceived noise by 20 decibel,
- The reduction of aircraft NOx emissions by 80%,
- Enhancing the safety in aviation by the factor of five.

For the implementation of these goals the advisory council ACARE involving all aeronautics stakeholders created the *Strategic Research Agenda for Aeronautics* [2]. It became the baseline not only for the Aeronautics Research in the Framework Programme but also for activities on national level and within industry and research community.

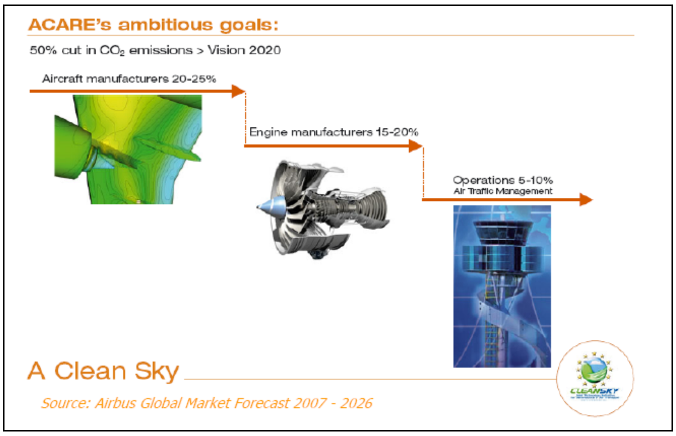

Fig. 5: Potential for CO^2 emission reduction in Aeronautics

If one takes the most ambitious goal of reducing the fuel burn per passenger-kilometre, only the combined efforts for advanced technologies of aerodynamics and flow control, light-weight structures and reduced specific fuel consumption of the engines can achieve the ambitious 50% reduction target. About half of it can be achieved by the aircraft manufacturers e.g. by using advanced composite lightweight structures, improved aerodynamics by technologies as laminar flow control, which has a potential of about 10% drag reduction.

The engine industry can achieve up to 20% mainly by an improved thermal efficiency, new materials and a higher by-pass ratio.

A more optimised Air Traffic Management system can reduce the trip fuel by up to 10% according to an estimate of EUROCONTROL.

The complex and multi-disciplinary approaches of all three sectors require future simulation capabilities through high-level computational methods.

Because of the high complexity and the enormous effort needed, a new public private partnership was launched this year within FP7, the Joint Technology Initiative (JTI) 'Clean Sky', where all aeronautics key players of Europe aim jointly to tackle the most critical technology up to the validation on system level. The JTI 'Clean Sky' addresses all important aeronautics technology areas through its seven Integrated Technology Demonstrators (ITD).

The planned Technology Evaluator has finally to assess the achievements of the ITD and their contributions to the goals of the 'Vision for 2020'. For this a large scale simulation platform of the aircraft and the air transport system challenging high-performance computer based numerical methods will be needed.

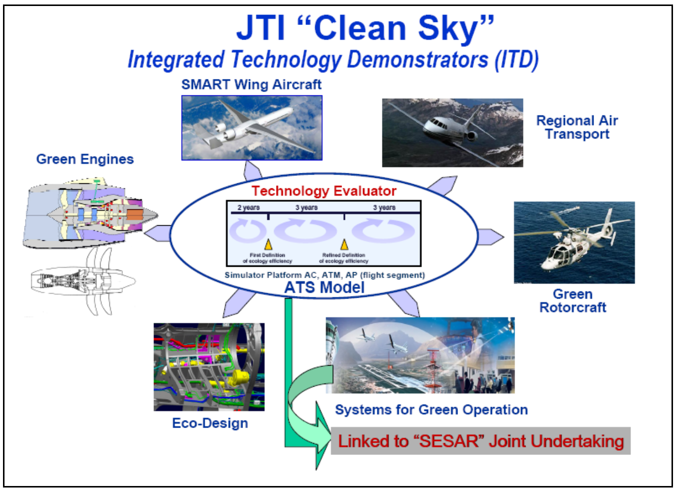

Fig. 4: The Joint Technology Initiative "Clean Sky" and its Integrated Technology Demonstrators

The air traffic management (ATM) related research will be tackled by the *Joint Undertaking SESAR (Single European Sky ATM Research)*, which is co-financed by the European Commission, EUROCONTROL and industry within Europe's *Single European Sky* initiative.

In the following some examples of European research with successful achievements are given for some key technology areas.

Although the aircraft industry uses large primary composite structures since the eighties, in Europe large scale collaborative projects address the optimization of materials properties, manufacturing methods and life cycle costs since about ten years. Fig. 5 shows the synergy of complementary projects, which involve the industrial supply chain as well as the research community of Europe. The FP7 project MAAXIMUS will aim for the 3rd generation of high-fidelity simulation tools for a fast production of large scale primary composite airframe structures. It relies on the results of previous projects from FP5 and FP6.

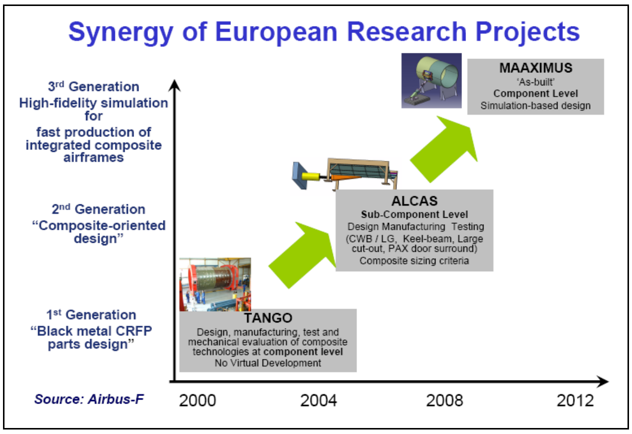

Fig. 5: Synergy of European research projects in the field of large primary composite structures

A summary of the projects funded by FP6 are published in [3].

The increasing air traffic density at all major airports, in Europe and world-wide, requires a significant noise reduction of future generation of civil aircraft. EU projects address the advanced technologies for the reduction of engine and airframe noise. Amongst others the Airbus A340 SN001 was used for full scale technology validation successfully in the SILENCE(R) project. It contributes to achieving the goals of the *Vision for 2020* for noise reduction.

Fig. 6: The SILENCER project used the A340 SN 001 for airframe noise reduction research (Source: SILENCE(R)/ SNECMA)

7. Summary and Conclusions

Through FP7 and its four main thematic areas the EU has established the world-wide largest international research collaboration that addresses all necessary technology areas, which are needed to tackle the global challenges and to ensure its society's needs and competitiveness of its industry on a global market. It is open to world-wide partnerships and collaborations. Advances in computational methods will be needed to tackle the challenges. FP7 offers opportunities for progress in many of its thematic programmes.

How successful the Research Framework Programme of the EU is, can be seen by the fact that often five to ten times more proposals for research projects are submitted than EU funding is available.

In Aeronautics the Framework Programme activities contribute significantly to the implementation of the goals of the 'Vision for 2020'.

References

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[2] Advisory Council for Aeronautics Research in Europe (ACARE), *Strategic Research Agenda (2nd issue)*, 2004

[3] European Commission (Editor) *Aeronautics Research 2003 – 2006 Projects* (Vol.1 and Vol. 2), 2006 and 2008

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