

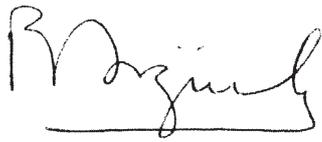
EUROPEAN AERONAUTICS: A VISION FOR 2020

Meeting society's
needs and winning
global leadership

REPORT OF THE GROUP OF PERSONALITIES

JANUARY 2001

Group of Personalities



Pedro Argüelles



John Lumsden



Manfred Bischoff



Denis Ranque



Philippe Busquin



Søren Rasmussen



B.A.C. Droste



Paul Reutlinger



Sir Richard Evans



Sir Ralph Robins



Walter Kröll



Helena Terho



Jean-Luc Lagardère



Arne Wittlöv



Alberto Lina

A Vision for 2020

Aircraft and an air transport system that are responding to society's needs, despite a three-fold increase in air transport

- | Because aircraft are cleaner, safer and quieter, can fly, land and taxi in all weather conditions and air traffic is very efficiently managed
- | Thanks to the efforts of all stakeholders
- | A world-class European aeronautics industry leads in global markets for aircraft, engines and equipment

EUROPEAN AERONAUTICS: A VISION FOR 2020

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Foreword by Philippe Busquin, European Commissioner for Research

It is my pleasure to present what I believe is a landmark report in the history of Europe's aeronautics. I hope it will be read not only by the industry's stakeholders and by policy-makers in European and national institutions, but also by a broader public in whose lives air transport now plays such an important part.

In forming the Group of Personalities, I gave them a deceptively simple task: to produce, in the context of implementing the European Research Area, a vision for aeronautics in the year 2020. This is not a distant deadline but a sensible reflection of the lead times in the research, development and manufacturing of many of the industry's products and services. It seemed to me that only such a unique grouping could identify a formula for transforming the sector from a follower into a global leader over this period.

The industry must rise to this challenge and confront the competitive pressures imposed on it both by the rapid development of globalisation and environmental needs. Since this process is also fuelling such a strong growth in passenger demand that air traffic will triple over the next 20 years, the Group's vision has had to encompass the air transport system and not just the manufacture of aircraft and equipment.

That is why its members are drawn from the airport and airline sectors, regulators and air traffic managers as well as from airframe, engine and equipment manufacturers. The results of their work have more than satisfied my request for a thoughtful analysis of how a reorganisation of our research and development efforts could both better serve society's needs and also strengthen a quest for global leadership. The way we do things

at the moment, at both national and European levels, has failed to keep pace with changes in the industry's own structures.

An inclusive vision is precisely what Europe needs in order to arrive at a safe, efficient and environmentally-friendly air transport system that will strengthen the competitiveness of its increasingly integrated economy. It will help to deliver European excellence with a global dimension because that is what the market now requires.

The vision set down in the following pages is imaginative and ambitious without ever straying into science fantasy. Crucially, it calls for a more strategic approach to the identification of research priorities and new mechanisms for forging a consensus among stakeholders in pursuit of these priorities. It also proposes the launch of new forms of cross-border collaboration in the application of research, with additional financial support from the European Union.

European Aeronautics: A Vision for 2020 provides rich material for a great debate on precisely how the European dimension can generate more efficient and effective research for a sector that is crucial for the continent's economic future. The Commission will lead that debate and in a short time draw the appropriate conclusions. Then it will be time for the Union and its Member States to join aeronautics stakeholders in a new partnership dedicated to capturing the vision described in this report.

Finally, I would like to thank all members of the Group for the time and attention they have devoted to this exercise and their commitment to see its conclusions implemented.

A unique grouping to chart a path from follower to global leader

An inclusive vision to deliver European excellence with a global dimension

Rich material for a great debate on generating efficient and effective research



Air Transport and Aeronautics: Key Assets for the Future of Europe

Aviation has delivered immense social and economic benefits to mankind

An outstanding contribution

History does not lack for examples of giant leaps forward in science and technology that subsequently transform human experience and possibilities. But few have touched more lives than the invention of the aeroplane at the beginning of the last century. It has shrunk the planet, destroyed distance and vastly expanded human mobility. The resulting economic and social benefits have been immense.

Europe can win two great prizes: global leadership and a world class air transport system

Conquest of the skies has liberated us from the bonds imposed by geography, terrain and water. Air routes are the highways of the global economy, transporting people and goods over vast distances at great speed. Aviation has massively multiplied and facilitated business and leisure opportunities, cultural exchanges and the development of international institutions and political relationships. Very few other developments have made such an outstanding contribution to the development of mankind over the last 100 years.

Europe must “go for it”

The rapid journey from the first tentative flights to the modern airliner is a testament to the restless search for technological improvement that has long characterised the aircraft business. Many aspects of technological evolution are shaped by a combination of changing social needs and competitive market forces. Today, these forces are still generating relentless pressures for change in the air transport system.

This report is an attempt to demonstrate that Europe can continue to meet the challenge of change by mobilising all of those interests and actors – nowadays known as “stakeholders” – behind the task of producing the competitive products and the air

transport system that will be needed in the first decades of this new century.

There are two great prizes: global leadership in the marketplace and a world class air transport system for Europe. Europe must go for them or its achievements of the last 30 years will be in jeopardy. Its air transport system has become an indispensable part of the continent’s economic infrastructure. Turnover in the aeronautics sector exceeded €65 billion in 1999 and its balance of trade surplus – the difference between the products it sells to the world and the equivalents that are imported – was €22 billion.

Though it is currently struggling to keep pace with the phenomenal increase in mobility and demand, Europe’s air transport system is providing safe, reliable air travel that is essential to the requirements of millions of people. It also guarantees them a choice. Without European aeronautics, air travel over medium and long-haul routes would be almost completely dominated by US aircraft.

Conscious of its responsibilities to society at large, the sector is well aware that it has to find an acceptable balance between public expectations and requirements, and the constant, fierce competitive pressures upon it. A generation ago, “Higher, Further, Faster” were the imperatives for any vision of the future for air transport. Now they are “More Affordable, Safer, Cleaner and Quieter”, reflecting the need to combine cost-effectiveness with an uncompromising attachment to safety and environmental objectives. The key to securing these objectives is investment in Research and Technology¹ according to a strategy that can meet the demands of the market as well as the needs of the community.

“More Affordable, Safer, Cleaner, and Quieter” are the imperatives driving R&T

⁽¹⁾ Throughout this report “Research and Technology” (R&T) refers to developing new technologies while “Research and Development”(R&D) includes also the effort for the development of new products.



Pioneering the “knowledge society”

Aeronautics is a key asset for the future of Europe. Its direct contribution to economic prosperity is a measure of its success in pioneering the “knowledge society” that the European Union is now urgently seeking to achieve². As users, developers and suppliers of advanced innovative technologies, aeronautics companies know the value and importance of continuously developing human skills.

Many of the 400,000 people directly employed in the industry are highly skilled “knowledge” workers, well practised in the use and exploitation of advanced technologies, including the new digital information technologies. Others push forward the technological frontiers in research laboratories, developing the knowledge that is crucial for keeping the industry’s firm grip on world markets. Many of the fruits of their research also find applications in markets quite distant from aeronautics that need the technologies but lack the resources to develop them. A great deal of the research work is done in teams, by people whose different national and cultural backgrounds are a reminder of the talent that Europe can mobilise.

Aeronautics is a particularly high-tech business working on long lead times and requiring huge capital sums

(2) At its meeting in Lisbon in March 2000 the European Council set the strategic goal for the EU “to become the most competitive and dynamic knowledge-based economy in the world”.

European
aeronautics
has built
a global position
with much less
financial support

Today's strength was built on earlier strategies

Aeronautics is a very unusual business requiring specific rules: it works on very long lead times and requires huge capital sums for developing its products. Governments are important sources of research funds and exercise unusual influence over priorities for civil and military products, while manufacture of its largest and most costly items, aircraft and their engines, is concentrated in a few very large companies.

The European sector invests 15% of its turnover in R&D (more than €9 billion a year) and has built a global position on much less public financial support than is enjoyed by its main rivals. The seeds of its current strength were sown in the 1960s. They were not scattered randomly, but planted according to strategies for achieving competitive products for civil and military aircraft markets into the 21st century.

The benefits are now being harvested. Airbus is one of the world's two dominant civil aircraft producers. Its share of the market grew steadily throughout the 1980s and its share of world order books is now around 50%, even though more than 85% of the world's passenger aircraft have been built in the US. In the civil helicopter market, EU-designed and originated helicopters now hold around 32% of the world market, while European manufacturers of regional jet and turboprop aircraft have had more than 60% share of these markets over the past 10 years.

Comparison of market shares in civil aero engines is difficult because of the intensity of cooperation between European and

foreign firms. But there are striking differences in size between firms: the two largest US producers make twice the revenues of their European counterparts.

For its part, the equipment sector has been able to maintain a leading role in most areas and continues to be competitive against much larger foreign rivals. Little known outside the industry, for example, is the fact that the vital "Primary Flight Control" systems on the latest aircraft from both Boeing and Airbus were developed and are produced in Europe.

Partnerships and consolidation are more essential than ever

But new product development is enormously expensive and for many years the costs of developing and producing a family of new civil airliners have been progressively beyond the reach of one company, and of the budgets of most single nations. So companies inside and outside Europe have had to seek partnerships. The most celebrated in the airframe sector is the European Airbus consortium set up in 1969. Alliances, many of them transatlantic, also characterise relations between engine and equipment manufacturers.

All partnerships reflect the fact that aeronautics is a dynamic global business in which the drive for competitive advantage seeks out the best possible synergies, wherever they can be found. Collaboration is constrained by competitiveness rather than geography, which is why European companies need to be world class to forge the best possible partnerships.

Within the European Union, and more recently supported by it, the pieces on the



board have been energetically rearranging themselves. Collaborative networks for R&D have proliferated across borders, broader commercial relationships created and bonds established that have helped to pave the way for mergers, joint ventures and takeovers. Although restructuring of the sector in Europe has lagged behind the equivalent process in the United States, this process of consolidation is creating the platform for maintaining and enhancing its competitiveness over the next couple of decades. R&T systems need redesigning, reorganising and refitting if they are to support the vision described in the following pages.

**Within the EU
the industry is
energetically
restructuring itself**

**Vision is a strategy
for competitive
excellence and
meeting society's
needs**

This vision is broad and comprehensive, seeking to bind and coordinate the efforts of all stakeholders behind a strategy for competitive excellence dedicated to meeting society's needs. It will not be easily achieved. But if the vision can be shared and acted upon by all, the payoff is enormous: leadership in the global marketplace and a first class air transport system for Europe.



A Vision for European Aeronautics in 2020

In the next few pages, our vision offers the beginnings of a design for satisfying aeronautics primary need for world class standards of innovation and technology. It should not be read as a promise nor a prediction. We cannot know today precisely what technologies will be available to the civil aircraft of 2020 and beyond, but we do know that our competitive position will be fatally undermined unless we reach out for them.



Responding to society's needs

Air travel will not develop in a vacuum: its size, shape and success will be determined by society as a whole. Aeronautics must satisfy constantly rising demands for lower travel costs, better service quality, the very highest safety and environmental standards and an air transport system that is seamlessly integrated with other transport networks.

2020

2018 2019 2020

2019 2020

2021



Quality and Affordability

In 2020, the stressed-out passenger and the anxious freight forwarder belong to aviation past, not present. There are no more queues and interminable waiting for a delayed departure or arrival. From start to finish, the entire flying experience is designed to ensure a contented traveller and satisfied shipper. At all prices, an airline ticket buys the four Cs:

Choice

The consumer constructs his or her journey from a palette of satisfying choices. There are more routes and more flights to and from most destinations. A network of regional airports provides easier access to air travel. Flying is a much more customised experience, with on-board choice extending far beyond different price categories, hot or cold meals and a couple of movies.

Cabin facilities may cater for different needs for those who want to work, for example, or play games, access video or audio libraries, or spend most of their journey reading and sleeping.

Convenience

Once more, an airline timetable is something that can be relied upon. Departure and arrival times are dependable in all traffic densities and weathers, except the most apocalyptic. Airports are no longer a test of the traveller's stamina and patience. Thanks to electronic check-in, automated luggage-handling and advanced people-moving, passage through the buildings at both ends of the journey is steady and smooth. Nor is flying the isolating experience it used to be. All the benefits of the information society are available on demand through the system of advanced telecommunications linking the aircraft to the world below.

Comfort

People come in all shapes and sizes and so do the choices of available seats and leg room. Cabins are very much more passenger-friendly than they were 20 years ago and offer the same well air-conditioned comforts as home and office. Aircraft interiors are no more cursed by noise, vibrations and turbulence than an executive car travelling at motorway speed.

Costs

In 2020, the European airline system is operating with greater efficiency and making much better use of aircraft and flying space. In addition, European-built aircraft cost less to own, operate and maintain, savings that are passed on to paying passengers.

goals

- Punctuality: 99% of all flights arriving and departing within 15 minutes of the published timetable, in all weather conditions.
- Time spent in airports: no more than 15 minutes in the airport before departure and after arrival for short-haul flights, and 30 minutes for long haul.
- A steady and continuous fall in travel charges through substantial cuts in operating costs.
- Passenger choice: the same choice of facilities that are available on other forms of transport including leg room, flexible seating and office facilities incorporating state of the art communications. A greater choice of flights from regional locations.
- Air freight services: a larger percentage (by value) of cargo travels by air because it is more competitive with land and sea transport and it is fully integrated into a seamless intermodal freight transport system.

GOALS

Aircraft will achieve a five-fold reduction in the average accident rate of global operators.

Aircraft will drastically reduce the impact of human error.

Higher standards of training for aircraft operations and maintenance and for air traffic management.

Safety

In 2020, the skies are safer than ever before because safety has remained the top priority of the aircraft builders and operators and of air traffic managers.

Aeronautics has made huge steps towards eliminating accidents altogether by designs and automatic systems that lighten the burdens on the crew and help them make correct decisions.

Other causes of accidents are addressed by monitoring systems designed to react to technical problems immediately they occur.

GOALS

Total engagement by the industry in the task of studying and minimising the industry's impact on the global environment.

A reduction in perceived noise to one half of current average levels.

Eliminate noise nuisance outside the airport boundary by day and night by quieter aircraft, better land planning and use around airports and systematic use of noise reduction procedures.

A 50% cut in CO₂ emissions per passenger kilometre (which means a 50% cut in fuel consumption in the new aircraft of 2020) and an 80% cut in nitrogen oxide emissions.

Environment

In 2020, aircraft are cleaner and quieter and the aeronautics sector's contribution to a sustainable environment is widely understood and appreciated. Many of its products are made of recyclable materials and have minimal environmental impact. Though hydrocarbon-based fuel is still the main source of energy, the range and volume of damaging emissions has been substantially reduced.

Aircraft noise is no longer a political and social issue. It has ceased to be a nuisance to people living close to airports thanks to a concerted effort to develop quieter engines, optimise operational procedures and improve land planning and use around airports.

GOALS

An air traffic management system that can handle 16 million flights a year with 24-hour operation of airports and a more flexible and efficient use of European air space.

A seamless European Air Traffic Management system mainly based on a civil global satellite system.

Integration of air transport into an efficient multimodal transport system.

European Air Transport System

In 2020, Europe has managed to create a seamless system of air traffic management that copes with up to three times more aircraft movements than today by using airspace and airports intensively and safely. The development of sophisticated ground and satellite-based communication, navigation and surveillance systems as well as free flight has made this possible. Noise nuisance is much reduced and large airports can operate around the clock. Capable of flying safely in all weathers, aircraft are running on schedule 99% of the time.



Securing global leadership

| The World's Number 1

In 2020, European aeronautics is the world's number one. Its companies are celebrated brands, renowned for the quality of products that are winning more than 50% shares of world markets for aircraft, engines and equipment. Though coming in all sizes from multinational corporations to small and medium-sized enterprises, their position is built on formidable competitiveness in all areas, from research to design, from product development and support to manufacturing, operation and maintenance.

The front runners in the sector are highly flexible and innovative, drawing technological strength from a rich network of European and global research partnerships. They lead the world in anticipating market developments and in the speed with which they can move a product from the drawing board to delivery to the first customer.

They enjoy the considerable benefits flowing from Europe's fully integrated single market, especially the access to efficient capital markets and the ability to recruit from Europe's pool of well educated and trained professionals.

The public sector plays an invaluable role in this success story. Governments, together with the European Union, are operating joint programmes for the management of the air transport system that range from a single safety authority to a unified approach to airspace management, and a common perspective on airport planning.

Crucially, they are coordinating a highly effective European framework for research cooperation, while funding programmes that put the industry on more equal terms with its main rivals.

goals

For the European aeronautics industry

- A new framework that permits and encourages companies to work together more effectively in setting and achieving their industrial priorities. This will strengthen competitiveness and improve responses to changing market conditions.
- Achieve new standards of quality and effectiveness so that Europe has at its disposal the most competitive research system in the world.
- Make more determined efforts to match the synergies between civil and military research achieved by competitors, despite differences of political structure.
- Halve the "time to market" for new products with the help of advanced electronic analytical, design, manufacturing and maintenance tools, methods and processes.

goals

For European
Governments –
Parliament –
Union –

Adopt more flexible approaches to the industry that encourage rather than hinder its adaptation to changes in the market.

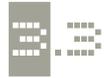
Acknowledge that the competitiveness of industry is based both on civil and defence related products and that this has to be taken into account in optimising the R&T system.

Facilitate greater integration of European, national and private research programmes so that maximum value is obtained from available funds.

Ensure that education policies are directed at supplying the engineers, scientists and other skills aeronautics badly needs.

Act rapidly to implement the European Union's economic reform agenda including adoption of measures to encourage mobility, such as cross-border portable pensions and mutual recognition of qualifications, and to promote the rapid growth of electronic networks, eCommerce and eBusiness.

Ensure closer and more effective coordination of the positions of European governments in international institutions whose work impacts the aeronautics industry, supporting the creation of level playing-fields world-wide (e.g. the International Civil Aviation Organisation, the International Telecommunications Union, the World Trade Organisation).



Establishing supportive public policy and regulation

Regulation is one of the means by which society ensures that its values and priorities are reflected in the procedures and operations of the air transport industry.

In 2020, regulatory arrangements are providing a clear and consistent regime within which aeronautics are developing and prospering. Most rules are standard around the world so that their impact does not favour one set of national interests over another.

The European Union's regulation of the sector now extends to more than 30 countries. Airlines are free to settle their own routes, capacities and fares subject to the competition rules in an enlarged internal market.

Safety is now regulated by a pan-European Aviation Safety Authority that has long since replaced the Joint Aviation Authorities (JAA). The Authority covers all aspects of the safety of civil aviation, including air traffic management, airport operations, aircraft certification and associated licensing of personnel. A high degree of global standardisation has also been achieved for safety rules.

Air Traffic Management now applies to a "single European sky" in which air space is assigned and managed as though national sovereign zones no longer existed. All European air traffic control providers, whether or not they are privatised, have reached world class standards of efficiency.



The Aircraft

In 2020, the aircraft is both the symbol and the reality of the globally competitive European aeronautics "system". It is the end product of the European way of organising and funding research and of applying its fruits. It is an expression of the depth of Europe's human talent and of the capacities of its companies to take on and withstand competition.

Aircraft design and production has been transformed, in particular, by the emerging technologies. From the first phases of conception, the structure, the systems and the engines have been integrated by Computer Aided Design, permitting huge reductions in production and manufacturing time and costs. This has been one factor making for cheaper air travel. Others have been lower operating and maintenance costs, better overall management of the aircraft and its use and the development of emerging technologies such as a new generation of lighter materials which are corrosion resistant, tolerant of damage and repairable as often as necessary.

Engines are still fuelled by hydrocarbons, their polluting emissions having been reduced to acceptable levels by efficient combustion, lighter airframes and better aerodynamics. However, low-polluting cryogenic fuels are becoming affordable.

Driven by the concepts "More Affordable, Safer, Cleaner and Quieter", the industry is working on more competitive aircraft designs with different configurations, although the classic cylindrical fuselage with engines hanging from low wings is still

very much the dominant design at work in the world's skies.

Aircraft still at the computer-design phase are addressing society's needs as well as the market for the next generation of super-liners. These will carry the population of a large village – 1200 or so people – with superbly efficient fuel consumption in a new dimension of comfortable, cost-effective travel. This is by no means all: the industry is also ready for the development of niche markets for supersonic aircraft and freight-carrying airships, as well as the emergence of flying wings and innovative vertical take-off and landing vehicles.

The systems' equipment and components

In 2020, European leadership will be evident on aircraft throughout the world. The industry in Europe is the leading developer and supplier of avionics systems and its engines and systems are simply the best. Its prowess also extends to air traffic management (ATM). Such has been the success of the "European solution" for ATM, that a *de facto* world standard has been created.



Identifying the research agenda

The research agenda must be at the service of Vision 2020 and the goals it identifies. Broadly, the air travel requirements of “More Affordable, Safer, Cleaner and Quieter” will dictate the main priorities, but customer demands for more reliable services must also be satisfied.

It is not the purpose of this exercise to define a detailed research agenda. This will be an evolutionary process which should, among other things, lead to a greater concentration on large programmes in a few key areas, capable of maintaining transparency, integration of the supply chain and access for small companies.

Our goals for the air transport system point to many areas that need to be addressed. The management of aircraft movements on the ground and in the air is a natural family of similar technologies, whilst the aircraft itself and its many complex systems is another.

Transforming Air Travel

Many technical barriers need to be tackled in a comprehensive and coordinated manner if substantial improvements are to be made to the Air Transport System.

Limiting the impact of weather

We want to continue to reduce the weather as a disrupting factor for aircraft operations and a source of discomfort and danger during flight. We cannot control it but we need to learn to live with the elements and steadily eliminate the service disruption that they may cause.

Integrated air traffic management

Air traffic management is a major research challenge that is already being confronted at a European level. The lack of integration of Europe’s air traffic control systems places additional burdens on the European air travel system as well as on the environment. We need new operational concepts and systems that permit aircraft to operate in all weather conditions, to fly closer together at lower risk so as to allow optimal and efficient allocation of the airspace between its civil and military users, while limiting as far as possible the construction of new airports and runways. We also need to pocket the fuel savings that are possible by permitting aircraft to fly the optimum route length with no speed restrictions and by putting an end to stacking aircraft in holding patterns and making them wait a long time for a take-off slot. Among other things, this means designing aircraft systems that integrate with airlines, airports and air traffic management operations and procedures so as to greatly improve the efficiency of airspace management.

A new approach to airport management

Imaginative management systems addressing both air and land side operational issues are badly needed for airports. Despite the technologies of automated ticketing, passengers and their baggage are still handled in the same way as 40 years ago. “Just in Time”, for example, is well established for the manufacturing industry. How can these principles be applied to customers of airports? Innovative solutions are also needed that integrate the air transport system with other transport modes.



The Research Challenges (examples)

Quality & Affordability

- | Permanent trend monitoring
- | Flexible cabin environments
- | Passenger services
- | Anticipatory maintenance systems
- | Integrated avionics
- | ATM related airborne systems
- | Novel materials and structural concepts
- | Lead time reductions
- | Integrated design manufacturing and maintenance systems
- | Advanced design methods
- | System validation through modelling and simulation
- | Concurrent engineering

Safety

- | Flight hazard protection
- | Advanced avionics
- | Probability and risk analysis
- | Computational methods
- | Human error checking systems

Environment

- | Drag reduction through conventional and novel shapes
- | Fuel additives
- | Noise reduction
- | Propulsion concepts
- | Emission reduction
- | Environmentally friendly production, maintenance and disposal
- | Better aircraft/engine integration

European Air Transport System

- | Innovative ATM operational concepts
- | Advanced, intelligent and integrated ATM ground, airborne and space systems
- | Rotorcraft integration in ATM systems
- | High density traffic systems capability in all weather conditions
- | Airport capacity and advanced management
- | Increased use of airspace capacity

Global Leadership and competitiveness



The Regulatory System

The above agenda is a broad one and does not imply any order of priorities. These will be determined by a dynamic process, partly shaped by time factors and available funds, that is driven by the industry, the research community, the public authorities and society at large.

Research subjects included here should be regarded as examples. Many will affect more than one goal so part of the challenge will be the successful optimisation of the whole research agenda. An integrated approach can provide the basis for satisfying society's needs and ensuring European leadership in this global industry by 2020.

The research agenda must be underpinned by a strong cohesive regulatory system.

| The Aircraft of Tomorrow

Literally thousands of systems work together within a modern aircraft: the airframe itself, the engines, the navigation systems on the flight deck are a few of the “high tech” ones, but seat, galley and many other technologies play their part.

Competitive, cost-conscious travel with choice, comfort and convenience

In an air transport system that must be more closely matched to the needs of customers and citizens, the cost and efficiency of the aircraft as well as its design and manufacturing must be the most competitive in the world. Aircraft may be acquiring new shapes and sizes by 2020 to improve the technical efficiency of the air transport system and to raise their safety and environmental performance. Flying wings could offer more efficient and quieter solutions, airships may finally establish themselves as a cheap alternative for carrying freight, and convenience flying could be a reality with tilting wings that allow vertical take-off and landings. The super-liners able to carry 1200 or more passengers may need new airport systems to handle them, folding wings to avoid occupying too much airport space, and entrances and exits of a size once found only on passenger ships.

Safety and environmental gains

In the meantime, today’s aircraft will continue to be improved by technology advances. Second-generation composite materials and use of hybrid laminar flow over the entire aircraft could make vast contributions to reducing aircraft weight and air drag, thereby reducing fuel consumption. Big strides in safety will be possible through human factors, research and intelligent monitoring and control systems that will anticipate problems and take preventative actions even before the pilot is aware anything is going wrong. The crew’s confidence that it is making the best possible decisions will be assured by electronic systems.

There is a relentless demand for every industry to reduce emissions and burn less fuel and these are goals the aeronautical industry will continually strive for. Cleaner and alternative fuels – hydrogen, for example, if its production costs can be lowered – may be able to help in reducing harmful emissions. More efficient engines are achievable that will not only burn less fuel but will also reduce damaging emissions to a fraction of their current levels. But to bring them within reach, temperatures and pressures in the heart of the engine need to be raised still further and ways to achieve peak efficiency throughout the whole flight are needed.

| Making the most of advanced electronics

The digital revolution is enabling huge strides to be made in aircraft design, production, manufacturing, maintenance and operating and traffic management. There will be vital impacts on flight systems, where much greater integration will bring top line operation, minimal fuel consumption and dramatic improvements in safety standards. Integrated electronic systems will greatly improve reliability, remove causes of unscheduled maintenance and allow the opening of “the office and home in the sky”.

| Plotting the Course

The research agenda must be fleshed out in enough detail to allow rational choices to be made about the radical leap in capability that is required. Once endorsed at the highest levels, it can then act as a beacon for the aeronautics industry across the EU. That is the theme of our next section, The Way Forward.



The Way Forward: Creating Partnership for Research and Innovation

Keys to Success

Describing the vision is the easy part of our task. The real challenge lies in achieving it by changing mentalities and investment priorities for research and making the best use of total outlays in Europe. We are making recommendations for an evolutionary process requiring a long-term commitment by all stakeholders – the aeronautics industry, airlines, airports, air traffic control service providers, governments and regulators, research institutes and academia – to work in closer partnership and on the basis of consensus. In working together they must keep firmly in mind some important keys to the successful achievement of our vision.

They include:

- ┌ **Maintaining consensus** | Maintaining a continuous consensus among key aeronautics stakeholders based on common interests and a commitment to implement its priorities.
- ┌ **Balanced research** | Encouraging better co-ordination and distribution between research funded at the EU level and programmes sponsored by national governments and individual enterprises.
- ┌ **Create new research synergies** | Creating new synergies between EU, national and regional research programmes and minimising unnecessary duplication of research, while recognising that a degree of competition between companies and agencies is desirable and necessary.
- ┌ **Optimisation of research facilities** | Optimising research facilities. This requires a long-term view of the infrastructure needed to sustain public and private networks of excellence within a framework of European collaboration.
- ┌ **Synergies between defence and civil sectors** | Fostering synergies between defence and civil sectors. The two sectors share many technology needs and Europe should promote synergies between them to make the same gains that other nations do.
- ┌ **Priority for education** | Giving education a high priority to ensure the long-term supply of first-class, well-trained and suitably qualified people.

Securing the keys

The current set-up cannot secure the keys

These keys to success need to be secured. But we doubt that they can be under present arrangements. European aeronautics is now a cross-border industry, but too much of its research strategy is shaped within national borders without clear reference, or indeed, knowledge of what is happening elsewhere within the Union. The result is fragmentation when we need a more coherent picture, greater awareness and critical mass.

These are serious weaknesses. Nevertheless, there is a real breadth and depth to existing relationships, collaborations and partnerships between industry stakeholders, the Member States and the European Institutions that, with shared vision, drive and commitment, could be transformed into something more systemic.

There are limits to crossborder cooperation

We are not questioning political prerogatives at the national and European levels neither are we calling for radical changes in the centres of decision-making as they impact aeronautics research, nor in the ways in which research is financed. We also recognise that there are limits to potential cross-border research cooperation: what may be possible in one sector does not necessarily apply to others.

However, there is a definite need to create the conditions for better decision-making and for more efficient and effective research by the Union, the Member States and the aeronautics stakeholders. We require:

- a common strategic approach to the definition of priorities and long-term funding;
- new partnerships to complement and build on the old;
- a more efficient and effective sharing of tasks.

Strategic definition of priorities

We believe these objectives can be attained through mobilising Europe's formidable research capacities behind a much greater common effort without in any way prejudicing healthy competition within the industry.

The path to a sharper focus on strategic research lies in a regular and continuous dialogue between aeronautics stakeholders and the highest political levels in the Member States and the European Union. Among a range of issues, this dialogue will need to cover relations between civil and military aeronautics. But its primary products would be a Strategic Research Agenda, adopted every two years, and a work programme derived from it, together with a more coherent and coordinated approach to optimising research efforts by all stakeholders.

Coordination would not be imposed, but facilitated and, in effect, implied by the common adoption of priorities developed within a framework commanding broad support from all stakeholders.

Partnerships

In addition to purely national efforts by governments and companies, aeronautics research is already characterised by cross-border partnerships within Europe and across the Atlantic. None of these should feel threatened by the development of the Strategic Research Agenda, which is intended to present new opportunities for existing combinations as well as to stimulate the formation of additional ones.

Sharing of tasks

Greater inter-dependence and specialisation of function than currently exists is likely to emerge from common efforts that are better organised and structured. EU aeronautics research would stand on the following three pillars, the first two of which are already well-established:

National publicly-financed programmes;

The EU research actions;

New forms of cross-border cooperation and partnerships between national and EU programmes. Changes in national regulations that are currently obstacles to such partnerships, as well as an adaptation of the EU research instruments, might be required to allow for a better structure of the aeronautics research landscape in Europe.

Collaboration, cooperation and competition

A regular and continuous dialogue is needed to optimise research efforts by all stakeholders

Create new mechanisms to facilitate stronger cooperation and partnership

The Strategic Research Agenda (SRA)

This is the beacon to light the way towards our vision. In section 3.4 we have only managed to give a very broad description of some of the research areas that might feature in such an Agenda. Produced by representatives of all those with a stake in research, the SRA would be a timed and scoped statement of research priorities with recommendations for implementation. Biannual updating will steadily encourage convergence of the priorities of individual funding programmes in both the public and the private sectors and allow evaluation of global results.

Maximum benefit would be gained from the SRA through the co-operation and, where appropriate, inter-dependence, of the stakeholders in its implementation.



We recommend

Build a consensus in favour of strategic actions

Creation of a new entity, the **Advisory Council for Aeronautics Research in Europe**, designed to turn the current patchwork into a research network by defining the content of the Strategic Research Agenda and helping to make it a reality. The Council must be tripartite in composition, bringing together, in a non-bureaucratic way and recognising their particular roles, authoritative, senior figures from aeronautics stakeholders, Member States and the Commission to build consensus in favour of strategic actions.

Exercise influence in favour of SRA priorities

A light structure with major stakeholders represented

We would expect that participation in the work of the Advisory Council would involve a commitment to influence all stakeholders to plan research programmes in the light of SRA priorities. Consensus at the Council level should also help in the sharing of tasks

and shaping relations between national and EU programmes as well as influencing the deployment of funds.

The Advisory Council should also be an effective instrument for promoting the educational policies and standards needed to ensure that highly-qualified and talented people are available to the industry and to the research community in general.

While this is not the place to determine the details, we think it important that the Council should be a light structure of 20-30 people, identified for their experience, commitment and vision. Direct representation of the major stakeholders would be essential for this process to succeed. The Council's functions would be to:

Launch and approve the Strategic Research Agenda and update it every two years.

Make strategic and operational recommendations and commission future studies for implementing the SRA and achieving the 2020 vision.

Evaluate the overall results and benefits of the SRA for Member States, the Commission and stakeholder groups. Develop and implement a communications strategy with two broad objectives:

- promoting awareness of the SRA within the stakeholder communities and outwards to larger public audiences;
- disseminating sufficient information on stakeholders' research programmes to facilitate a consensus on priorities.

Recommend accompanying measures for:

- getting the best out of existing research infrastructures;
- achieving cost-effective investment in new infrastructures;
- ensuring educational policies that will produce the scientists, engineers and other skills the industry needs.

Supported by a small, suitably qualified staff

The Council would be supported in executing its functions by a small, suitably qualified staff (the "Support Group") embodying, like itself, the tripartite principle. We would hope that this group would be drawn from the Commission, Member States and from stakeholders.



The SRA Process

1. Compiling the SRA: in producing the proposal on the content of the SRA, the Advisory Council's Support Group could commission highly qualified independent experts to provide input.

2. Approving the SRA: after detailed consultations with the aeronautics industry, Member States and the European Institutions, the Support Group would draft the SRA for approval by the Advisory Council.

3. Transmission to funding authorities: once approved, the SRA would be passed to the European Parliament, the Council of Research Ministers, Member States, and the European Commission.

4. Mapping the route: the Advisory Council's Support Group would translate the SRA into more operational terms and develop a strategic work programme as the basis for research programmes and associated requirements. This would be passed to all stakeholders and decision-makers involved in aeronautics research.

The success of this exercise almost entirely depends on rallying the political, industrial and research communities behind the SRA's priorities. If they do so, research priorities will converge, research performance will be more efficient and effective, there will be more opportunities for collaboration, and European aeronautics will become a global leader that responds to society's needs.

Financing the vision

Public funding is needed to secure global leadership

Gradual realisation of our ambitious vision must be facilitated by an increase in public funding. European aeronautics has grown and prospered with the support of public funds and this support must continue if we are to achieve our objective of global leadership. Although it is a preliminary estimate, total funding required from all public and private sources over the next 20 years could go beyond €100 billion.

A variety of mechanisms are needed for more effective research

Its justification is clear: research and technologies are needed to protect the public interest in areas such as safety and the environment; regulators need the products of science and technology in order to fix sound, practical rules; a major competitor, the United States, makes a very important financial contribution to its domestic aeronautics research and, given the synergies between civil and military aeronautics

research, steady reductions in defence budgets in Europe over the last decade have been working against our ambitions.

In addition, patterns of funding need to adapt both to changes in research priorities and to the impact of changes in the industry's structure. A variety of mechanisms is needed to achieve more effective research. Some, including the EU's Framework Programme, already exist while others will need to be created. Article 169³ of the EU Treaty may be one such mechanism for creating synergies.

The proportion of total public funding for aeronautics research provided by the EU has increased during the last ten years in an evolutionary process that has to find an appropriate balance between EU and national funding.

(3) Article 169 allows for voluntary joint research efforts involving some, but not all, Member States, with additional funding from the EU. The Article says: "In implementing the multiannual framework programme the Community may make provision, in agreement with the Member States concerned, for participation in research and development programmes undertaken by several Member States, including participation in the structures created for the execution of those programmes."

Setting up milestones

Against this background:

Europe needs a Strategic Research Agenda for aeronautics as soon as possible; the Advisory Council needs to start work in the spring of 2001 and to deliver an SRA by early 2002;

resources for new mechanisms jointly funded by the EU and Member States should be made available before 2003.

Subsequent milestones will be established by the Advisory Council according to its priorities and available funds.

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European Aeronautics: A Vision for 2020 sets the agenda for the European Aeronautics' ambition to better serve society's needs and strengthen its quest for global leadership. The vision has been developed by very senior personalities widely drawn from the industry and other stakeholders. They recommend strengthening and reorganising research and development efforts to improve competitiveness and provide a safe, efficient and environmentally friendly air transport system.



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