



ACARE

Strategic Research Agenda Executive Summary

Advisory Council
For Aeronautics
Research in Europe

October 2002

Executive Summary

Background

Aviation and a New Age - An imperative for Europe

Proud of its contributions during the first century of flight, world aeronautics now stands at the threshold of the new, third age of aviation. First came the Pioneering Age, from the inception of powered flight to the jet airliner. Then, the Commercial Age, which has become familiar to all with 50 years of dramatic air traffic growth. Today, Europe approaches a watershed, bright with opportunity, but heavy with risk, at the start of the New Age - the Age of Sustainable Growth - requiring more affordable, cleaner, quieter, safer and more secure air travel. **See Figure 1.**

It is an ambitious and very challenging plan but the penalties of failure would be a loss of immense dimensions to the whole of Europe and not just to the aviation community. ACARE therefore presents its first year's work, fully conscious of the difficulties ahead, but committed to success in a great European endeavour.

Last year's formation of the Advisory Council for Aeronautics Research in Europe (ACARE) signalled that Europe is ready to seize these opportunities in the new age of aviation and will not succumb to the risks. The relentless increase in aviation traffic cannot be endured by the world's present systems, particularly in Europe, for more decades without profound and unacceptable penalties. Fundamental changes in perspective will be required in future years to balance upward demand and the broader needs of society for economic and social benefits. The solutions must embrace such challenges as noise, emissions, congestion, delays and inconvenience. Europe now has a fresh opportunity to shape its contribution to the global future of aeronautics and this Strategic Research Agenda (SRA) provides its technological foundations.

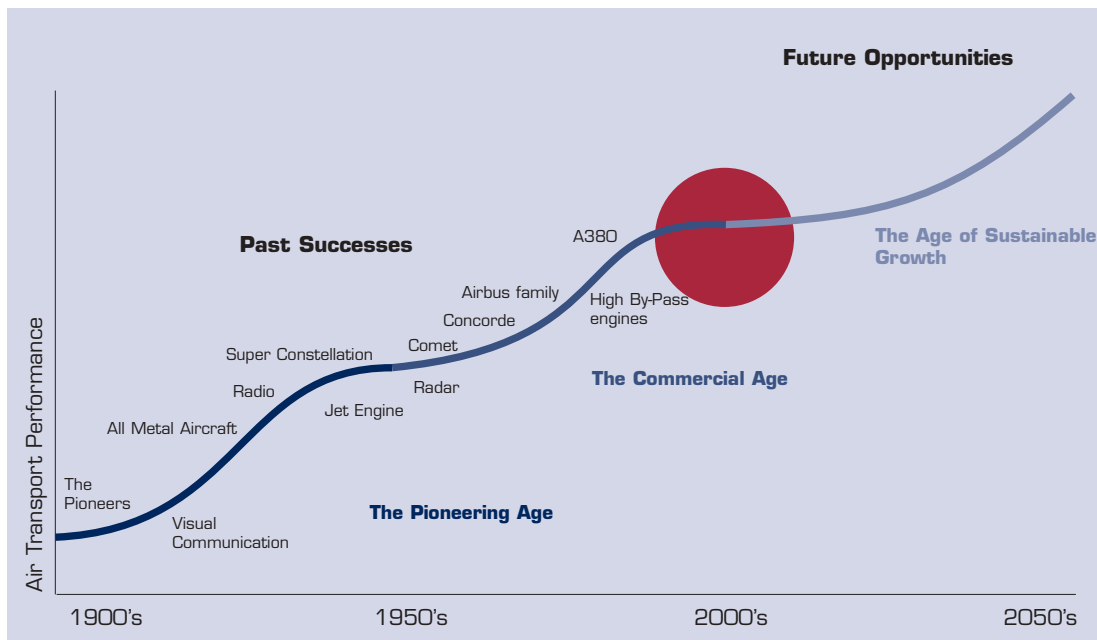


Figure 01

ACARE - The First Year

How it all started

The Commercial Age was a period during which major advances were made in terms of speed and range. More aircraft tended to mean more noise and more fuel consumed but this was tackled aggressively by the aircraft and engine builders. Engine and aerodynamic efficiency were raised, noise was dramatically reduced, and fuel consumption halved. Larger aircraft were introduced. Despite all of this success the relentlessly rising tide of demand has brought the aviation community to the realisation that all air traffic demand forecasts indicate fundamental problems for the future. Social change and familiarity, as well as the increase in traffic, means that protests have become louder – not just against noise and pollution, but also about delays, unreliable schedules, crowded facilities, congestion and inconvenience.

These issues present fundamental challenges that will not yield to incremental and steady progression but will need an aggressive, ambitious and more holistic approach. So, in 2000 Commissioner Philippe Busquin contributed significantly by inviting a Group of Personalities to set out an ambitious vision for the future of aeronautics over the medium to long-term. Their report "European Aeronautics - a Vision for 2020" was published in early 2001.

It recommended the formation of an Advisory Council to create a Strategic Research Agenda that would enrol all those with a stake in the future of aeronautics to collaborate in exploring and advancing the technologies that will lead to the realisation of the goals of Vision 2020. The Advisory Council for Aeronautics Research in Europe (ACARE) was formed in mid 2001.

The two **Top-Level Objectives** for **European aeronautics**, identified in the Vision 2020 report, were:

- To meet society's needs
- To achieve global leadership for Europe.

ACARE's main activity to date has been to assemble this Strategic Research Agenda by organising pan-European working teams. Their initial findings are presented below.

ACARE Key Findings

- The **Top Level Objectives, even though ambitious, are achievable in Europe**, if the challenging Strategic Research Agenda, prepared by ACARE, is adopted, implemented and its results deployed into practical products and services with a high level of commitment.
- The SRA provides strategic directions for solutions and R&T¹ road maps to achieve the Top Level Objectives as outlined in Vision 2020. The objectives are **not** achievable **without important breakthroughs, both in technology and in concepts of operation** - evolutions of current concepts will not be sufficient.
- Delivering these European ambitions will require substantially more output from the European aeronautic research community which must devise **new ways to make the system of research, in all its forms, more efficient.**
- Delivering the Top Level Objectives **will require a number of additional and significant Pan-European enabling mechanisms within the European Research Area.** Five areas for new mechanisms are identified: the European research infrastructure, the supply chain, certification and qualification, education and Trans-European synergy of research.
- **It is clear that more investment from both public and private sources will be needed.** The preliminary estimate as mentioned in Vision 2020 "possibly in excess of 100 billion euro over 20 years" has been confirmed.
- The aspirations for European leadership will only be achieved if the climate in Europe remains conducive to retaining and advancing core competence, capacities and centres of aviation research. The ambition of SRA is for the European stakeholders to succeed in the global market, both by competition and by collaboration, from a strong, effective European base. **This requires that major corporations, which increasingly have international links and options, continue to invest their resources in Europe. From its side Europe must provide a receptive environment, ensuring equal competitive footing with other countries and economic regions, to encourage those investments to remain in Europe.**

¹ R&T: Research and Technology refers to developing new technologies – more specifically it covers basic research, concepts, technology development and technology integration & validation

The establishment of these findings has involved a vast amount of work undertaken under ACARE's leadership, extending across European stakeholders in aeronautics, the European Commission and in the governments of Member States, European Institutions, and across manufacture, operation, regulation and research. This has been the first time that a proposal on this scale has been attempted in Europe and, in itself, represents a substantial vindication of the concept that a single SRA could be created from the diverse interests of Europe's stakeholders. It is an important achievement from the first year.

The work has underlined very clearly the immense scale of the ambition contained in Vision 2020. This ambition stems from a determination not to compromise the conflicting demands of cost, performance and society's needs at a low level but to extend our reach and grasp the challenge of having more benefits in more ways. The SRA will enable the magnitude of that challenge to be dimensioned. It provides a new perspective within which to comprehend the prerequisites for success. The SRA is focused on technology and the reality that the great changes that are needed will be impossible without new technologies in new applications. The SRA also points the way toward actions in other fields where equally important changes will be needed; in public policy, in regulation, and in areas of international co-operation.

The Strategic Research Agenda

The strategic directions set out in the SRA necessarily look beyond 2020 since it will only be in later years that the results of some of the ongoing research will have their impact. In addition the SRA addresses additional enabling mechanisms that will be needed to ensure a successful outcome.

The **technical content of the SRA** is driven by **five major challenges** that interact in addressing the top-level objectives. The ambition to provide more affordable, cleaner, safer and more secure air travel determines the major challenge areas. These challenges, each of which has clearly identified goals, contributors and solutions, are:

- **Quality and Affordability** – the challenge of delivering products and services to airlines, passengers, freight and other customers whilst increasing quality, economy and performance for sustained international competitive success.
- **The Environment** – the challenge of meeting continually rising demand whilst demonstrating a sensitivity to society's needs by reducing the environmental impact of operating, maintaining, manufacturing and disposing aircraft and associated systems.
- **Safety** – the challenge of sustaining the confidence of both the passenger and society that commercial flying will not only remain extremely safe, notwithstanding greatly increased traffic, but will reduce the incidence of accidents.
- **The Efficiency of the Air Transport System** – The economic needs of Europe's citizens, international competitiveness and the convenience of passenger and freight customers' demand that rising traffic shall not exacerbate the downsides of congestion, delay and lost opportunities. The challenge is therefore that the efficiency of the whole system taken together must be substantially increased. This will require radical new concepts to be introduced.
- **Security** – Recent events have underlined the reality that protected and uninterrupted air services are a foundation for all the economic and social benefits of the air transport system. The challenge is to devise measures that will improve security, on a global basis, within a highly diverse and complex system and against a strong backdrop of increasing traffic.

Meeting the Challenges

Solutions and technical contributions are identified to meet these challenges. But considering each challenge separately is not enough, a global or holistic view is necessary if the optimum benefit for all stakeholders is to be achieved. To this end the SRA identifies both positive and negative interactions amongst the different challenges and highlights vital concurrent developments required to create a breakthrough in order to achieve the Top Level Objectives.

To some extent change will be evolutionary, progressive and incremental. ACARE investigation shows this alone will not suffice. Just as the demands of 20 and more years ahead will be different in nature from those of today, so the solutions will also need to be different in nature, and not just in degree. This will require step changes in concepts using new and breakthrough technologies to create a future system that is as distinct and different from today's air transport system as today's is from that of the 1930's.

Two examples are in the areas of environmental mitigation and in air traffic management. The Environmental Challenge has clearly identified the limits of current technology, which, whilst it has more to offer and more that will be achieved over the next decade or so, must be succeeded by completely fresh approaches that require an early start. In the air traffic management area, the Efficiency Challenge has shown clearly that extrapolated development of the current paradigm of control over air-craft movements will not meet future traffic demand. So new concepts are being studied and these will require new and critical technologies to be developed before they can reach operational maturity.

New concepts and novel technology will need other changes for their exploitation. In particular they may need new or amended regulations to allow different approaches to be introduced in ways that protect the interests of the public whilst permitting the benefits of the new concepts to be realised.

Realising the Ambitions

Vision 2020 was not focused on implementing research programmes but on delivering change. This change is likely to be dramatic. ACARE has considered how best to exploit the technical research and bring it to fruition for the European citizen. This must be seen in a Pan-European setting in which the Research Agenda will become implemented through research programmes subscribed to in a variety of ways by the stakeholders who fund research at company, national and European levels. Their participation will vary but the SRA, their own creation, will be a powerful influence on the formation of these research programmes. This is illustrated at **Figure 2**. But creating vital research programmes is not enough. The programmes need to be supported and exploited by a variety of enabling mechanisms that allow them to be efficient and effective and which will encourage and stimulate their output to be used in pursuit of the objectives. Many of these mechanisms exist, of course, but ACARE has identified the need for more efficient or new mechanisms grouped in five enabling themes:

- **A research infrastructure** capable of delivering the means by which the planned research can be completed to a world leading standard.
- **A competitive supply chain**, from strong primes to the smallest suppliers, capable of exploiting all of the expertise in Europe and contributing to the necessary research and turning new technologies into competitive products.
- **Certification and qualification processes** that facilitate the rapid introduction of new and innovative technologies into production models.
- **An educational system** capable of delivering the required diverse and multi-cultural skilled research workforce.
- **Trans-European synergy** to make best use of the research effort being applied.

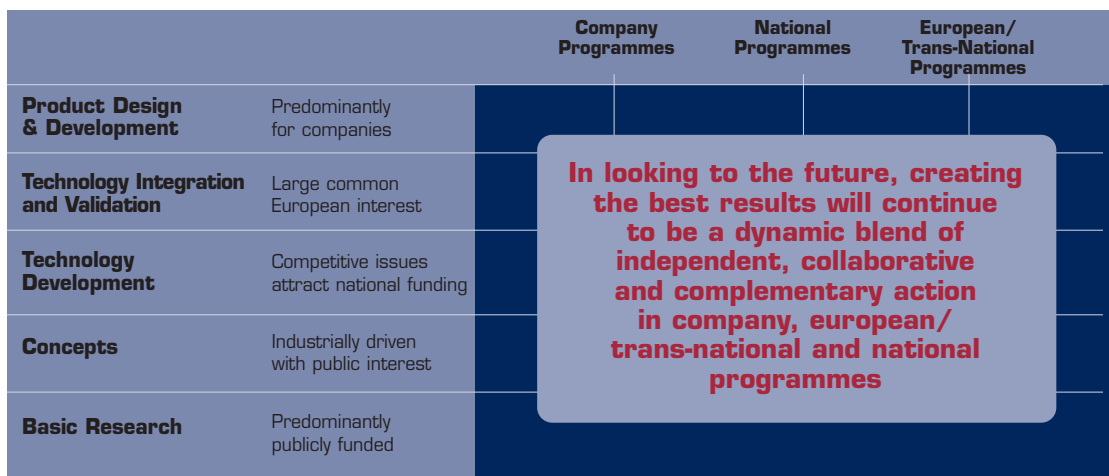


Figure 2

The Mechanisms

The new mechanisms that will support the enabling themes above fall into two categories – Project Based Mechanisms and Broad-based (or transversal) mechanisms.

Project-based Mechanisms

Mechanisms for R&T already exist serving the spectrum of engagement, from basic research and concepts through to technology development and integration and for accommodating varying roles in company, national, trans-national and European level programmes. The existing mechanisms need to be continued and built upon but the following new mechanisms are identified, particularly to support trans-national and European programmes.

- **Technology Integration Platforms** (allowing a number of technologies to be validated in a system context) will be concerned with ensuring that technical concepts work reliably in integration and at the scale of the full system needs
- **Large Scale Research Test-Beds** will be needed in Europe on a scale that are unlikely to be affordable by single companies or countries, and which can be used flexibly by the whole supply chain for testing advanced systems.
- **The Nursery, or Incubator mechanism** (encouraging new concepts to be explored under the protection of ring-fenced funding) will give support to the essential concept work that must provide some of the breakthrough thinking for the future. This needs to be highly innovative to aim to strive for major advances in performance, even if accompanied by radically new approaches embodying both new technology and new methodologies.

Broad-Based mechanisms

Alongside the project based mechanisms, ACARE has identified the need for additional general mechanisms in support of the enabling themes.

- **Mechanisms in support of improving the research infrastructure in Europe**
Improving the capability and utility of the European research infrastructure is an important investment in the future. The opportunities for Pan-European collaborative research efforts to exploit the very best research capabilities, both human and capital, rest in three main areas – testing and simulation facilities, R&T programme structures, and collaborative mechanisms. A number of possible mechanisms have been proposed; for example the establishment of a forum able to identify opportunities and needs for a European approach to investing in infrastructure and facilities.

- **Mechanisms to support the ambition to realise the untapped energy and expertise of Europe's technology supply chain.** New mechanisms will address one priority aspect of this challenge, lifting the levels of awareness by both customers and suppliers to very much higher levels. Customers need to have better information on the capabilities of suppliers whilst suppliers need much better knowledge of what opportunities exist. A central objective is to establish a powerful information network with Aeronautics Contact Points supported by a comprehensive web-based portal to enable easy knowledge transfer across the whole European technology supply chain. The need is clear – unless Europe can establish a different concept of supply chain information networking major opportunities for benefit are being lost.
- **Mechanisms to optimise the system of certification and qualification** that will enable advances in technology and design to be deployed in a safe and timely manner into products that will lead to the changed experience of travellers, customers and citizens. As systems become more complex and technology is able to provide new solutions the needs of safety and security remain vital. New mechanisms for certification and qualification will enable advances in technology to be deployed quickly and safely.
- **Mechanisms to promote education.** Unless there is a sustained flow of competent, trained and motivated people into aerospace the ambitions for creating the future vision will be limited. Among mechanisms proposed is one to assemble a transparent comparison of the scope of European educational qualifications as an aid to mobility for researchers.
- **Mechanisms to encourage Trans-European synergy** of research in aeronautics. The extent of complementary and collaborative effort achieved will be a balance. Advantages of economy, effectiveness and scale flow from complementary programmes and many such programmes exist already. But independent programmes are also needed to sustain competitive advantage and meet regional needs. Many industrial concerns have a trans-national character, ACARE exists and is proving a valuable forum and its stakeholders are committed to create better mechanisms. They are developing mechanisms to encourage transparency, allowing opportunities for collaborative and complementary programmes to be visible and to be subscribed to under the over-arching principle of voluntary participation.

Efficiency and Resources:

"More research for the money: more money for the research"

Underpinning all of this, and examined by the SRA, is the need for substantially greater output from the European Research Area in the field of aeronautics and how this is to be resourced, in terms of funding and people.

More output is needed as European aeronautics prepares itself for the new phase of developments that will become the Age of Sustainable Growth. The research work for this needs to be started now, and needs acceleration from continuing the development of existing trends. New and radical solutions are needed and they will demand intensive research preparation.

Some of the increased output must be the product of greater efficiency and the additional mechanisms identified will enable greater output to be produced from the same levels of funding. The SRA will, with its wide support from the stakeholders, act as a powerful agent for focusing research on to those areas where the greatest benefit will result, avoiding wasted duplication of effort.

The mechanisms for harnessing the research output are illustrated in **Figure 3**. Efficiency will stem in large part from a combination of well-focused research programmes that reflect the strategic directions of the SRA. Efficiency will also come from sustaining a balance and integration between areas of research. The research work done under each of the challenge headings of the SRA does not stand alone, each will impact on work elsewhere. In the end the concepts, products and services of the stakeholders will deliver the changes that are needed to the system.

Nevertheless, even allowing for the gains expected to be achieved through greater efficiency, it is clear that more funding will be needed. In producing the SRA it has been confirmed that the estimate of the figure quoted in Vision 2020 "possibly in excess of 100 Billion euro" will prove to be within the right ballpark, which represents a substantial increase relative to current funding levels. This funding will need to come from both public and private sources. This is in line with the general conclusions of the Barcelona European Council meeting in March 2002 for research in Europe. It concluded that overall spending on R&D² and innovation in the Union should be increased with the aim of approaching 3% of GDP by 2010.

Finally the whole will depend, as ever, on people. The great opportunities and the great needs of the new century will demand educated and trained people who can bring both vision and competence to bear on these exciting challenges and the SRA addresses the issues that will arise in ensuring that the human resources needed can be provided.

² R&D: Encompasses Research and Technology (R&T) as well as the effort for the development of new products.

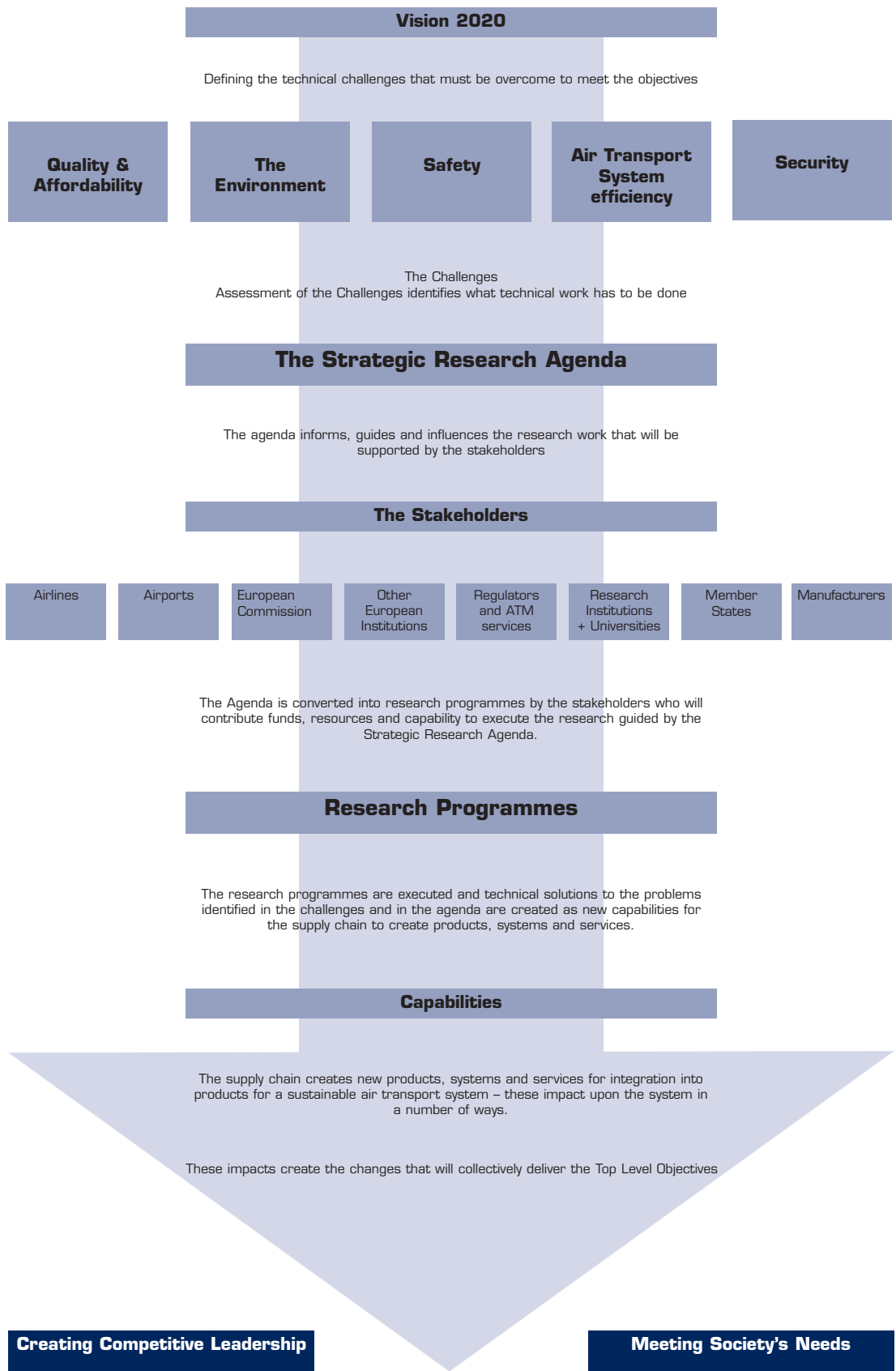


Figure 3

The Next Steps

This is the 1st Edition of the Strategic Research Agenda. No edition of the SRA can be a rigid long-term plan and successive editions, probably at 2-3 year intervals, will allow new information and changed circumstances to be admitted to the Agenda. In parallel it will be possible progressively to look at selected aspects in more depth and to assemble a wider set of studies on situations that might have significant influence on the priorities for the future. These will allow the optimum balance of investment to be assessed and will inform and guide stakeholders in their support for specific research programmes.

ACARE is confident that the SRA provides a firm foundation for the fulfilment of European aspirations for sustainable long-term global aerospace leadership, providing that the measures that it suggests for adoption receive the universal support that is required.

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