

dti

AEROSPACE & DEFENCE DIRECTORATE

Aerospace & Defence
Technology Report
2002/2003

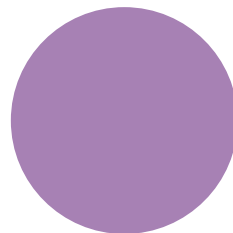
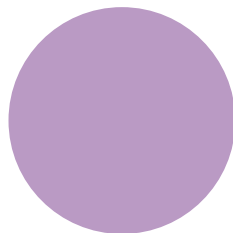
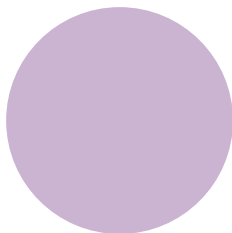
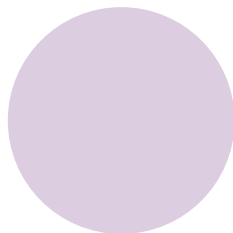




The DTI drives our ambition of 'prosperity for all' by working to create the best environment for business success in the UK. We help people and companies become more productive by promoting enterprise, innovation and creativity.

We champion UK business at home and abroad. We invest heavily in world-class science and technology. We protect the rights of working people and consumers. And we stand up for fair and open markets in the UK, Europe and the world.





ministerial foreword

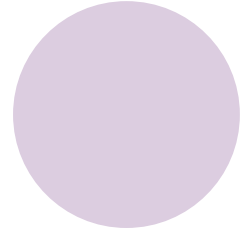
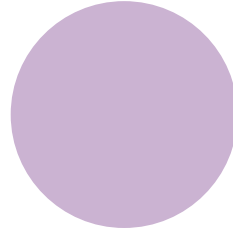
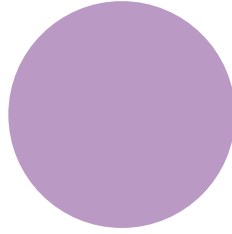
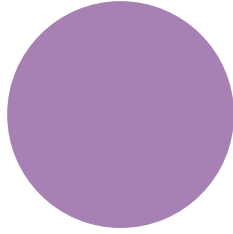
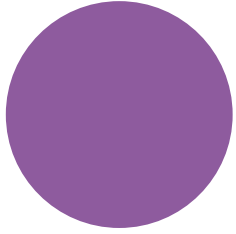
jacqui smith,
minister of state for industry
and the regions and deputy
minister for women and equality

I am delighted to be able to present the Aerospace & Defence Technology Report for 2002/2003. Technology is critical to the success of the UK Aerospace industry. The report sets out how the Department has been working with the industry to raise productivity and competitiveness through support for an integrated portfolio of technology measures.

The UK aeronautics industry has an impressive performance on many fronts. It is one of the UK's leading manufacturing sectors and has achieved an enviable record of continual technological advance and productivity improvement. It embraces the knowledge driven economy with success. It has to maintain a capability across a broad range of technologies to sustain its long-term global competitiveness and the aerospace industry is a major investor in R&D.

We work to draw together key stakeholders including the industry, the Ministry of Defence, the Engineering and Physical Sciences Research Council and academia in complementing the DTI's activities for competitiveness of the industry. This helps to ensure that the pull from the science base is well coordinated with the needs of industry for future civil and military applications. While the Department's Aeronautics Research Programme is no longer open to applications, there will be opportunities for the industry to continue to pursue a wider range of innovative work when the Department's new business support products come on stream next spring. The Aerospace Innovation and Growth Team, led by Sir Richard Evans, presented its report on 11 June 2003. The report focuses particularly on technology and the need to maintain and expand the national strategic direction to take the industry forward. Implementation Groups are taking the report's recommendations forward.

The sector makes a significant contribution to the UK economy and the needs of society through reducing the environmental impact of air travel, reducing its real cost and enhancing safety, security and comfort. I want to see the UK industry build on its success and maintain and expand its world-leading position in many areas through developing and proving long-term cutting-edge technology.



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foreword

david way

This is the second annual technology report produced by DTI's Aerospace & Defence Unit, and we have continued to widen its remit to reflect the broad technology thrust we are pursuing. Malcolm Scott will shortly replace Penny Ciniewicz as Head of the Unit, and I, David Way, remain responsible as Director, Aerospace & Defence Technology for promoting the technological competitiveness of the UK industry.

The past year has been one of profound importance to the future of the industry. September 11 has continued to cast its shadow over the whole industry. The Iraq war further depressed demand and the outbreak of SARS hit Far Eastern traffic hard. However, we forecast the long-term future of the industry to remain bright with passenger traffic predicted to double within the next fifteen years. The aerospace and defence industry remains one of the UK's leading manufacturing sectors, competing highly effectively in global markets. Technology remains crucial for the industry's future and this report explains how we are working with industry to maximise UK benefit.

The Secretary of State announced in April 2002 the establishment of an Innovation and Growth Team to look at the future of the aerospace industry in the UK, chaired by Sir Richard Evans. The IGT has drawn together a team of over 140 senior people from across the industry, from Government, academia and the UK aerospace unions to undertake one of the most comprehensive reviews of the UK-based industry for over forty years. The report published in June this year, identifies a vision that by 2022 "the UK will offer a global aerospace industry, the world's most innovative and productive location, leading to sustainable growth for all its stakeholders". The report makes recommendations in a number of key areas including research and technology where it concludes that the UK must sustain a level of focused aerospace, applied research and demonstration sufficient to maintain and enhance the UK's position in the global aerospace market. A joint industry-DTI implementation team has been established to take forward the recommendations of the IGT, and this will represent a key area for the work of the Aerospace & Defence Unit over the coming year.

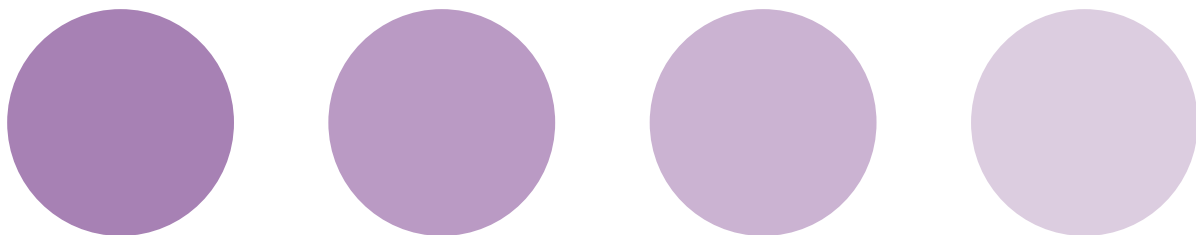
The joint Treasury-DTI Innovation Review, published in December 2003, developed an action plan to promote through innovation the competitiveness of UK business. The development of a co-ordinated technology strategy, building on both the strength of the UK science base and of UK business, is a major plank of this action plan.

The work done by the Aerospace Innovation and Growth Team is feeding directly into the development of this strategy, which is shaping the new collaborative research and technology business support products to be launched by DTI as part of its business support transformation programme.

The Technology Team have worked actively with official and industry colleagues across Europe in developing the first Strategic Research Agenda (SRA) for European civil aerospace, which was published through the Advisory Council for Aeronautics Research in Europe (ACARE) in October 2002. The SRA represents a challenging vision for the future and recognises the need for both evolutionary and revolutionary research to meet the aerospace challenges of the next twenty years, covering quality and affordability, environmental impact, safety and security, and the efficiency of the air transport system.

The government announced its defence industrial policy in October 2002. The policy is aimed at enhancing the competitiveness and sustainability of the UK defence industry, while continuing to provide high quality equipment at best value for money. It recognises that the industry is a key part of our economy, contributing significantly to our balance of trade and employment. The policy recognises that investment in research and technology is crucial to the future prosperity of a defence industrial base and the capability of the armed forces. The Aerospace & Defence Unit is working closely with colleagues throughout Whitehall and industry, to ensure the effective implementation of this policy, including the co-ordination of resources to maximise exploitation of civil technology and to target investment into areas of military importance in which the UK industry can be global leaders. The Technology Team in the Aerospace & Defence Unit are participating fully in this challenging activity.

The aerospace and defence industry sector is becoming ever more global in outlook, with major rationalisation at all levels of the supply chain. The government continues to show a high level commitment to sustaining the necessary conditions for the UK to remain a leading aeronautical manufacturing nation. The technology team within the Aerospace & Defence Unit works actively with all the key stakeholders to develop and realise a more integrated national strategy for aerospace and defence research and technology acquisition, working through the National Defence and Aerospace Systems Panel (NDASP) and the IGT. This report describes the work undertaken by the Unit on technology over the past twelve months and we take pleasure in presenting this report for 2002/2003.



industry background

rob morris

The UK aerospace industry is the second largest in the world. The aerospace industry is one of the UK's most successful manufacturing sectors with a turnover of £18.4bn in 2001 and producing nearly 8% of UK manufactured exports. The sector has a strong portfolio of products and is one of the few UK manufacturing industry sectors with a consistent trade surplus since 1980: the trade surplus in 2001 was £2.8bn. UK manufacturers' successful performance in the world market depends critically on their competitive technology.

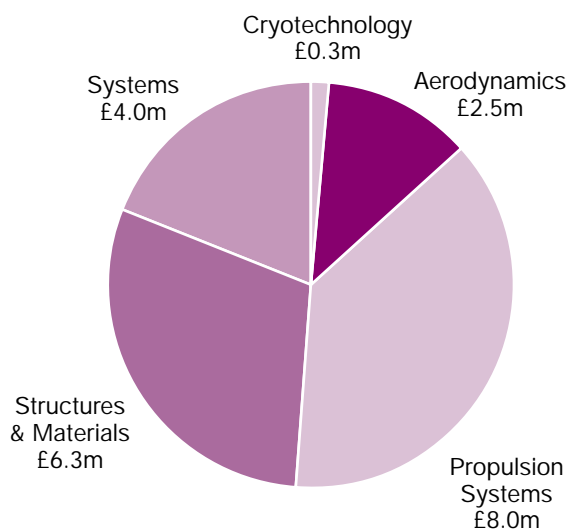
Demand for civil aerospace products is typically cyclical. We are presently in a period of weak demand that began in early 2001 as US and European economies began to falter, and which was exacerbated by the events of September 11 and the War in Iraq. However, the beginnings of a robust recovery are expected to result in a returning growth trend by the latter part of next year. Longer term, civil air traffic is expected to grow at around 5% per annum, resulting in deliveries of around 17,000 large passenger aircraft over the next 20 years.

The UK is well placed to take advantage of this growing market, with a particularly strong portfolio of products across a wide range of aeronautics market sectors. Presently the UK share of the global civil airliner market stands at around 10% and rising, with a consistently positive aeronautics trade balance. UK manufacturers continue to perform well, with Airbus (in which BAE SYSTEMS is a major shareholder) now firmly established in the civil airliner market, with around 2,900 aircraft in service around the world and a further 1,540 aircraft on firm order. Development of the Airbus A380 is now gathering pace, with the aircraft's first flight scheduled for early 2005 and the first aircraft on target for delivery in early 2006.

Rolls-Royce's share of the civil aero-engine market continues to grow, with the Trent family firmly established on the Airbus A330 and A340 and Boeing 777, and the latest family member, the Trent 900, established as lead engine on the Airbus A380. Rolls-Royce also have a strong position on smaller aircraft, with the successful Tay and BR700 series engines.

UK-based systems companies continue to be successful; BAE SYSTEMS supplied the fly-by-wire system for the Boeing 777 and the head-up-display on the new generation Boeing 737; Smiths Industries are a major supplier of actuation and control systems and other systems to all the major global aerospace primes.

aeronautics research budget 2002/2003 (£20.0m)





aerospace & defence technology – setting the strategic scene

dr ray kingcombe,
aeronautics research
programme director

The Technology Branch of the Aerospace & Defence Unit is carrying forward the DTI vision of Prosperity for All through enhancing the productivity and competitiveness of the UK aerospace and defence industry by advancing their technological capabilities. We work for the interests of the industry and of civil aeronautics in the whole UK programme of research involving defence and basic research at universities and funded from a wide range of sources (MOD, EPSRC, EU...), as well as DTI.

The long-term prospects for significant growth in air traffic remain good. However this year has seen depression of air traffic compared with past years due to continued global uncertainty, particularly regional incidents. Hence there has been a shortage of investment for all features of the business from new equipment to research. However the UK industry has, in general, recognised the importance of long-term and has maintained a significant base of ongoing research.

Hence there is a good market base for enhancing the long-term capabilities of the aerospace and defence industry in the UK through support for technology. The industry is seeking maximum leverage from its own investment and most major companies have a choice of a number of locations around the world for such work. The DTI Aeronautics Research Programme is anchoring high value activity in the UK.

The scope of activity in the Branch, and the benefits from the Aeronautics Research Programme are wider than for the manufacturing industry. This year it has become even clearer that the focus is on the whole of the civil air transport system, offering benefits:

- to passengers, through reduced cost and increasing access to air travel;
- to non-travellers by ensuring air transport does not adversely impact on everyday life;
- by increasing operational capacity, both of the airspace and of airports;
- by enhancing safety and security.

These aspects were confirmed in the European Strategic Research Agenda which was published by the Advisory Council for Aeronautics Research in Europe (ACARE) after work to identify the challenges to respond to society's needs and to secure global leadership in Europe for 2020.

There has also been considerable activity in the UK on the Aerospace Innovation and Growth Team (AeIGT) report. This was commissioned by the Secretary of State with the executive comprising the Chief Executives of the major aerospace and defence firms in Europe. The AeIGT vision report was published during the year and the full recommendations have since been published. The importance of technology is confirmed, with the need to maintain a strategy to make best use of current resources and the need for more investment from industry and government for themed programmes of research and technology demonstration.

In the current tighter business climate the focus of activity this year has inevitably been on cost reduction: both first cost for the operator (involving shorter and simpler design and manufacture) but also reduced operating cost, particularly through reduced maintenance and increased reliability. There has also been increased focus on defining the opportunities for the UK manufacturing industry in the emerging new air traffic management scenarios for increased operational capacity. Work has continued on environmental topics (reducing noise and emissions). Although long-term sustainability remains vital for the industry, bringing forward new work in this area has been difficult in the current economic climate.

The Technology Branch is helping the UK industry focus on the important long-term capabilities through partnership activity with industry and other government funding bodies and by supporting competitiveness of the civil aeronautics industry with the Aeronautics Research Programme. The industry needs fully proven technological capabilities for exploitation in high value areas to enhance the competitiveness and productivity of the industry in the UK.



aerodynamics programme

ian wilson

Aerodynamics has reached a very advanced stage, but it is not yet mature. Further technology advances are capable of producing significant benefits when applied in industry. Advanced, rapid and robust methods which can be applied with confidence are a necessity for industry to design wings for improved aerodynamic efficiency and reduced cost of ownership. The methods are applied in the assessment of the aerodynamic and economic performance of proposed future aircraft systems and inform decisions affecting the design evolution of projects.

The evolution of Computational Fluid Dynamics (CFD) methods remains a high priority, and research has continued to improve the accuracy and applicability, particularly of viscous and unsteady methods in close association with Airbus.

The market drivers for civil aeronautics are defined in European Aeronautics: A vision for 2020 as:

- Quality and Affordability
- Safety
- Environment
- European air transport system.

Aerodynamics research supported by DTI contributes directly to these priorities which are closely aligned with those of the Aeronautics Research Programme.

Attention has recently turned towards aircraft configurations which are not constrained by conventional considerations, and there has been activity to establish the validity of design and analysis techniques for such applications.

Experimental programmes generating high quality data are required to enable validation of theoretical methods if the methods are to be confidently applied and exploited in an industrial environment. Experimental programmes are also a necessity in the exploration of the fundamentals of aerodynamic phenomena such as boundary layer transition.

Two new Defence and Aerospace Partnerships (DARPs) in aerodynamics were launched during the year, MSTARR and PUMA. These involve the major aerospace industries and universities in the UK, and bring together funding from DTI, MOD and EPSRC to maximise the scope of the projects which they undertake.

A long standing project to acquire validated methods applicable to the aerodynamic design of wings for large aircraft was concluded during the year, having established an extensive database to underpin future activities.

aerodynamics programme - highlights

Reductions in the drag of the aircraft make direct contributions to both the environment and cost saving. For current aircraft designs, the largest reductions in drag could be achieved by the incorporation of larger regions of laminar flow on the wing, nacelle and tailplane. The advances in transition prediction and the coupling of these methods to a design method for the suction system by QinetiQ have made a significant contribution to the EC fifth framework programme ALTTA. This work will help to reduce the risk in specifying suction system requirements for any future Hybrid Laminar Flow Control (HLFC) aircraft.

The ability to predict the viscous flow about an aircraft can significantly impact on affordability. Research supported by DTI has developed a systematic approach of incorporating turbulence models into methods for solving the Navier-Stokes equations. A paper describing the QinetiQ suite of turbulence models was presented at the CEAS Aerospace Aerodynamics Research Conference in 2002.

The wakes from aircraft impact both safety and the environment. A dual coherent Doppler lidar method was used to make the first dedicated measurements of the vortex wakes from a large transport aircraft. The system allowed the measurement of the later stages of the vortex life cycle and contributed important and novel information about the breakdown of the vortices. Measurements were also taken from seeded vortices so that for the first time accurate information on the velocity profiles in the wake has been achieved.

Improvements in the lifting capability of the aircraft during both take-off and landing have a major influence on safety and the environmental impact. The EC fifth framework programme HELIX, is developing novel concepts for high-lift aerodynamics. Two concepts have been selected from the first phase as promising ideas deserving further investigation. The use of flow control, particularly by Sub-Boundary Layer Vortex Generators to improve the performance of convenient high-lift systems has also been a highlight of the work within the NEXUS programme.

Within the EC fifth framework programme EPISTLE, new leading edge devices for a supersonic transport wing has been tested in the ONERA wind tunnel. The results will have a significant impact on the take-off performance of any future supersonic civil transport.

propulsion systems programme

ian wilson

The Propulsion Research Programme aims to help industry to maintain its position in a market which is fiercely competitive through support for a portfolio of projects in the key technologies. A long-term technology acquisition strategy has been compiled to ensure that the benefits from a wide range of projects and participants are maximised. The research strategy is continuously updated to reflect changes in priorities and competitive pressures. Most research activity is now funded through collaborative grants between industry and other partners.

The involvement and exploitation of the science base continues to be a positive feature of the propulsion programme with Rolls-Royce's University Technology Centres providing a strong, focused and well integrated contribution to the programme. In addition the industry is working within two new Defence and Aerospace Partnerships (DARPs) in aerodynamics which were launched during the year, MSTARR and PUMA. These involve the major aerospace industries and universities in the UK, and bring together funding from DTI, MOD and EPSRC to maximise the scope of the projects which they undertake.

The market drivers for civil aeronautics are defined in European Aeronautics: A vision for 2020 as:

- Quality and affordability
- Safety
- Environment
- European air transport system

Propulsion research supported by DTI contributes directly to these priorities which are closely aligned with those of the Aeronautics Research Programme.

The programme has maintained strong emphasis on the key areas of manufacturing costs, engine performance, efficiency and reliability, all fundamental to competitiveness. Combustion, emissions and noise research continue to be of high priority in view of the high profile of environmental impact, and its importance to commercial success.

Technology from the research projects is pulled through to underpin major technology validation programmes in industry. The purpose is to allow the products of research to be matured in conditions which are representative of engine conditions, thus reducing risk to a level at which they can be committed to new engine projects. The Technology Validation Programme is known as ALPS/ACCORD (Advanced Low Pressure Systems/Advanced Civil Core Demonstrator), the latest phase of which was concluded during the year.

A collaborative project between QinetiQ and Alstom continued to make good progress, and another new project was launched to explore aspects of turbine design. A project between QinetiQ and AIT examining novel fuel injection systems for advanced engine cycles also continued to make good progress.

DTI is working with MOD to jointly support generic dual-use research in areas relevant to propulsion through two joint competitive programmes.

propulsion systems programme - highlights

A new method to predict the effects of discontinuities in engine acoustic liners has been validated and used to optimise the liner specification for future engines. This will lead to significantly reduced fan noise, which is required to meet the stringent noise controls in place at some airports.

Serrated nozzle treatments to reduce jet noise were demonstrated at full scale and confirmed the 4 dB reduction measured in flight tests. This programme was the culmination of six years of research at Rolls-Royce and QinetiQ, supported throughout by the DTI, through scale model tests performed at QinetiQ's Noise Test Facility (NTF). This facility is currently being upgraded to allow further noise research programmes to proceed to meet ambitious noise reduction goals.

A DTI-supported low NO_x combustion research programme has passed a major milestone. A full annular combustor has been successfully rig-tested demonstrating good light up, and light around characteristics and excellent low power stability over a range of air and fuel mass flows. The design is currently on target to reduce emissions of NO_x by 40% compared with conventional technology whilst still maintaining sufficient operability to meet commercial aero-engine requirements.

Compressor research undertaken at Cambridge University using low-speed linear cascade testing and unstructured CFD, showed that bleed slot geometry had a strong interaction with compressor flow at low bleed rates typical of normal operation. Modifications to the current geometry were made to address this. A comparison of the original and modified geometry shows a significant improvement to the compressor flow aerodynamics with the new bleed slot geometry. The new geometry retained the good aerodynamic performance of the original geometry at high bleed rates.



**structures
& materials
programme**
dr sarah bishop

The civil aeronautics structures and materials research programme addresses airframes and aero-engine materials. DTI funding directly contributes to industrially-based research. Aircraft and equipment manufacturers and the materials supply chain are widely represented in airframe projects aimed at wing structures, landing gear, brakes and nacelles among other aero-structures. Priorities for research are:

- development of theoretical predictive modelling for low-cost manufacturing processes, design and through-life issues
- development of low-cost manufacturing processes
- developing understanding of in-service issues to improve design, increase reliability and reduce life cycle costs.

Carbon-fibre composite technology for airframe applications has become strategic for the maintenance of UK Industry's competitive position and will feature strongly in future aircraft structures; cost-effective manufacture and novel processing will be essential for winning contracts. This year five DTI-supported projects on composites (total value £13M) have been launched involving Airbus UK, Aerostructures Hamble, Hurel-Hispano UK, GKN Aerospace and BAESYSTEMS with materials suppliers and research organisations.

Most airframes will continue to be manufactured predominantly from metallic materials. Aluminium alloys continue to be preferred, but increasing interest is being shown in low-cost titanium to replace steels with significant weight savings. Research commenced this year on titanium metal-matrix composites for wider aerostructure application, building on past MOD and DTI-supported research for aero-engine components.

For aero-engines, materials with good high temperature properties are crucial to engine life and reliability as well as improvements in engine performance but cost of manufacture, cost of ownership and environmental impact are also important. An important DARP research programme, ADAM was launched this year, with DTI supporting research on welding of advanced nickel alloys and net-shape manufacture of large titanium components.

Last year we reported that DTI had joined MOD in its Research Competition with the aim of bringing benefit from defence research to civil aeronautics industries. DEWMIPS, a research programme, led by TWI in the competition on Structural Joints and Joining Technologies, was launched this year with projects supported by MOD and DTI. In the two competitions covering Propulsion Technologies and Supportability issues, Rolls-Royce and QinetiQ were successful in Projects involving dual-use propulsion materials research.

**structures & materials
programme - highlights**

DTI support for research on carbon-fibre composite airframe structures has resulted in lower-cost manufacturing and significant increases in confidence in UK Industry in design with composites. There has continued to be a marked effect on the position of UK companies in global organisations. DTI funding has:

- strengthened Airbus UK's leadership in wing technology and positioned them and their UK-based supply chain well, for the supply of composite structures for future aircraft,
- enabled Bombardier Aerospace Belfast to develop technology to manufacture composite structures at 25% of the cost of metal structures
- strengthened many UK companies as potential suppliers of composite components for the Boeing 7E7 project.

Cost-effective net-shape manufacture of metallic structures has featured in DTI-supported research. Aluminium alloy casting technology has demonstrated potential for structural components such as Airbus hinged ribs for wing flaps. UK casting producers are positioned well to supply structural castings for Boeing. Titanium powder metallurgy is increasingly becoming attractive and is the subject of current research.

A DTI-supported prediction methodology for lifing aero-engine components has saved Rolls-Royce an estimated £37M by increasing service lives of discs in two marks of Trent engine, thus avoiding unscheduled maintenance and disruptions to aircraft operators.

Low-temperature film-adhesive repair technology for structural composites, has been developed in DTI-funded research led by the Advanced Composites Group working with civil aircraft industries. The technology is likely to lead to a reassessment of current repair techniques.



flight systems technologies programme
dr gill richards

This Programme aims to progress pre-competitive, collaborative research into areas under the remit described as Flight Systems. These areas cover systems associated with air traffic management, electronics, the flight deck, avionics, mechanical and power systems, cabin environment, computing and software. The research must be aircraft orientated but can extend to systems that interface with the aircraft. This is to accommodate the move towards integrated systems, including the use of modular avionics and increased air-ground integration.

Flight Systems is therefore a broad programme where much of the aircraft systems are addressed in terms of underlying technologies, complex systems, human factors, ground movement and interfaces with external influences such as ATC, Aircraft Operations and passenger services.

The programme has shifted its emphasis due to industry led national strategies and the changing role of QinetiQ. The LORCAS work undertaken by QinetiQ came to an end at the end of this year. The ongoing, industry programmes on the portfolio are collaborative and led by industry with university and SME participation. There are also a number of small, specialised projects which have been developed from particular needs expressed by industry.

Currently there are 10 collaborative programmes, the largest having 14 partners. Six programmes successfully finished within the year, five have started and many more are on the "starting block". The successes of finished programmes are expected to lead new projects in the future. The diversity of the newly started programmes indicates the spread and depth of UK industry in Flight Systems, each of the five programmes covering very different technologies. The DARPs initiative started last year produced two jointly funded, collaborative industry and university projects. Smaller projects have covered such topics as standards, obsolescence, human factors and wealth creation.

There are five National Advisory Committees, (NACs), in the Flight Systems area. They are:

- Human Factors
- Avionics and Flight Systems
- Synthetic Environments
- Systems Engineering
- Electronic Materials and Devices.

These committees have been involved in several initiatives to assist in the national strategy and direction of the industry.

One initiative has been to identify emerging technologies for the National Defence and Aerospace Systems Panel. Another has been to identify areas of strategic importance. Following this initiative three of the NACs, (Human Factors, Avionics & Flight Systems and Synthetic Environments) with the DTI and the CAA, have been in the process of organising a "Call for Proposals" in the relevant, identified areas. This Call will take place next year with DTI grant funding. The Synthetic Environments NAC is arranging a DTI-sponsored symposium for 18th November, 2003.

aircraft systems programme - highlights

Many of the Flight Systems themed projects come under the 'More Electric Aircraft' title, the largest being TIMES. This project is aiming to build facilities for the demonstration of 115V and 230V distributed powered systems. Most industrial sectors benefit from distributed electronic systems and when applied to the Aerospace industry, these benefits include:

Enhanced systems reliability and integrity, reduced fuel burn and emissions and enhanced prognostics capability. One of the key problems to overcome is safety critical operation in harsh environments. The HiTEAM project successfully developed electronics for control of the electric smart actuator and was also able to transfer this technology through to the smart well in the Oil and Gas industry, via the collaboration team. The ASPECTS project showed by the demonstration of duplex power generation and control system, the potential for the all electric hub.

SEALS, that also has cross-sector application, developed technology to enable broadband noise and vibration control to improve passenger comfort. MAFAS, a part DTI-funded EU project, recently ended with flight trials demonstrating semi-autonomous control using on-board technology and data link for air/ground communications. This type of technology leads the way into implementing the European Strategic Agenda and Vision 2020.

Three of the DTI/MOD funded Flight Systems National Advisory Committees are jointly organising with the CAA, a Call for proposals in the following three themes: Systems to Optimise Airspace Capacity, Processes for Through Life Support and Systems Integration. This Call, which is also supported by Operators, is anticipated to prompt a positive response to the initial stage for applications.



civil aviation & the environment

peter newton

The world's aerospace industries, and in particular the engine manufacturers, have to respond to a number of pressures that shape its technological, environmental, commercial and social responses over time. Environmental pressures have been in evidence for the past thirty years or more and the industry has long since recognised the need to respond appropriately. The reductions in all pollutants from aircraft engines has been real and sustained over this period, but gains are becoming harder to produce as the conventional technological boundaries are approached. DTI supports the research and innovation that addresses the need to control emissions, thereby facilitating the industry response to the growth of the aviation industry, with appropriate recognition of the need to address the industry's long-term sustainability.

The environmental standards to be met by aircraft and their engines are recommended by the International Civil Aviation Organisation's environment committee, the Committee on Aviation Environmental Protection (CAEP). These regulations relate, inter alia, to emissions and noise, and the next meeting of CAEP (CAEP6) will take place in February 2004. It is at this meeting that the current regulations for aircraft engine emissions will be reviewed with a view to setting possibly tighter standards for the future. Over the past 21/2 years, DTI has made a significant contribution to CAEP/5, the emissions Working Group of CAEP which has been considering proposals for tighter certification standards, and assessing the costs they might impose on the industry along with the benefits they might offer in terms of emissions reduction from civil aviation for the future. This process is still underway. However, the analysis thus far suggests that technological progress made by the engine manufacturers suggests that a modest tightening of current regulations might be in prospect.


Another working group is addressing the question of how to set long-term technology goals for the engine industry to both influence the industry's environmental performance along sustainable lines, whilst

offering a "forward view" regarding the prospects for improved environmental performance for the future. DTI has led the task group examining the setting of long-term technology goals. Proposals will be made to the meeting of CAEP/6 to initiate this long-term forward view for the industry. It is hoped that this process will assist all aviation industries in targeting their technological endeavours towards meeting the sustainability objectives for the industry over the long-term.

DTI has continued to contribute to the development of an aircraft emissions forecasting "package" for the AERO2K project sponsored by the European Commission. AERO2K will provide an aviation emissions forecast model that will provide an agreed view of the emissions from aviation in response to a range of growth scenarios. DTI leads on the forecasting task which will provide the facility to forecast aircraft emissions over a 25 year period, with the means to extrapolate trends over a further 20 years if necessary. This work is on track to complete at the beginning of 2004. The results of modelling will be used as inputs to European (and possibly global) policy making on aviation environmental issues over the next decade.

Still in the European scene, there is a growing desire to introduce alternative measures to reduce emissions from civil aviation within Europe, possibly the most effective means being the introduction of emissions charging. Charges are already imposed within Switzerland and Sweden, and it has been recognised that a harmonised charging regime would not only facilitate the introduction of schemes, but also provide a coherent message to the manufacturing industries for an appropriate technological environmental response: this was the rationale behind "ERLIG". ERLIG is a method of categorising aircraft environmental performance on the basis of the mass of emissions the aircraft produces during a landing and takeoff cycle, using certificated and publicly available data. This approach has been promoted by DTI as the fairest manner by which to categorise the emissions performance of aircraft. It has been adopted as the model to be used in charging regimes within Europe.

DTI has sponsored a "Bio-fuels" assessment project at Imperial College under the aegis of ICCEPT to examine the potential for renewable energy supplies to be provided for civil aviation. This research has now reached fruition and a report on this project is now available.



uk technology partnership

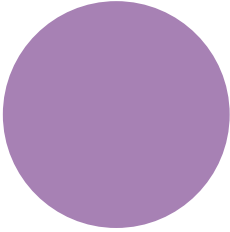
The Technology Branch of Aerospace & Defence in DTI is promoting a partnership approach for industry with government, academia and all organisations involved in aerospace and defence technology. The main focus for this is the National Defence & Aerospace Systems Panel although other bilateral activity, particularly with MOD, is included. This will be taken forward within the context of the Aerospace innovation and Growth Team which has been tasked to develop a shared strategy to enhance further the global competitiveness and success of the UK aerospace industry.

national defence & aerospace systems panel (ndasp)

The National Defence & Aerospace Systems Panel was launched in April 2002, sponsored jointly by MOD and DTI, to take forward the work begun under Foresight by the Defence, Aerospace and Systems Panel (DASP). It represents a unique forum to develop and co-ordinate strategy of importance to the defence and aerospace sectors. It comprises senior representatives of the major stakeholders: industry, MOD, DTI, EPSRC and academia, chaired by Ken Maciver, recently retired CEO of TRW Aeronautical Systems. During the past year the Panel has been specifically tasked to update the National Defence Industry Technology Strategy and to investigate mechanisms for improving the pull-through of the science base into business.

The Panel also continues to drive two key strands of work initiated by DASP: National Advisory Committees (NACs), and Defence and Aerospace Research Partnerships (DARPs). NACs bring together UK experts to act as national fora for defence and aerospace research and technology acquisition within their respective areas, and steps are being taken to ensure that their recommendations play a key role in setting national technology priorities. NACs have been established in the following areas:

- Aerodynamics
- Materials and Structures
- Avionics and Flight Systems
- Human Factors
- Synthetic Environments
- Systems Engineering
- Aerospace Manufacturing
- Mechanical Systems
- Electronic Materials and Devices



DARPs are industry-led university-based partnerships that focus on important areas of research. Projects valued in total at £18m have been placed over the past year through the DARPs 2002 initiative, funded jointly by the DTI Aeronautics Research Programme, MOD, EPSRC and industry.

defence technology

DTI also has a strong interest in maximising the benefit to the UK industry of MOD research funding. There has been activity at a number of levels directly with MOD over the past year. MOD has pursued initiatives such as Towers of Excellence, smart procurement and increasing commercial off-the-shelf (COTS) acquisition as well as launched the first tranche of Defence Technology Centres. We have been developing links with the Defence Science and Technology Laboratory (DSTL). We have built links with the MOD Capability Directorships which sponsor their Applied Research Programme. We would like to explore areas where it might be possible to work together more closely on dual-use (civil/military) areas. MOD stand to gain through increased visibility of technology in industry on the civil side for potential application in defence.

MOD are gradually opening much more of their research programme to competition. In appropriate dual-use areas we have joined MOD in the competition, offering DTI funding from the Aeronautics Research Programme to run projects of civil relevance aligned to the defence projects.



european issues

european commission framework programmes

Aerospace & Defence Technology Branch has been working closely with all parties to promote UK aeronautics interests in European Framework programmes. We have been taking a central position in awareness of the funding opportunities and in co-ordination and networking in the UK.

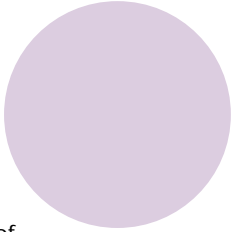
Framework 6 was launched with a strong Aeronautics programme and a budget for Aeronautics and Space of €1075 million. This broadly represents a continuation of the previous levels of funding but with additional funding for measures to increase operational capacity. In the first call in aeronautics, the topics had a strong element on operational capacity in which the UK does not have strong industrial capability. The share of funding to the UK may therefore be below that in previous Framework Programme calls.

Following the launch of the Vision 2020 paper in January 2001, the Advisory Council for Aeronautics Research in Europe (ACARE) has produced a Strategic Research Agenda. The Technology branch has been active in the work of the Council and the Working Teams preparing the Strategic Research Agenda (SRA). DTI held a dissemination event in the UK following SRA publication and has been active in the planning of follow-up activity for a second phase of the SRA.

group for aeronautical research & technology in europe (garteur)

The Director of Aerospace & Defence Technology is one of the UK representatives (with MOD) on the Council of GARTEUR, which is a unique body created under intergovernmental MOU to promote collaboration in civil and military aeronautics research within Europe. Membership includes all seven major European aeronautics nations: UK, France, Germany, Sweden, The Netherlands, Spain and Italy. The UK has been pressing the Council for some time to take a more proactive role in ensuring that GARTEUR contributes cost effectively to the European collaborative aeronautics scene.

Following the report of a GARTEUR Working Group on future strategy, a number of major changes to the organisation of GARTEUR have been agreed which should improve significantly the value of the organisation to the Member Nations including the UK.




The major strength of GARTEUR is its Groups of Responsables (GoRs) and the action groups they establish; teams of technical experts drawn from industry, RTOs and academia who come together to define and undertake programmes of collaborative research, drawing on a range of civil, military and industry funding sources. The Chairs of these GoRs will in future report directly to the Council and attend Council meetings. It is increasingly important that aerospace technologists representing both civil and military industry are well represented on these groups, to ensure that the collaborative research undertaken benefits fully UK business.

european transonic windtunnel (etw)

The UK in partnership with Germany, France and the Netherlands has established in Cologne a high Reynolds number windtunnel for the accurate testing of aircraft models under representative flight conditions.

Industry representatives have expressed their satisfaction with technical progress. ETW has been making an important contribution to the testing of models for the A380 aircraft. However these technical successes achieved by ETW have yet to be rewarded commercially. Market prospects are not as strong as the original forecasts indicated when it was decided, many years ago, to build ETW.

The current funding regime is for the period 1 January 2000 to 31 December 2003. As far as the UK involvement is concerned, the DTI will be making the entire UK financial commitment to ETW in 2003 enabling MOD to focus its limited resources on higher priorities. To ensure the long-term availability of this facility, the partner governments will be exploring all options from direct government subsidy to seeking from industry a much more active involvement in the management of ETW.



related initiatives in aerospace & defence

competitiveness challenge programme

As in previous years, Aerospace & Defence has supported the Society of British Aerospace Companies (SBAC) in the delivery of two important initiatives: Lean Aerospace (see below) and the Competitiveness Challenge. Key elements and achievements of the Competitiveness Challenge are:

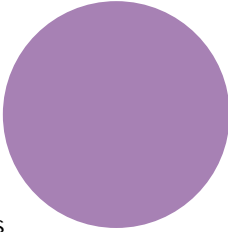
People Management – this activity has been strengthened by an interactive self-assessment tool within the SBAC's Careers website, which now consistently receives more hits per month than any other area of the site. In addition, the SBAC has forged links with both the Royal Aeronautical Society (RAeS) and the Science, Engineering and Manufacturing Technologies Alliance (SEMTA) to help develop effective people management activity.

e-Business – SBAC has developed a voluntary Code of Ethics for Reverse Auctions, and has also now completed a report covering Public Key Infrastructure (PKI)/Digital Signature technology. The Practical e-Business Leadership programme, described below is also pursuing this area.

Knowledge Management – SBAC maintains a website providing access to best practice information on a range of areas.

uk lean aerospace initiative (uklai)

The SBAC was originally awarded a DTI grant of £2.45m in January 2000 to train a team of Lean Master Engineers. The programme has now been extended and continues to offer subsidised Lean intervention activity to UK aerospace companies. The original target was to deliver over 300 Lean Engineering Master Classes for the UK Aerospace Industry, and this has now been exceeded with 312 Master Classes complete. Accelerated Improvement Workshops have also been developed and undertaken – these provide a shorter introduction into the benefits available from the implementation of Lean Enterprise techniques, thus providing a “stepping-stone” into a full Master Class.



Independently audited results from the Master Classes show that there has been significant benefits to the companies involved, with (for example) a mean improvement of over 50% for Value Added per Person being recorded.

In addition, SBAC's Lean Master Engineers have been working alongside those of the automotive sector's (SMMT IF's) Lean Master Engineers, using the same output measures and deployment methodologies, enhancing the overall capability of the sectors concerned. This process has been so successful that a Memorandum of Understanding is now in place to allow sharing of the two industry's Master Engineers.

This practical help in implementing Lean principles has been underpinned by an academic programme using four UK Universities to undertake targeted research into new Lean tools. Again new developments from this programme are made available to Industry at large via the SBAC's “Best Practice” website.

practical e-business leadership

Aerospace & Defence has also provided support to the Practical e-Business Leadership Programme, run jointly with UK Online. DTI support for this programme will continue until April 2004, and has provided e-Business assessment and improvement activity in 12 UK companies, which should increase to about 100 by the end of the programme. Also, 150 companies now better appreciate the benefits and impacts of e-business through the use of the PeBL Focus tool.

launch investment

The Department has supported the Industry for many years through Launch Investment, which represents a risk-sharing investment in major new aerospace developments and generates a positive cash flow to the Government. Significant projects supported in the past include the Airbus A320 and A330/340 programmes and Rolls-Royce V2500 and Trent programmes. More recently the Department has supported Airbus UK in the development of the new wing for the Airbus A380 programme and Rolls-Royce for the development of the Trent 600 and Trent 900 aero-engine programme. Launch Investment has helped to maintain the UK's competence in aerospace research and development by supporting Airbus and Rolls-Royce manufacturing centres of excellence in the UK.

aerospace & defence within the dti

Aerospace & Defence is a coherent unit in Business Relations which is part of the Business Group.

Recognising the vital importance of the industry to the success of the UK's economy, the Aerospace & Defence Unit seeks to further enhance the UK's productivity and competitiveness through:

- building strong relations with companies, trade associations and other government departments;
- ensuring industry's interests are taken into account in government decision-making;
- identifying specific opportunities for the maintenance and development of high technology and strategic industrial capabilities.

The Aerospace & Defence Unit is organised into five teams:

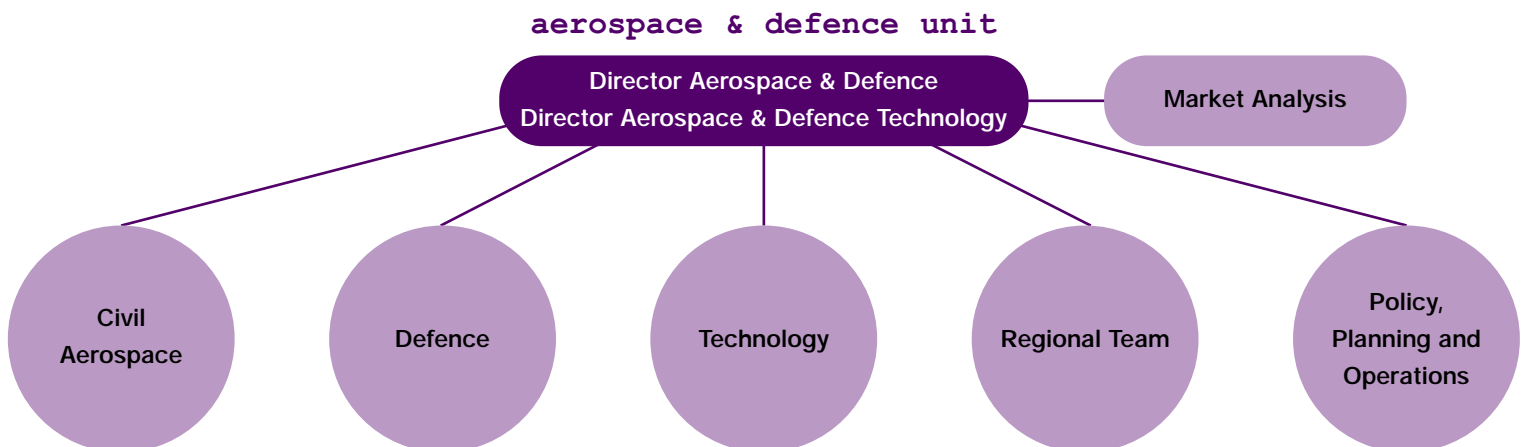
Aerospace – responsible for relations with the airframe (civil), regional jet, aero-engines and aerospace and equipment industries; civil export issues; follow-up to the Aerospace Innovation and Growth Team report; launch investment.

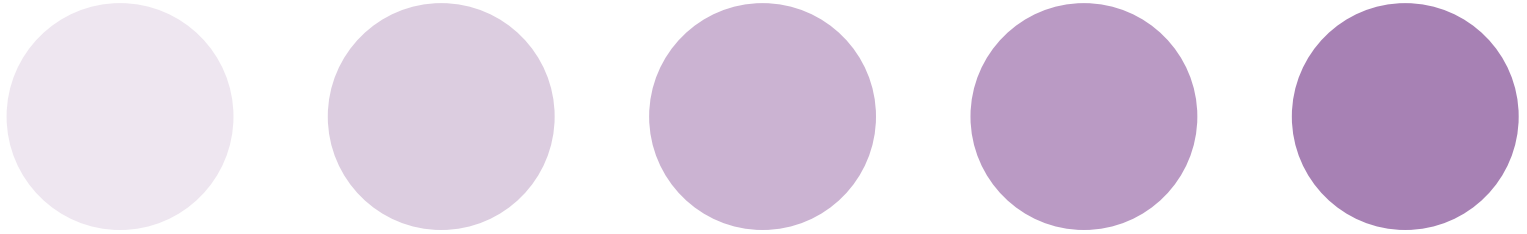
Defence – responsible for relations with defence prime contractors and the Defence Industries Council, and the helicopter, guided weapon and defence land systems industries; co-ordination of evaluation of the industrial implications of major UK defence procurement programmes; and DTI involvement in the development of UK defence industrial policy.

Technology – responsible for provision of technical advice in Aerospace & Defence; working with civil aeronautics companies to support a long-term technology strategy with the DTI Aeronautics Research Budget (formerly CARAD); and promoting partnership in technology acquisition between government, industry and academia on the industry agenda; responsible for aerospace environmental issues.

Regional Team – responsible for regional outreach; relations with medium sized companies and regional trade associations; and relations with the Small Business Service.

Market Analysis – responsible for market and strategy analysis in support of the aerospace and defence industries.





aerospace & defence technology team

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http://www.dti.gov.uk/sectors_aerospace.html





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