



**midlands aerospace alliance**

**Aerospace in the East Midlands:  
industry structure, industry dynamics  
and innovation drivers**

**RESEARCH REPORT FOR  
EAST MIDLANDS TRANSPORT INET**

**JUNE 2009**

## **Executive summary**

This report summarises the structure of the aerospace industry in the East Midlands, sets out the key industry dynamics from the perspective of technology and innovation, and identifies the main drivers of innovation from industry and policy perspectives.

### **Structure**

The aerospace industry is a highly attractive and growing sector on a world scale.

The Midlands is home to one of the world's largest aerospace clusters.

The East Midlands contains one half of the overall Midlands aerospace cluster.

The core technologies underlying the Midlands aerospace cluster are:

- systems that power aircraft – gas turbine engines and other propulsion systems
- systems that control the moving parts of aircraft and engines – electrical, mechanical, electronic, hydraulic and pneumatic
- specialist metal and composite materials that enable these systems to perform with precision in exacting environments
- specialist engineering design services, factory equipment and tooling

There are about 250 Midlands companies at the core of the aerospace cluster.

Long-term relationships between customers and suppliers in supply chains are critical to the structure and functioning of the aerospace industry.

Small and medium sized enterprises (SMEs) are generally peripheral to the structure, dynamics and innovation drivers of aerospace.

The East Midlands has a high concentration of aerospace research activity at universities, sponsored by key UK and global prime contractors/ systems suppliers:

The main regional support body is the Midlands Aerospace Alliance.

Rolls-Royce large civil aircraft engines play a central role in East Midlands aerospace. In addition, companies focus on supplying specialist technologies to pan-European aerospace programmes and have built on the strengths of the Midlands cluster to win global business.

A number of companies are very dependent on aerospace markets. A larger number, however, are less than 50% dependent on aerospace markets.

East Midlands aerospace suppliers have linkages with other transport sectors, especially automotive. Links to non-transport sectors are at least as important, including power generation and oil and gas.

## **Dynamics**

Since the 1950s, the commercial global aerospace industry has experienced a sustained period of market growth -- punctuated by periodic economic and political shocks.

Boeing's current 20 year industry forecast projects that the size of the world's aircraft fleets will double.

From an innovation policy perspective it is important to recognise the slow clockspeed of the aerospace product life cycle.

The main thrust of innovation in aerospace is primarily about developing new technologies to insert them onto new aircraft programmes.

For the Midlands, the emerging Boeing and Airbus "New Short Range" (NSR) programmes represent a particularly important opportunity.

Relatively, the Midlands is not a defence-dependent region.

Midlands companies will continue to find outlets in niche markets.

For the supply chain as a whole, it is vital that companies invest in developing their contributions towards technologies ready for insertion on new aircraft.

## **Innovation focus**

A basic SWOT analysis of innovation in the Midlands aerospace cluster suggests that while there is still a strong base, and major programme opportunities, innovation support along the supply chain is fragmented, whilst governments in other countries and regions are making sustained investments to attract global aerospace business into their territories.

Key business enablers related to innovation -- capabilities and capacities East Midlands aerospace companies must possess if they are to compete successfully to bring NSR business and therefore employment into the region -- include:

- Investment in large-scale National Aerospace Technology Strategy (NATS) programmes (such as Environmentally Friendly Engine and Next Generation Composite Wing) that provide the technology building blocks
- Development of new technologies for aerospace applications – including greener technologies – in coordinated ways along the entire supply chain
- Technology foresight for supply chain companies and regional networking in technology development
- Integrated regional strategy to coordinate regional resources, including roadmapping and development of regional centres of excellence.

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## 1 Introduction

### 1.1 *This report*

This report summarises the structure of the aerospace industry in the East Midlands, sets out the key industry dynamics from the perspective of innovation and new technology, and identifies the main drivers of innovation from industry and policy viewpoints. It is based on a series of research and policy documents developed in recent years by the Midlands Aerospace Alliance (MAA) led by the MAA Innovation and Technology Group which includes senior engineering and technology managers from the region's leading aerospace companies. These documents have been brought together so as to provide a summary of the key themes.

### 1.2 *The aerospace industry*

The aerospace industry is a highly attractive and growing sector on a world scale. The UK has the largest aerospace industry outside the USA and is potentially well placed to exploit further growth in the global marketplace. Along with pharmaceuticals and finance, aerospace is recognised by the government nationally as one of the UK's most globally competitive industries. With a turnover exceeding £20 billion annually, the sector exports more than 60 per cent by value of all its sales and supports a positive balance of trade worth in excess of £2 billion.

Aerospace is a high-technology industry and invests more than £2.5 billion each year in research and technology development. At the same time, aerospace provides important balance to the UK economy by sustaining high-value careers in design, research, engineering and manufacturing: 34% of all UK aerospace employees hold a university degree or equivalent (forecast to increase to 40% by 2010); skilled technicians comprise a further 31% of the workforce (also growing); salaries are 43% above the national average and 31% above the manufacturing average. In the key UK aerospace regions – North West, South West, South East and Midlands -- aerospace is a high value user of labour and makes a significant contribution to economic vitality and regional GVA.

The Midlands is home to one of the world's largest aerospace clusters, and aerospace systems designed and made in the Midlands can be found on the world's most advanced aircraft. Leading names such as Rolls-Royce, GE Aviation, Goodrich and Meggitt are major players in the region, supported by a significant cluster of aerospace companies and associated institutions which stretch across the East and West Midlands, linked by common technologies and skills, integrated supply chains, and shared challenges.

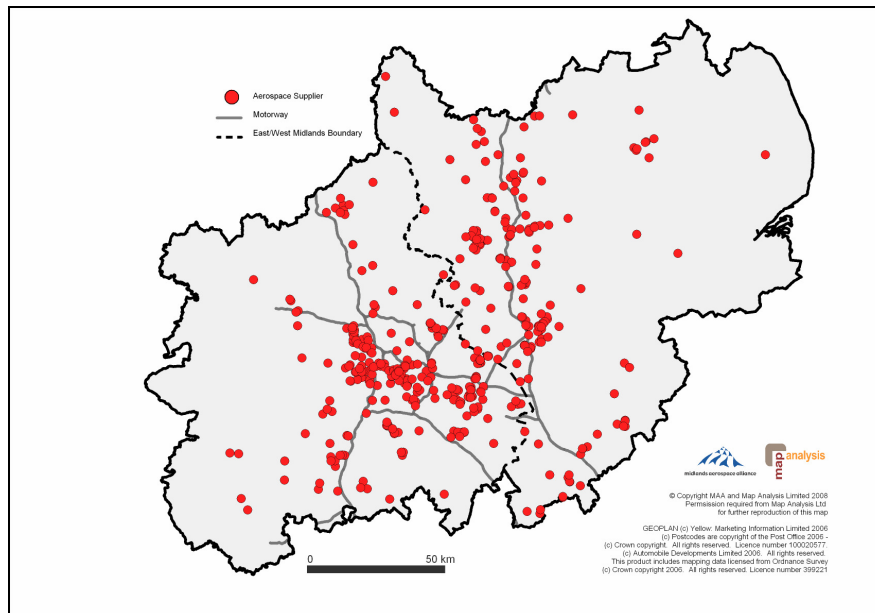
## 2 Industry structure

### 2.1 Size of industry in the East Midlands

The East Midlands hosts one half of the overall Midlands aerospace cluster, accounting for 40% of the estimated 700 companies that participate, to varying degrees in aerospace supply chains, and 55% of the estimated 45,000 full-time-equivalent jobs created by aerospace industry revenues drawn into the region from global markets.

### 2.2 Location

As the map below reveals, most East Midlands aerospace companies are located along the M1 corridor, in Leicestershire, Nottinghamshire and Derbyshire.



Source: MAA

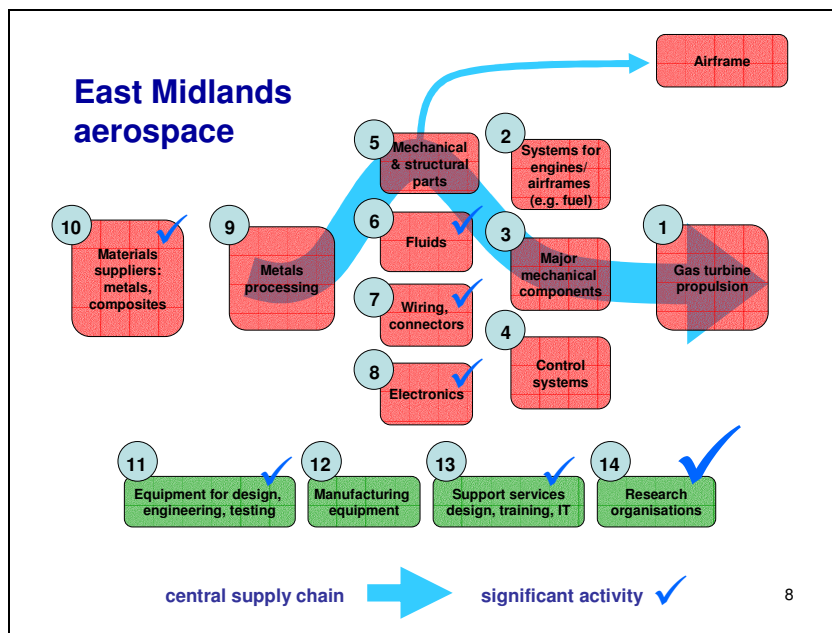
### 2.3 Core technologies

The core technologies around which the Midlands aerospace cluster coheres are

- systems that power aircraft – gas turbine engines and other propulsion systems
- systems that control the moving parts of aircraft and engines – electrical, mechanical, electronic, hydraulic and pneumatic
- specialist metal and composite materials that enable these systems to perform with precision in exacting environments
- specialist engineering design services, factory equipment and tooling

## 2.4 Cluster structure

There are about 250 Midlands companies at the core of the aerospace cluster. Supply chains for the core technologies criss-cross the region from prime contractors (OEMs) and technology systems suppliers in the East Midlands to the West Midlands and vice versa and extend deep into the region’s advanced engineering economy. The core cluster structure of aerospace in the East Midlands aerospace is centred on the gas turbine technologies supply chain around Rolls-Royce, and the company itself accounts for about 40% of all aerospace employment in the East Midlands. This structure is illustrated in the blue arrow in the chart below of the structure of the Midlands aerospace cluster as a whole. Other significant parts of the cluster represented in the East Midlands are indicated by blue tick marks.



Source: MAA

## 2.5 Key role of supply chains

Because aircraft remain in production for 25-50 years (see below), long-term relationships between customers and suppliers in supply chains are critical to the structure and functioning of the aerospace industry. Qualifying a supplier to make a particular part on an aircraft is resource-intensive and expensive, which makes switching difficult. Accordingly, an inter-firm relationship can typically last for several decades.

Many Midlands companies tend to be situated in the lower tiers of supply chains, as suppliers of components and parts for engines and systems, and specialist materials and services. There is no production of aircraft *per se* of significance in the region. To a large degree, has position of the cluster as a whole has enabled the region to build on its strengths and diversify markets across global aircraft programmes located elsewhere (see below). The same technologies that are furnished to Rolls-Royce and Airbus are also offered to these companies’ global competitors.

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## 2.6 SMEs

It is worth noting that small and medium sized enterprises (SMEs) are generally peripheral to the structure, dynamics and innovation drivers of aerospace in the East Midlands even if they play useful supportive roles from a cluster perspective. While two in three aerospace companies (>95% in whole East Midlands) are SMEs, these are responsible for less than one in ten aerospace jobs (70% in whole East Midlands).

Few SMEs can thrive in the core structure of the global aerospace industry because of its high investment requirements and its slow product lifecycle clockspeed. Merger and acquisition of successful and failed companies alike, over the course of the economic cycle, tends to produce larger business groups over time. In the East Midlands, aerospace SMEs are concentrated in: engineering/machining of mechanical parts (3% of East Midlands aerospace jobs), engineering equipment specialists (1%) and support services (3%).

## 2.7 Research organisations

The East Midlands has a high concentration of aerospace research activity at universities, sponsored by key UK and global prime contractors and systems suppliers:

### *Rolls-Royce*

- Loughborough – combustion
- Nottingham – transmissions
- Nottingham – manufacturing

### *BAE SYSTEMS*

- Leicester – controls
- Loughborough – systems engineering

### *GE Aviation*

- Nottingham – power controls

By their nature, these centres are nodes in national or global innovation systems and tend to be linked primarily to the sponsoring prime contractor which has created them to undertake its research work and may not be located in the East Midlands. In some cases there are links to regional aerospace companies (e.g. Nottingham, manufacturing) but this is not the norm (e.g. Leicester, controls).

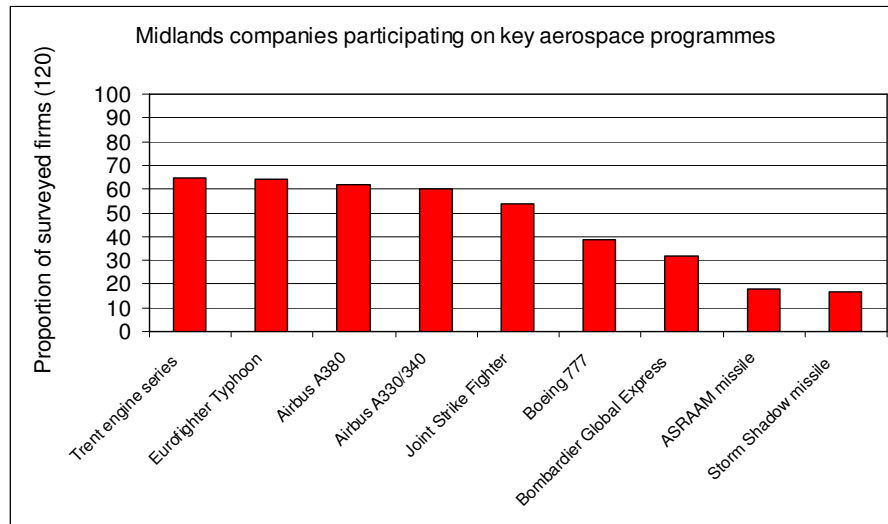
## 2.8 Support bodies

The main regional support body is the Midlands Aerospace Alliance, covering East and West Midlands. This is one of a UK-wide network of regional aerospace alliances under the umbrella of the Society of British Aerospace Companies, The MAA has 250 member companies, and its board represents both the main regional primes/systems suppliers and the aerospace supply chain. The MAA is partly funded by member subscriptions, and largely through the delivery of regional government support programmes to aerospace companies and employees funded by Advantage West Midlands and the East Midlands Development Agency: principally to support business development, innovation and new technology, and improved supply chain performance.

## 2.9 Key aircraft programmes

Rolls-Royce large civil aircraft engines (Trent series) play a central role in East Midlands aerospace. In addition, the legacy of the aerospace industry's role as a UK "national champion" industry can be

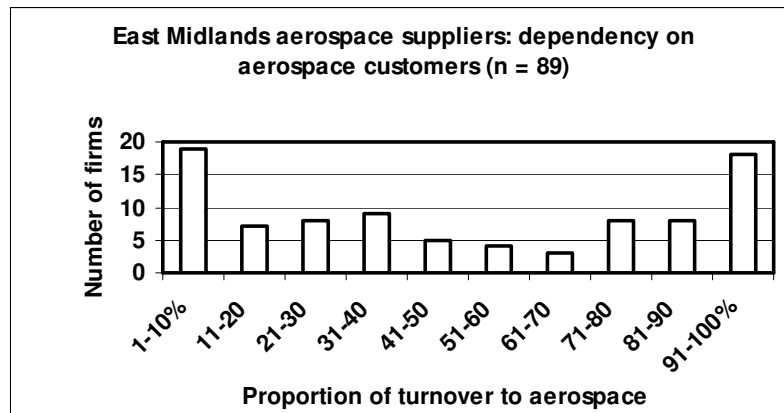
seen in the Midlands focus on supplying its specialist technologies to pan-European aerospace programmes – Airbus wings, Eurofighter Typhoon components, weapons technologies. But many companies have built on the strengths of the Midlands cluster to win global business, partly through Boeing, but also through the Canadian aircraft manufacturer Bombardier and indeed Rolls-Royce’s rivals in the engine market including US companies GE Engines and Pratt & Whitney.



Source: MAA 2006 (data refer to whole Midlands, not available for East Midlands)

### 2.10 Aerospace market dependency

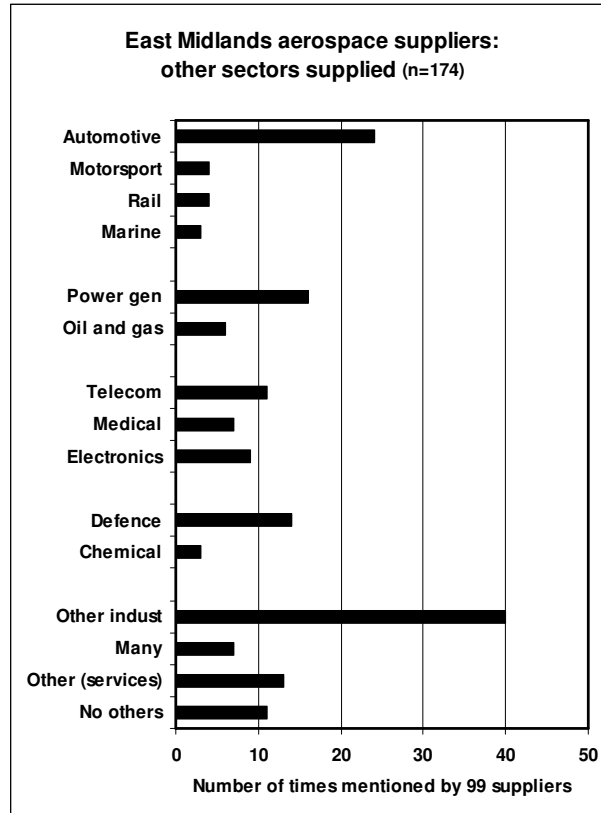
The degree of aerospace market dependency amongst aerospace suppliers shows a typical U-shape pattern. A number of companies are very dependent on aerospace markets, especially manufacturers of “flying parts” (i.e. go onto aircraft) in the direct supply chains of aerospace prime contractors and systems suppliers. A larger number, however, are less than 50% dependent on aerospace markets, especially companies that furnish “non-flying” services and equipment to the industry.



Source: emda aerospace cluster study

### 2.11 Inter-industry links

Data on other markets supplied by East Midlands aerospace suppliers shows linkages with other transport sectors, especially automotive. There are some links to rail and motorsports; marine links tend to be for large-ship gas turbine engine technologies. Links to non-transport sectors are at least as important, including power generation, oil and gas, defence, telecommunications, medical and electronics.

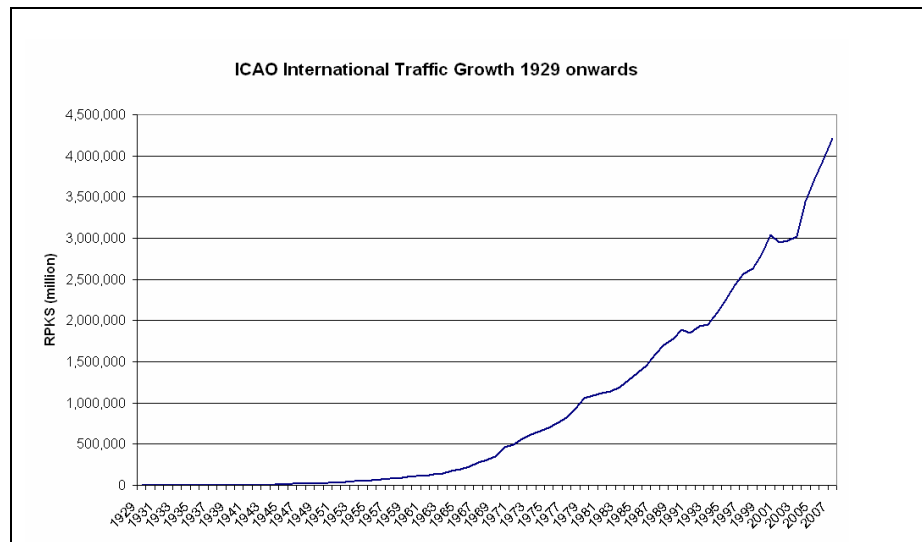


Source: emda aerospace cluster study

### 3 Industry dynamics

#### 3.1 Long term global growth

Since the 1950s, the commercial global aerospace industry has experienced a sustained period of market growth -- punctuated by periodic economic and political shocks. Consumer demand, measured in aerospace as *revenue passenger kilometres*, is projected to continue to grow for the next 20 years at least, at rates of 4-5% per annum.



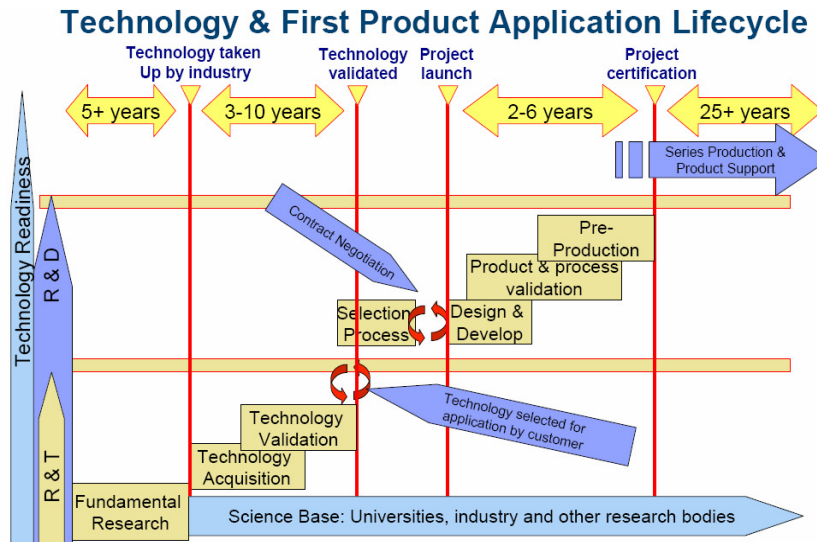
Source: UK DBERR based on ICAO

The world's leading makers of large civil aircraft, Airbus and Boeing, publish market projections for the number of new aircraft needed to meet consumer demand. While they differ in detail, the projections are broadly similar. Boeing's current 20 year industry forecast projects that the size of the world's aircraft fleets will double. Taking into account that many of today's aircraft will need to be replaced, over 28,000 new aircraft will be required by 2028.

#### 3.2 Innovation clockspeed

From an innovation policy perspective it is vital to recognise the slow clockspeed of the aerospace product life cycle. Aircraft are in military service today that were designed 60 years ago. Some of the world's currently most successful civil aircraft were designed over 40 years ago. The design and development of a new civil aircraft takes typically some 6 to 7 years. Potential suppliers of parts and equipment must get involved at the earliest stages, often several years before the design phase is formally started, offering the most innovative technical proposals and creative and competitive commercial packages. With the lifecycle of a new aircraft typically then extending more than 25 years following entry into service, it is important for suppliers to win approvals from customers to produce new aircraft parts and thus win a share of the available business emanating from the programme. Failure to do so means companies are excluded for the lifetime of the aircraft.

The lifecycle of a typical aircraft development programme is illustrated below.



Source: BERR department

### 3.3 Importance of key aircraft programmes

The main thrust of innovation in aerospace is therefore primarily about developing new technologies – for instance, to reduce aircraft weight or reduce engine emissions -- to insert them onto new aircraft programmes. With the new Airbus A380 (large aircraft category) and Boeing 787 (twin aisle aircraft category) moving into series production and the technologies for the Airbus A350 (twin aisle) currently in development already largely settled, the next big prize for companies involved in the global aerospace industry is to secure positions contributing to a new aircraft programme variously dubbed “New Short Range” (NSR) or “New Single Aisle” (single aisle category). Airbus and Boeing have – as yet not publicly announced -- plans to offer competing new aircraft in this segment for first delivery to airlines in about 2018-20. NSR would replace the Boeing 737, first introduced by Boeing in 1967, and the Airbus A320, commercially launched in 1988. The UK BERR department forecast that these aircraft will account for 60% of all civil aircraft deliveries over a 40 year period. Companies that supply materials, components and systems on NSR will have secured business for decades, as the last aircraft produced will require maintenance and overhaul for a further 20 years. Whilst other new aircraft will be launched, NSR is viewed as the key opportunity of the next decade by aerospace companies -- and regions -- the world over.

For the Midlands, NSR represents a particularly important opportunity. Midlands companies have strong positions on the A320, ranging from the supply chain for one of the engines offered to airlines, through Rolls-Royce’s IAE partnership, to the supply of key mechanical parts for the wings by Goodrich. But the Boeing 737 is largely a US-made aircraft, with no Rolls-Royce engine offering and little Midlands participation. Thus while Midlands companies will have to defend their current positions on A320 against tough global competitors when it comes to the Airbus NSR aircraft, the advent of Boeing’s NSR presents an important opportunity for the region. The question here is what share of the manufacture of the Boeing NSR aircraft’s materials, components and systems can be attracted to the Midlands – ranged of course against the same global competitor companies and regions which equally seek a share. Notably, Boeing’s aircraft subsequent to the 737 – from the 747 to the 787 – have seen higher levels of Midlands participation as Boeing has increasingly tapped into Midlands capabilities that were initially developed for the UK and European aerospace industry.

The principal beneficiaries have been GE Aviation in Wolverhampton and Rolls-Royce in Derby, but various other companies have also won contracts to supply Boeing or Rolls-Royce's competitors.

Relatively, the Midlands is not a defence-dependent region. Defence markets – for example, supply of components and systems to the Eurofighter Typhoon aircraft currently in series production -- make up one quarter of regional aerospace turnover, compared to one half for the UK as a whole. Midlands companies would benefit from any future sales of Typhoon to the growing defence markets of the Asia Pacific region. Other firms will benefit from UK participation as a partner in the world's largest defence aircraft programme, the US-led Joint Strike Fighter (Lightning II), which is currently completing its development phase.

Midlands companies will continue to find outlets in niche markets, in the fields of general aviation, rotary winged aircraft (helicopters) space, and unmanned air vehicles (UAVs) for civil and defence use. But whilst there are smaller new aircraft programmes planned in intervening years, such as the Bombardier C-Series, new technologies for insertion on NSR must be central to the innovation focus for aerospace in the East Midlands to secure the industry's long-term future.

### 3.4 Innovation focus for NSR

To prepare for NSR, the aircraft manufacturers, engine makers, systems suppliers and materials providers are already undertaking significant work to develop technologies that can offer the airlines more aerodynamic designs, more environmentally friendly engines, lighter-weight composite materials and “more electric” power systems throughout the aircraft – and thus give NSR a step-change performance advantage over the 737 and A320. The UK as a whole is well positioned to compete in a number of technology areas anticipated to be key to NSR. The East Midlands in turn is well positioned in a subset of technologies. In the chart below, areas of East Midlands' strength lie in contributions to: new generation engines, moveable surface systems, electric self powered taxiing, faster cooling brakes, simpler and aerodynamic landing gear, distributed electronics, more electric, systems integration, innovative manufacturing, improved communications, efficient lightweight structures using new materials and processes, quicker & more accurate refuelling, improved aerodynamics and laminar flow, greater electrical power generation & distribution, and deeply integrated supply chain.



Source: UK BERR department

For the supply chain as a whole, it is therefore vital that companies invest in developing their contributions towards these technologies ready for insertion on the aircraft and ready for their manufacture and servicing. In this context timing is everything.

## 4 Industry SWOT

A basic SWOT analysis for the Midlands aerospace cluster puts the innovation challenge facing the East Midlands (bold, below) into broader competitive context. While there is still a strong base, and major programme opportunities, innovation support along the supply chain is fragmented, whilst governments in other countries and regions are making sustained investments to attract global aerospace business into their territories.

<b>SWOT analysis for Midlands aerospace cluster</b>	
<p><b>Strengths</b></p> <ol style="list-style-type: none"> <li>1. Global market access and reputation of key companies</li> <li><b>2. Expertise in design, manufacturing, materials, strong research base</b></li> <li>3. Broad range of flexible supply chains</li> <li>4. Strong skills base with active labour market</li> <li>5. Active regional clustering to build on</li> </ol>	<p><b>Weaknesses</b></p> <ol style="list-style-type: none"> <li>1. Traditional supply chain companies unprepared to compete in global markets</li> <li><b>2. Fragmented support for technology innovation along supply chain</b></li> <li>3. Deficits in operations management capability</li> <li>4. Ongoing skills, capability and knowledge gaps</li> <li>5. Clustering weakened by poor vertical supply chain relationships</li> </ol>
<p><b>Opportunities</b></p> <ol style="list-style-type: none"> <li>1. Global and inter-industry business opportunities across the sector</li> <li><b>2. Innovation of new products and services using customer needs and major national programmes as drivers</b></li> <li>3. Participation in industry supply chain improvement programmes</li> <li>4. Potential to continue to draw young people into high-tech industry</li> <li>5. Application of best practice in clustering within region and from other regions.</li> </ol>	<p><b>Threats</b></p> <ol style="list-style-type: none"> <li>1. Growing threat of developed economy and emerging market competitors across the board</li> <li><b>2. Technology base in competing regions is increasingly capable as governments strategically target aerospace</b></li> <li>3. Lean global competitors address quality, cost, delivery with increasing effectiveness for superior performance</li> <li>4. Low cost of overseas labour and investments in growing large engineering cadres</li> <li>5. Competitor regions invest heavily in widely agreed cluster development strategies</li> </ol>

Source: MAA

## 5 Regional innovation strategy for aerospace

It is possible to define a series of key business enablers -- capabilities and capacities East Midlands aerospace companies must possess if they are to compete successfully to bring NSR aerospace business and therefore employment into the region. Investing in these capabilities will equally prepare the region's companies to compete in other aerospace markets which will increasingly demand the same technologies and management capabilities as NSR - as this aircraft programme becomes the new industry benchmark.

In addition to business enablers related to business development capabilities, operational and supply chain performance, finance availability, workforce skills and clustering, enablers related to innovation in East Midlands aerospace include:

- Investment in large-scale National Aerospace Technology Strategy (NATS) programmes (such as Environmentally Friendly Engine, Next Generation Composite Wing, SAMULET or Power Up) that provide the technology building blocks
- Development of new technologies for aerospace applications – including greener technologies – in coordinated ways along the entire supply chain
- Technology foresight for supply chain companies and regional networking in technology development
- Integrated regional strategy to coordinate regional resources, including roadmapping and development of regional centres of excellence

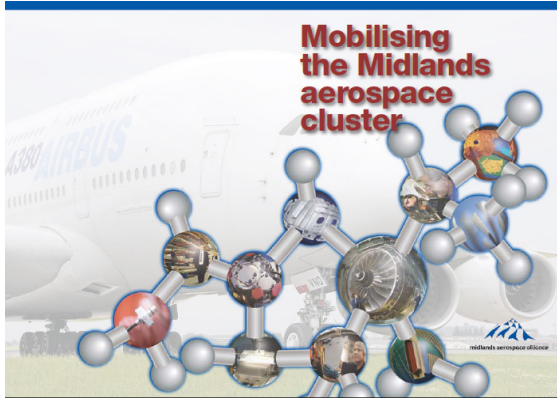
In order to better define the best focus of regional policy intervention to support aerospace in the Midlands, the Midlands Aerospace Alliance Innovation and Technology working group, comprised of senior engineering and technology managers from across the region, developed the strategy and required actions set out in the table overleaf. The group's main recommended priorities are identified in bold italics.

The three paramount objectives	Main objectives	Related objectives	Identified actions and objectives to which they contribute
1. Integrated strategy for Midlands aerospace	<p><b>A</b> Ongoing regional strategy formulation Links to Euro and national R&amp;D programmes Influence “national” strategies</p>	<p><b>B</b> Clear long-term agenda for Midlands aerospace innovation and technology development, private and public, within national framework <b>G</b> Accurate and updated Midlands aerospace R&amp;D capabilities map.</p>	<p><b>A</b> Ensure Midlands representation on all key national bodies A, B, E Identify high/medium/low potential sub sectors A, B, G <b>Regional technology roadmap for aerospace</b> C, F, A Link closely to regional economic strategy (innovation priorities and sectors and clusters) A, C Solid industry participation in regional strategy A, B Identify and communicate relevant national strategies A, B, E Regular consultation exercise following establishment of strategy A, B <b>B</b> Pull strategy – tier 1s and primes A, B Develop growth strategy for high potential sub sectors A, B Focus on NATs priorities for region A, B Top down/bottom up industry-led exercise to align national &amp; regional including identifying regional priorities not included in national strategy A, B <b>G</b> Regular survey of all MAA companies A, B</p>
2. Future technology planning for individual companies	<p><b>F</b> Assist with company technology development, insertion and exploitation strategy. Identify and plan insertion of new technologies (down, up, sideways). Work with supply chain companies to ensure they have good technology/ innovation strategies</p>		<p><b>F</b> <b>Deliver a technology requirement planning package of support for supply chain company innovation</b> F Resource – linkage with other programmes where relevant, e.g. MAS F, C</p>

The three paramount objectives	Main objectives	Related objectives	Identified actions and objectives to which they contribute
<p>3. Development of support package to promote supply chain participation in R &amp; T programmes.</p>	<p><b>D</b> Ensure high level of participation by Midlands aerospace companies and organisations in national and global aerospace technology development programmes</p>	<p><b>E</b> Assist companies to access national (e.g. TSB, EPSRC) and European (e.g. Framework 7) funds and regional resources. Regional intervention to focus on supply chain</p>	<p><b>D</b> <b>Supply chain technology investment programme with substantial resources</b> -- like MAA's West Midlands Technology Exploitation D, C, E, F Work with primes to develop technology collaboration with suppliers D, E, E <b>Encourage RDA investment in technology in supply chain (NATS)</b> D, E Lead companies and MAA to help communications (several) E Provide supply chain company bid funding and mentoring E Communicate – up coming opportunities, collaboration requests and success stories E Ensure effective communication by funding sources and regional providers E Provide a funding opportunities service with specific contacts for access E</p>
<p>4. Other</p>		<p><b>C</b> Promote manufacturing innovation and embedded into supply chain <b>H</b> Retain talent in our region – create jobs</p>	<p><b>C</b> Workshops/seminars. Promotion events. Case studies C, D, E Midlands membership of extra regional technology centres (eg AMRC) C Form best practice manufacturing sub-group of active companies to share knowledge (community of manufacturing managers/technologists) C <b>H</b> Promote university/industry graduate researcher exchange H Teaching company / knowledge transfer scheme linked to innovation H</p>

## 6 For further information

The additional documents below can be obtained by contacting the Midlands Aerospace Alliance at [info@midlandsaerospacealliance.org.uk](mailto:info@midlandsaerospacealliance.org.uk).



An analysis of the economic functioning of the Midlands aerospace cluster including innovation drivers



Handbook of aerospace specialist research and technology development activities at universities in the Midlands



Midlands Aerospace Alliance membership directory published each year with details of 250 companies



Midlands Aerospace Alliance quarterly newsletter with news on MAA support programmes, innovations and new technologies for aerospace customers