
SECTOR BULLETIN: AEROSPACE



In association with:

MANUFACTURING ROUND UP

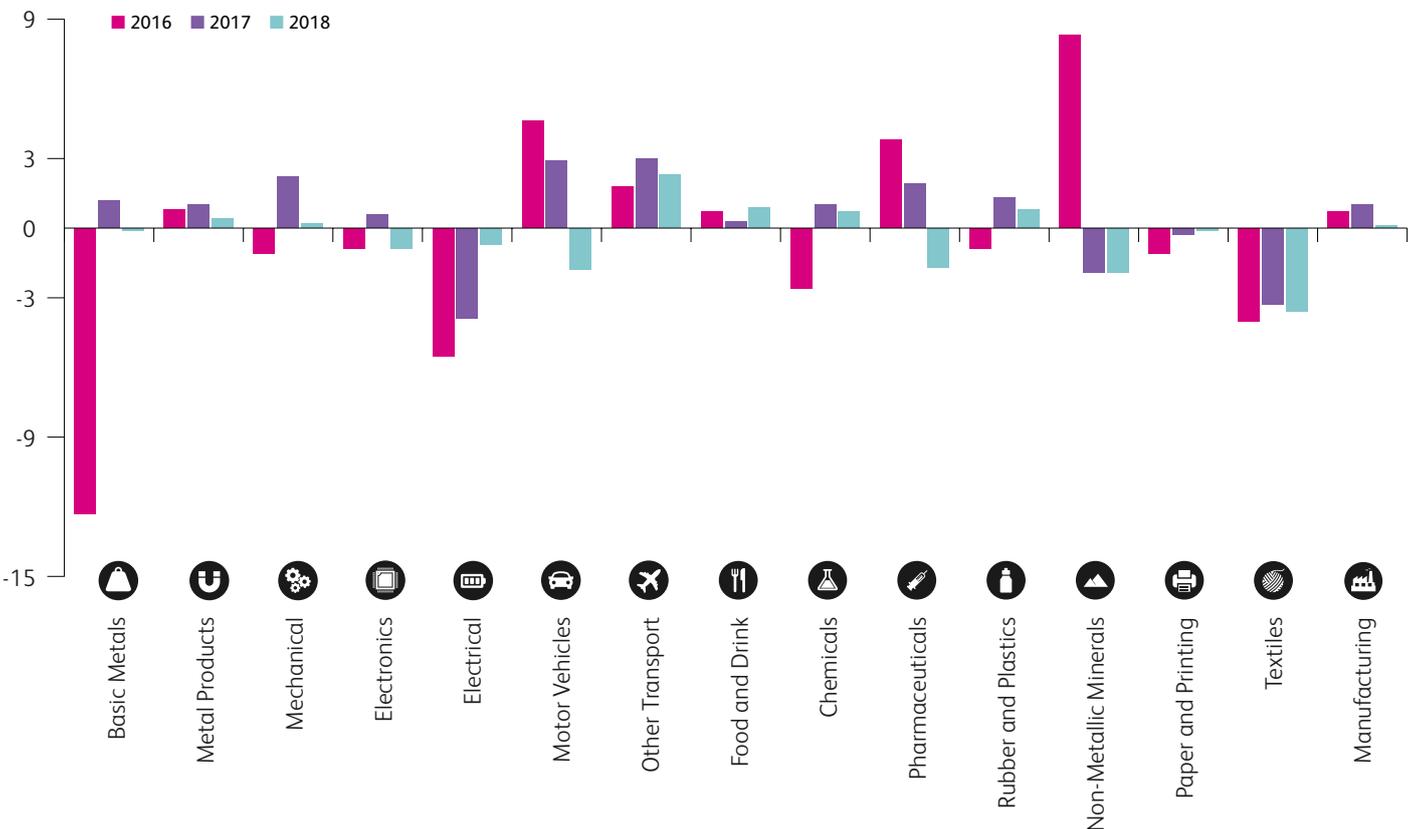
Welcome to our second Sector Bulletin report in partnership with Santander. This time we take a deep dive into the UK’s aerospace industry, looking at its structure, global presence, recent performance, risks, opportunities and long-term trends. But before we turn our attention to everything aerospace, we take stock of how the overall manufacturing industry has fared over the past year and the key trends affecting the outlook of different sectors.

The manufacturing industry recorded solid growth in 2016, with output expanding by 0.7%. However, once again, growth was underpinned by significant variation in the performance of manufacturing sectors. Soft global demand, weak manufacturing investment and the slump in global commodity prices saw the capital goods and metals industries take a significant hit. On the other hand, global deflationary pressures provided a significant boost to consumer-facing manufacturing sectors, as UK households moved to spend the extra cash on the UK economy.

Since the end of 2016 we’re seeing a reversal of these trends. The combination of improving export demand from key overseas markets and the hefty depreciation in Sterling is providing supportive conditions for export-intensive sectors. Conversely, the mix of rising global commodity prices and Sterling depreciation is pushing up inflation, spelling bad news for consumer-facing sectors. In this section we look at how these trends are likely to affect manufacturing sectors in 2017.

Manufacturing round up

% yearly change, GVA output



Source: EEF & Oxford Economics (2017)



GLOBAL MANUFACTURING ACTIVITY ON THE UP

Global manufacturing activity has picked up considerably since mid-2016. After a soft patch that stretched to almost two years, manufacturing PMIs in the US, China and the Eurozone are all firmly rooted in positive territory at the start of 2017.

As a result, manufacturing investment has come back online and orders have been flowing through the international supply chain. What's more, the Sterling

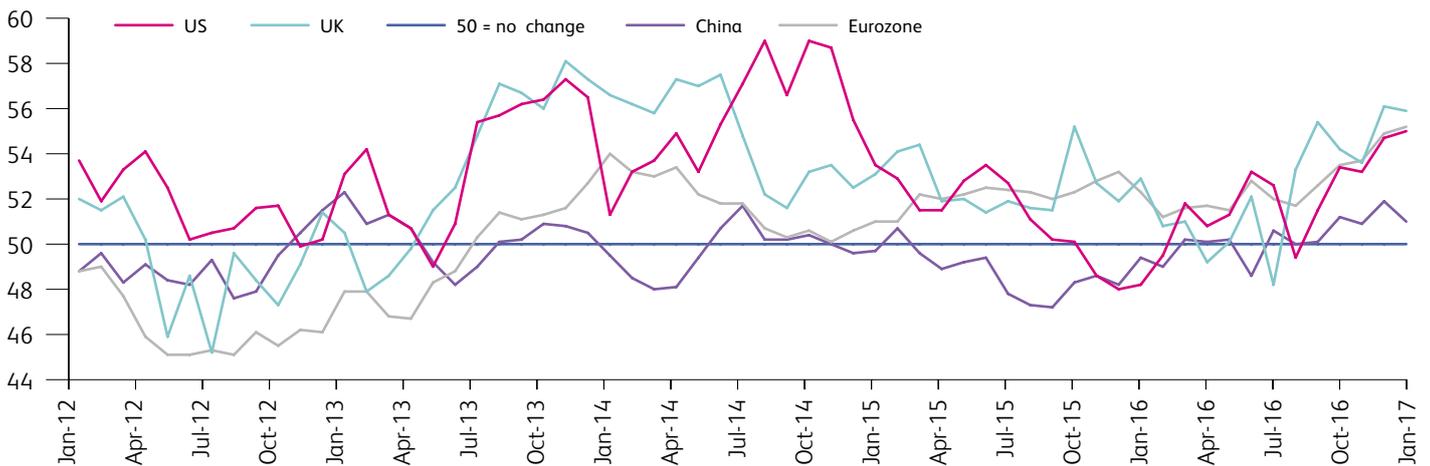
depreciation has positioned UK manufacturers to take advantage of improved global demand conditions. Export-intensive manufacturers in commoditised industries, such as basic metals and chemicals, are likely to see the most of this twin benefit. High value-add manufacturers with an exposure to overseas markets, such as mechanical equipment and motor vehicles, should also benefit from stronger demand, while the low

Sterling could help them win some orders at the margin.

Conversely, sectors predominantly catering to the domestic market, like food and drink and textiles, are unlikely to benefit much from this trend. Nevertheless, the increase in import prices could prompt some consumers and manufacturers to switch to UK suppliers if and where domestic production capacity is in place.

Global manufacturing activity on the up across the UK's key export markets

Purchasing Managers' Index, 50 = no change in output



Source: Markit, ISM, Caixin



INFLATIONARY PRESSURES BUILDING UP

The key trend shaping the fortunes of the UK economy in 2017 is the build-up of inflationary pressures. This is mainly down to two significant price movements:

1. The real effective exchange rate has depreciated by 13.1% since January 2016, pushing up the price of imported materials and components.
2. The oil price has increased by 77.8% since January 2016, propping up CPI inflation via an upward pressure on energy prices.

The impact of these price pressures has already been felt in the manufacturing

industry, with input prices rising by a staggering 20.5% in the year to January 2017, their fastest rate of annual growth since September 2008. This contrasts to growth in output prices of just 3.5% in the same period, signalling considerable pressure on manufacturer's profit margins.

While manufacturers across all sectors will see their input costs surge, it's the most import-intensive companies that will suffer the most. Manufacturers in the electronics and electrical equipment industries, which import 48% and 43%

of all their inputs into production, are particularly vulnerable to this trend.

But it's the sectors which are both dependent on imported materials and sell to UK consumers, such as food and drink and textiles, that are likely to bear the brunt. First, their low export-intensity means they're less able to hedge against lower profit margins in their domestic sales through higher export volumes. Second, the increase in CPI inflation is expected to weigh on household consumption and in turn on demand for consumer goods.

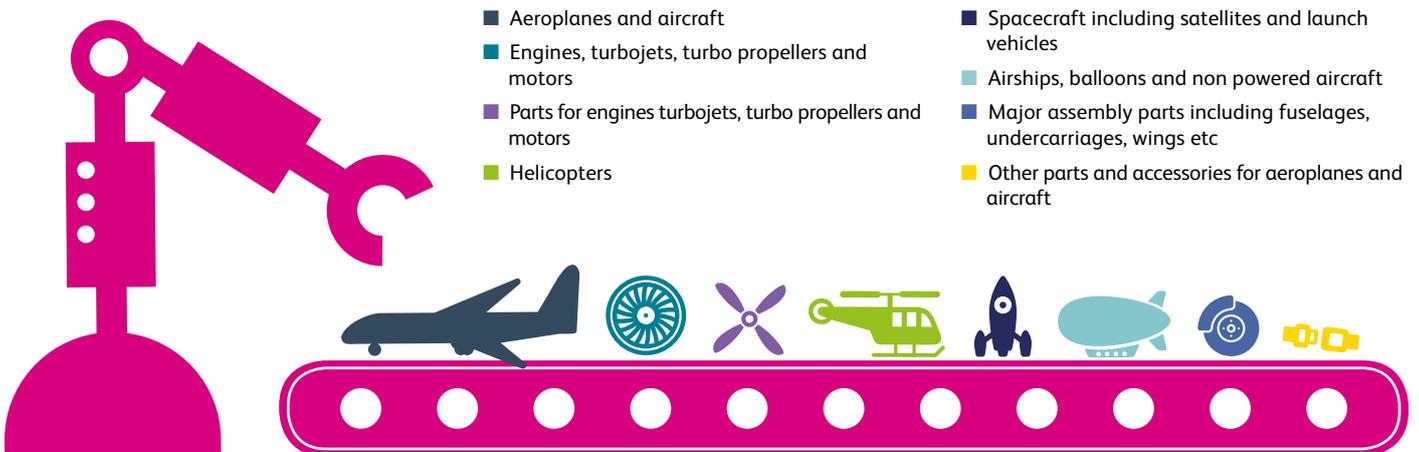
UNDERSTANDING AEROSPACE

The aerospace industry is one of the most dynamic manufacturing sectors in the UK and one of the most successful globally. It manufactures everything from aeroplanes and helicopters to spacecraft, rockets and satellites, airships, balloons and gliders.

However, the sector is dominated by the manufacture of parts for civil and military aircraft, such as turbojets, turbo-propellers, rotors and other engine parts and sub-assemblies. Likewise, the major assembly parts include wings, fuselages and undercarriages, as well as smaller components ranging from de-icing equipment, safety belts and brakes.

According to ADS, the split between civil and defence aerospace revenue was 50/50 in 2011¹, while a report by the UK Space Agency in 2016 valued the space manufacturing industry (spacecraft, rockets and satellites) at £1.2 billion for 2014/15, or approximately 4% of total UK aerospace revenue².

Sector make up



Source: ONS (2015)

What makes the sector tick?

The UK’s aerospace industry has thrived on the back of its competitive advantage in the production of high-value technology-intensive products. The ability of UK aerospace manufacturers to stay at the forefront of cutting-edge technologies has ensured the continued competitiveness of the industry internationally and the retention of a high share of global aerospace sales.

While the UK has some presence of companies that manufacture aircraft, such as BAE Systems (combat jets) and Leonardo (civil and military helicopters), the aerospace sector is dominated by parts manufacturing. The industry specialises in the production of high-quality parts for civil and military aircraft, such as wings, engines, aero structures and advanced systems. The sector’s structure is defined by clusters of manufacturers that produce complex

aircraft components for Original Equipment Manufacturers (OEMs) both in the UK and overseas, and their supply chains.

Production volumes for the aerospace supply chain are driven by demand from a few select OEMs manufacturing distinct products. In civil aerospace, main customers include Airbus Group and to a lesser extent Boeing in the US and Bombardier in Canada. For example,

¹The ADS Group, “UK Aerospace Survey”, 2012

²UK Space Agency, “The size and health of the UK space Industry”, Dec 2016

the Airbus plant in Broughton manufactures the wings for all its civil aircraft, which together with other critical components and systems (such as Rolls Royce or General Electric engines), are funnelled to Airbus’ final assembly plants in Europe and China.

For defence aerospace, BAE and Leonardo are the major OEMs, which also support the presence of an extended supply chain underneath, comprised largely of the same companies that serve the civil aerospace market. Their main end-customer is the UK Ministry of Defence but significant volumes of assembled aircraft and components

are also exported to overseas markets.

The aerospace sector is characterised by long lead times and order books. A key difference between aerospace and other manufacturing sectors is a clear visibility of the order pipeline underpinned by consistent demand for new aircraft.

Airlines – the end-customers – will order new fleets in bulk, tying-in OEMs and in turn their key suppliers into long-term contracts. This provides companies across the supply chain with the certainty to invest and innovate for the long-term, maintain high quality standards and nurture

their competitive advantage in R&D-intensive production.

The Aerospace Growth Partnership (AGP) has played a key role in ensuring the continued growth and competitiveness of the UK aerospace supply chain. A collaborative partnership between government and industry, it was set up in 2010 to tackle barriers to growth, boost exports and grow the number of high value jobs in the UK aerospace industry. The AGP also supports the Sharing in Growth Programme which has helped SMEs secure contracts worth over £1 billion and create around 1600 UK jobs.

MEP LTD CONTINUE TO MOULD THEIR FUTURE IN THE AEROSPACE AND DEFENCE SECTORS

Based in Kent, MEP Ltd are an award winning moulding and machining company that manufacture complex metal and plastic components. The business supplies into various markets from motor sport to rail, however 80% of the company’s turnover goes into the aerospace and defence sectors, where MEP operate at various levels of the supply chain from tier 1 downwards.

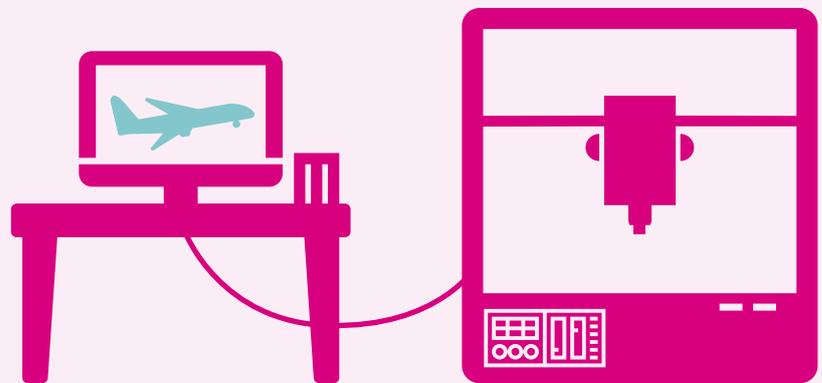
The company’s major customers are based in the UK and include a number of the largest aerospace and defence OEMs. MEP also sources the majority of its materials domestically from a large number of suppliers, but experiences challenges further down their supply chain from surface treatment houses who are not able to meet their demands. This has a knock-on effect on the company’s ability

to deliver on their customers’ requirements.

MEP faces price pressures from both sides of the supply chain. They work in an industry that expects continuous improvement, yet they must manage this alongside requirements to lower their prices, at the same time that suppliers are pushing them up.

Moves by aircraft manufacturers to build new more economical

aircraft plus the growing demand for air travel in the Middle East and Asia has ensured MEP have seen growing demand from the aerospace and defence sectors. The company plans to capitalise on their strengths in innovation, quality and delivery to expand their customer base in the UK and overseas. They are also looking to address the challenges in their supply chain by reviewing internal solutions to mitigate the risks they currently face.



SUPPLY CHAIN STRUCTURE

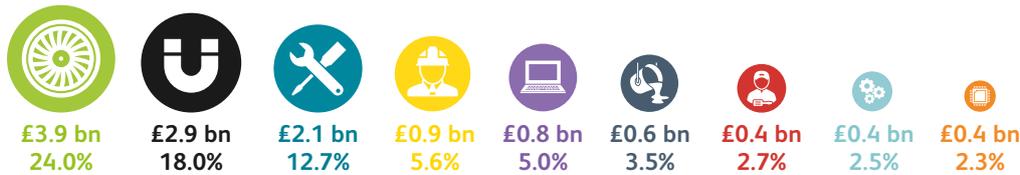
At the top of the UK Aerospace supply chain are the OEMs, who make and design aircraft, spacecraft and satellites. They are supplied major critical parts by Tier 1 manufacturers, who in turn source complex components from Tier 2 suppliers. At the base of the supply chain are Tier 3 companies which provide raw materials and sub-components to the tiers above.

Through the pressures of globalisation and the requirement for suppliers to meet stringent requirements on quality, reliability and safety, to gain access to major clients, the UK Aerospace supply chain has become increasingly consolidated. A small number of large companies make

up the OEMs and Tier 1 suppliers, with smaller companies tending to make up the other two tiers. While there are few OEMs with assembly plants in the UK, the cluster of Tier 1 suppliers is one of the largest and most dynamic globally, supplying OEMs across the world.

Domestic supply chain

£ value of products going into aerospace and % total



- Parts of air and spacecraft and related machinery
- Fabricated metal products
- Repair and maintenance of aircraft and spacecraft
- Architectural and engineering services; technical testing and analysis services
- Computer programming and consultancy services
- Other basic metals and casting
- Installation
- Machinery and equipment
- Computer, electronic and optical products

Source: ONS (2014)

OEM's, also known as prime contractors, are the designers, manufacturers and assemblers of aircraft. Some of the key players in the UK include BAE Systems, Airbus Space and Defence, Leonardo, and Hybrid Air Vehicles.

to the OEMs, such as engines, wings, landing gear or fuselages. Key Tier 1 manufacturers are companies such as Airbus (commercial aircraft), Rolls-Royce, Bombardier, GKN Aerospace, and Marshall Aerospace and Defence.

These include components such as parts for engines, aerostructures and interiors. They may also supply products into other sectors.

Tier 1 companies manufacture and supply final parts and large assemblies

Tier 2 manufacturers supply sub-assemblies and complex parts to Tier 1 companies.

Tier 3 manufacturers will supply sub-components and raw materials to the tier above, such as collectors and cylinders. Most Tier 3 companies supply their products across multiple sectors.



REGIONAL EMPLOYMENT

The aerospace industry provides employment across the UK’s regions. The sector is relatively evenly distributed, with no one region dominating. The South West is the largest cluster in terms of aerospace employment, where a number of key Tier 1 suppliers, like Rolls Royce, General Electric and GKN, as well as OEMs, such as BAE and Leonardo, have extensive manufacturing facilities.

The aerospace industry also provides significant employment in Wales and Northern Ireland.

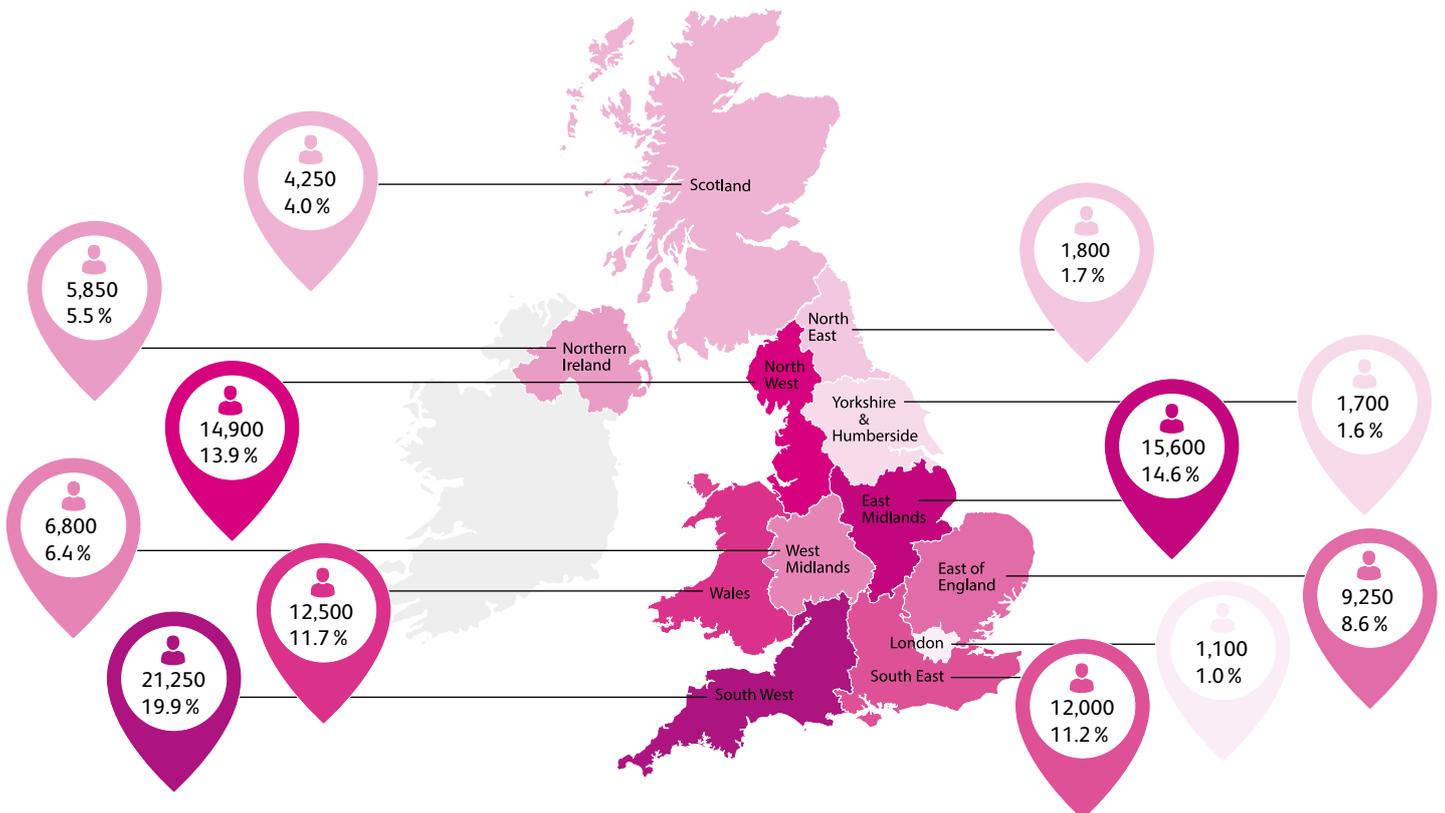
In Wales, the Airbus plant in Broughton is responsible for assembling the wings for all Airbus civil aircraft and employs more than 6,000 people. Similarly, Northern Ireland’s aerospace sector is built around major Tier 1 aircraft supplier Bombardier.

The aerospace industry also has a substantial presence in the South East. This is predominantly down to the concentration of spacecraft manufacturers, with the University of Surrey Space Centre leading the research and commercialisation of satellite technologies over the past few decades. Airbus Space and Defence, a division of Airbus Group, is the major employer in the region, after it acquired SSTL – the University of Surrey spin-off – in 2009 and the merger of Airbus-owned companies Astrium and Cassidian in 2014.

Employment in aerospace across UK regions

% of aerospace employment

 = employees



Source: ONS (2015)

A GLOBALLY FOCUSED SECTOR

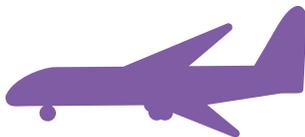
International aerospace supply chains are truly global in their nature, with major component parts being manufactured across the world, before being funnelled into a single OEM plant where final assembly takes place. The extent of their global presence can be seen in the wide spectrum of Tier 1 suppliers used to produce Boeing’s 747 four engine jet liner. No fewer than eight different countries are involved – ranging from Japan, to the UK and Australia. These Tier 1 suppliers are themselves sourced by hundreds of Tier 2 and 3 suppliers, resulting in a truly globally inter-connected system.

This however is the source of one of the aerospace industry’s greatest challenges. The length of the supply chain exposes production processes to disruptive kinks or bottlenecks. This was illustrated last year when technical issues with engines from American manufacturer Pratt &

Whitney left Airbus’s new aircraft the A320 neo stranded engine-less in Toulouse, delaying flight trials and its release. OEMs have as a result begun to look at evolving their supply chain to prevent future disruptions and improve responsiveness.

Top imported products by value

£ value and % share of total aerospace imports



Aircraft:
37.5%
£9.4 bn



Parts for turbojets or turbo-propellers:
25.6%
£6.4 bn



Turbojets:
19.2%
£4.8 bn



Wings, fuselages, doors, control surfaces, landing gear, fuel tanks etc:
11.2%
£2.8 bn



Undercarriages & parts:
2.5%
£0.6 bn



Helicopters:
2.5%
£0.6 bn

Source: uktradeinfo (2016)



THE EVOLVING GLOBAL SUPPLY CHAIN

The growing demand for air travel, and the subsequent pressure this puts on supply chains has resulted in OEMs looking to employ lean principles to improve efficiency in the production process. Central to this are OEM’s decisions to outsource the development of entire sub systems,

as opposed to piece parts, that they used to handle internally. As a result, the number of suppliers has been reduced, helping to improve supply chain efficiency.

The outsourcing of entire systems has seen the emergence of “Super Tier 1

suppliers” – suppliers who are being entrusted with complete modules and systems by OEMs. An example includes the aerospace manufacturer Stelia, formerly Aerolia, who was formed when Airbus outsourced the production of its nose fuselage parts in 2009. It now manages entire parts

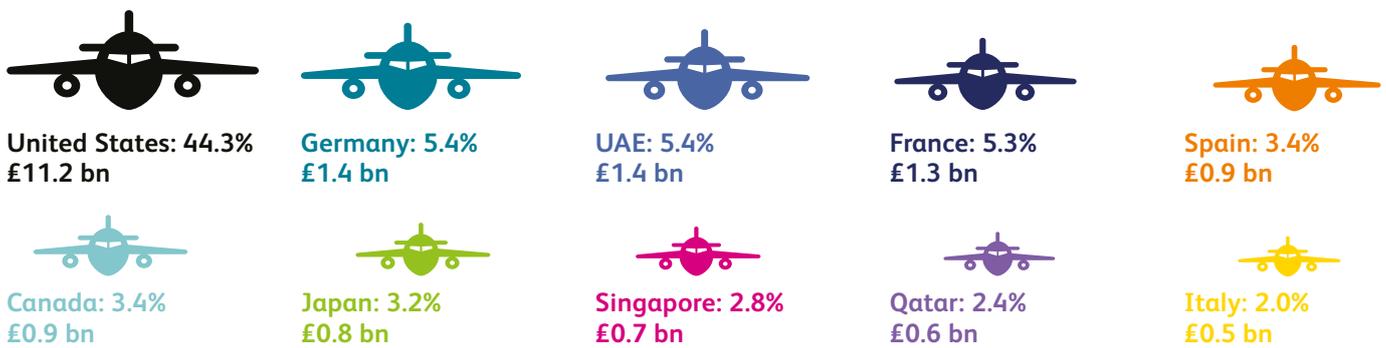
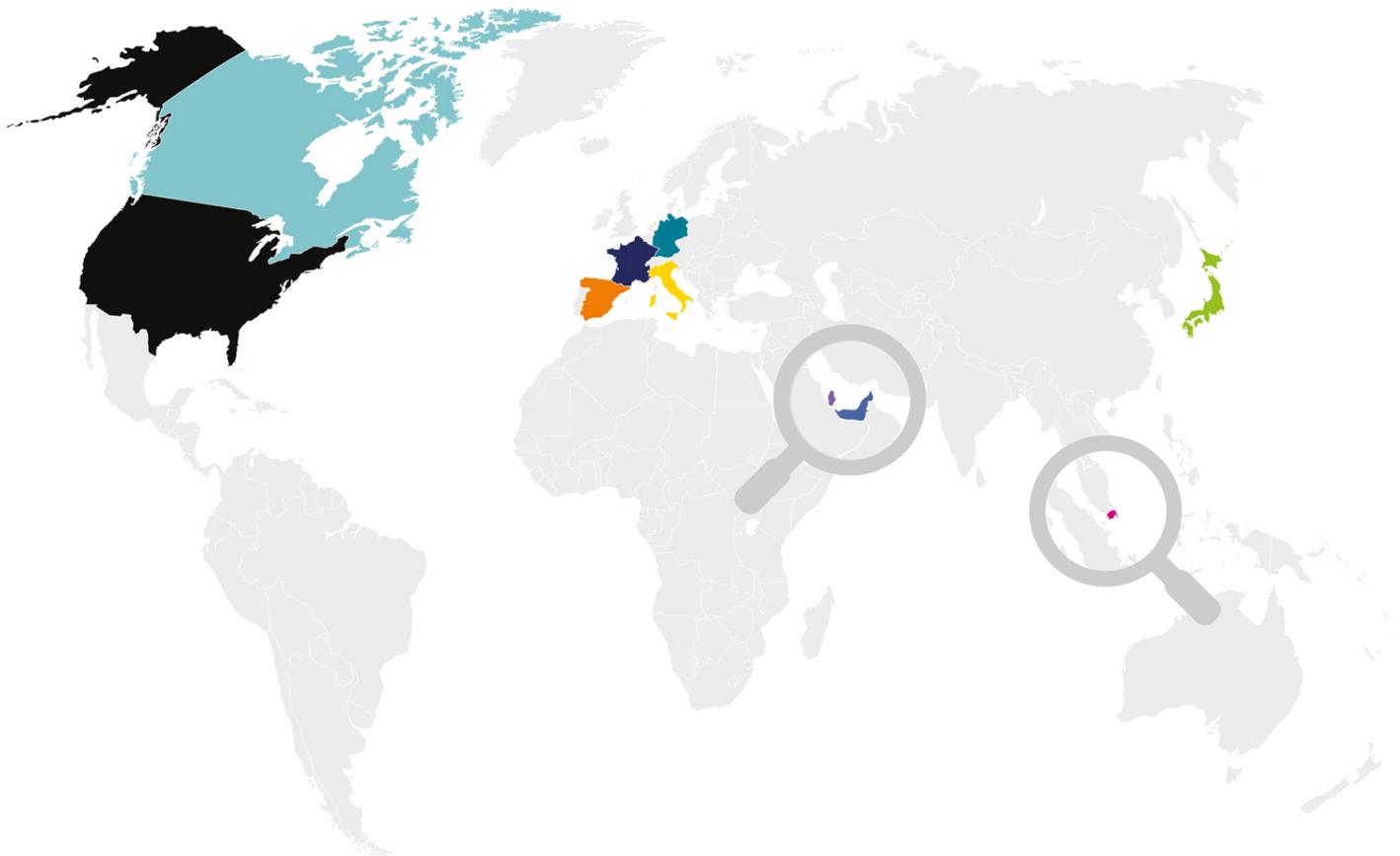
such as fuselage sections and wings, and has its own value chain.

The emergence of Super Tier 1

suppliers does in itself have hurdles, as companies are forced to change their focus, extend their engineering capacities, build relationships with

new suppliers and recruit employees capable of producing whole systems. Support is therefore often needed from the OEMs.

Key import markets



Source: uktradeinfo (2016)

47% OF TOTAL SUPPLY INTO PRODUCTION IS IMPORTED

Source: ONS (2014)

GLOBAL PRESENCE

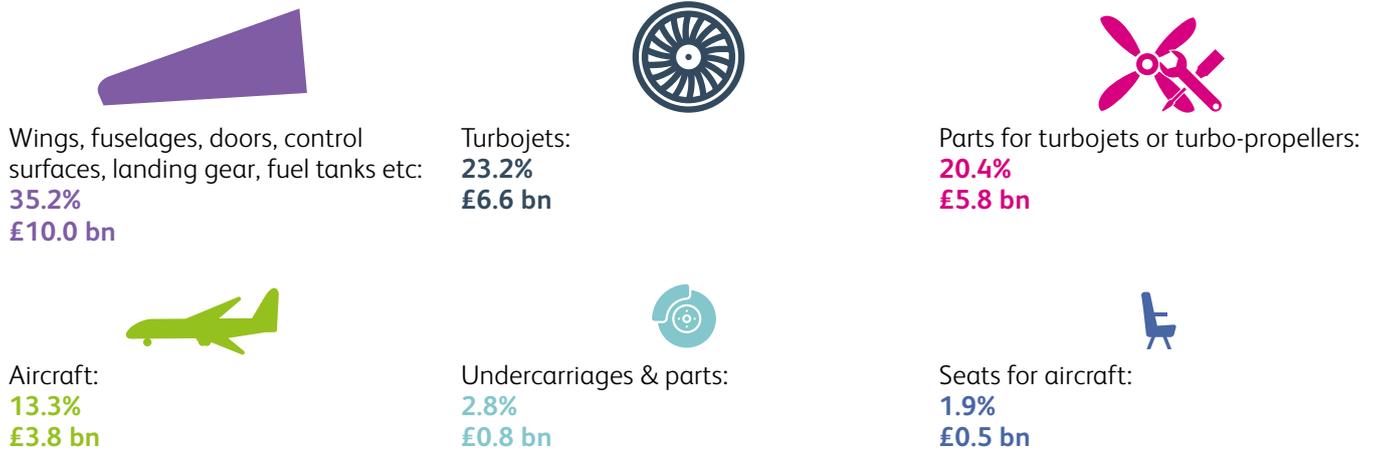
The UK is a global powerhouse in the production of aircraft, spacecraft and related parts. It's the 2nd largest manufacturer, only behind the US, and 4th largest aerospace exporter in the world. The sector is highly export-intensive with 59% of GVA travelling to overseas markets, the highest of any manufacturing sector.

The UK's specialisation in engines and parts of aircraft is reflected in its overseas sales, accounting for 79% of all UK aerospace exports. Of that, 35% are exports of wings, fuselages, doors, control surfaces, landing gear and fuel tanks. A further 23% is accounted for by turbojet engines and 20% by engine parts. Exports of aircraft make up 13% of all aerospace overseas sales.

Eight out of ten of the UK's top export markets are located outside of the EU, albeit Germany and France are in 2nd and 3rd place respectively. The US is the UK's top export market, while the rest of the list is dominated by the Middle East and Asia, with three countries each.

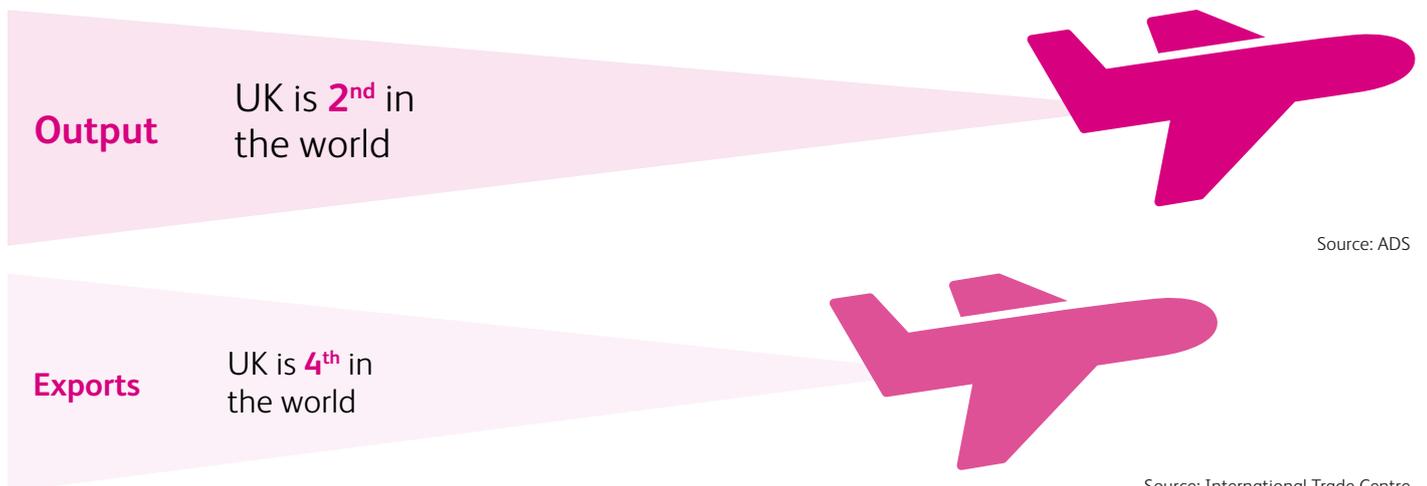
Top exported products by value

£ value and % share of total aerospace exports



Source: uktradeinfo (2016)

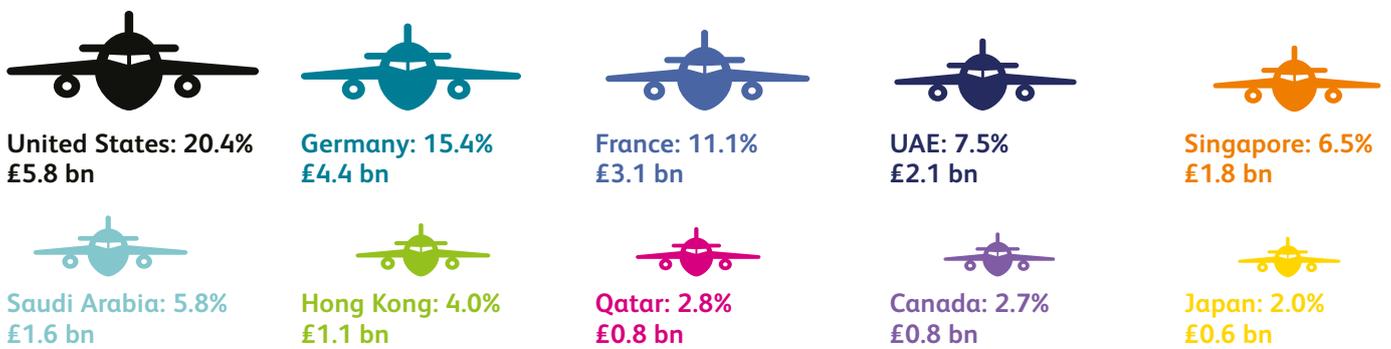
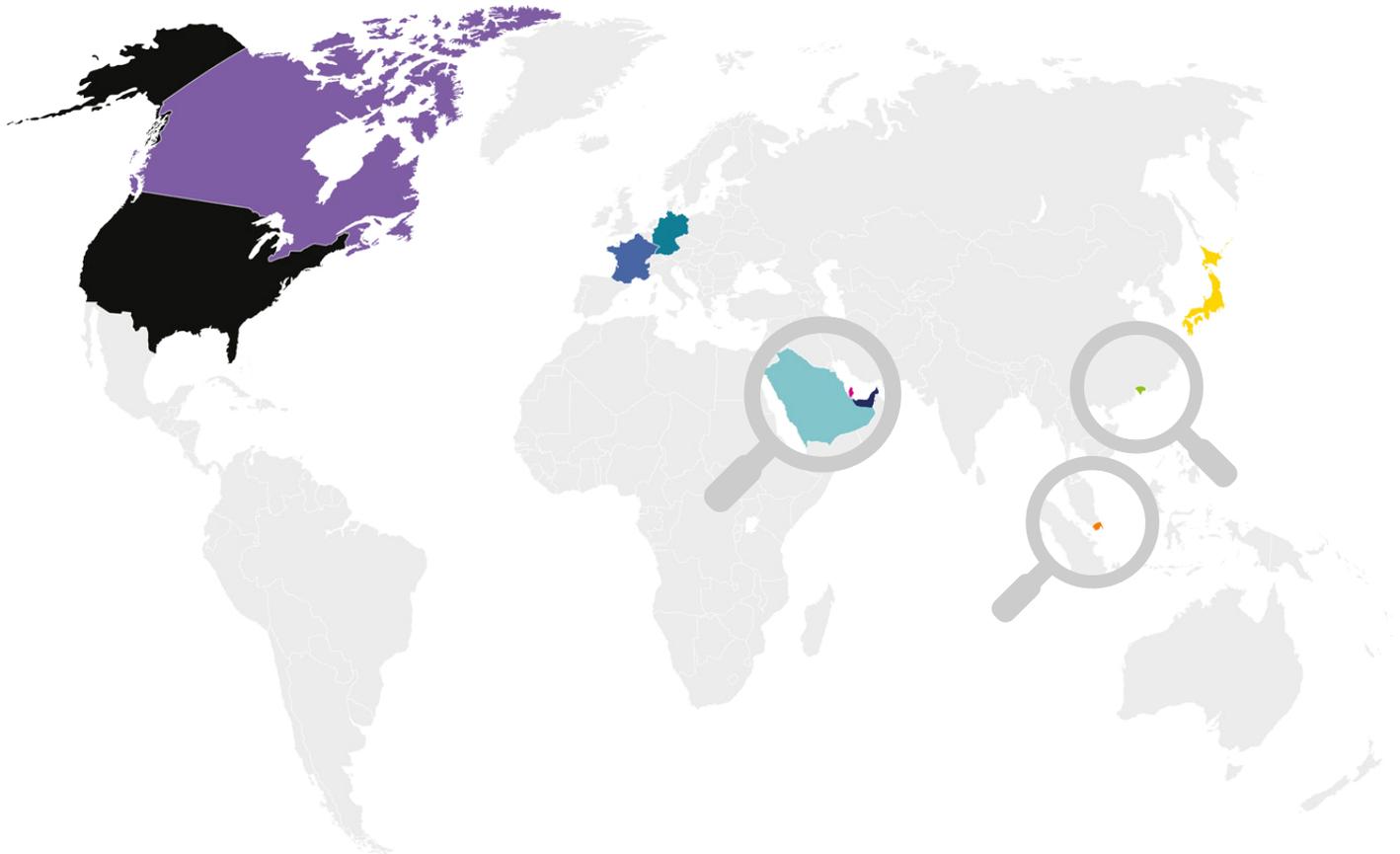
Global market share



Source: ADS

Source: International Trade Centre

Key export markets



Source: uktradeinfo (2015)

Top 10 high growth markets



Country	% Growth in exports (2010-2016)*
Morocco	6403%
Iceland	4491%
South Korea	589%
Netherlands	262%
Qatar	243%
Spain	174%
UAE	144%
Germany	127%
Russia	126%
Singapore	79%

*>0.5% of total UK aerospace exports

Source: uktradeinfo (2016)

ARE EXPORTS FLYING?

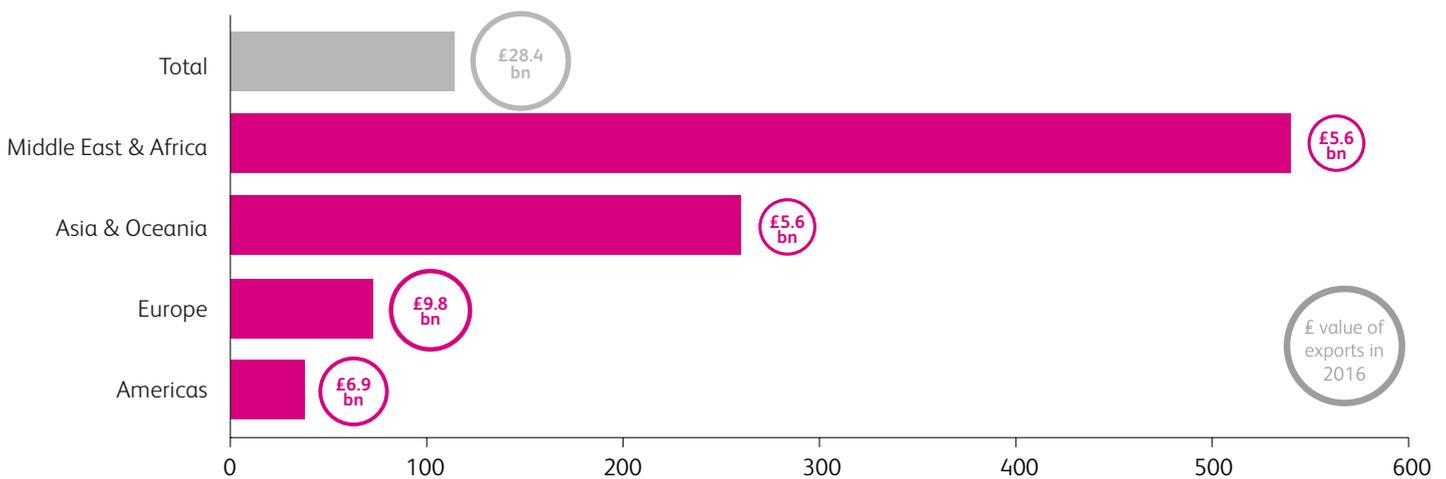
UK aerospace exports have taken off over the past 15 years. Since 2002, the UK aerospace industry has more than doubled its overseas sales from £13.2 billion to £28.3 billion in 2016, an increase of 114%. Growth has been solid across all continents, although demand has been growing the fastest in emerging markets.

Exports to the Middle East have seen the heftiest growth at 540% between 2002 and 2016, while Asia & Oceania has also been a consistent source of demand for UK aerospace manufacturers with exports growing by 260% in the same period. What's more, these markets now

represent a significant piece of the pie, accounting for 20% of all exports each, up from 7% for the Middle East & Africa and 12% for Asia in 2002. However, Europe remains the top export market at 35%, followed by the Americas at 25%.

Aerospace export growth by continent

% growth, £ value of exports (2002-2016)



Source: uktradeinfo (2016)



CAV ICE PROTECTION'S PRODUCTS TAKE GLOBAL FLIGHT

CAV Ice Protection, who have their main manufacturing operation and headquarters located in Consett, in the North East of England, are experts in the design and manufacture of ice protection systems for civil and military aircraft. As a Tier 1 supplier into the global aerospace industry they are able to deal directly with the OEMs, allowing them to build relationships and create long term business for the company.

Overseas trade is the key to CAV Ice

Protection's business, in fact 98% of their turnover is accounted for by exports, as there is insufficient domestic demand. Since the US is the main source of their overseas business – making up 80% of exports – they have a sister company in the States that acts as their aftermarket distributor, and ensures efficient availability of their product in the marketplace. A global supplier, CAV Ice Protection export to another eight countries outside of the US, including several countries in the

European Union and across Asia.

A key concern when exporting is protection of their intellectual property rights. Occasionally they have to secure export licences, depending on the country or intended application of their products. However these are merely details to be overcome rather than deterrents for the company, their main consideration is generating business with the right customers wherever they may be located in the world.

DEFENCE SPOTLIGHT: AEROSPACE INDUSTRY THE BACKBONE OF UK DEFENCE EXPORTS

The UK is the leading defence exporter in Europe and behind only the United States in global terms. In 2015, the most recent year for which official Government statistics are available, the global market was estimated to be worth £63 billion. The UK share of this was valued at £7.7 billion, mostly down to the strength of the UK aerospace sector.



Indeed, the global market for defence exports is dominated by aerospace, which broadly accounts for

around two-thirds of all contracts by value. In the UK, the aerospace sector has been even more fundamental to success, making up 85% of all defence exports over a 10-year period up to 2015.

Exports of marquee platforms such as the Eurofighter Typhoon multi-role combat aircraft, BAE Systems' Hawk trainer jet and Leonardo's Wildcat helicopter are the most high profile contributors, though the UK is also a major exporter into global supply chains. Rolls-Royce remains the world's second largest provider of defence aero-engines, while UK industry (led



by BAE Systems) will build 15% of Lockheed Martin's more than 3,000 planned F-35 Lightning II combat jets.

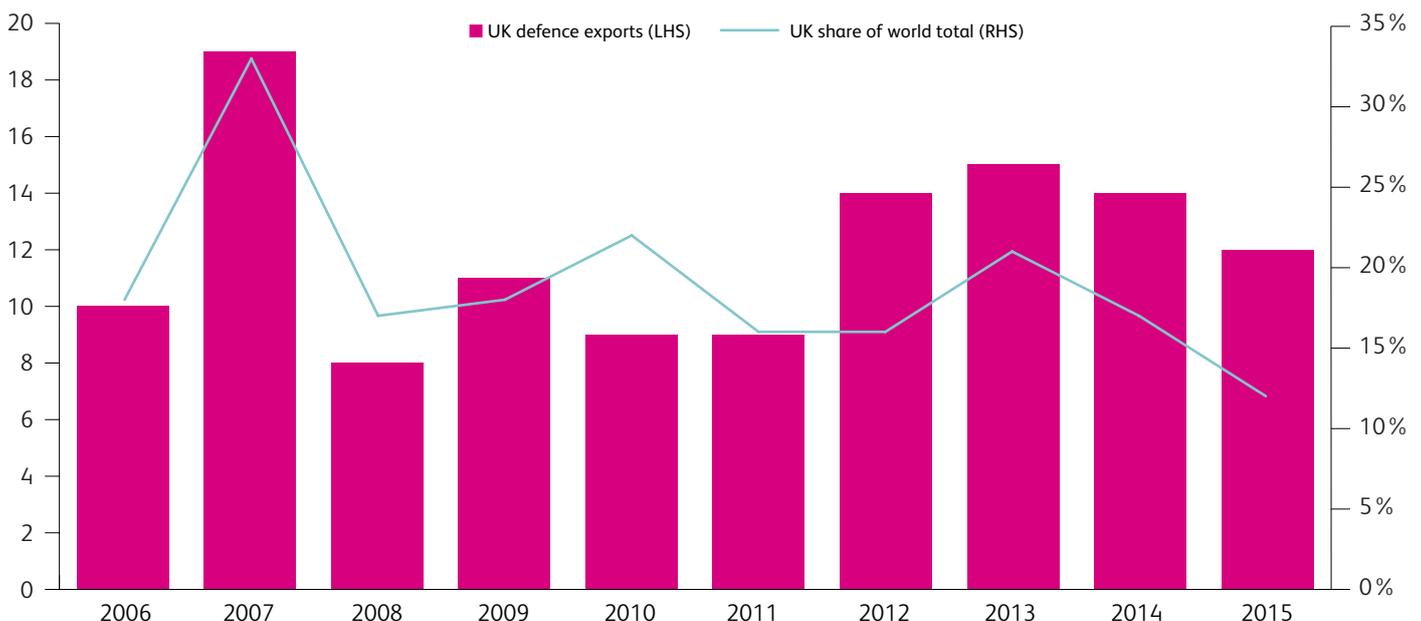
The UK benefits from enduring partnerships with key importing nations, particularly in the Middle East. The globalised nature of supply chains also means that the UK realises significant value from supplying components into the programmes of our closest allies.

UK IS THE 2ND LARGEST DEFENCE EXPORTER IN THE WORLD

Source: UKTI DSO (2015)

UK defence exports

Orders, \$ billion, market prices



Source: UKTI DSO (2015)

AEROSPACE ACCOUNTS FOR 85% OF ALL UK DEFENCE EXPORTS

Source: UKTI DSO (2015)

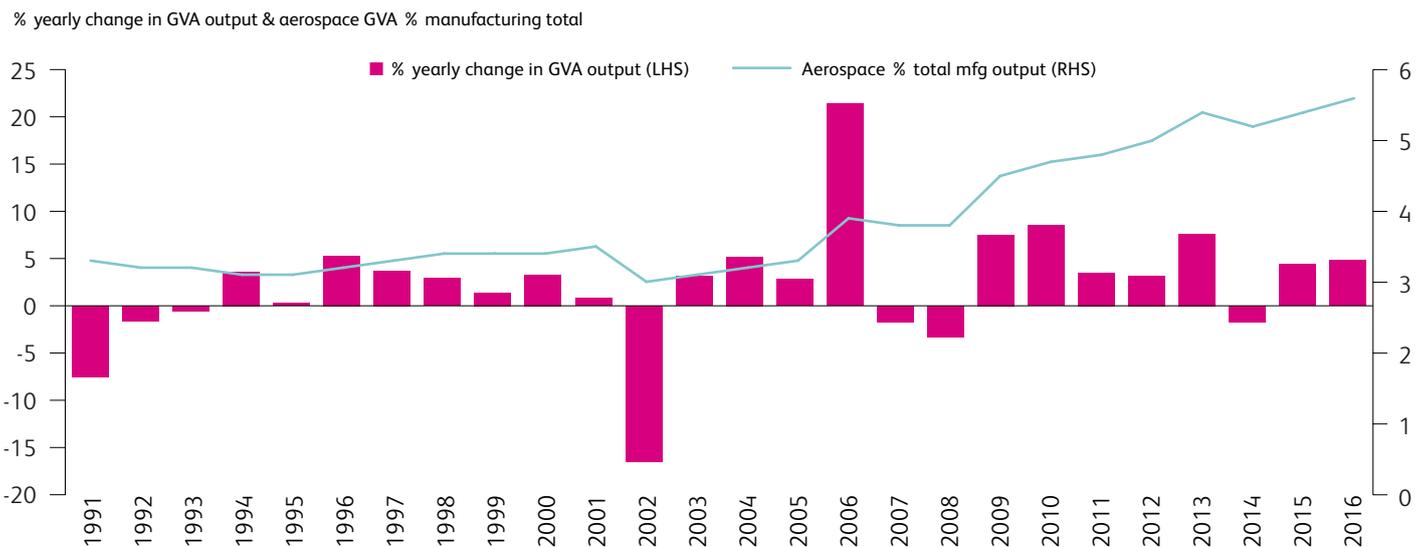
A SECTOR TAKING OFF

The aerospace industry, unlike many other manufacturing sectors, has experienced a rapid rise over the last 25 years. Output has grown by a staggering 73 % since 1990, whereas traditional sectors such as basic metals and machinery have gone into reverse, contracting by 40 % and 22 % respectively.

Key to the success of the aerospace industry has been the ability of UK manufacturers to move up the value chain through continuous innovation. The global aerospace industry is underpinned by a relentless drive and focus on improving not just the performance and safety of the final product but also the manufacturing process itself. Whether this is through the increased use of composite materials

by airline manufacturers, the deployment of “commercial off-the-shelf” technologies for satellite production, the development of 4IR technologies such as 3D printers and collaborative robots, or developing a viable alternative fuel to kerosene for aircraft; the sector is constantly evolving and has seen huge technological advances, especially in the last 10 years.

Aerospace output as % of total manufacturing output has increased dramatically in last 25 years



Source: ONS (2017)

UK manufacturers have made the most of these advances, with aerospace output increasing at the second fastest pace of any manufacturing sector over the past decade at an impressive 37%. Significant tailwinds from globalisation since the turn of the century, combined with an insatiable demand for air travel have contributed to an annual turnover of

£30 billion in 2015, up 40% from its level in 2008. The growth in the sector is further illustrated by the number of enterprises almost quadrupling in the period between 2008 and 2015 – up from 617 to 2398, while the sector employed 107,000 people in 2015.

It hasn't been completely plain sailing however. The industry's nadir came in 2002, when output declined by

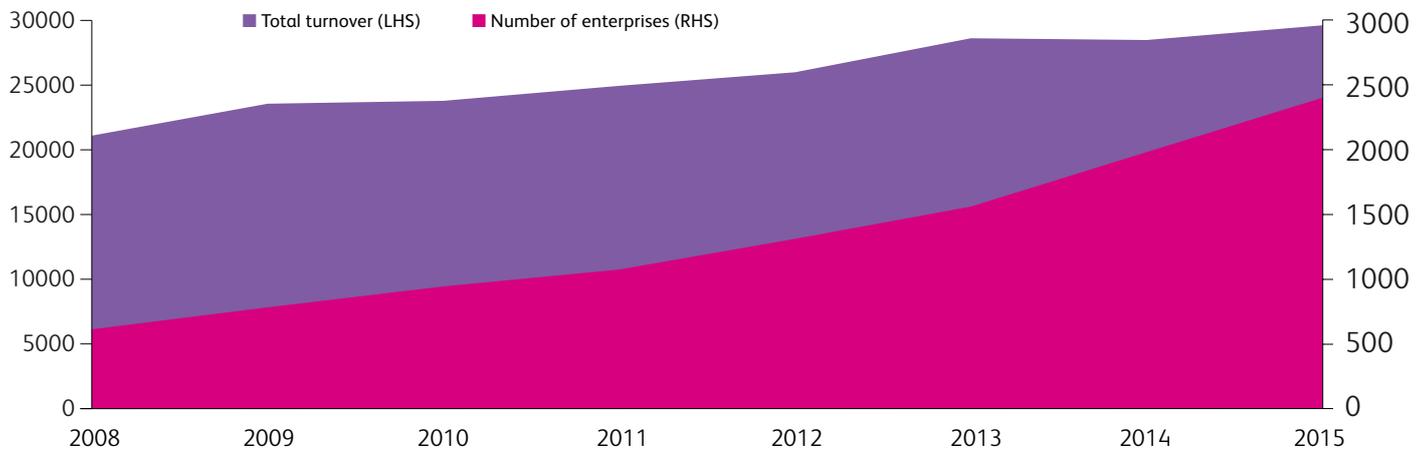
16%, a likely consequence of the fall in demand following the 9/11 attacks. Since then however, the sector has performed consistently well with small contractions during the financial crisis and 2014 being offset by the general positive trend in yearly output growth. As a result the share of aerospace output as a percentage of total manufacturing has increased from 3.9% in 2006 to 5.6% in 2016.

107,000 PEOPLE ARE EMPLOYED IN THE AEROSPACE SECTOR IN THE UK

Source: ONS (2015)

Aerospace turnover up to £30 billion in 2015

£ turnover (millions) & number of enterprises



Source: ONS (2016)



R&D INTENSIVE

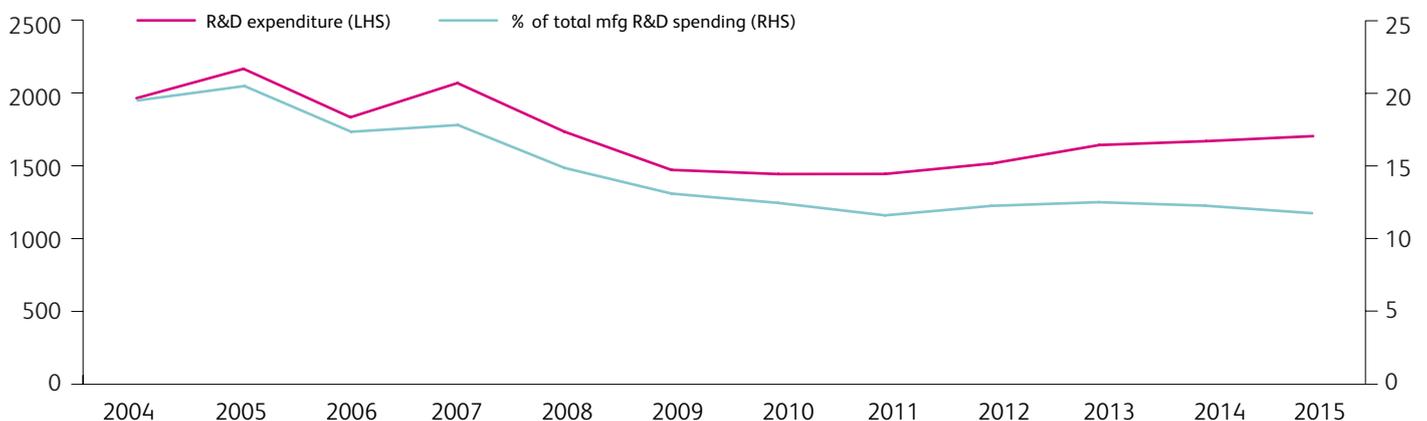
Business spending on Research and Development (R&D) underpins most of the technological advances

that have made the UK aerospace industry such a success. The aerospace sector accounted for 12% of all manufacturing R&D expenditure in 2015, the third highest after pharmaceuticals and

the resurgent automotive sector. Whilst the sector's share of total R&D spending has declined since 2004, the sector still invested £1.7 billion in 2015, or 19% of GVA output.

Over 10% of all manufacturing R&D is in the Aerospace sector

R&D expenditure (£, millions) & aerospace R&D % manufacturing total



Source: ONS (2016)



INNOVATIVE BUSINESS MODELS

The UK aerospace industry has maintained its position as a leading global player not only through embracing new technologies but also through unlocking new business models. A classic example is Rolls Royce's "Power by the Hour" program,

where the company sells flying time rather than engines. The company guarantees engine flying time for a fixed sum per flying hour, with a complete engine and accessory replacement service. This allows operators (airlines) to forecast

maintenance costs with accuracy and relieves aircraft manufacturers from the need to purchase stocks of engines and associated parts.

Recently, the rise of digital technologies has enabled Rolls

Royce to build in sensors that detect maintenance issues in real time and transmit the data to its engineers around the world or even fix them automatically. This has improved

the quality of the service by slashing response times and often preventing the need to strip the engine down, a costly and time-consuming process. The success of this “servitisation”

business model has led to several other Tier 1 suppliers, such as Bombardier, General Electric and Pratt & Whitney, developing similar programs.



Source: ADS (2016)

AIRCRAFT DELIVERIES AND BACKLOG

2016 was a record breaking year for the UK aerospace industry, with figures from ADS illustrating that unrelenting demand for air travel resulted in the number of new global aircraft deliveries rising 3% to 1,433, up 74% from their level in 2006³. This was the sixth successive annual record in commercial aircraft deliveries, with 2016’s deliveries worth up to £27 billion to the UK’s aerospace industry.

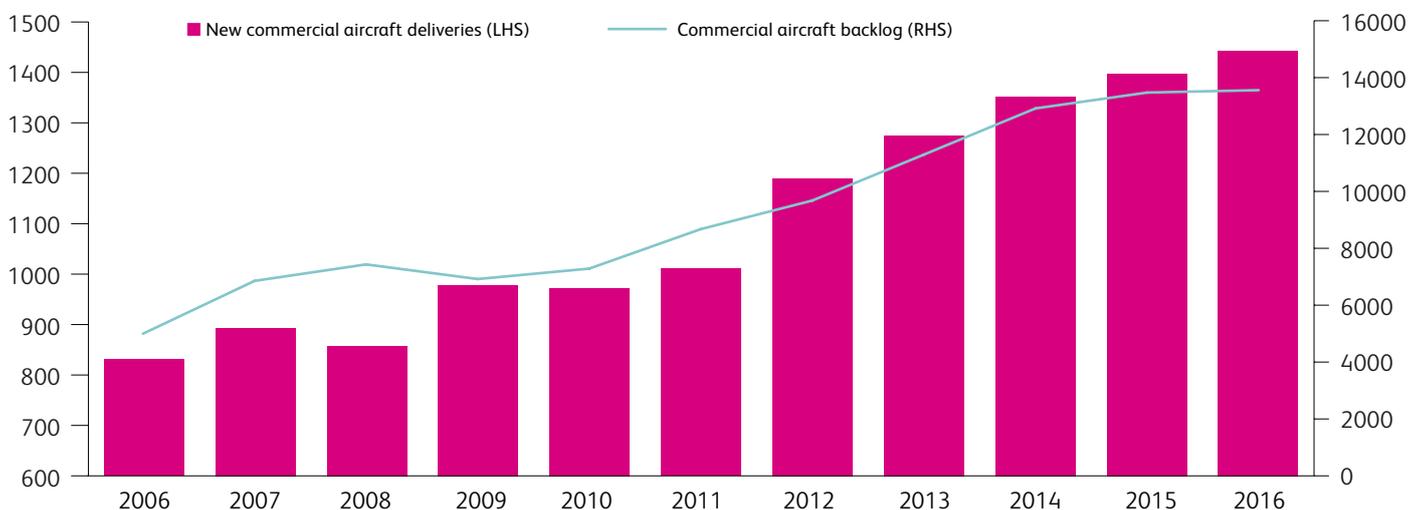
Encouragingly the sector’s recent growth shows no signs of letting up, with 2016 also seeing a new industry backlog record of 13,567 aircraft. This represents almost 10 years’ worth of work in hand for the UK aerospace industry, and potentially worth up to £200 billion (at 2016 prices). Manufacturers’ are therefore able to enjoy the security of a strong pipeline of work for the coming years, a commodity afforded to very few

other industries given the uncertain macroeconomic environment.

With records being broken year on year, and no sign of easing given the growing demand from emerging regions, manufacturers are looking to raise production rates – bringing with them new jobs and investment to what is fast becoming one of the great success stories of UK manufacturing.

Current backlog represents 10 years work in hand to UK aerospace industry

No. of new commercial aircraft deliveries & no. of commercial aircraft backlog



Source: ADS (2016)

³The ADS Group, “Economics Briefing”, 2016

CLEAR SKIES AHEAD

The aerospace industry has become an integral part of the UK economy over the past two decades, achieving healthy growth rates on an almost yearly basis. This has been mainly driven by the rise in demand for air travel since the turn of the century and underpinned by huge technological advances in aviation.

Encouragingly, the outlook remains bright, with order books backlogged at record levels and consumers' appetite and need for air travel showing no signs of abating. Further

opportunities, notably from growth in emerging regions, provides continued cause for optimism about the aerospace industry's growth outlook in the medium term.



AEROPLANES ARE GETTING BIGGER

According to data from Ascend⁴, passenger numbers on UK airlines will grow by a staggering 80% by 2034, reaching 218 million. To cope with increasing passenger numbers and growing demand for international flights, UK airlines are looking to invest in new aircraft to increase seating capacity, thereby representing an opportunity for aerospace manufacturers.

Currently, UK airlines offer on average

161.7 seats per single aisle aircraft flight. However with new investment, this is set to rise to 179 seats by 2034, according to ADS. This represents an 11% increase and should go some way to fulfilling the growing demand for European and other regional flight routes. Notably, instead of investing in similar sized aircraft and attempting to squeeze in more seats, UK airlines are looking to follow the general aviation trend, and invest in much larger aircraft that can carry more passengers.

UK airlines have recognised the need for greater capacity, and have already invested in over 370 new aircrafts, worth around \$27 billion. These larger, greater capacity single aisle aircrafts are expected to enter service over the next 8 years. Conversely wide body aircraft, used for long haul flights will not see any rise in average seating capacity over the coming years, rather greater flexibility and choice in seating.



A TRANSFORMED FLYING EXPERIENCE

A further opportunity for aerospace manufacturers comes from the new equipment and capabilities that new aircrafts will possess, and as such, the manufacturing of these components. Over the coming decade UK passengers will experience a transformed flying experience as advances in technology are implemented into new aircraft, improving passenger comfort and safety.

Airline seat manufacturers have

already invested significantly in R&D to improve both the weight and comfort of aircraft seats, across all classes. This includes investment in "plug and play" capabilities, allowing passengers to use their electronic devices, as well as thinner seats which allow for greater leg room without compromising comfort.

A further key element in improving passenger comfort levels, is increased connectivity. As well as in-flight entertainment improvements, access

to high speed internet will soon be common place on aircraft. At the moment, Wi-Fi connected aircraft have significant barriers, including prohibitive costs as well as the issue of protecting passenger privacy in the air. However future innovations are set to overcome these barriers. Companies such as Inmarsat, a British satellite telecommunications company, are actively looking at ways to provide protected, low cost and fast internet connectivity to airlines and aircraft manufacturers.

⁴The ADS Group, "The Great British Take Off", data from Ascend Flight Global Consultancy, 2015



DEMAND FROM EMERGING MARKETS IS GROWING

Rising GDP and household incomes from emerging regions, coupled with the globalisation phenomenon is set to increase the demand for air travel in the coming years. There is therefore a clear opportunity for the UK aerospace industry and its suppliers to position themselves to benefit from growing commercial markets in relatively untapped regions.

Over the next 15-20 years, growth of UK airlines and the derived demand for aerospace manufacturers is expected to be underpinned by growing demand from emerging regions and the “Rest of the World” market i.e. destinations not

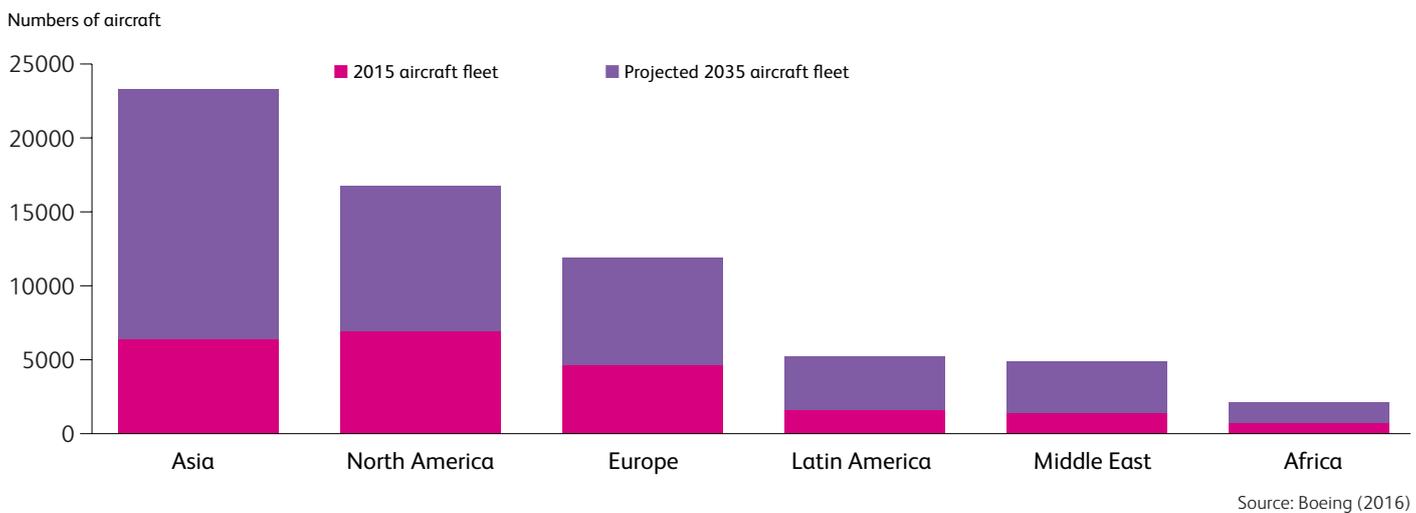
in Europe or North America. According to ADS, currently around 32 million passengers travel to and from the UK to destinations not in Europe or North America. This number is set to grow to 86m in 2034 – an impressive 5.4% annual growth rate⁵.

The increased demand for aviation from emerging region represents an opportunity for UK aerospace manufacturers at various stages of the supply chain. New aircraft production programmes will face a number of challenges, most notably developing a reputation for reliable and safe air travel, product development

and cost effectiveness. As emerging regions look to exchange expertise in manufacturing techniques and processes, UK manufacturers could find themselves with increased demand for their proven and established products.

The Middle East should continue to represent one of the greatest opportunities, as the region looks to cement itself as the centre for long haul connecting flights. However it is in Asia where growth is expected be strongest with Boeing forecasting that its aircraft fleet will more than double from 6350 in 2015, to 16970 in 2035⁶.

World aircraft fleet expected to double by 2035, with Asia leading the pack



CHINA: A CASE STUDY

As discussed, emerging regions represent the greatest source of growth for the UK aerospace industry, none more so than China. Rising incomes, a growing middle class and reduced visa requirements have resulted in air passenger numbers rising from 67million in 2000 to 320

million in 2016. Furthermore the IATA forecasts that China will displace the US as the world’s largest aviation market (defined by traffic to, from and within the country) by 2024⁷.

The UK aerospace industry must therefore position itself to benefit

from this growing market through gaining long term contracts for the production and manufacturing of required aviation components. Investing in China will be key to the UK aerospace industry maintaining and hopefully growing its global market share over the coming years.

⁵ The ADS Group, “The Great British Take Off”, data from Ascend Flight Global Consultancy, 2015

⁶ Boeing, “Current Market Outlook 2016-2035”, 2016

⁷ International Air Transport Association (IATA), “20-Year Air Passenger Forecast”, 2016

RISKS ON THE RADAR

Strong fundamentals and long order books mean that the aerospace sector is fairly resilient in the face of short-term demand fluctuations. However, there is a range of risks and uncertainties that could jeopardise this positive outlook over the next few years.

In particular, the UK's decision to leave the EU could have significant consequences for the shape of the aerospace supply chain, while geopolitical developments could mean a less supportive external

demand environment for the sector. How the industry approaches these challenges will have a significant bearing on the prospects of the UK aerospace sector going forward.



IMPACT OF BREXIT UNCERTAINTY ON INVESTMENT DECISIONS

The UK's decision to leave the European Union has thrown up risks and uncertainties in effectively every manufacturing sector, and aerospace is no different. In particular the concerns around the nature and conditions of any Brexit deal has raised serious questions about the next generation of aircrafts and where they will be produced.

Airbus for instance is facing growing political pressure to bring jobs back to France, Germany and Spain as a result of the UK's decision to leave

the single market. Currently, Airbus employs around 15,000 people and manufacturers virtually the entire wing for the Airbus jumbo jet, the A380 in Broughton, North Wales. However there have been moves by German and Spanish manufacturers to take away as much wing work as possible, as this is the most lucrative part of the supply chain. Both of these nations are keen to accelerate their aerospace sectors. With the UK leaving the EU and potentially losing access to highly skilled EU labour, this pressure is likely to ramp up, and puts

both Germany and Spain in a strong position when it comes to bidding for further work as new models are produced.

Concerns are also mounting over the UK's membership of the European Aviation Safety Agency (EASA), which certifies aircraft, engines and their components. If the UK opts to create its own regulatory regime, and UK suppliers still have to seek certification from EASA, costs would rise. This would act as a further disincentive to any future investment.



GROWING CONCERN EXPORTS WILL BE HIT BY PROTECTIONIST MEASURES

The UK aerospace industry is export driven, with data from ADS indicating that the industry derives almost 90% of its turnover from exports. Whilst aircraft and their parts are exempt from tariffs under WTO rules, there is a growing concern that competitors could try to encourage governments to find loopholes to raise the cost of production for UK businesses. For

instance the UK aerospace supply chain could be hit if EU exemptions for the raw materials used to make component parts are reversed, thereby raising the cost of production and making UK aerospace products less competitive. This effect is set to be compounded by the fall in Sterling, and the subsequent rise in the cost of imported goods used in production.

In addition, there are concerns that restrictions to the free movement of EU labour could adversely affect the UK's ability to attract aviation-related talent from EU countries, as well as non-tariff barriers such as changes to the regulatory framework creating costly delays at borders if the UK leaves the customs union.



AGEING SATELLITES UNDER THREAT FROM CYBER ATTACKS

The satellite industry is an integral part of the wider UK space industry. According to the UK Space Agency⁸, satellites, along with payload and spacecraft make up almost half of total space manufacturing income in the UK. Today, satellites underpin almost all of our critical infrastructure – from communications and GPS, to defence systems. They have therefore

become integral to the way we live our lives, highlighting the growing importance of satellite manufacturing.

However, as satellites and their security systems become dated, they are increasingly susceptible to cyber-attacks. This represents a significant challenge for UK satellite manufacturers such as Thales Alenia Space UK and Airbus

Defence and Space, who are having to rethink how they build products and what solutions they can offer to their customers who are looking for additional security assurances. With cyber-attacks becoming more and more prevalent, innovating and staying one step ahead of hackers is likely to shape satellite manufacturers' strategy going forward.



INPUT COST PRESSURE ON MARGINS

Rising energy prices and the depreciation in Sterling is putting

significant upward pressures on manufacturer's input costs. Input prices in the aerospace industry increased by a hefty 8.4% over the year to October 2017, their fastest pace of annual growth since the time series begun in 1997.

While this is unlikely to cause significant production disruptions, it's likely to weigh on the profitability of domestic aerospace companies and put pressure on smaller companies that are less well positioned to absorb the increase in input costs.



WEAKNESS IN THE DOMESTIC SUPPLY CHAIN

Although the UK is known for its competence in areas such as engines and aerostructures, there are also several weaknesses in the supply chain, in certain capabilities, availability of some products, but also in the skillsets on the manufacturing and management side. This means that the supply chain faces threats from global competition as the top tiers – who are not wedded to buying domestically and who feel that UK suppliers cannot deliver all their needs – are increasingly looking at the global supply chain to meet their needs. The industry naturally has an intense focus on quality and standards, but this can act as barrier to the lower tiers of the supply chain, as

gaining supplier accreditation and approved status can be time consuming and expensive. Added to this suppliers are often only able to secure relatively short contracts, which does not offset the major investment they have to make to undertake this work.

Despite the challenges for the supply chain, there are opportunities moving forward, as aircraft manufacturers push forward with innovation, for example reducing aircraft weight by the increasing use of light-weight composites. If manufacturers can rise to the challenge of meeting these new capabilities they would be well placed to secure future work.

OVERRELIANCE ON SAUDI MARKET



The UK has a historic advantage in the defence aerospace export market that is based on enduring defence relations in the Gulf, most importantly with Saudi Arabia. The region accounted for nearly 60% by value of all UK defence exports over the ten year period 2006-15. Saudi Arabia is the world's largest defence importer and, alongside the United States, the UK is its longstanding partner of choice. With the Royal Saudi Air Force operating Eurofighter Typhoon, Tornado and Hawk aircraft, flown by pilots trained by the UK armed forces, this is a strategic relationship both economically and diplomatically.

However, the extent of the reliance of this partnership exposes a distinct sectoral risk should investment not be sustained. Recent volatility in oil price and the impact on Saudi budgets has brought this into sharp focus although, despite fiscal constraints, defence expenditure has to date been maintained. Should a scenario in which Saudi investment shrunk, or exports from the UK became politically untenable, new near-term markets to fill such a void are not immediately apparent.

⁸ UK Space Agency, "The size and health of the UK space industry", Dec 2016

LOOKING TO THE FUTURE

Over the last decade, the UK aerospace industry has gone from strength to strength. While not without its challenges, the sector benefits from a well-developed ecosystem of world class research institutions, competitive supply chains, strong technological capabilities and collaborative partnerships. These advantages position the sector well to grasp the opportunities and minimise the risks in the short to medium term.

But in order to maintain its position as global manufacturing powerhouse over the longer-term, the industry must also harness a number of emerging trends on the horizon.

Whether this be through implementing new and innovative

manufacturing processes, or entering relatively untapped markets such as space tourism, the industry must not rest on its laurels, but rather protect its competitive advantage by continuing to evolve and embrace new technologies.



FACTORY OF THE FUTURE/3D PRINTING

Innovation is synonymous with the aerospace industry. New designs and equipment are evolving at a rapid pace in the digital age, bringing with them improvements in performance, productivity and safety. However the very process by which these products are being made is also changing, thanks to greater automation and 4IR technologies. The factories of the future will be dominated by automated assembly lines, collaborative robots and in particular 3D printing technologies. 3D printing or Additive Layer Manufacturing (ALM) is set to

revolutionise the production process.

Traditionally, component parts are made from a solid block of material, which is cut away at to form the required shape and dimensions. However 3D printing works in reverse, creating from the inside out. The process repeatedly prints very thin layers of material on top of each other until the layers form a solid object. As a result components created by 3D printers have a natural and topologically optimised shape, greatly improving efficiency and performance. Furthermore

such components are lighter yet still strong, have lower lead times and ultimately less expensive than conventional parts.

There are still some limitations to the technology, including the size of component parts that can be created, a narrow range of printing materials and inconsistent quality. However as advances in the technology continue to be made, these challenges should be overcome, allowing widespread adoption of the technology and the associated benefits.



USE OF COMPOSITES

Over the coming decade, the use of composite materials in aircraft manufacturing is expected to rise significantly. The global composite materials market, which aerospace

and defence accounted for over 65% in 2015, is expected to reach \$33.44 billion by 2024⁹. Growing air passenger traffic and the resultant surge in the manufacturing of

aeroplanes in North America, Europe and emerging regions is expected to drive the growth, as manufacturers realise the full potential of composite materials.

⁹Grand View Research Inc., "Market Research report", 2016

Composite materials offer several advantages over conventional metallic materials, namely their excellent durability and high stiffness to density ratios. They are also

much lighter, allowing for greater fuel efficiency and therefore travel distances. It is estimated composites enable a 20% saving in terms of weight. In addition to lowering the

overall aeroplane weight, moving to a composite primary structure also reduces the overall maintenance needed to be carried out on the aircraft.



HYBRID AIR VEHICLES AND THE WORLD'S LARGEST AIRCRAFT

British company Hybrid Air Vehicles are the designers and manufacturers of a revolutionary new hybrid aircraft at their base in Bedfordshire.

This innovative company, who are world leaders in their field, have developed the Airlander 10, which at 300 feet in length is almost 60 feet longer than a Boeing 747 and is the largest aircraft currently flying anywhere in the world. Although it looks like a conventional airship, it is quite different, combining elements of fixed-wing, rotary and lighter-than-air aircraft,

using a combination of buoyancy and aerodynamic design to generate lift.

The Airlander has good environmental credentials versus other aircraft, being both low in noise and air pollution. It is capable of 5 days continuous manned flight at an altitude of up to 16,000 feet and has a multitude of potential uses, including communication and surveillance functions, as well as transportation for up to 10 tonnes of cargo. In fact the company is developing an even larger vehicle, the

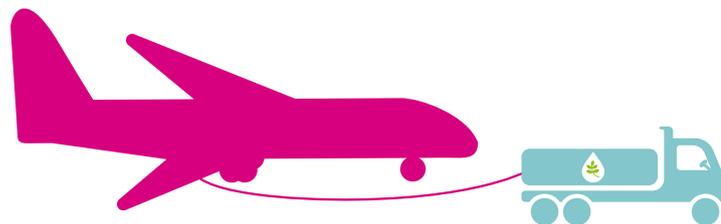
Airlander 50, whose main purpose will be movement of heavy cargo.

The next test flight for Airlander 10 is planned for the second quarter of 2017 with further flights throughout the rest of the year. Hybrid Air Vehicles expect the first commercial vehicle to come off the production line in early 2018, and in the next 5-10 years the company hope to have a full production line established manufacturing at least 10 vehicles per year, for a wide variety of uses across the defence and civil sectors.

ALTERNATIVE FUELS

The aerospace industry recognises its responsibility and role in helping to combat the challenge of climate change and pollution. Aviation impacts the environment in a number of ways; contributing to climate change through emitting greenhouse gases, causing noise pollution and generating derived emissions and congestion from travel to and from airports. There has therefore been an increased focus in the industry to explore the possibilities of alternative fuels, namely biofuels, which have the long term potential to reduce CO₂ emissions. There is also the added incentive that the increased use of biofuels decreases dependency on crude oil as well as exposure to oil price variations, which have been particularly volatile in recent years.

For biofuels to be successful, and widely adopted, they must be technically



suitable for use in engines and aircraft fuel systems. They must also be able to be mass produced in a commercial environment, as well as being competitive on price to conventional kerosene.

Research has found that second generation biofuels, rich in bio derived oils, such as soybeans and algae can be chemically processed to make high quality jet fuel. There has already been a marked move towards this technology with airline companies such as Lufthansa and EasyJet signing deals with Solena, a US based aviation biofuel producer in 2012, to provide new sources of sustainable jet biofuel.

The UK Government has also recognised the need for further research and investment into alternative fuels. In the latest Autumn statement the Chancellor announced, through the newly formed National Productivity Investment Fund, £20 million for the development of alternative aviation and heavy goods vehicle fuels.

However even with this extra investment, it is widely accepted that biofuels remain some way off replacing traditional kerosene in civil aviation. According to IATA an investment of US\$10-15 billion¹⁰ will be required to bridge this gap.

¹⁰Capgemini, "The changing face of the aerospace and defence industry", 2011



SPACE TOURISM

Space tourism is a new, highly sought after sector in the emerging “New Space” industry. Despite being very much in its infancy stage, with only a handful of companies such as Virgin Galactic looking to develop commercial spacecraft, it represents a growing market and opportunity for the UK aerospace industry and its supply chain.

The government has recognised this, and in February 2017 the science

minister Jo Johnson announced that grants worth up to £10 million are being made available to help develop commercial launch capability for spaceflight. This funding is underpinned by the government’s ambitions for the UK to capture a greater share of the commercial spaceflight market, worth an estimated £25 billion over the next 20 years.

However this branch of aerospace faces many challenges and hurdles

before achieving commercial viability. Not only is the cost hugely prohibitive – many have argued that the £10 million in government grant funding falls short of the hundreds of millions that would actually be required to build the necessary infrastructure – but safety issues remain abundant. As with any new industry, significant innovation will be required to iron out safety issues and make the industry more cost-effective.



BAE SYSTEMS TAKE LEAD ON THE DEVELOPMENT OF UNMANNED AIR SYSTEMS

Unmanned Air Systems (UAS) already play a central role in the world’s leading air forces and their strategic importance is destined to grow exponentially in coming decades. For surveillance and reconnaissance missions in low-threat environments, UAS offer greater persistence and broader coverage, delivering better intelligence and contributing to more effective operations. As entry-level costs fall, driven by maturing technology, volume production and miniaturisation, a growing number of operators will seek to incorporate such technology into their force structure, opening up new export markets.

For the UK to stay ahead from a military and industrial perspective, attention is already focused on next generation capability. These platforms will operate with a much greater degree of autonomy, flying missions in highly contested air space with the minimum of human intervention. Such systems are envisaged to replace existing manned combat capabilities from the 2030s. UK government and industry are already funding R&D in anticipation of this, reflecting the strategic necessity to maintain both national security and commercial advantage.

BAE Systems are the UK’s global pioneer and, with advanced

technology demonstration programs such as Mantis and Taranis, the company is a world leader in the development and application of autonomous system design. However, costs associated with a UK-only capability are expected to be prohibitive, with limited production runs and a strictly controlled export market. Collaborative development with allied nations and their own industries is therefore anticipated. In 2016 Britain and France announced plans to begin full-scale development of such a system, building on BAE Systems’ R&D in this field alongside the complimentary work led by France’s Dassault Aviation.



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