World Class

A blueprint for the future of the aerospace industry

amicus
the union

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Chapter 1 Executive Summary

Objectives

- The overall purpose of this research is to gain a more detailed understanding of the current scale and nature of employment in UK aerospace manufacturing and to identify the key economic trends that are impacting on the UK workforce.
- In particular, the report seeks to evaluate whether changes in employment represent a 'hollowing out' of UK aerospace manufacturing jobs and capacity in the longer term, especially through a dilution of higher value-adding activity in the UK. This would represent a serious threat to UK aerospace manufacturing capacity and capability. On the other hand, there may be opportunities to concentrate more value-adding employment in the UK and therefore boost the industry and strengthen employees' prospects as a whole.

Methodology

The study involved a combination of desk research and interviews with expert industry representatives and analysts, together with an analysis of selected data sets provided, for the most part, by the DTI and SBAC.

Economic overview of the UK aerospace industry

- The UK aerospace industry has the largest turnover in Europe and a global presence second only to the US.
  It is a significant contributor of earnings to the UK economy, based on the manufacture and export of aircraft systems, engines and equipment.
- UK aerospace turnover has risen steadily since the mid-1990s, especially on the civil side of the industry, having overtaken domestic and export demand for military products
- The industry directly employs around 155,000, and whilst this figure is unlikely to grow significantly in future, the skills base is changing as the 'intellectual content' of aerospace work increases.
- The industry is highly dependent on skilled engineers and scientists, with the highest proportion of professional, technical and scientific employees working in any of the UK's engineering sectors. However, like many other industries, aerospace companies are feeling the effects of skills shortages.

Other challenges facing the industry include a narrowing productivity gap against such competition as Germany and France. These competitors are also outstripping the UK in terms of R&D investment, which is essential to maintain and enhance technological edge.

Is the UK industry hollowing out?

- 'Hollowing out' is defined by three measures – the degree to which UK aerospace companies' strategic control over investments is headquartered in the UK; the degree of technology leadership acquired by UK aerospace companies in key programmes and markets, and the skills/knowledge base and profile established in, and required by, the UK workforce to underpin technology leadership in these programmes and markets.
- We have concluded that UK aerospace primes and first tier suppliers are still largely headquartered in the UK, and still achieving technology leadership, based largely on the knowledge and skills of their employees. UK companies are winning places on important international collaborative programmes, and employ a growing proportion of technical, scientific and professional staff.
- However, there are threats to the industry as UK aerospace companies are increasing their ownership of aerospace assets overseas and incentives to invest in overseas locations are becoming ever more attractive. R&D spending is too low a proportion of turnover relative to competitor countries and shortages in certain skill areas are threatening to weaken UK companies' capacity to win work in this country.

Key issues in the UK aerospace industry

- Globalisation and consolidation are major issues shaping the aerospace industry, through global mergers and acquisitions, collaboration, global sourcing and offset arrangements. Whilst UK aerospace companies are well placed to take advantage of these developments, capacity and employment may be threatened by increased outsourcing and the location of production overseas.
- The UK Government continues to play an important role in the industry, through defence procurement and support for R&D. However, Government assistance through such initiatives as Repayable Launch Investment (RLI) and the Civil Aircraft Research and Technology Demonstration fund (CARAD) is far surpassed by public investments in major competitor countries. It is essential that the aerospace industry receives Government support for long-term research in order to retain its high-value manufacturing capability.

- Supply chain dynamics are undergoing radical changes as prime contractors gradually shift their role to become systems integrators. There is a shift of roles, risks and responsibilities towards SMEs, offering new opportunities to the supply chain. Conversely, as the supply chain is also threatened by global sourcing and production, suppliers will be required to minimise cost, position themselves as preferred suppliers to their customers and enhance their service provision.
- The UK aerospace workforce and, more widely, the labour market are necessarily affected by developments in the global industry. In order to gain competitive advantage in changing world markets, it is essential that the UK aerospace industry asserts and retains technology leadership. An assured supply of technologically skilled and qualified labour throughout the supply chain is therefore a critical success factor. It is important that engineers working in aerospace benefit from high quality training and development in a broad range of skills including engineering, design, ICT, management and lean manufacturing techniques.

Policy implications

- The issues raised in this report should be used to strengthen the Union's lobbying links with key partners in industry and Government (local, regional and national). The AEEU can take a lead in drawing renewed national attention to the implications of globalisation for the long-term wealth and employment creating potential of the industry.
- Improved labour market and business intelligence is needed and the AEEU could explore, with partners, the feasibility of setting up a UK Aerospace Industry Observatory to monitor trends in investment decisions and flows, international trade and exports, employment and workforce development.
- The Government plays an important role in the aerospace industry and is urged to establish clearer 'audit trails' linked to its various forms of direct financial support and other commercial dealings with the industry – notably through CARAD, RLI and MoD procurement. These financial and commercial arrangements should be accompanied by a system of monitoring that clarifies whether and what UK economic benefits flow from the monies invested.

EXECUTIVE SUMMARY

- The supply chain must be supported by continued assistance with initiatives such as Supply Chain Relationships in Aerospace (SCRIA) and the Lean Aerospace Initiative (LAI). These initiatives help companies improve relationships throughout the supply chain and must be supported to improve industry competitiveness.
- Education and training is vital to ensure that UK aerospace employees have the skills necessary to deliver technological innovation, improved products and services and lifelong employment. Unions have a crucial role to play in negotiating with employers for quality training provision.
- A joint approach to training and education amongst smaller firms, particularly in areas where there are strong aerospace clusters, may enhance the provision and quality of training and education. Government support is necessary to enable SMEs to combine forces and achieve some economies of scale in developing shared training packages.
- Using the new legal right for union officials to take time off to promote learning at work, AEEU representatives will be able to take advantage of this ruling to encourage employers to promote workforce training and education. They are encouraged to establish Learning Centres at work, or to develop and run union training schemes, produce learning materials and encourage people in the workplace to get involved in training at every level, from basic skills to professional development.

The Union can take a lead in building partnerships with other stakeholders in the UK aerospace industry. The AEEU should continue to negotiate a presence and a voice for its members in key decision-making arenas and at every level – from the factory floor to the Boardroom, and from the local LSC to Government departments. Supported by vigorous and ongoing membership education campaigns, and using this report and other intelligence, the AEEU's influence and profile in the debate about the future of the UK aerospace industry can only grow.

This study was undertaken prior to the tragic events on 11th September 2001. The aim of this study is to look at the long- term trends within the Aerospace industry. Although the current climate is now very different from when the report was written many of the issues highlighted are still relevant.

The AEEU has undertaken this study in order to help update the Union's understanding of key changes taking place in the UK aerospace industry and to strengthen its policy response to these changes.

On the face of it, the aerospace industry is successful, with order books full. But AEEU members are concerned to see what looks like an increasing flood of UK investment in capacity and workload going to overseas companies and locations.

Airbus is mounting the most serious threat ever to Boeing's world lead in civil markets and Eurofighter looks set to win significant market share worldwide.

The UK also has a stake in both of the camps that are currently competing for the JSF contract. So there are clearly signs of continuing growth in the civil and military aerospace markets worldwide, and very good prospects for UK firms. But we need to know whether – and under what conditions – this growth will actually benefit our members. How secure are the higher skilled, better-paid jobs that have underpinned the Union's strength in the past and contributed so much to the UK's success in world aerospace markets?

The overall purpose of this research, therefore, was to gain a detailed understanding of the current scale and nature of employment in UK aerospace manufacturing and to identify the key economic trends that are impacting on the UK workforce, particularly at prime contractor and first tier supplier levels.

Specifically, the study set out to:

- Assess the overall value of UK aerospace industry outputs, including civil and military airframes, space systems and equipment (aero-engines, avionics, structures and sub-assemblies).
- Determine the net balance of trade and recent trends in UK manufactured aerospace goods overall, with particular reference to the effects of 'offset' arrangements with overseas customers (work outflows) and with overseas prime contractors or consortia (work inflows).
- Assess the current position and recent trends in UK aerospace manufacturing employment in relation to both the total numbers employed and the types of employment involved (occupational composition/skills profile), with particular reference to prime contractors and first tier suppliers.

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- Determine the extent to which such trends can be attributed to:
  - a shift in UK aerospace manufacturing capacity/investments overseas
  - inward investments/shifts of capacity into the UK by overseas manufacturers
  - offset arrangements with overseas customers and/or contractors
  - mergers and acquisitions
  - outsourcing strategies, supply chain rationalisations or reforms.
- Measure the extent to which the resulting levels and types of employment found in the UK represent either:
  - a 'hollowing out' (or an enhancement) of UK aerospace manufacturing employment in the longer term
  - a dilution (or concentration) of higher value-adding employment in the UK
  - a threat (or an opportunity) to UK aerospace manufacturing capacity and capability.
- Identify any recent examples of successful investments in/extensions of aerospace industry jobs and capacity in the UK.
- Determine what aerospace industry leaders, observers and analysts see as critical in shaping future investment decisions in the UK.
- Identify policies which the AEEU might adopt and pursue with the industry and Government, aimed at improving and sustaining:
  - high levels of employment in the aerospace industry
  - the supply of skilled people
  - appropriate levels of Government (and other) investments in R&TA, both at a UK regional and national level.

In order to meet these objectives, the study involved a combination of desk research and a small number of interviews with expert industry representatives and analysts, together with an analysis of selected data sets provided, for the most part, by the DTI and SBAC. The bulk of the research was undertaken between January and May 2001.

Desk-based research consisted of identifying and 'mining' existing published trade reports, journal articles and other published material. These are listed in section 6. Specific data sets containing official trade statistics (export figures and Research and Development expenditure), together with employment figures, were also analysed.

To gain a fuller understanding of UK aerospace industry and its strategic position in the global marketplace, a series of in-depth telephone and face-to-face interviews were undertaken. These consisted of consultations with 17 key informants – three face-to-face and the remainder by telephone. In consultation with the Project Manager at the AEEU, UKRP selected participants from the following organisations:

2.1 Prime contractors and first tier suppliers

Senior representatives from eight leading UK aerospace manufacturing companies were consulted on topics covering technology, R&TA, market strategy, trends affecting the workforce, skills and training, partnerships and alliances, the supply chain, and future challenges and opportunities.

The companies involved were:

BAE Systems

Rolls-Royce plc

TRW Aeronautical Systems (Lucas Aerospace)

GKN Aerospace Services

Smiths Industries Group

Bombardier Aerospace

Cobham plc

Thales UK

2.2 Industry experts

Six leading aerospace academics and commentators were consulted over key trends within the UK aerospace industry and its global market position. Interviews also examined the direction of the industry, key economic drivers, Government policy, and the impact of offset arrangements, partnerships and alliances on UK manufacturing and the workforce.

Those consulted were from the following organisations:

Society of British Aerospace Companies (SBAC)

The University of York, Economics & Related Studies Dept

Cranfield University

AIRLINE (Aerospace Industry Regional and Local Authority Network)

Department of Trade and Industry (DTI), Aerospace Directorate

North West Aerospace Alliance

2.3 AEEU aerospace site convenors

Senior officials representing AEEU members' interests at three aerospace sites were also interviewed. Their views were obtained on skills and training requirements, company plans, Government policy, supply chain relationships, implications for the workforce and the Union's role within the industry.

Those interviewed were from the following sites:

BAE Systems, Filton

Messier-Dowty, Gloucester

Rolls-Royce, Derby

This report on the findings of the study is structured as follows:

- *Chapter 3.* Provides a business overview of the UK aerospace industry and context for the study, highlighting key trends. These cover value and productivity, the balance of trade, the export market, offset arrangements, distribution and supply chains, employment and skills, and research and development. The intention of this section is to 'set the scene' for the key issues discussed in chapter 4.
- *Chapter 4.* Reports on the main challenges facing the UK aerospace industry. These focus on the four main issues that are having a significant impact both globally and on the UK industry. They cover:
  - Consolidation and globalisation – restructuring of the industry
  - in the structure of the supply chain
  - The role of Government, together with research and development
  - The labour market, skills and training needs

  It is these dimensions that form the basis for the policy suggestions highlighted in chapter 5.
- *Chapter 5.* Presents a set of policy recommendations and conclusions for the AEEU to take forward –practical ways in which the AEEU might engage with stakeholders more widely, and at every level, within the aerospace industry.

Chapter 3

Economic overview of the UK aerospace industry

3.1 Introduction

This chapter highlights key economic and labour market trends in the UK aerospace industry. These cover value and productivity, the balance of trade, supply chains, employment and skills and R&D. The overview is intended to provide a basis for a more in-depth discussion concerning key themes and issues emerging within the industry, contained in chapter 4, and to establish the context for policy considerations highlighted in chapter 5.

The findings presented in the following sections are based on an analysis of secondary sources (mostly published reports, journal articles, etc.,) and data sets kindly provided, for the most part, by the SBAC and the DTI. Some of the data used to describe supply chains in the UK aerospace industry is taken from recent SBAC and industry sponsored research that has not yet been published in full.

3.2 Value and productivity of the UK aerospace industry

In order to gain an understanding of how the UK aerospace industry has performed during the 1990s, it is important to assess what is known about the overall value and level of productivity over time, and implications for the industry.

The UK aerospace industry turnover is the largest in Europe

According to the SBAC[1], UK aerospace industry turnover between 1998 and 1999 amounted to £17.59 billion. This accounts for over 42% of the total EU aerospace industry and 13% of the major aerospace producing economies[2].

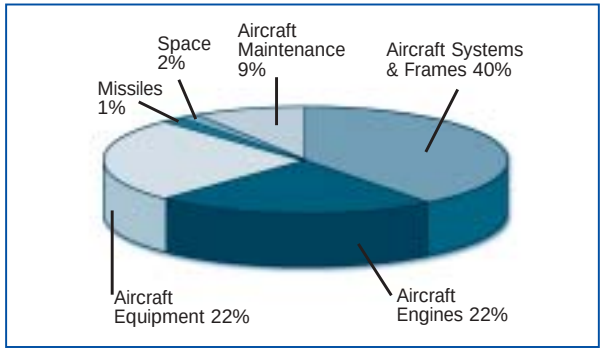
The aerospace industry is one of the UK's most successful manufacturing sectors, providing about 2.5% of UK manufactured output and 5% of manufactured exports[3].

In comparison with the other major aerospace-producing nations worldwide, the UK is the second largest (in terms of turnover) after the USA. The US industry is, on this measure, about four times bigger than the UK's.

Figure 3.1 indicates that, in 1999, the largest proportion (40%) of turnover was accounted for by the manufacture of aircraft systems and frames. The remainder is divided between equipment (26%) and engines (22%), with aircraft maintenance, missiles and space making up the rest. This highlights the fact that the value of the UK aerospace industry is concentrated in the manufacture of aircraft systems and frames, equipment and engines, and is worth a total of ce: SBAC UK Aerospace Industry Statistics Supplementary Data, 1999.

[1]SBAC (1999) UK Aerospace Statistics Key Points and Trends. www.sbac.co.uk
[2]EU-15, US, Canada and Japan
[3]Lawrence (2000) DTI Foresight Defence Aerospace and Systems Panel. www.foresight.gov.uk

Figure 3.1
UK aerospace industry turnover by product group as % of total UK turnover 1999.

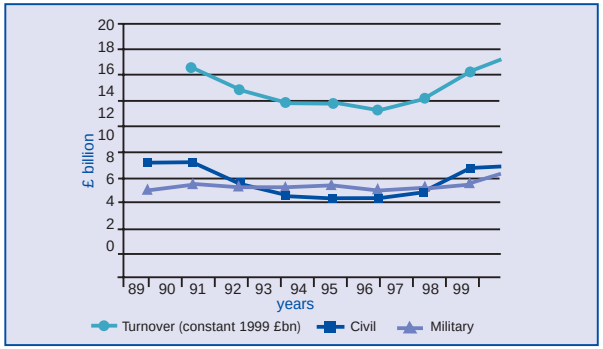


Source: *SBAC UK Aerospace Industry Statistics Supplementary Data*

UK aerospace turnover recovered and rose steadily during the second half of the 1990s

Figure 3.2 shows the trend in turnover between 1989 and 1999. The period 1991-1995 clearly represents some of the poorer performing years for the UK aerospace industry, when turnover fell below £15 billion. The fall coincided with the recession of the early 1990s, reflecting both the general downturn in the production of UK manufactured goods and simultaneous downturns in civil and military aerospace markets. However, the period 1995-1999 was much more fruitful, as turnover rose by 6%. Turnover peaked over this period in 1997 at £17.86 billion.

Figure 3.2
UK aerospace unconsolidated turnover by civil and military value 1989-1999



Source: *SBAC UK Aerospace Statistics, Key Points & Trends, 1999*
Note: *unconsolidated turnover excludes sales from EU-consortia*

Figure 3.2 also shows that the proportion of military and civil turnover is fairly similar over time. Indications are that, whereas military spending outstripped civil spending in 1989, this trend was reversed in 1999, with military

expenditure falling. The relatively small difference between the proportion of turnover attributed to military and civil contracts demonstrates the importance of both sectors to the overall value of the UK aerospace industry.

The UK aerospace industry has a considerable manufacturing capacity (referred to as 'global assets') throughout the world. It was noted above that the industry had a turnover of £17.59 billion in the UK in 1999. UK aerospace has an additional turnover of £2.82 billion in the US, and £1.44 billion throughout the rest of the world, amounting to an overall worldwide total of £21.8 billion. This means that almost 20% of UK aerospace turnover is generated through overseas assets. Current trends suggest that this global 'footprint' will grow considerably over the next few years.

International comparisons – UK aerospace industry has the highest turnover in Europe

In comparison with competitor nations, the US has by far the greatest value of turnover, estimated at £70 billion in 1999. During the 1980s and 1990s, the US aerospace industry peaked at just under £90 billion (in 1985), and declined to its lowest level (£60 billion) ten years later. This rose again gradually during the last quarter of the 1990s.

In relation to Europe, the difference in turnover between the UK, France and Germany is less significant. AECMA[4] figures indicate that 35% of EU turnover is accounted for by UK industry, 33% by France and 17% by Germany. Although the UK aerospace industry has the greatest proportion of turnover, it is closely followed by France, which is a key competitor in an increasingly global industry.

Overall productivity has increased in recent years

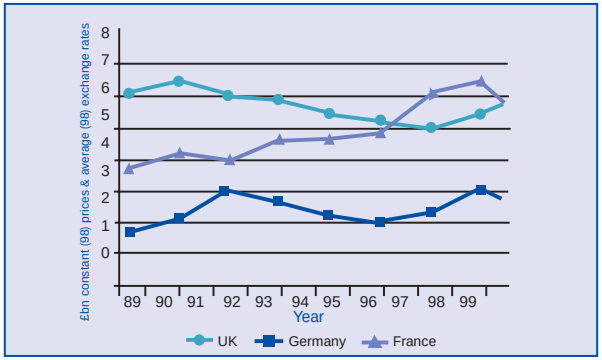
The level of Gross Value Added (GVA) provides a broad indication of productivity in the industry. GVA represents the total sales and work undertaken, less the cost of materials, fuel costs and other costs (excluding salaries).

Figure 3.3 shows that the UK GVA for the aerospace industry in 1999 was £7.1 billion (current prices), £6.2 billion for France and £4 billion in Germany. In comparison with the USA aerospace industry, the value-added of the UK, French and German aerospace industries is significantly lower. The GVA in the USA has in recent years been about five times larger than the UK, at an estimated £35.5 billion. However over a ten-year period (1985-1995), it dropped by approximately 46 per cent.

[4]AECMA (1999) Statistical Survey

ECONOMIC OVERVIEW

Figure 3.3
Aerospace Gross Value Added (GVA) by selected country 1989-1999

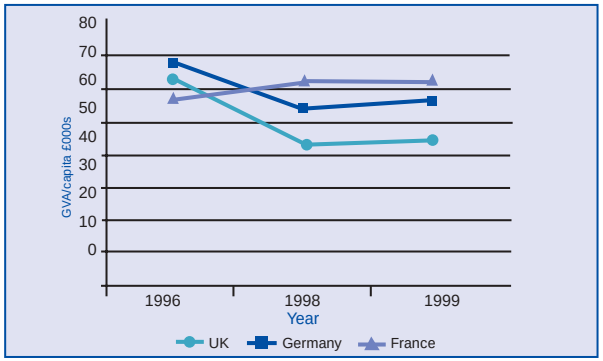


Source: *SBAC UK Aerospace Industry Statistics Supplementary Data, 1999*

The French aerospace industry is closing the gap in productivity

Figure 3.3 shows that, between 1995 and 1999, UK GVA rose by 1.7 per cent. But by the mid 1990s, French productivity had begun to overtake the UK's, although this lead has not been sustained.

Figure 3.4
Aerospace Gross Value Added (GVA) by selected country 1989-1999



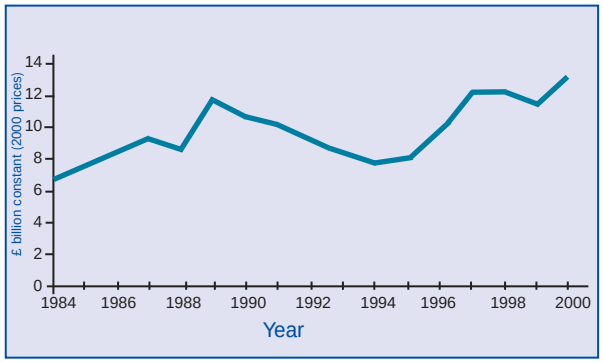
Source: *AECMA Statistical Surveys, 1997-1999 and SBAC UK Aerospace*
Note: *Data for 1997 is missing from source*

Figure 3.4 illustrates GVA per capita (i.e. in relation to the number of aerospace employees) as a further measure of productivity. Not only is France edging closer to the UK in terms of its share of the EU market, but both measures of GVA trends also suggest that the productivity gap between UK and French aerospace industries is closing. If current trends continue, the French aerospace industry may soon outstrip UK GVA as well as GVA per capita.

3.2.1 Balance of trade in UK manufactured aerospace goods

Total exports of UK aerospace goods were at their highest value in 2000

Figure 3.5
Total UK aerospace exports civil and military 1984-2000



Source: *DTI analysis of Overseas*

Figure 3.5 shows the value of exports using the latest figures available from the DTI[5]. Total exports of UK aerospace goods stood at £13.2 billion in 2000 – the highest value since 1984. However, trends are somewhat erratic and unpredictable. After a decline in exports during 1989 and 1994, the level of exports rose, with an increase of almost 16% between 1999 and 2000.

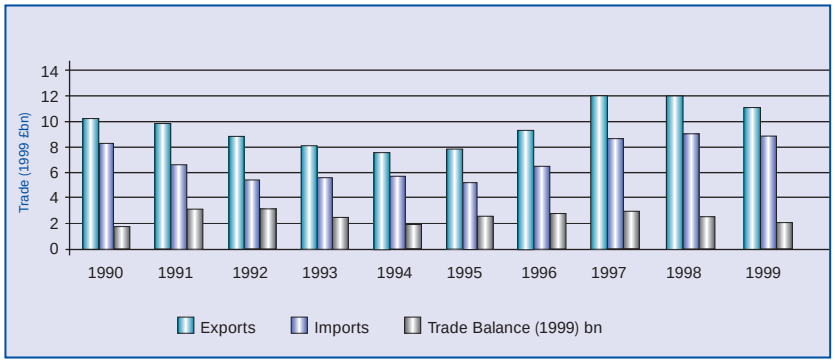
Around 67% of production is exported, a very much higher proportion than the EU aerospace industry average of 51%. This level of exports indicates the importance of the export market to UK companies and is clear evidence of their continuing ability to compete in an increasingly global marketplace.

The UK aerospace industry contributed a positive trade balance of an average of £2 billion per annum during the 1990s

Figure 3.6 shows that, in 1999, the UK aerospace industry as a whole contributed a positive £2.1 billion to the UK balance of trade. Although the trade balance dropped between 1992 and 1994 (and again, but less so, in 1997/99), it has on average contributed over £2 billion every year throughout the 1990s. Factors such as the strength of sterling and a drop in military sales to the Middle East have clearly had periodic impacts on the overall balance of trade.

[5]Department for Trade and Industry

Figure 3.6
UK aerospace industry trade balance 1990-1999

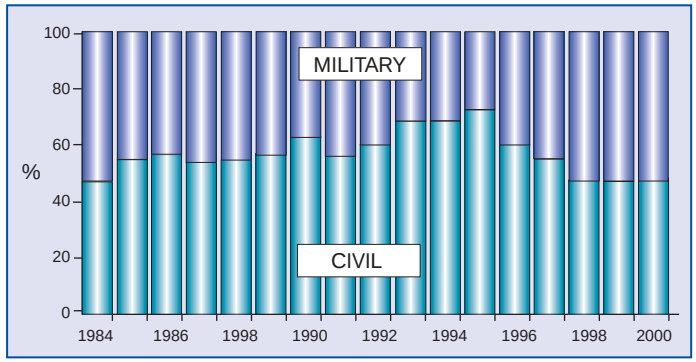


Source: *SBAC UK Aerospace Industry Statistics Supplementary Data, 1999*

There is a growing market for civil aerospace products

Figure 3.7 shows that, in terms of the difference between civil and military UK exports, the overall trend in the last 16 years has seen a steady increase in civil exports. In 1984, civil exports amounted to £3 billion, more than tripling (in real terms) to £10.4 billion in 2000. This highlights the growing importance of the market for civil aerospace products and the UK's relatively strong position in the global market place. The overall trend in the level of civil exports is accounted for by the worldwide rise in the number of new aircraft being commissioned.

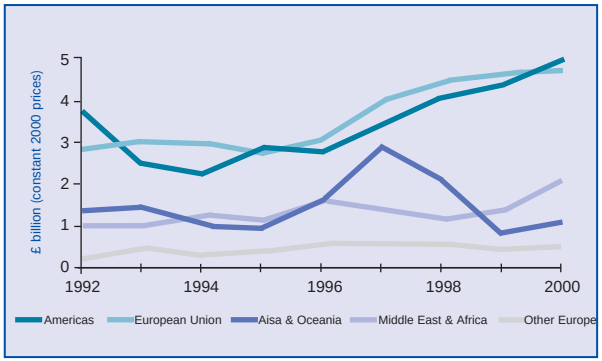
Figure 3.7
UK aerospace industry trade balance 1990-1999



Source: *DTI analysis of Overseas Trade Statistics, 2001*

According to the Royal Aeronautical Society[6], over the past 15 years the global number of commercial aircraft in service has doubled – from 7,000 to 14,000 – and this trend is expected to continue. Airbus Industrie[7] forecast an annual average delivery rate of 733 new passenger aircraft per year over the next ten years. In parallel, the overall number of military orders has declined, partially due to the 'peace dividend' delivered in the late 1980s.

Figure 3.8
UK Aerospace global exports 1992-2000



Source: *DTI analysis of Overseas Trade Statistics, 2001*

The USA and EU are key export markets for UK aerospace companies

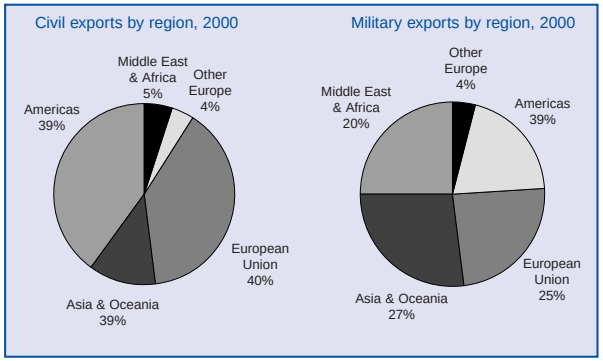
Figure 3.8, which shows the latest available DTI figures, demonstrates that the two main export markets for both civil and military UK aerospace products are in the Americas and the European Union. These have been key markets throughout the 1990s, and in 2000 both export markets reached a peak of nearly £5 billion.

Other key overseas markets are the Middle East and Africa, Asia and Oceania and other non-EU European countries. Despite a sharp decrease in exports to the Middle East and Africa between 1998 and 1999, sales in these regions recovered slightly between 1999 and 2000. During the same period, UK aerospace exports increased to just under £2 billion in Asia and Oceania, suggesting an emerging export market for UK aerospace products. The volatility and adverse political environment of some Middle Eastern countries has dramatically affected UK exports, as depicted in Figure 3.9.

Figure 3.9 shows the main destinations for UK aerospace exports, broken down by civil and military. EU countries and the Americas together account for almost four fifths (79%) of the market for civil exports. This contrasts sharply with the military export market, which is more diverse. Whilst EU countries account for one quarter of exports in 2000, the largest

[6]RAeS conference (2001)
[7]Airbus (2000) Global Market Forecast 2000-2019. www.airbus.com

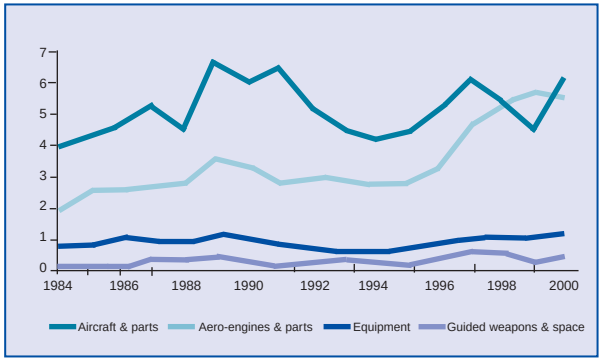
Figure 3.9
Civil and military exports by region 2000



Source: *DTI analysis of Overseas Trade Statistics, 2001*

proportion (27%) of military goods go to Asia and Oceania. Collectively, Middle Eastern, African countries and the Americas purchase 44% of the UK military aerospace exports.

Figure 3.10
Exports by product sector 1984-2000



Source: *DTI analysis of Overseas Trade Statistics, 2001*

Figure 3.10 shows that, between 1984 and 2000, the two main export sectors were aircraft and parts, together with aero-engines and parts. During the late 1990s, exports of aero-engines and parts rose steeply, increasing in overall value. As the export value in aircraft and parts dropped in 1998 and 1999, the aero-engines and parts sector became the largest export earner. However, in 2000, exports of aircraft and parts increased to £6.2 billion and continued to be the largest sector of UK aerospace exported goods.

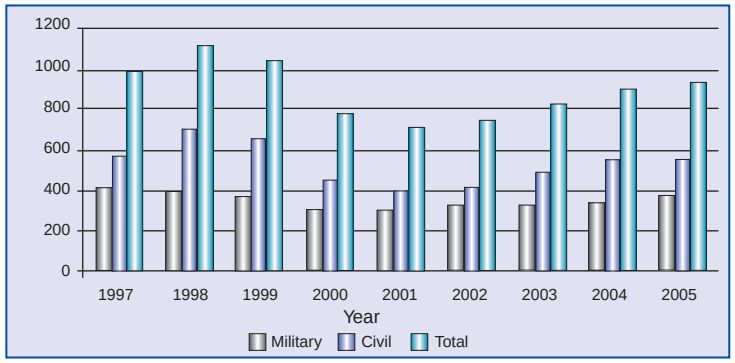
Overall, it appears that the market for aircraft is more erratic than the market for aero-engines and parts, which appears to have undergone a step change growth since the mid-1990s.

The growth in civil aircraft deliveries is expected to continue

Overall, the global market for both civil and military aircraft has changed over the past fifteen years. Governments have cut defence budgets since the end of the Cold War, with annual spending on defence across the world dropping by 30 per cent from over $1 trillion in 1988 to $704 billion in 1997[8]. Yet during this period – with the notable exception of the 'blip' in the late '80s/early '90s – the demand for civil aircraft rose as airlines expanded their fleets, new routes were opened up and low-cost budget airlines, such as Easyjet, Buzz and Go, entered the airline market.

This increase in passenger travel has created a demand for more aircraft, as shown in Figure 3.11. This indicates that the global value of aircraft deliveries is forecast to grow by an estimated $230 billion from 2001 to 2005, with the greatest area of growth predicted to be in civil aircraft.

Figure 3.11
Global civil and military delivery forecast 1998-2005



Source: *SBAC UK Aerospace Facts and Figures, 1999*

Industrial offsets

There is evidence to indicate that defence related offsets benefit companies further down the supply chain

The UK has an Industrial Participation (IP) policy under which overseas companies supplying goods to the MoD worth £10m or more (or more than £50m in the case of France and Germany – a reciprocal agreement) undertake to place business up to an agreed proportion of the value of the contract with UK defence companies (and vice versa)[9]. The aim of the policy

[8]A.T. Kearney (2000), The Impact of Global aerospace Consolidation on UK Suppliers

[9]It is difficult to determine exactly what this proportion is or how it is calculated or agreed between the parties involved. This is because definitions of what counts as an 'offset' and the way in which each contract 'cake' is cut between customer and supplier countries are not at all clear and do not appear to have been agreed formally. SBAC- based estimates are nevertheless detailed on the following page

is to correct the imbalance in competitive barriers faced by UK companies abroad, by ensuring that a proportion of the contract value is with UK businesses.

There are two types of IP's – direct and indirect:

Direct IP – Work on the MoD programme itself. The offshore bidder is required to identify UK companies able to carry out elements of work as part of its bid.

Indirect IP – This comprises other (mostly defence) work and can be subsequent sales to third parties of the equipment supplied to MoD or work on other defence equipment supplied by the offshore company. Technology transfers and other innovative solutions can also contribute to this Indirect IP.

SBAC[10] states that this policy protects British jobs and industrial defence capabilities, and represents a valuable export marketing tool for UK companies, especially those in the supply chain, to become involved in major overseas programmes. Figures produced by SBAC certainly suggest that defence offset deals are beneficial to UK industry. For example:

- The value of existing Industrial Participation obligations is in excess of £4.7bn, over £2.5bn of which will be in the form of indirect offset (goods and services which are unrelated to the products being sold).
- £260m worth of IP-related contracts will be placed with UK industry per annum over the next 8 years.
- In 1999, some £433m worth of IP-related contracts were placed with British industry by overseas contractors, of which £315m worth of business was placed with lower-tier suppliers.

It therefore appears that, in recent years, the UK aerospace industry has benefited from defence related offsets through the Industrial Participation policy. However, from the limited information available, it seems that the extent of inward and outward offsets has become less of a factor compared with the effects of global restructuring within the aerospace industry.

It is worth noting that the Industrial Participation policy covers all defence production, not just aerospace. However, according to one industry expert, it is estimated that on average, 70% of defence contracts placed by overseas companies in the UK are aerospace industry related. This suggests that, in 1999, IP-related aerospace contracts were worth around £303 million (70% of all IP-related business). Taking this into account, we estimate that UK defence related offsets were worth less than 4% (3.7%) of total UK military aerospace turnover. And as a proportion of all UK aerospace activity, offset accounted for under 2%.

Whilst no information is available regarding outward offsets, we can make an estimate about its value using information available regarding US offset agreements[11]. Between 1996 and 1998, the value of defence offset

[10]SBAC The Industrial Participation Forum. www.sbac.co.uk

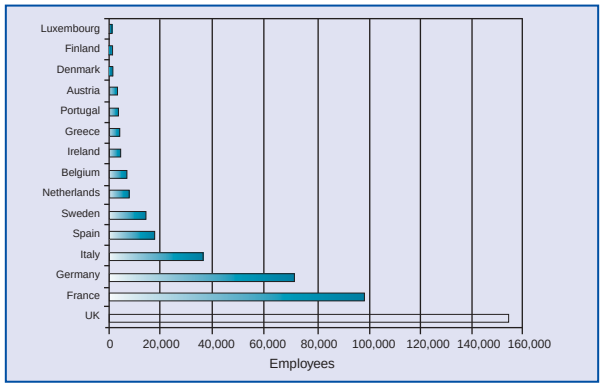
[11]Office of Strategic Industries and Economic Security (1999) Status Report of the Presidential Comission on Offsets in international Trade

agreements as a percentage of US defence exports was between 12% and 25%. Assuming that offset agreements form a similar proportion of UK defence exports, we can estimate that outward offsets are worth between £470 and £980 million (based on defence export values of £3.92 billion in 1999). Based on UK aerospace industry turnover for 1999 of £17.59 billion – this represents between 2.7% and 5.6% of total turnover. This suggests that the value of contracts gained through inward defence offsets is exceeded by the value of outward offset agreements. The negative balance of offset trade is entirely consistent with the balance of aerospace trade overall, with exports consistently outstripping imports. The implications of offset arrangements are explored further in chapter 4.

3.3 UK aerospace employment

Figure 3.12 indicates that, in comparison with other EU countries, the UK has the highest number of people directly employed in aerospace, accounting for one third of all jobs in the EU aerospace industry. However, as might be expected (given the relative scale of operations across the Atlantic), the US aerospace industry employs four times the numbers working in the UK.

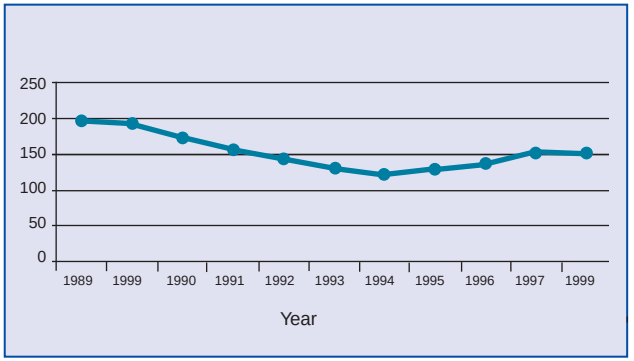
Figure 3.12
Direct EU employment in aerospace industry 1999



Source: *AECMA Statistical Survey, 1999*

Figure 3.13 shows an overall decline in employment in the UK aerospace industry between 1989 and 1999, with close to 50,000 direct jobs lost. But between 1996 and 1999, employment levels recovered somewhat, so that by 1999 the industry directly employed 154,500 people. The current expectation is that this figure represents, at best, a plateau, and that direct employment amongst prime contractors and first tier suppliers is unlikely to grow.

Figure 3.13
Employment in UK aerospace industry 1989-1999

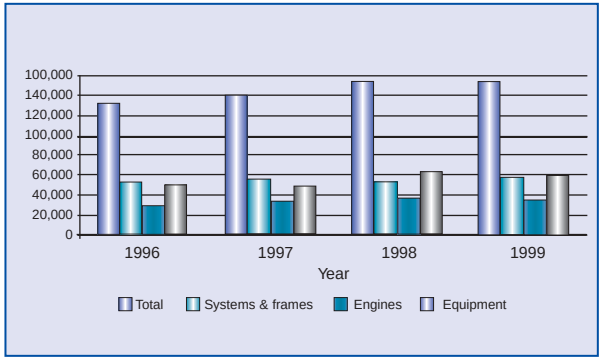


Source: *SBAC UK Aerospace Industry Statistics Supplementary Data, 1999*

Employment growth has been concentrated in equipment and engines manufacture, in production and R&D and amongst highly skilled workers

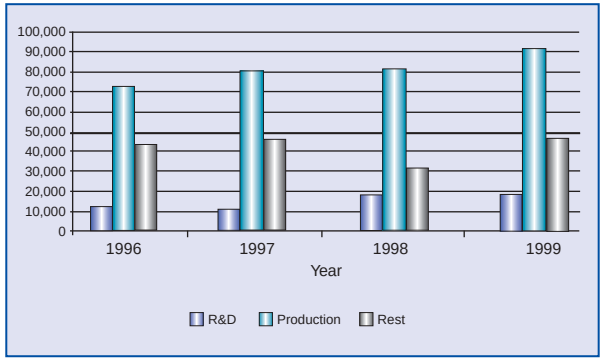
The three following charts show trends in aerospace employment according to different sectors, functions and occupational groups within the industry between 1996 and 1999, when employment started to pick up. Figure 3.14 shows that, although there was growth in employment across all three major sectors, the greatest increase was in the manufacture of aerospace equipment and engines.

Figure 3.14
Employment in UK aerospace industry by sub-sector 1996-1999



Source: *SBAC UK Aerospace Industry Statistics Supplementary Data, 1999*

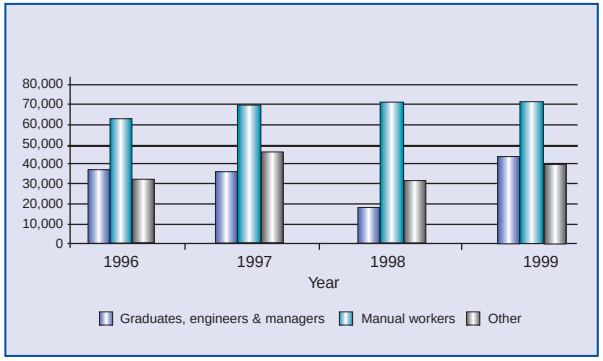
Figure 3.15
Employment in UK aerospace industry by function 1996-1999



Source: *SBAC UK Aerospace Industry Statistics Supplementary Data, 1999*

Whilst Figure 3.15 shows that the biggest increase in the UK aerospace workforce was amongst people employed in the production process, there is also a notable growth in the numbers working in R&D. Figure 3.16 goes on to show that, although employment remains concentrated amongst manual workers, recent trends suggest an increasingly important role within the industry for graduates, engineers and managers. Indeed, as the prime contractors adopt more of a systems integration function at the top of the supply chain, the intellectual capital invested in project planning and management roles at this level – the 'knowledge base' of the industry – is bound to grow. This clearly has important implications for the occupational and skills profile of the industry in the longer-term.

Figure 3.16
Employment in UK aerospace industry by broad occupation 1996-1999

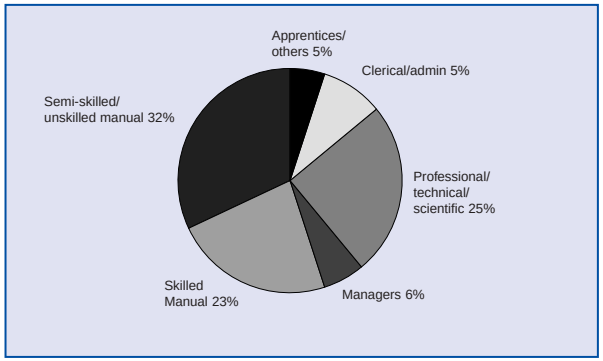


Source: *SBAC UK Aerospace Industry Statistics Supplementary Data, 1999*

There is a concentration of high-skilled, high value-added jobs in the UK aerospace industry

Figure 3.17 indicates that the aerospace industry workforce has a high proportion of professional, technical, scientific and skilled manual workers. In comparison with other engineering sectors[12], the aerospace industry has the highest proportion of professional, technical and scientific employees, reflecting the concentration of high-skilled, high value-added jobs in the industry. In addition, around one third of employees in aerospace hold a university degree or equivalent qualification[13] compared with just a fifth of the UK workforce as a whole[14].

Figure 3.17
Aerospace workforce by occupation



Source: *EMTA National Engineering Survey, 1999 (aerospace industry data)*

3.4 Supply chain characteristics and the distribution of aerospace establishments

During the 1990s the number of micro-businesses in UK aerospace dramatically increased

During the 1990s, the UK aerospace industry underwent a distinct change in the structure of sites. As depicted in Figure 3.18, the trend has seen a dramatic increase in the number of small manufacturing establishments. According to ABI figures[15], in 1991 there were about 470 aerospace sites in Great Britain, increasing to 1,170 in 1998 (an increase of almost 150%). This increase is mostly accounted for by a growth in the number of sites employing fewer than ten people. The other main structural difference during this period was the marked upward shift in the number of medium-sized (200-399 employee) establishments, from 33 to 132.

[12]EMTA (1999) National Engineering Survey
[13]SBAC (1999) UK Aerospace Statistics Key Points and Trends
[14]DfEE (2000) Skills for all: Research Report from the National Skills Task Force
[15]Annual business Inquiry (ABI) - recalculated Annual Employment survey data

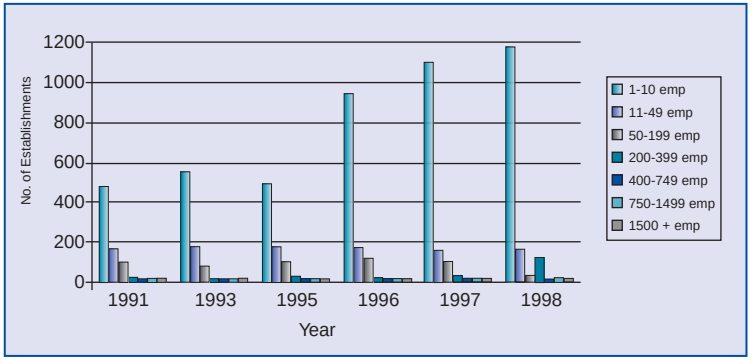
This restructuring within the aerospace supply chain is likely to be the result of a combination of factors, such as the effect of the recession of the early 1990s, leading to rationalisation and outsourcing in medium-sized and large manufacturing firms, enhanced business opportunities for micro-businesses providing advanced manufacturing processes, and a continued shake-out of the R&D function from the 1980s.

Changes to the methodology of collection and analysis of official data throughout the 1990s could also partially explain the relatively high number of small business units recorded by the survey from 1996 onwards. Since this time the Office for National Statistics have operated three types of survey – Census of Employment, Annual Employment Survey and recently the Annual Business Inquiry. The apparent increase in the number of small companies in this sector may therefore be attributable to different data collection and/or classification procedures.

Despite this factor, the recent SBAC[16] supply chain study found a high incidence of small businesses in the industry. Almost 70% of suppliers surveyed were SMEs employing 11-250 people and 20% were micro-businesses, employing fewer than ten people.

Whilst, therefore, this marked increase in the number of micro-businesses may be partially explained by official data collection changes, we believe that this sharp rise can also be attributed to a real increase in the number of small companies providing specialist services to the aerospace industry.

Figure 3.18
Aerospace workforce by occupation



Source: *EMTA National Engineering Survey, 1999 (aerospace industry data)*

The UK aerospace industry has a successful supplier base

The industry has a number of world-class supplier and aerostructures companies, representing some of the UK's most profitable manufacturing companies. In terms of operating margins, the UK's top four most profitable aerospace performers in 1998 were from the supply sector, whilst the UK aerospace average operating margin was 6.9%[17]

[16]SBAC (2001) Supply Chain Reaearch Project by UK Research Partnership
[17]SBAC (1999) UK Aerospace Industry Statistics Supplementary Data www.sbac.co.uk

According to a recent SBAC study[18], there were over 2,500 companies in the UK prime contractors' supply chain, providing £2.9 billion worth of goods and services during the 1999/00 financial year. An earlier SBAC report on the equipment sector supply chain[19] found that around 1,500 companies were supplying almost £1.3 billion of goods and services to first tier aerospace companies during the 1997/98 financial year[20]. The vast majority (almost 80%) of the companies in both surveys are located in the UK.

Table 3.1 First tier supplier operating margins (1998)

Company	Aerospace operating margin
Cobham	17.7%
Smiths Industries	16.6%
Meggitt	16.3%
Ultra	13.0%

Source: *Philip Lawrence - Contribution to DTI Foresight defence Aerospace and Systems Panel, 2000*

The estimated combined turnover of the firms supplying the equipment sector reaches some £9 billion and the most recent Supply Chain Research Project shows that the combined turnover of all companies supplying the primes is estimated to be around £12 billion. These surveys give the best estimate yet of the contribution of the supply chain – at first, second and, in some cases, third tier levels – to the wealth of both the UK aerospace industry and the UK economy.

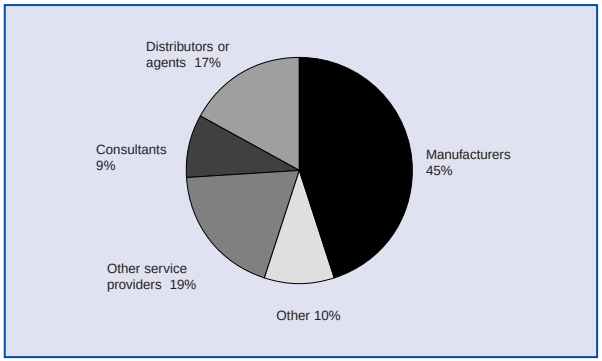
The supply chain is involved in manufacturing and service provision

Using the same SBAC data, Figure 3.19 indicates the role of the supply chain in providing aerospace components, products and services to prime contractors. Just under half of the suppliers surveyed described their principal business activity as manufacturing, with the remainder mostly acting as distributors/agents or service providers.

However, the data goes on to indicate the specialised role played by SMEs and micro-businesses in service-based activities. The reports highlight the difference in business activity between micro-businesses, SMEs and large companies.
The former are more than twice as likely to concentrate on non-manufacturing activities, such as service provision and distribution. There appears therefore to be an emerging cluster of smaller companies in the supply chain providing specialist services to their customers.

[18]SBA (2001) Supply Chain Research Project by UK Research Partnership
[19]SBA (1999) Equipment Sector Research Project by UK Research Partnership
[20]It must be noted that there is a small degree of overlap between the firms surveyed for the supply chain and equipment sector research projects. it is therefore not possible to aggregate data from the two surveys

Figure 3.19
Main activity of suppliers

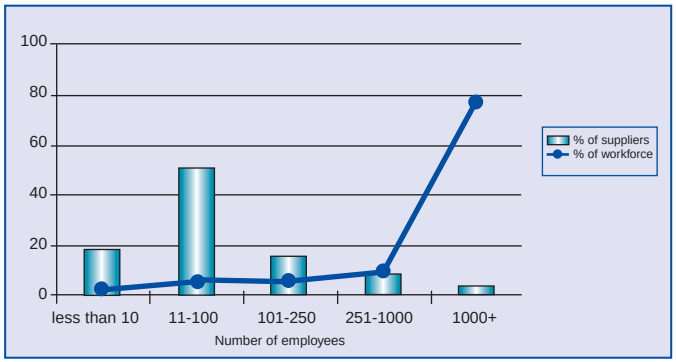


Source: *SBAC Supply Chain Research Project, UK Research Partnership Ltd, 2001*

Most employees work in larger companies in the supply chain

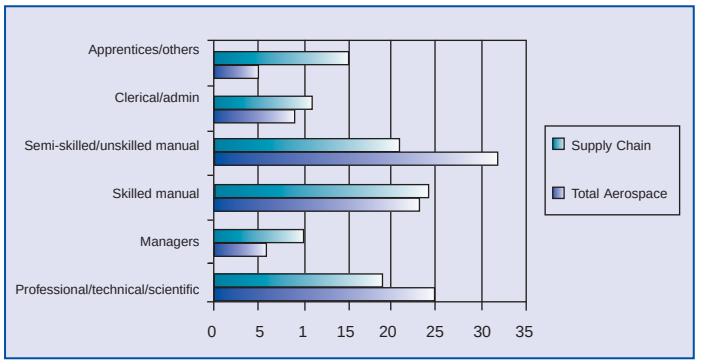
The SBAC Supply Chain Research Project reveals (see Figure 3.20) that around 70% of suppliers in the first tier are SMEs employing between 11 and 250 people. Micro-businesses account for 20% of suppliers, but they employ less than one per cent of the workforce. Whilst the majority (78%) of the supply chain workforce is employed in large establishments of 1,000 employees or more, SMEs and very small companies remain an important element of the industry.

Figure 3.20
The UK aerospace supply chain by employment size



Source: *SBAC Supply Chain Research Project, UK Research Partnership Ltd, 2001*

Figure 3.21
Workforce by occupation – whole industry and supply chain comparisons



Source: *EMTA National engineering survey, 1999 (aerospace industry data)*

Figure 3.21 sets out the occupational breakdown of the aerospace industry as a whole compared with the supply chain. Although using different data sources, comparisons confirm that the bulk of the workforce in aerospace as a whole and in the supply chain is made up of skilled, semi-skilled or unskilled manual workers. In the aerospace industry as a whole, there appears to be proportionately more professional, technical and scientific and semi-skilled or unskilled manual workers than in the supply chain. The supply chain itself has a slightly higher percentage of skilled manual workers.

The data presented above shows a vibrant supply chain, experiencing growth and playing an important role in providing goods and services to the aerospace industry. The supply chain provides highly skilled, value-added jobs and manufacturing remains an important focus within the sector. Yet it appears that the supply chain is experiencing an interesting dynamic of an increase in the number of micro-businesses concentrating on service activities. These range from the provision of site services that may have been contracted out as non-core business activities, through to more specialised, higher-value 'producer services' – such as R&D – which rely heavily on the knowledge-base and skills of smaller companies. The challenge for such businesses will clearly be to offer value-added, niche services in order to compete within a global supply chain.

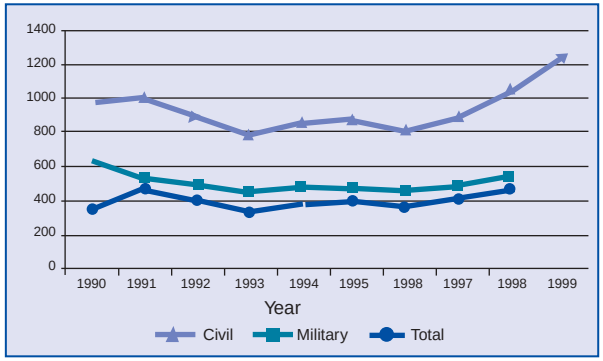
3.5 Research and development

Between 1996 and 1999, R&D expenditure in the UK increased by £425 million

Figure 3.22 indicates that, throughout the 1990s, the overall trend in R&D expenditure saw an initial fall from over £1 billion in 1991 to £782 million in 1993, followed by a sharp rise again between 1996 and 1999. In the last three years of the 1990s, expenditure on R&D increased by £425 million to reach a high point of £1.2 billion.

According to the DTI[21], there was little difference between civil and military R&D expenditure during the 1990s. Latest figures for 1998 indicate that R&D spending on military technology has remained slightly higher, with a difference of £69 million between civil and military.

Figure 3.22
Trends in UK aerospace R&D expenditure (1990-1999)



Source: *DTI (NB no 1999 figures were available for civil and military)*

The majority of R&D is funded by the aerospace industry's own funds and other UK businesses

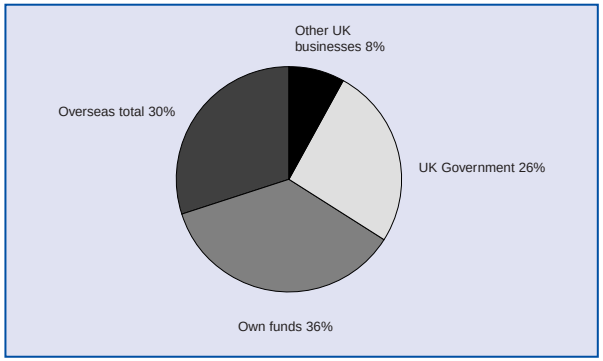
Figure 3.23 contains the latest data available[22] and shows that, in 1998, UK businesses accounted for the largest single share (44%) of the funds for R&D, accounting for £457 million. Aerospace companies specifically contributed over £164 million.

Prime contractors are traditionally the major investors in R&D in the industry, yet it appears that the supply chain is increasingly involved in such activities. The SBAC Supply Chain study[23] shows that just over half of the 400 suppliers recently surveyed invested in R&D, spending an average of £800,000 per company. Evidence presented to the Select Committee on Trade and Industry shows (see Figure 3.24) that R&D spending amongst

[21]Department for Trade and Industry (2001)
[22]SBAC (1999) UK Aerospace Statistics 1999 Key Points and Trends. www.sba.co.uk
[23]SBAC (2001) Supply Chain Research Project by UK Research Partnership

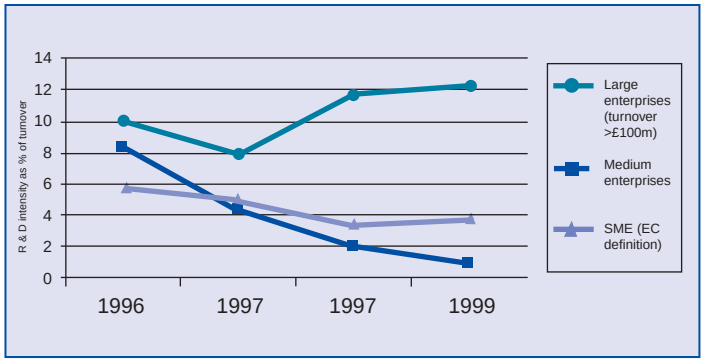
large companies, as a percentage of turnover, has started to recover after a drop in 1997. More notably, funding by SMEs is proportionately higher than medium-sized companies, indicating increasing R&D activity amongst the UK aerospace supplier base.

Figure 3.23
Sources of funding for R&D in UK aerospace industry 1998



Source: *SBAC UK Aerospace Statistics Key Points and Trends, 1999*

Figure 3.24
R&D Spend in the UK Supply Chain 1996-1999



Source: *Select Comittee On Trade And Industry, Minutes Of Evidence, 23 January 2001*

The Government provided £265 million of the total of £1 billion (through such initiatives as the Civil Aircraft Research and Technology Demonstration fund (CARAD) and the Repayable Launch Investment (RLI).

However, since 1972 total CARAD payments have dropped by 80% (in real terms). In 1972, CARAD funding was worth £104 million, falling to £21 million in 1999. Although the Ministry of Defence received £2.3 billion via the Government for total R&D from 1989 to 1999, it is not known how much of this expenditure ultimately reaches the aerospace industry. Approximately £1 billion per annum goes to the Defence Evaluation and Research Agency (DERA).

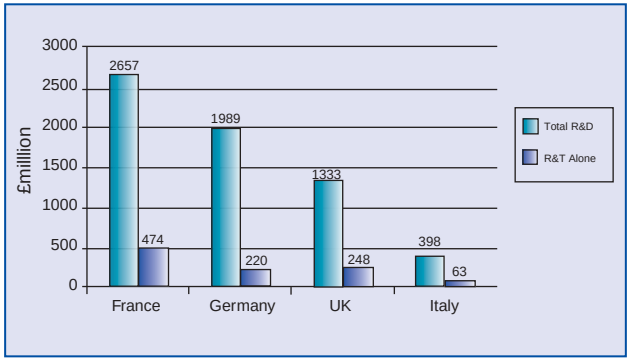
UK aerospace R&D expenditure is lower than France and Germany

Notwithstanding the recovery in R&D expenditure in the UK industry, in 1999 the total UK figure stood at 11.4% of turnover[24] compared with the European aerospace industry as a whole, which spent 14.5% of turnover (i.e. almost 30% more as a proportion of turnover). Figure 3.25 shows the R&D expenditure of the highest spenders – the UK, France and Germany – using 1997 data. This indicates that total aerospace R&D in France was roughly twice that of the UK and for Research and Technology alone it was almost three times the level of UK.

The German aerospace industry also spends approximately one third more on R&D than the UK. This means that, although R&D expenditure in the UK has increased over the last five years, both the French and German Governments have supported aerospace related research much more strongly over the same period.

R&D funding has traditionally been higher in the US, with research (from the University of West of England) suggesting that Government support for the US aeronautics industry is more than three times greater than in the EU[25]. Moreover, nations in South America, Asia and the Pacific Ring are currently increasing their support for aeronautical research. A loss of R&D capacity in the UK aerospace industry could clearly have a deleterious effect not only on the development of new technology but also on high value-added jobs and the expansion of the knowledge economy.

Figure 3.25
European comparisons of aerospace R&D 1997



Source: *SBAC, AECMA, 1999*
Note: *French R & T is estimated by SBAC, AECMA*

3.6 Summary of key issues

This overview highlights some of the key economic trends within the UK aerospace industry, and identifies opportunities and challenges that will be explored further in the next chapter. The UK aerospace industry has the largest turnover in Europe and a presence within the global aerospace market place second only to the United States. It is a significant contributor of earnings to the UK economy, operating at the eading edge of manufacturing technology. The foundation of the industry is the manufacture and export of aircraft systems, engines and equipment.

Despite a relatively buoyant industry from 1995 onwards, mounting challenges are being faced, particularly in Europe, as the productivity gap between France and the UK narrows, and as the gulf between the level of R&D investment in this country and similar funding in Germany and France widens. This is likely to put greater competitive pressure on UK aerospace companies operating in high value-added sectors. As the aerospace market restructures, becoming more globalised, prime contractors and the supply chain will be seeking a competitive edge to maintain and enhance their market share. It will thus be essential for the industry to invest in R&D to improve efficiency in such areas as fuel consumption, carrying capacity, safety, travel times and turnaround times for aircraft maintenance.

Exporting is a vital contribution to the industry and a critical indicator of success. It is therefore extremely important for the UK aerospace industry to be competitive in the manufacture and export of high value-added aerospace products. US and EU markets are essential to the UK aerospace industry as major export markets, yet the competitive imperative lies in new opportunities in other regions. It is absolutely imperative to capture new markets in emerging economies, such as in Poland, Romania and China, as they seek to build up both their military and civil aerospace capability.

The employment profile and skills base of the industry in this country is changing. Although direct employment at prime contractor and first tier supplier levels is not expected to grow, the nature of the work undertaken will continue to change. A systems integration approach, which now defines the functions of companies at the top of the supply chain, is likely to require a marked shift in the capabilities of the people involved. The knowledge base of UK aerospace must change to keep ahead of the competition. This means significant changes are likely in the nature of work and occupations at this level.

In the following chapter, these findings will be explored further, providing a more detailed analysis of the main challenges for the UK aerospace industry. The discussion will concentrate on four main dimensions:

1. Consolidation and globalisation.
2. The role of Government.
3. UK aerospace supply chain.
4. Changes in the labour market.

These dimensions will underpin the policy recommendations outlined in chapter 5.

[24]SBAC (2001) UK Aerospace Industry: Interim Business Trends. www.sbac.co.uk
[25]Lawrence, P. (1999) Transatlantic Rivalry in the Commercial Aircraft Industry. www.ess.uwe.ac.uk/Aerospace/Transatlantic.htm

4.1 Introduction

This chapter highlights the key issues impacting on the global aerospace industry and, in turn, their relevance for the UK.
The four key issues identified from primary and secondary information as the key influences on the industry are:

- consolidation and globalisation
- the role of Government
- supply chain dynamics
- changes in the labour market

This section considers the impact of globalisation on the UK aerospace industry, which is increasing competition and leading to restructuring at all levels of the sector. As globalisation prompts aerospace companies to seek the most attractive sites for their business, we go on to consider the role of UK Government in developing the infrastructure for a world class defence and aerospace industrial base. The challenges presented by globalisation to the aerospace supply chain are also considered, as many hundreds of smaller companies and their workforces respond to global consolidation trends and increased competition. Finally, we examine developments in the industry in relation to the UK aerospace workforce – now and in the future – as globalisation extends both challenges and opportunities to aerospace employees and employers.

4.2 Consolidation and globalisation

Global restructuring of the aerospace industry has been under way for several decades, yet the sheer pace of recent change has profound implications for the UK aerospace industry. Industry experts interviewed as part of this research all agreed that there probably remained little scope for restructuring at prime contractor level. Yet the implications of recent changes are deep-seated, both for prime contractors and the supply chain. In turn, large scale restructuring and consolidation is expected to gather pace at supply chain level.

4.2.1 UK aerospace prime contractors

The world's aerospace and aviation industries have undergone a huge transformation

Aerospace and aviation sectors that were until recently nationally based and fragmented have gone through consolidation in response to global pressures. Leading academics in the field of aerospace industry supply chain management from Cranfield University state that:

"It is clear that one of the effects of the restructuring is a move away from the traditional nationally based industry in terms of R&D and production." [26]

Consolidation has been strongest in the US aerospace and defence industries, but there is increasing activity in Europe, especially among the prime contractors. In the US, six main contractors have emerged: Boeing, Lockheed-Martin, Raytheon, General Dynamics, Northrop Grumman and BAE SYSTEMS. In Europe, acquisitions and mergers have produced two main groupings around BAE SYSTEMS, of the UK, and EADS – the European Aeronautic Defence and Space Company.

The European aerospace industry is now centred on BAE SYSTEMS and EADS ...

The UK's largest aerospace prime contractor is BAE SYSTEMS, which has a stake in several European aerospace companies, such as Matra BAe Dynamics, Airbus, Alenia Marconi and Astrium, but it counts itself a US company in the US.

EADS has merged much of the German, French and Spanish aerospace and defence industries, and a planned joint venture will also draw in Alenia from Italy. The group was formed from a merger of DaimlerChrysler Aerospace (Dasa), of Germany, Aerospatiale Matra, of France, and Construcciones Aeronauticas (Casa), of Spain. It has become the world's third-largest aerospace group after Boeing and Lockheed-Martin of the US.

... and Airbus is an example of European collaborative success

Airbus Industrie is a major world player in commercial aerospace and the launch of the A3XX as a direct competitor to Boeing in the very large aircraft market has intensified competition. Dr Braddon and Professor Lawrence[27], aerospace academics from the University of the West of England, see Airbus presenting an impetus to further change, promoting European aerospace integration. They view the addition of a military aerospace dimension to the Airbus portfolio through the development of the A400M as *"... both an imperative strategically in terms of potential European global power projection and essential in terms of enhancing European commercial competitiveness".*

Braddon and Lawrence go on to state that the A400M programme offers Europe the kind of project that would enable the European aerospace industry to secure the synergic advantages available to US competitors. It is therefore important that UK prime contractors obtain key places on European collaborative projects in order to reap the benefits of European integration and secure jobs for their workforce and amongst the supply chain.

[26]Moore,D.M, Neal, D. and Antill, P.D. (2001) Supply chain management in SMEs within the defence/aerospace industry, International Journal of Aerospace Management1 (1) 35-45
[27]Braddon, D. and Lawrence, P. (2000) A400M: The Strategic Case. www.ess.uew.ac.uk

The transatlantic dimension is essential to assert global competitiveness ...

Aerospace analyst Neil Hampson of Roland Berger asserts that the logic of aerospace consolidation now points to transatlantic moves but that *"... these must await an easing-up of ownership restrictions".*[28] Whilst restrictions on ownership do make acquisitions difficult, especially in the defence arena, UK companies have a growing presence in the US. For example, BAE SYSTEMS made four acquisitions in the US defence market in 2000, including two former Lockheed-Martin businesses, and Rolls-Royce has strong interests in the US, including Allison Engine.

However, Alexander Nicoll, writing in the Financial Times, states that the transatlantic dimension is more likely to be characterised by collaboration than acquisitions. He argues that US firms are more likely to pursue European links to improve market prospects, technology resources and the supplier base than to make European acquisitions[29]. Joint ventures, such as the one between Northrop Grumman and Thales, and between Raytheon and EADS, are recent examples of such transatlantic partnerships.

Another view emerging from our interviews with industry experts indicates a trend by US firms towards establishing headquarters in Europe, especially in the UK. Companies such as Lockheed-Martin, Boeing and Raytheon are already established in the UK in order to seek a local presence.

It appears, therefore, that a major challenge for aerospace firms is to compete with and within the US. One route is clearly through collaborative projects with North American companies, whilst another may be by establishing a local presence in the US market. Our interviews revealed that companies are certainly seeking to present themselves as 'multi-domestic' or local in order to win shares in foreign programmes. This is resulting in firms being both Europe- and US-facing in their strategies:

"You want to be both global and local. It's hard to break into some markets without a local manufacturing presence." First tier supplier

... yet the US defence market remains closed ...

It is clear that Europe's defence companies can no longer rely on domestic orders to maintain a defence industrial base and that the US must become the major market for Europe's defence companies. However, the US defence market is, to a large extent, closed to European companies and no foreign company has yet acquired or merged with a major US prime contractor.

There are various reasons for the lack of European success in entering US defence markets. One is that the US has concerns about the risks of technology transfer to European countries and wants to protect

[28]Jasper, C. (2001) Aerospace Forecast 2001. Flight International, 2-8 January
[29]Nicoll, A. (2001) Aerospace Survey: Consolidation. Financial Times, 18 June 2001

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technological superiority. Another is that Governments have tended to support domestic defence industries, and whilst US companies have managed to penetrate the European market due to technological and cost advantages, only BAE SYSTEMS has had any measurable success due to being treated as American in US markets by the Department of Defence.

Whilst half of the total defenceequipment bought by EU Governments comes from the US, only 3% of equipment bought by the US Government comes from the EU, fostering European accusations of US protectionism. European success in breaking into US defence markets therefore appears limited. Whilst, as we have seen, BAE SYSTEMS is now treated as American by the US Department of Defence, the only real opportunities for other companies appears to be centred on collaborative projects.

4.2.2 UK aerospace supply chain

Consolidation is also a feature of the supply chain

Restructuring at prime contractor level has had a major impact on the supply chain, as suppliers are placed under ever-greater pressure to improve efficiency and productivity. The response has been increased rationalisation and collaboration throughout the supply chain.

Neil Hampson predicts that consolidation at first or second tier levels will be the key factor in the near future, leading to *"... a redefinition of the tier ones"* engaging in vertical mergers and building size rather than speciality. Indeed, the strategy of all the first tier companies interviewed for this study centres on growth, either through diversification, acquisition or collaboration. A number of industry representatives discussed diversification plans, concentrating on developing expertise in service provision and systems integration and extending the customer base.

Growth through acquisition and collaboration is also a major priority for the first tier suppliers we interviewed, seeing future consolidation of the equipment sector as an area offering opportunities for growth:

"There'll be significant future consolidation and we want to be part of it – on a global basis." First tier supplier

It is clear from our interviews that global mergers, acquisitions and collaboration will increasingly occur as consolidation is necessarily driven by scale and synergy advantages. Industry experts we interviewed believe that the UK aerospace industry is in a strong position to take advantage of the opportunities for such global activity.

Figure 4.1 The Western European aerospace industry ownership jigsaw - selected manufacturers with cross-ownership interests

Source: *adapted from June 2001, Defence Systems Daily, www.defence-data.com*

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Collaboration and joint ventures are an important aspect of the industry

Collaborative ventures, where both parties invest in and share the risk of distinct programmes, are becoming an important aspect of the industry.

Such partnerships promote cross-border business, technology development and employment. A major joint venture at prime contractor level is that agreed between BAE SYSTEMS and Boeing in May 2001 in the military tanker market, which strengthens BAE SYSTEMS' position in the US defence market.

There is increasing evidence of cross-border equity swaps and purchases, the development of joint ventures, licensed production and technology transfer, based on a strategy of internationalisation by the companies involved.

Figure 4.1 provides an insight into the increasingly complex world of company ownership in selected Western Europe countries. Leading UK manufacturers, such as BAE SYSTEMS, Rolls-Royce and GKN, all have a stake in several major European aerospace businesses, such as Alenia Marconi Systems in Italy, the French company EGA SA and STN Atlas Elektronik in Germany. Probably the most significant is BAE SYSTEMS' 20% equity holding in the Airbus Integrated Company created with the EADS company. A major competitor to Boeing, highlighted by the development of the new Airbus superjumbo, EADS is the main driving force for the consolidation of European aerospace companies.

Interviews also revealed the growing trend of risk sharing ventures between prime contractors and suppliers, whereby both parties invest in product and technology development:

"We have lots of partnerships [with prime contractors and other first tier suppliers] where we invest in a programme. We are a risk-sharing supplier. That's an important phrase from our point of view in describing it. We invest upfront in the engineering part of the aeroplane. If the aeroplane didn't sell at all, we'd lose all that money." First tier supplier

Interviewees from companies involved in the JSF, Airbus and Eurofighter programmes also spoke appreciatively of the "partnership culture" being inculcated by the lead partners:

"They are talking the language of partnership and we've never had that sort of relationship before and it's good. It's been a conscious decision on their part because they recognise that if we fail, they fail, and they're anxious for us not to fail, that's why they're working with us on lots of issues, not just manufacturing." First tier supplier

However, it is clear that only world-class manufacturers will be awarded places on such large projects and thus reap the benefits of profitable projects and partnerships. Investment by the industry at this level in new techniques and processes to reduce costs and add value is therefore essential. Government assistance and partnership is also required, through support for R&D and export activities, improved management techniques and capital investment.

4.2.3 Offset arrangements

Offsets are compensatory, reciprocal trade agreements for industrial goods and services imposed as a condition of military-related export sales and services, although they are also used in the purchase of civil aircraft. Offsets can be indirect and direct. Direct offsets involve compensation in related goods and often involve some form of co-production, license or joint venture. Indirect offsets involve trade in goods and services that are unrelated to the products being sold.

One major recent offset deal has been the arrangement between BAE SYSTEMS and the South African Government for Hawk aircraft, where the offset arrangement includes activities in the automotive industry, procurements, agriculture and export facilitation.

The value of offsets is difficult to assess

Professor Neil Cooper, an academic expert in the defence and aerospace field, states that the:

"… secrecy surrounding defence deals means that the value of offset obligations incurred by UK contractors is not made public by the Government, in contrast to practice in the USA which now publishes an annual report detailing the value of offset obligations incurred by US contractors."[30]

Despite our earlier attempt to estimate the value of offsets as a proportion of total aerospace business in the UK, it remains extremely difficult to make a judgment as to the extent or value of defence offsets in the UK, since neither the MoD keep records on offset arrangements nor UK aerospace companies publish details of any agreements they undertake.

Our interviews with industry representatives yielded little information regarding the extent of inward or outward offsets on defence or civil contracts. Partly due to its uncertain and elusive nature, offset is often a controversial issue. It remains difficult to establish the extent and value of contracts undertaken overseas and therefore the impact on UK jobs.

Offset deals appear to be in decline – both ways …

Although defence offsets through the Industrial Participation policy are thought, on balance, to be of benefit to the UK aerospace industry, there are signs that offset arrangements with the US (the major source of inward offsets) are declining in importance. US companies have usually offered foreign competitors only local sub contracts or offset.

However, with the development of large-scale programmes, such as JSF,relationships are changing, as US companies are increasingly aware of the need to work with European partners if they are to expand. Under JSF agreements, there are no longer industrial offset programmes, in which

[30]Cooper, N (2000) The cost fo UK Defence Exports Department of Politics, University of Plymouth

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British companies were guaranteed work equal to the value of UK orders. Boeing and Lockheed-Martin have instead built teams featuring 'best in class' amongst suppliers, regardless of nationality.

Outward offset agreements between the UK and overseas countries also appear to be declining. Industry representatives we spoke to explained that offsets are becoming less important:

"There are some deals we have where offset is an issue. But by and large, offset is becoming less of a drive in sourcing policy. There are some things that cause us to source [overseas], but it's now more down to where the most competitive supply chain in the world is." First tier supplier

"If you look at the prime level, there are offset agreements with them, but not much flows down to us. Looking at the level of offset activity in our business, it's lessening." First tier supplier

The SBAC[31] survey of suppliers to three UK prime contractors indicate that only three per cent of their suppliers are awarded work through offset or workshare arrangements – the major method being through open competition. Survey evidence suggests that offset deals do not have a significant bearing on the award of contracts that benefit companies in the UK aerospace supply chain.

Outward offsets, or a case of multinational collaboration?

An industry expert we interviewed claimed that UK aerospace and defence companies are increasingly obliged to offer offsets to overseas purchasers of UK civil and military equipment, especially in developing countries. He pointed to the case of Indonesia, which had demanded civil aerospace offsets from the purchase of Airbus and Boeing commercial aircraft, asking for co-production rights, effectively saying *"we'll buy the aircraft if you give us some work on them".* He also highlighted the practice of 'buy back', in which the UK prime contractor will have to buy back some of the products made in the partner country.

However, new offset arrangements are seen as more like joint venture agreements, and go beyond the real definition of an offset deal. Yet, as with global outsourcing, these arrangements pose a threat to the UK supply base as work is lost to overseas countries.

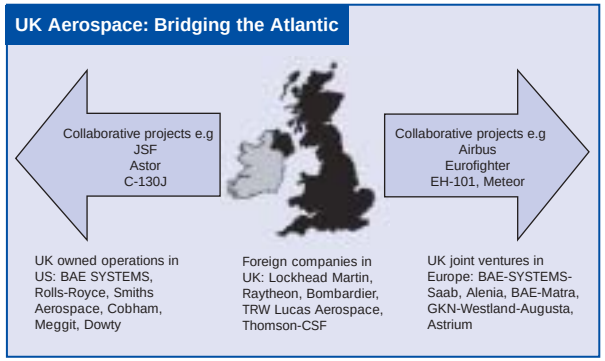
Whilst respondents pointed to the growing importance of countries like China as emerging markets and their demand for offset deals, the focus again appears to be on encouraging partnerships with manufacturers rather than placing work within the emerging market.

[31]SBAC (2001) Supply Chain Research Project by UK Research Partnership

4.2.4 Current global market activity

As we have seen, the shape of the aerospace industry is increasingly being cast by cross-national collaborative projects. Figure 4.2 indicates the extent of cross-national projects as they stood in early 2001. UK aerospace companies have major roles in three of the largest projects – the Joint Strike Fighter (JSF), Eurofighter and Airbus.

Figure 4.2
Global market activity



Source: *SBAC UK Aerospace in the 21st Century: Market trends and Competiveness, 2000*

Joint Strike Fighter

The JSF, which replaces existing fighters with a single design for the US Air Force, Navy and Marine Corps, is the first US weapons programme to involve foreign Governments. The UK Government will pay $2 billion or 10% of engineering manufacturing development costs and have a full say in decision-making. Teams led by Lockheed-Martin and Boeing are currently competing for JSF contracts that could be worth several hundred billion dollars, and a winner is due to be selected by the end of 2001. Whilst President Bush has cast uncertainty over the decision, talking of *"skipping a generation"* of weapons technology and by-passing the JSF project altogether, US defence experts predict that at least aircraft for the Marine Corps will go ahead as planned, with a possible postponement of air force and navy orders[32].

Lockheed-Martin operates with Northrop Grumman and BAE SYSTEMS as if they were a single organisation. Boeing acts as a prime contractor for its version, but has enlisted a wider group of 34 sub contractors. Nine of these are British, including BAE SYSTEMS, Rolls-Royce, Flight Refuelling, Messier-Dowty and Martin-Baker.

[32]Cook, N. (2001) Aerospace Survey: US Fighter Aircraft. Financial Times. 18 June 2001

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Eurofighter

The primary contractors in the Eurofighter consortium are BAE SYSTEMS, EADS and Alenia, which have invested heavily in new plant and technology to produce the Typhoon. Power for Eurofighter is provided by Eurojet, a consortium of MTU (Germany), Fiat (Italy), ITP (Spain) and Rolls-Royce (UK).

A recent announcement has been made concerning the replacement of the Eurofighter, involving six European countries and five aircraft manufacturers. They will co-operate to develop a combat aircraft operating with or without a pilot The six countries are Germany, France, UK, Sweden, Italy and Spain and all will have equal shares in the project.The businesses concerned are Alenia (Italy), BAE SYSTEMS (UK), Dassault (France), Saab (Sweden) and EADS. The new aircraft are expected to be operational in about 15 years.

Airbus

Airbus has around 40,000 employees in France, Germany, the UK and Spain. Formed in 1970, it previously operated as a consortium under which the four parties – Matra, Dasa, Casa and BAe (now BAE SYSTEMS) – kept ownership of engineering and production assets, with Airbus Industrie effectively operating as a sales and marketing company. It is now a single corporate entity. Airbus Military Companie (AMC) is leading the development of the A400M military transport aircraft and the civil side will concentrate on the A320 – a single aisle aircraft – and the A380 superjumbo.

Global projects are an important feature of the aerospace industry

These projects have important commercial and strategic implications for the UK aerospace industry. Due to their size, there may be few comparable programmes for the future and there will be fewer opportunities to win places on large projects, for both prime contractors and those in the supply chain. Yet the UK aerospace industry appears to be well placed to take advantage of the increasing trend of collaborative projects, thanks to its experience and expertise in partnership projects.

Conclusion – UK aerospace prospects

The industry representatives interviewed for this study all agreed that consolidation and globalisation are the biggest issues affecting the aerospace industry, determining both the location of centres of excellence and the location of major decision-making in shaping the industry.

Globalisation is reshaping the industry due to restructuring through acquisitions and mergers, transnational collaboration, global sourcing, and offset arrangements, all of which present challenges and opportunities for the UK aerospace industry. Prime contractors must retain and extend their technological and manufacturing edge in order to thrive and to serve as routes to market for the UK supply chain. In turn, the supply chain must

retain their domestic competitiveness and seize opportunities within the global market. This requires continuous development of, and investment in, technology, manufacturing techniques and the UK workforce.

4.3 The role of Government

The Government plays a major role in aerospace, as a customer, regulator and developer of technologies and markets. In 1999, 14% of the total output of the UK aerospace industry was sold directly to the UK Government (mostly defence related). 10-25% of UK aerospace research and technology demonstration (R&TD) spending is financed by Government procurement systems. The Government's influence also extends through programmes such as Civil Aircraft Research and Technology Demonstration (CARAD), Launch Investment and through its taxation, export and environmental policies.

Defence equipment expenditure has risen as a percentage of total spending and in constant terms over the last 25 years

Expenditure on defence as a proportion of Gross Domestic Product (GDP) has reduced gradually since the 1980s. In 1987, defence spending represented 4.6% of GDP, but spending plans for 2001/02 have it set at almost half this, at 2.4%. The greatest spending cuts have occurred in personnel, with expenditure reduced from 47% of the defence budget in 1976 to nearer 39% in recent years. In contrast, expenditure on equipment has increased as a proportion of total defence spending from 35% in 1976 to an estimated 44% in 1999. Total spending in constant terms rose from £1.8 billion in 1975 to £9.8 billion in 1999[33] .

Defence procurement is handled by the Defence Procurement Agency (DPA), part of the Ministry of Defence (MoD). The DPA buys over £5 billion of new equipment and spares for the armed forces annually, which makes it the single biggest purchaser of manufactured goods in the UK.

Defence procurement has been transformed by Smart Procurement

Smart Procurement (or Smart Acquisition) was introduced in 1999 to enable the MoD to acquire the best equipment possible, cheaper and quicker. Smart Procurement offers opportunities for UK aerospace companies through the change of approach to defence procurement.

On the one hand, the search for more affordable procurement will lead the MoD to require commercial, off-the-shelf (COTS) products, forcing companies to develop cheaper, dual-use technologies and products. On the other hand, there will also be opportunities for companies to enter into partnership with the MoD as it seeks a systems integration approach from its suppliers, managing programmes all the way from 'requirements

[33]DASA (2000) defence statistics. www.dasa.mod.uk

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definition' through to maintenance, operations and training. Both scenarios – of responding to cost pressures or developing partnerships with the MoD – offer opportunities for the aerospace industry and necessitate a more collaborative approach with the MoD as a customer.
A representative from AIRLINE (the Aerospace Industry Regional and Local Authority Network) we interviewed argued that a better understanding of Smart Procurement from the MoD was needed, in order to take into account the industrial consequences of defence procurement:

"It's unsystematic and there's no agreed methodology for measuring industrial impacts. We must be able to measure or anticipate the likely impacts of major procurement decisions."

There exists, therefore, a proposed role for Government to systematically analyse the overall industrial implications of procurement as well as the implications for the defence industrial base and the capacity of the defence industry. How the defence base, and especially SMEs, adapt to changes in defence procurement and the impact on the UK workforce will be important aspects of the MoD's eventual evaluation of Smart Procurement.

Industrial collaboration is of increasing importance to military programmes

In 1998/99 the MoD spent 13% of the defence equipment budget (£1.3 billion) on 64 co-operative equipment programmes involving 19 partner nations. The number of co-operative programmes is likely to rise and around 40% of new defence procurements will be through international collaboration.

Most previous European collaborative programmes have had 'juste retour' workshare agreements, which ensure that the industry or each country involved in projects has a share of the work in direct relation to their financial contribution:

"As a result, the allocation of contracts can have little basis in the competitiveness of different potential supplier bids[34]"

To address these problems of workshare arrangements, Germany, France and the UK have developed a European arms procurement agency – the Organisation Conjointe de Cooperation en matière D'ARmament (OCCAR), or the Organisation for Joint Armament Co-operation. The Governments setting this up have agreed to accept an allotment of workshare in the projects on a global balance over several projects and years rather than on a programme by programme basis. One of the experts we interviewed stated that, with such moves to make procurement more efficient within the European defence and aerospace arena, there is a good chance that procurement would lead to more work in the UK. He stated that: *"We [in the UK] are technologically ahead of just about every other country in Europe".*
The consequence of this increasingly collaborative nature of defence

[34]Select Committee on Defence (1999) The OCCAR Convention 25 November 1999

procurement is another prompt to cross-national working amongst UK aerospace companies:

"Our defence contracts are almost never national stand-alone now. Collaboration is unavoidable." Major equipment manufacturer

However, industry experts and manufacturers we interviewed expressed frustration at the official barriers to procurement, as European Governments often remain nationally focused. They highlighted the need to apply pressure for a more efficient procurement regime in order to create a level playing field for UK aerospace:

"The real issue is to try and educate our allies to introduce something similar [to competitive procurement] and to lobby about this. We are efficient and they [European countries] are not – we've got smart procurement and they have public sector industries which are not cost effective." Industry expert

Most Government funding to civil aerospace are through CARAD and Launch Investment

But CARAD funding has fallen dramatically ...

The Civil Aircraft Research and Technology Demonstration (CARAD) programme supports pre-competitive research and technology demonstration (R&TD) to enhance civil industrial competitiveness. The five-year phase of the current CARAD III programme finished in March 2001. Whilst an important funding stream, Figure 4.3 shows that total CARAD funding has fallen from £104 million in 1972-73 to £21 million in 1998-99 (a fall of 80 per cent over the period in real terms).

CARAD supports pre-competitive research and technology demonstration to enhance competitiveness and environmental sustainability of the civil aeronautics industry. It also promotes links between industry, research agencies and academia, and supports international collaborative projects. CARAD has played a role in developing centres of excellence in the UK, providing the basis for the launch of future projects[35] .

SBAC argues that, although CARAD makes a useful contribution to UK aerospace research and technology demonstration, there is a serious shortfall in overall spending on UK aerospace technology acquisition, exacerbated by a decline in the MoD budget. Industry experts and manufacturers we interviewed for this research urged a continuation of and massive boost in CARAD funding, viewing it as an important way of developing collaboration and technology and arguing that any reduction would have an adverse impact on UK industry:

"We have to reduce the technology gap between the UK and US; otherwise there cannot be any collaboration. If we don't have some sort of [research and development] systems, we might as well give up." Prime contractor

[35]Select Committee on Trade and Industry Memorandum submmitted by the Department of Trade and Industry, 23 January 2001

Repayable Launch Investment (RLI) is very important, but the industrial impacts are unclear

RLI is a risk-sharing investment by Government in the design and development of UK civil aerospace projects. A Memorandum for the DTI to the Select Committee on Trade and Industry notes:

"Although financial institutions understand the long-term nature of the industry, they are reluctant to risk investment in these projects because of the long payback period and as a result Launch Investment bridges this gap in funding[36]."

As at March 2000, the UK Government had outstanding launch contracts worth over £2 billion with four UK prime contractors. The Government has recently announced its investment of £530 million in partnership with BAE SYSTEMS to ensure UK participation in the Airbus A380 'super jumbo' project. However, Launch Investment is centred on prime contractors only and it is clear from our interviews with representatives of first tier suppliers that this lack of funding for the supply chain was causing consternation:

"We would like there to be a change in Government support. We would like the Government to support first and second tier suppliers, not just the prime contractors. We invest just as much as Rolls-Royce and BAE SYSTEMS. We're growing and we need just as much help in investing in projects." First tier supplier

Companies in the supply chain often lack the resources necessary to build risk-sharing partnerships on new projects with prime contractors. However, as the long-term nature of such projects often makes it difficult to secure capital funding, it does appear that there is a need for this kind of launch investment and assistance for companies in the supply chain.

Whilst Launch Investment is a useful Government tool to develop markets for the aerospace industry and could be extended down the supply chain, it is important that information regarding the full industrial implications of such public expenditure is made available. A strong message from convenors is that certain conditions should be attached when Launch Investment is awarded, so that recipients make pledges to safeguard UK aerospace jobs, or at least to make information available regarding the effects of such investments on aerospace jobs and capacity in the UK. £530 million launch investment was made in the Airbus 380 in March 2000 and it was claimed that the A380 would bring more than 20,000 new jobs to the UK and safeguard another 62,000[37]. It is important that information is made available to both understand the basis and judge the long-term implications of these claims.

The Government's role also extends to export assistance, environmental policies, etc.

[36]Select Committee on Trade and Industry (2001) Memorandum submmitted by the Department of Trade and Industry, 23 January 2001

[37]DTI (2000) Byers Hails Major Landmark For A380 Project. www.dti.gov.uk

The Export Credits Guarantee Department (ECGD) provides insurance guarantees for British firms trading abroad. According to SBAC[38], the UK aerospace and defence industry is highly dependent on exports. As we saw earlier, in 1999, 60% of total aerospace turnover was exported (nearly £12 billion), contributing £2.1 billion to the UK balance of trade. The UK aerospace and defence industries are one of the major users of ECGD services, accounting for 62% of ECGD's new business in 1999/2000. The ECGD continues to play an important role, but commercial exports are under pressure as the subsidy deal for purchasers of aircraft and engines it makes available is to be scrapped in March 2002, as the ECGD is to be turned into a commercial organisation.
The SBAC has warned:

"The ECGD represents the only viable means by which many large, medium and long-term overseas contracts receive support. All the UK's major competitors and collaborators deploy similar mechanisms and any loss or degradation of the terms of UK support would have a serious affect on the UK aerospace industry."

Environmental concerns are growing

Environmental concerns will also increasingly impact on Government policy and aerospace manufacture. Greenhouse gas emissions from the world's aircraft fleet currently represent 3.5% of global warming attributable to man-made activities. But, according to some estimates, the overall impact is 2-4 times greater than that arising from carbon dioxide emission alone[39] . The industry will be under pressure from Government and non-Governmental organisations to control fuel efficiency, noise and emissions of new aircraft, thus requiring innovation in R&D and production methods.

Whilst the export environment looks likely to become tougher for aerospace companies – reciprocal action from France and Germany may address the question of 'level playing fields' by ending all subsidies to European companies. A different form of Government assistance via R&D tax credits may help the industry to train and recruit engineers to support R&D and product development and so respond to environmental pressures highlighted above. The tax credit on spending on R&D has been available to SMEs since April 2000 and is likely to be extended to larger companies with over 250 employees.

Conclusion – UK aerospace industry prospects

In the face of a declining defence market, and in response to changing procurement strategies, defence suppliers at all levels have to respond to pressures to reduce costs and improve customer service. As a result, partnership arrangements are being adopted between the MoD, prime contractors and their preferred suppliers. Whilst the aerospace industry has

[38]SBAC (2001) Export Credit Guarantee Review. www.sbac.co.uk 24 May 2001
[39]DTI Foresight (2000) Defence Aerospace and Systems Panel: futures. www.foresight.gov.uk

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to respond with supply chain management initiatives, the UK Government has a duty to monitor the effects of Smart Procurement and cross-national procurement and research on the industrial base.

Research and development funding for both defence and civil aerospace has seen a decline since the mid 1970s – between 1976 and 1996, R&D funding fell by 35% in real terms. In the view of the Foresight Panel on Defence, Aerospace and Systems, this raises *"… real concerns regarding the UK's future competitiveness and the UK needs to reinvigorate its research base if future competitiveness is to be assured"*[40] . Not only does R&D funding fall behind that in the US, Germany France and Japan, but the technology used in UK defence and aerospace products is based on research from 15 or 20 years ago. Unless the UK Government provides a conducive R&D environment, global companies may choose to locate in other countries with a higher degree of financial support. This is evidenced by Rolls-Royce's decision to develop some variants of its Trent engine in Canada after R&D funding was made available by the Canadian Government.

Finally, whilst the aerospace industry looks to the Government to provide a favourable business climate, environmental issues and pressure to reduce trade barriers all need to be considered in developing policies and assessing the UK aerospace business environment.

4.4 Supply chain dynamics

The supply chain is a vital part of the UK aerospace industry In 1997, SMEs made up over 80% of all companies supplying to the defence and aerospace industries and almost 65% of defence and aerospace industry turnover is generated by SMEs. The aerospace industry substantially contributes to employment within the supply chain. Prime contractors support an estimated 760,000 people in employment – representing around 3% of all manufacturing jobs in Great Britain[41].

SMEs supply almost £3 billion of goods and services to UK prime contractors and 80% of the value of these goods and services is added in the first tier of the UK supply chain, highlighting the valuable contribution made by aerospace SMEs[42] .

There are opportunities for the supply chain …

Prime contractors are gradually moving away from being manufacturing companies over a range of products to becoming systems integrators, project managing and pulling together inputs from sub contractors. Increasing use of outsourcing therefore offers opportunities further down the supply chain to take over more of the manufacture of aerospace products:

"Our customers are prime contractors and they tend to want to get on with the things they think are core to being a prime contractor – product design,

[40]DTI Foresight (2000) Defence Aerospace and Systems Panel: futures. www.foresight.gov.uk

selling the aeroplane, financing customers and so on. They don't want to make anything anymore. We find we have a lot of opportunity from taking over their manufacturer." First tier supplier

One prime contractor we interviewed acknowledged that, whilst their supply chain was becoming increasingly global in nature, this did not necessarily exclude UK companies. However, it did mean that UK suppliers have to be *"equal to the best in the world".*

But there are threats as well …

Dowdall, Braddon and Hartley[43] , writing for the DTI, state:

"Outsourcing by prime contractors in the defence industry has increased dramatically over the last decade, [they are] cutting drastically the number of smaller and medium-sized enterprises in their supply chains, while extending their geographic catchment area for suppliers on a global scale."

Industry representatives we interviewed tended to talk in terms of a supply chain that is split in two. The first part comprises companies that are responding to their customers' needs and are investing in the appropriate technologies to become globally competitive. The other part is not responding to changes in the industry and most interviewees see that these companies are susceptible to takeover. One equipment sector manager urged the UK supply chain to find a niche within which to compete on complex products and thereby avoid takeover:

"The UK supplier base will need to find a niche they are comfortable with, going for more complex products. The world is changing – they need to invest in technologies to be globally competitive."

Most aerospace companies have developed manufacturing and outsourcing strategies based on whether they can manufacture products at a competitive price. Outsourcing is becoming increasingly global; with industry representatives stating that they source more and more items from the Far East (such as Indonesia, China, Korea), Mexico, and Eastern European countries.

Rolls-Royce has developed a 'make/buy' strategy, reducing its own manufacturing in some areas and increasing purchasing through its supply network. Colin Green, the then Director of Operations at Rolls-Royce, explained in November 2000 that the company:

"… will focus our manufacturing activities and only make things that are vital to the business and which we are good at making. The rest we will buy but from fewer, more competent global suppliers[44]."

John Rose, the Chief Executive of Rolls-Royce, also stated that the company would move to outsource 85% by value of its workload, increasing this share from 65%.

[41]SBAC (2001) Supply Chain Research Project by UK Research Partnership
[42]ibid
[43]Dowdall,P., Braddon, D. and Hartley, K., (2000) defence Industry Supply Chain Literature and Research Review, DTI

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Whilst industry representatives would not convey the extent of global sourcing or subcontraction, the threat to the supply chain presented by the trend towards global outsourcing can only be exacerbated as overseas companies develop their products and technology, competing head-on with UK suppliers on quality as well as cost.

… and more is expected of companies in the supply chain …

Moore, Neal and Antill, supply chain experts from Cranfield University, state:

"Prime contractors are developing new views of the industry, resulting in the generation of strategic options that are redefining the paradigm. It is equally important that SMEs take stock of this paradigm shift[45]."

Industry experts explained that companies in the supply chain will be increasingly compelled to lower the cost of supplies to their prime contractors. This may mean finding economies of scale by developing dual use technologies, using both civil and military capabilities. Suppliers are also being required to engage in more R&D activity which can provide the supply chain with greater added value activity. As prime contractors offload more risk and responsibility onto their suppliers, the challenge for these companies is to be able to respond with the appropriate technology and know-how on a global basis.

Another dimension is that of partnership arrangements being forged between prime contractors and suppliers in order to deliver the quality and technological edge that prime contractors require to compete in international markets. This is increasingly resulting in first tier suppliers effectively operating as sub-prime contractors, managing their own supply chains. This offers the opportunity for the supply chain to develop systems integration expertise and to become core suppliers to the largest prime contractors. As one first tier supplier explained:

"The major planks of our strategy are outsourcing, diversification of products and changes in the production process. Now the impact on UK supplier networks will be beneficial if SMEs rise to the challenge. They've got to invest, be better, slicker, have more technology and be able to meet our highest expectations."

Prime contractors expect the supply chain to adopt new ways of working

All companies interviewed have been involved in developing lean manufacturing techniques and all have involved their supply chain in new systems. First tier suppliers are also usually involved in their prime contractors' systems. Interviewees involved in such programmes as the UK Lean Aerospace Initiative and the Six Sigma programme explained that their suppliers will be better placed to succeed if they become integrated into the production process:

[44]Select Committee on Trade and Industry (2001) Memorandum submitted by the rolls-Royce Barnoldswick Joint Shop Stewards Committee, 23 January 2001
[45]Moore, D.M., Neal, D. and Antill, P.D., Supply Chain management in SMEs within the defence/aerospace industry, International Journal of Aerospace Management

"We've done a lot of work with our main suppliers to put in place lean manufacturing. They get leaner as well and become more competitive." First tier supplier

The adoption of lean manufacturing also implies the necessary 're-education' of the workforce in the need for, and concepts embedded in, new work organisation and training in the skills required to carry out the techniques:

"Companies will be spending a lot of time on lean manufacturing. I think the skills element and commitment of individuals required to do that will be at its highest premium." First tier supplier

All industry representatives urged the supply chain to engage in lean manufacturing techniques, with one prominent first tier supplier stating:

"We can't do it in isolation – it's got to be done on the basis of everybody in the chain involved in the ultimate goal. Otherwise, they'll miss out."

Conclusion – UK aerospace industry prospects

As prime contractors gradually shift their role towards systems integration, project managing the work of their main sub contractors, so there is shift in the roles, risks and responsibilities assigned to SMEs. Increased use of outsourcing by prime contractors will allow SMEs to take over the manufacture of aerospace products, but the risk of global competition is getting stronger. Prime contractors are looking to their suppliers to offer integrated solutions, and as suppliers effectively become sub-prime contractors, the responsibility and associated rewards increase.

The skills levels of UK SME workforces will necessarily have to keep pace with changes in technology and work organisation through such developments as lean manufacturing techniques. Thompson's[46] report on People Management for SBAC describes this as the changing basis of competitive advantage through the need to offer better customer service, or R&D know-how.

4.5 Labour market – employment, skills and training

Globalisation is presenting significant challenges to the aerospace industry, and its ability to survive and thrive will to a large extent depend on the quality and size of the available workforce. Globalisation will permeate all levels or activity, from funding, research and development to production and servicing. As this results in fewer, but larger and more complex projects, such as JSF, Eurofighter and Airbus, there will be more demand for maintaining and developing skills.

All the evidence suggests that it is the increasingly international outlook of the industry, resulting in global outsourcing and procurement, that presents the greatest single threat to UK aerospace jobs and skills. Global outsourcing is commonplace as the industry seeks to take advantage of

[46]Thompson, (2000) Skills, Training and Business Performance in the Aerospace Sector. DTI/SBAC

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lower labour rates and, as such, UK aerospace manufacturing is increasingly losing out on high volume, lower cost products. However, the danger remains that skills development in overseas countries that are benefiting from outsourcing may provide a level of knowledge, skills and technology transfer such that competitors are able to beat the UK competition not only on cost but also quality.

4.5.1 Labour market issues

Manufacturing is facing a tight labour market ...

Manufacturing is clearly under pressure, with problems faced finding suitably qualified workers in today's tight labour market. Robert Taylor of the 'Financial Times' writes that skills shortages are causing problems, and that the problem is getting more acute as the tasks required of young workers grow more complex and diverse[47]. One of the critical shortages has been amongst skilled labour, which was traditionally provided by widespread apprenticeships. Training through apprenticeships has only recently been resuscitated after a period of neglect over the late 1980s and early 1990s. This is certainly reflected by the views of the AIRLINE representative we interviewed:

"In a tight labour market, you'll find shortages of labour across the board, not just in the aerospace industry. And this is much more a reflection of macro-economic conditions. On the other hand, there are some specific skills issues in aerospace, linked especially to the decision to cut training in the early 1990s, and we're suffering from the shortfall that has been produced in some of the skills the industry now requires."

The SBAC surveys of the equipment sector and prime contractors' supply chains revealed recruitment problems amongst professional, technical and scientific workers and specifically IT skills shortages. However, all industries appear to have shortages of IT skilled workers, even to the point that discussions on relaxation of immigration laws have occurred at ministerial level in order to ease the supply of people with these skills.

... yet the UK aerospace industry needs a diverse range of skills

Table 4.1, based on recent research by EMTA into engineering skills needs, highlights the likely impact of changes in technology on the skills base as aerospace companies strive for competitive advantage. New developments in materials and electronics are impacting on skills requirements, leading to a need for capabilities in advanced electronics, new materials, software, advanced manufacturing equipment and information systems.

The DTI Foresight Panel[48] for Defence, Aerospace and Systems highlights the need for a more diverse range of skills. It suggests that, for the UK to maintain its competitive position in an increasingly global market, the overall workforce

[47]Taylor, R. (2001) Industry in search of a suitable workforce. Financial Times. 9 May 2001
[48]DTI (2000) Foresight, Action for Future Systems - Defence, Aerospace and Systems Panel

will need to possess a base of both generic and transferable skills whilst at the same time possessing and updating relevant, specialist skills.

Table 4.1 Aerospace engineering skills and technologies

Technology	Change/trend/development	Possible use/benefit over current technology	Timeline	Skill requirements
Fly by wire	Increasing use of fly by wire hydraulics	Weight saving – no	Available	Systems engineers
Electric engine	Aircraft engine with magnetic bearings and embedded electrical power output – i.e. no hydraulics, pneumatics Electro-magnetic bearings	Greater efficiency	Planned	Electrical skills
Avionics	Flight management systems Engine management systems Interior services (in flight entertainment)		Available	Systems skills and interfacing avionics with other aircraft
Displays	Flat screen displays designed to take advantage of human factors research		Becoming available	R&D into man-machine interface particularly military
Jig-less manufacture	Replace major capital investment requirements for jigs with new jig-less techniques – including self-location/reduced tolerance	Aircraft wings – aim to reduce capital expenditure costs on jigs which can be very high	Under development	Greater need to consider design for production Need for libraries of techniques in jig-less manufacture
Composites	Pre-impregnated Resin Transfer Moulding Resin Injection Moulding Co-injection moulding Dough Moulding Compounds	Lighter/stronger aircraft Less machining required New resins allow faster cycle times Physical properties can be tailored to applications	Available/ Under development	R&D skills: Testing behaviour of materials Stress tolerances and life predictions Ability to recycle materials Maintaining product quality standards

Source: EMTA Engineering Technologies and Skills (2001)

Increasing flexibility is demanded of the workforce, including lifelong learning

Whilst the type of skills required from aerospace workers is changing, it is also apparent from consultation with industry representatives and experts that greater flexibility is also required:

"The skills mix has changed; we are much more demanding of people's flexibility, so we don't now define people [according to narrow skills] – we want people to work on a defined manufacturing cell with a variety of different machines. They have to have the capability and be trained to use these machines. That's quite a transition for people brought up in a traditional engineering environment." First tier supplier

"When they advertise for machinists now, they're not content with having a grinder, or turner – they've got to be multi-tasked [and be IT literate]. They've even started training some of them now to do their own programming – so it's becoming quite a hi-tech vocation now." Union representative

Lifelong learning is also necessary, it is argued, in order to enable workers to adapt to multi-skilling, developing the new skills required by the industry as it aims to maintain or achieve competitive advantage. Commitment to ongoing training in the industry was indeed evident from our interviews with industry representatives:

"Reskilling the workforce is critical. People will be more responsible for their own training, but the company will provide the mechanism." First tier supplier

"I think it's important that people's skills base is maintained, especially as people's jobs change. There is an obligation on the employer to provide training on site, such as NVQ training." First tier supplier

4.5.2 Challenges in the aerospace industry and implications for the workforce

The world of work is changing

The industry is faced with changing attitudes to work, as people are more willing to move between jobs and across sectors, no longer assuming that they will be in 'a job for life'. Flexibility will also be sought within the workplace as employees seek more flexible working patterns in response to the 24-hour economy and work-life balance demands. These issues, along with other innovative HR practices, will have to be adopted by industry in order to attract and retain committed employees.

The aerospace industry is facing recruitment difficulties ...

... partly due to image problems

Industry representatives we interviewed also spoke about the difficulties they faced in attracting young people into the industry. The traditional intake of people is now being tempted into other professions, such as IT:

"There's already a dire shortage on the technology side of skills. It's more fundamental than that though – in the industry there is a tremendous lack of interest amongst young people going into engineering and manufacturing." First tier supplier

'It is difficult to recruit well-rounded skilled people.
We've tended to move back towards apprentices. We tried to recruit a number of people – people in their mid-20s with training from other places – but found they didn't have the skill levels we wanted. So we've gone back to the old technician apprentices and they work fine for us." First tier supplier

Most interviewees believed that engineering, and especially manufacturing engineering, was facing an image problem. Unless young people could be persuaded that engineering was an exciting and challenging career, the industry would have to cope with increasing skills shortages and an ever-increasing training burden. It is clear that a decline in recruits from the UK labour market will mean that shortages will have to be met by existing employees who will need re-training and ongoing training.

… but also due to technical skills shortages …

Recent studies, such as the 1999 EMTA Labour Market Survey of the Engineering Industry in Britain, the DfEE Engineering Skills Dialogue (2000), the DfEE Employer Skills Survey (2000), and National Skills Task Force Final Report (2001), all highlight recruitment difficulties and skills gaps in the UK engineering manufacturing workforce.

But compared with other manufacturing sectors, aerospace and automotive employers have experienced particular problems in recruiting staff.

According to EMTA research undertaken in 1999[49], the majority of 'hard-to-fill' vacancies reported by aerospace companies were in technical occupations at higher and intermediate levels (e.g. professional engineers, technologists, scientists, also technician and craft engineers). The vast majority (75%) of aerospace employers attributed this to a lack of applicants who had the required qualifications and skills.

Another report by SBAC[50] indicates that skills shortages are being encountered amongst CNC machinists, software engineers, skilled technicians and design engineers. Skill shortages are also leading BAE SYSTEMS to recruit software engineers and graduates from abroad[51].

… and shortages in generic skills …

Whilst technical skills shortages are certainly a problem for the industry, with most industry representatives pointing to the long-term need for software and systems engineers, employers are also seeking generic skills, such as communications, innovation and team-working ability. Employers are increasingly looking for these 'softer skills' to be able to develop project and supply chain management initiatives:

"The types of skills needed will be engineering design, production engineers, technicians, IT technicians. But in general terms – innovators, entrepreneurs and team players." First tier supplier

4.5.3 Responding to the challenges of globalisation

We have already pointed to the increased trend towards partnership working between prime contractors and their suppliers, driven by the adoption of lean/agile manufacturing and new forms of supply chain management. Such developments, which require investment in new processes and training, clearly imply and require a shared role in developing best practice between primes and their suppliers. Moreover, the challenge for SMEs to offer integrated solutions to their prime contractor customers, further implies and requires a joint role in the development of both new technologies and associated skills. An industry expert we interviewed highlighted the significant need for *"the development of intellectual and engineering skills to support the move to research, design, development, technology, systems integration, because that's where we need the skills – higher level engineering skills".*

The lifelong learning approach, ensuring that employees respond to new skill demands, could be adopted jointly by prime contractors and suppliers in partnership. The regional aerospace fora that have developed over recent years, increasingly in close partnership with SBAC, are also presenting opportunities to support SME networks concentrating on best practice and building a co-operative approach to training and people development.

In response to the threats of rationalisation and global outsourcing, UK aerospace companies must be able to develop high value-added products and technologies. Marc Thompson's report on People Management for SBAC describes this as the 'high road strategy' – that is, deciding to compete on skills, quality and service. The 'low road', by comparison, competes purely on cost, leaving firms exposed to offshore competition and the global race for cheap labour[52]. In taking the high road, the sheer pace of technology change will require rapid skills development on the part of the UK aerospace workforce. Thompson suggests that this route requires management commitment to develop HR practices across the board for all employees.

Conclusions – UK aerospace prospects

As the UK faces problems associated with a tight labour market, the aerospace industry is facing specific skills shortages – in basic, technical and generic skills. It is important that engineers working in aerospace benefit from high quality training, affording them a sound foundation of engineering knowledge and understanding of fundamental engineering concepts. Continuing investment in apprenticeship training is clearly an important step in ensuring a pool of well-rounded, skilled workers. Indeed, our evidence suggests that the industry has, in part, returned to this traditional source of 'home-grown' skills. Building on this foundation, upskilling employees through continuous training and development will enable the industry to put in place the new techniques and processes needed to reduce costs, add value and stay in business.

This training and development will support the increased demand for technical, professional and managerial personnel as a result of changes in work organisation, and build on the demand for skill intensive, knowledge-based occupations.

The adoption of lean manufacturing techniques will also have far-reaching implications for people management and the industry, to put in place policies to develop skills in these new techniques across the whole of the workforce.

It was clear from our interviews that the industry believes the best technical knowledge and experience is based in the UK. Alongside English language advantages, the workforce is well-placed to be a source of competitive advantage which can be maximised through a mixture of the right support from unions, Government and industry.

The longer-term implications of skills shortages and gaps for UK aerospace

[49]EMTA (1999) Labour Market Survey of the Engineering Industry in Britain
[50]SBAC (1998) People Management in Aerospace: Report Summary
[51]Skapinker, M. (1997) Skills Shortages Forces BAe to Recruit Abroad. Financial Times 11 March p11
[52]Thompson, M. (2000) The UK Aerospace People Management Audit, SBAC

could be very serious. The industry itself argues that competitive advantage in world markets rests, ultimately, on technology leadership. If this is the case, then an assured supply of technologically skilled and qualified labour – especially, as we have seen, at graduate and other higher levels – is a critical success factor. If the UK falls any further behind in the supply of such skilled people, future investment decisions (either to make or buy in the UK) are bound to be affected adversely.

4.6 Conclusions

The UK aerospace industry is a highly successful global manufacturing sector

The UK aerospace industry is one of our most successful manufacturing sectors, providing about 2.5% of UK manufactured output and 5% of manufactured exports. 1999 turnover was £17.59 billion, which is the highest in Europe, and 67% of production is exported – a far higher proportion than the EU aerospace industry average of 51%.

The success of the industry has contributed a trade surplus of £2.1 billion to the UK's 1999 trade figures and an average annual positive balance of £2 billion over the last 10 years. Moreover, UK companies' global assets have contributed over £4 billion to annual turnover.

The civil side of the industry has continued to grow and has overtaken demand for military products, accounting for 55% of turnover in 1999. This trend is also reflected in exports, as the share of the market has risen from just under half in 1984 to around 80% in 2000.

The UK has two world-beating centres of excellence in civil aerospace – Airbus UK wing design and manufacturing, and Rolls-Royce aero-engine manufacturing. These centres of excellence reflect the industry's overall expertise in aircraft systems and frames and aero-engine manufacture. These sectors have contributed strongly to turnover and export sales and enabled the industry to gain places on prestigious, collaborative projects such as the Joint Strike Fighter (JSF), Airbus and Eurofighter.

The industry benefits from the MoD's Industrial Participation policy, as it is estimated that £303 million worth of aerospace defence contracts were placed with the industry by overseas contractors in 1999. It is estimated that outward defence offsets are worth slightly more than inward contracts – worth between £470 and £980 million to overseas contractors. But it is difficult to ascertain the extent or impact of either inward or outward civil offsets. However, it does appear that offsets will increasingly make way for more collaborative approaches in future, as aerospace companies work together more through joint ventures and partnerships to share investment, product and technology development and risks.

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The UK aerospace industry provides high skilled, high value-added jobs ...

The industry directly employed 154,500 people in 1999, accounting for one third of all jobs in the EU aerospace industry. The industry is highly dependent on skilled engineers and scientists and has the highest proportion of professional, technical and scientific employees working in any of the UK's engineering sectors. In particular, as the boundaries of technology are stretched, and with advances in high-technology manufacturing, IT-based skills are increasingly needed at all stages of development and production and at all levels of the aerospace supply chain. However, skills shortages are being encountered not only in the UK aerospace industry directly, but also in other manufacturing sectors and industries.

... which must be sustained through investment

For primes and first tier suppliers, competitive advantage is principally a result of technological superiority, and it is the only UK manufacturing sector retaining intellectual property rights. Relationships with Government and levels of R&D expenditure are major determinants of technological and competitive success, yet this position is threatened by falling levels of investment in R&D. Whilst the sector is investing heavily in technology and new production methods itself, Government assistance through such initiatives as Repayable Launch Investment and CARAD is far surpassed by public investments being made by the public sector in major competitor countries – the US, France and Germany. In the search for shareholder value, aerospace companies may choose to move production and R&D facilities overseas, attracted by a more conducive business environment. It is essential that the aerospace industry benefits from Government support for long-term research in order to retain its high-value manufacturing capability and the associated benefits of jobs, exports and the science and technology base.

The aerospace industry is increasingly organised on a global basis

The UK aerospace industry generates around £4 billion from overseas assets and many foreign companies have operations in the UK. Globalisation is also changing the shape of the industry through mergers and acquisitions, transnational collaboration and global sourcing. The industry is now dominated by the USA's three giant companies – Boeing, Lockheed-Martin and Raytheon – with BAE SYSTEMS and EADS as the main European players. Although further consolidation amongst the prime contractors cannot be ruled out, there is more likely to be such activity at first and second tier supplier levels, offering scale and synergy advantages to UK aerospace SMEs.

Globalisation is also illustrated by increasing use of collaborative projects, such as risk sharing partnerships between manufacturers and their suppliers. UK aerospace companies are involved, as well, in all of the most important transnational collaborative projects – Eurofighter, Airbus, and JSF. To succeed in this global environment, prime contractors must realise that their suppliers are critical to the success of their business and, as such, need to put in place programmes to ensure suppliers become efficient and engender long-term relationships. In turn, suppliers will need to develop expertise in project management, lean manufacturing techniques and put in place supply chain relationships with their customers.

Strong supply chain relationships are vital to the success of the industry

Changes in relationships with suppliers and their customers are altering the shape and dynamic of the industry. For example, in the defence arena smart procurement offers more open relationships in which joint approaches to cost reduction and product development are applied. As suppliers in the defence and aerospace industry become increasingly service-oriented, and supply chain management plays a stronger role, there will be potential benefits for lower-level suppliers. The challenge for SMEs is to consider their position in terms of skills and resources and identify ways they can be bundled together to win competitive advantage. Otherwise, the danger remains that the industry will lose business and thus employment to foreign suppliers as prime contractors develop a global supply chain.

Globalisation will affect the workforce at prime and supply chain level

The aerospace industry has been characterised by rationalisation and consolidation. Whilst further restructuring is most likely to take place within the first and second tiers of the industry, movement at the prime level will increasingly centre on collaborative ventures and diversification. Whilst UK aerospace prime contractors are in a strong position to take advantage of these developments, any increase in capacity and therefore employment may be balanced by further recourse to outsourcing and the location of production overseas. As primes develop into large systems integrators and seek competitive advantage through rationalisation of their supplier base, the effects will be felt at first and second tier level.

Continuing pressure will be felt by the supply base from global competition and increased global sourcing by their customers. In response, suppliers will be required to minimise cost, position themselves as preferred suppliers to their customers and enhance their service provision. All these requirements necessitate constant development of technology and workforce skills in parallel in order to respond to new challenges and compete in the global aerospace industry.

KEY ISSUES IN THE UK AEROSPACE INDUSTRY

5. Conclusions and policy implications

This study has set out to address a number of key questions about the current state of play – and likely future developments – in the UK aerospace industry that are of vital interest to our members. In what follows, we offer a summary of our conclusions in relation to each of the original research objectives, based on the evidence and analysis contained in the foregoing sections.

We end the report with a series of ideas and suggestions about what the Union might do – at a national, regional and local/plant level – to influence aerospace industry decisions. These decisions range from corporate-level strategies about investments in UK manufacturing capacity, through to the choices individual young people make about their future careers. In our view, the Union has a role to play at all these levels and should continue to engage with, and influence, the industry, Government and the general public across a broad spectrum of issues that affect the performance and prospects of 'UK Aerospace PLC'.

Objective 1: Assess the overall value of UK aerospace industry outputs

The UK has the world's second largest national aerospace industry in terms of employment and turnover and is the largest in Europe. The industry had a turnover of £17.59 billion in 1999 and directly employs around 154,000 people.

The major product groups accounting for the majority (88%) of UK aerospace turnover are aircraft systems and frames, aircraft engines and aircraft equipment. Aircraft parts and aircraft engines are also the two largest export sectors, accounting for around 86% of the £11.2 billion of sales in 1999, whilst the equipment sector accounted for around 10%.

The main area for growth in the industry has been in the civil sector, both for domestic sales and exports. In 1999 civil sales accounted for over half of the domestic market and 84% of export sales. However, there has also been growth in defence exports such that in 1997/98 their value in real terms was higher than at any time since 1985/86. As this coincides with a fall in MoD defence expenditure, it probably reflects a strategy by defence manufacturers to increase exports in order to sustain business.

Objective 2: Determine the net balance of trade and recent trends in UK manufactured aerospace goods overall

The value of total UK exports in both civil and military aerospace products has doubled over the last seven years, rising from £6.4 billion in 1994 to £13.2 billion, the highest since 1984. Aerospace is one of the leading export industries in the UK, accounting for 7% of the nation's total exports and its world market share rose from 9% to 13% between 1993 and 1999.

Overall, the success of the UK aerospace industry contributed a trade

surplus of £2.1 billion in 1999 and an average annual positive balance of £2 billion over the last 10 years.
UK aerospace companies' global assets contributed over £4 billion to annual turnover, whilst foreign-owned companies generated £2.5 billion of turnover in 1999. Contracts won from foreign companies or Governments have also contributed to industry turnover, with UK aerospace benefiting from defence related offsets through the Industrial Participation policy. But it is estimated that UK defence related offsets were worth less than 4% (3.7%) of total UK military aerospace turnover in 1999. As a proportion of total UK aerospace turnover, offsets accounted for under 2%, representing a very small proportion of total aerospace activity. Outward offsets are thought to account for more than this – between about 3% and 6% of UK aerospace turnover.
Whilst sourcing and subcontracting is undoubtedly organised on a global basis, it is impossible to assess the extent of such activity and the impact on employment. Without the availability of such data on a sector basis or any information conveyed by industry representatives, we cannot judge the impact on the UK Aerospace industry.

Objective 3: Assess the current position and recent trends in UK aerospace manufacturing employment in relation to both the total numbers employed and the types of employment involved

The overall level of employment in the UK aerospace industry has declined over the last ten years, with a net loss of around 50,000 employees. However the industry has experienced an upturn since the mid 1990s – direct employment rose from just over 124,000 in 1995 to about 154,400 in 1999. At best, this probably means that direct employment has reached a plateau. In the light of moves amongst primes and first tier suppliers to adopt more of a systems integration role, our view is that the headcount at this level is unlikely to grow significantly in future.

However, the skills base is changing and the pace of change is likely to accelerate as the 'intellectual content' of aerospace work increases – particularly in research, design, project management and systems integration functions. Indeed, recent trends in employment have shown significant growth in the numbers employed in R&D and at graduate, engineer and managerial level. The aerospace industry has the highest proportion of professional, technical and scientific employees out of all UK engineering sectors. Since this concentration of high-skilled, high value-added jobs occurs both within the industry as a whole and more widely through the supply chain, the industry is well placed to develop the 'knowledge base' required to sustain competitive advantage.

KEY ISSUES IN THE UK AEROSPACE INDUSTRY

Objective 4: Determine the extent to which such trends can be attributed to:

a) A shift in UK aerospace manufacturing capacity/investments overseas and

b) Inward investments/shifts of capacity into the UK by overseas manufacturers

The UK aerospace industry generates around £4 billion of its sales from overseas assets and employs nearly 40,000 people outside the UK. Foreign companies located in the UK generate almost £2.5 billion of turnover and support 20,000 jobs.

Examples of outward and inward investment:

Smiths Industries. Most Manufacturing is concentrated in the UK, but has facilities int the US. The US is its largest single market and Boeing is Smiths' largest customer.	Rolls-Royce has manufacturing facilities in England, scotland, US, Canada and Germany. 100 UK jobs were lost this year as a division was moved to Montreal, Canada.
Shorts brothers has been a subsidary of Bombarder - a Canadian company - since 1989. It is the largest privately owned employer in Northern Ireland, employing over 6,000 employees. The workforce is to rise to 7,200 over the next 3 years.	Lockheed Martin UK is a unit of the US company Lockheed Martin Corporation and has annual sales of approx £600 million. it has 1,000 employees at over 20 facillities in the UK.

Gaining domestic market access is extremely important for global companies if they are to grow their market share. Developing a multinational presence will enhance aerospace companies' access to markets, technological capability and competitive advantage. The danger remains, however, that UK firms will develop overseas capacity at the expense of UK jobs, judging that the business infrastructure is more attractive elsewhere. This is shown most markedly with the recent example of Rolls-Royce choosing to move key facilities from the UK to Canada.
However, our interviews revealed that UK aerospace companies believe that the best technical knowledge and experience is based in the UK. They would continue to choose the UK as the location to retain or expand capacity as long as there is a favourable business environment.

c) Offset arrangements with overseas customers and/or contractors

Offsets are extremely difficult to define and, since no official records are kept on defence or civil transactions, it has proved hard to obtain reliable information on their extent, value or implications. Offsets take various forms, from Government-to-Government military sales at one end to private company civil sales at the other end.

There is more information available on defence offsets, and certain calculations can be made about the value of such deals. For instance, it is estimated that, in 1999, the UK aerospace industry benefited from £303 million of Industrial Participation-related contracts. The benefits of involvement in inward offset deals can mean increased jobs, technology transfer and production experience to the domestic firm and reduction of dependence on foreign suppliers.

We also estimate that outward offsets are worth between £470 and £980 million (based on defence export values of £3.92 billion in 1999), representing between 2.7% and 5.6% of total turnover. This suggests that the value of contracts gained through inward defence offsets is exceeded by the value of outward offset agreements.

It is argued that offsets lead to negative consequences for UK aerospace as they move value creation, jobs and technology outside the country. However, such negative effects may be counterbalanced if the offset involves training or where transactions substitute one foreign supplier for another.

Offsets operate in a context of global competitors benefiting from variable degrees of state support and they are one way of enabling industry to compete in a global industry. Whilst there are concerns about loss of jobs and technology, the counter argument is that offsets allow industry to be globally competitive and this may be the only way to secure orders.

Of more relevance for the future, perhaps, is the picture emerging from our interviews and other sources that suggest that offsets are giving way, in certain instances, to more collaborative deals, as exporter and foreign companies take joint approaches to developing technology.

d) Mergers and acquisitions

Mergers, acquisitions and co-operation allow greater access to markets, technology and capital but also stimulate competition and encourage further globalisation. The JSF, Airbus and Eurofighter projects are key examples of partnership working amongst prime contractors and between prime contractors and key suppliers. It is vital that UK aerospace companies secure places – and adopt partnership working – on such projects, as their size may mean few comparable opportunities exist in the future.

Partnerships with prime contractors and their suppliers are an increasing feature of the industry, with partners sharing risk and enhanced technical capability. Partnerships between primes and their suppliers exemplify the way in which risk and responsibility is increasingly passed down the supply chain. These changes necessitate expertise in development, manufacture and support, thus requiring more sophisticated technical and leaner manufacturing skills amongst the supply chain workforce.

Examples of mergers, acquisitions and collaboration:

Cobham acquired facilities in Australia and the UK in 2000 and is actively looking at acquisition opportunities in manufacturing, avionics and services.	GKN-Westland and Agusta have merged to form the world's largest helicopter group - Agusta- Westland.
Airbus 1,700 jobs were created in 2000 at the BAE SYSTEMS Broughton site building wings for the A380 as part of the Airbus partnership.	UK companies have places on two major collaborative programmes: Eurofighter: BAE SYSTEMS and Rolls-Royce. JSF: BAE SYSTEMS, Rolls-Royce, Flight Refuelling, Messier-Dowty and Martin-Baker.

e) Outsourcing strategies, supply chain rationalisations or reforms

Companies at both prime and first tier level are increasingly resorting to outsourcing, which may account for the increase in the number of small businesses we identified in section 3.4. The move to outsourcing presents opportunities to the supply chain to respond to shifts in activity away from manufacturing towards systems integration, both amongst prime contractors and some first tier suppliers. Associated with these opportunities to bid for more value-added work will be an increase in the share of skilled technical, professional and scientific employees required further down the supply chain.

Examples of outsourcing

Rolls-Royce has a 'make/buy' strategy with a view to increasing outsourcing from 65% to 85% by value of its workload.	Shorts brothers (Bombardier) is a major sub contractor to Boeing, providing engineering and logistics support.

Objective 5: Measure the extent to which the resulting levels and types of employment found in the UK represent either:

- a 'hollowing out' (or an enhancement) of UK aerospace manufacturing employment in the longer term
- a dilution (or concentration) of higher value-adding employment in the UK
- a threat (or an opportunity) to UK aerospace manufacturing capacity and capability

In many ways, this question lies at the heart of this inquiry, focusing the concerns that AEEU members have about the future of their industry. We define 'hollowing out' in relation to three closely related measures of capability:

- The degree to which UK aerospace companies' strategic control over investments in research, design, technology acquisition and systems integration is headquartered in the UK.
- The degree of technology leadership acquired by UK aerospace companies in key programmes and markets.
- The skills/knowledge base and profile that has been established in, and is required by, the UK workforce to underpin technology leadership in these programmes and markets.

Each of these measures will determine the level of value-added activity that is likely to be undertaken in this country. Higher-technology, high-skilled activity is, by definition, adding more value. Any hollowing out would be evidenced by:

- A significant loss of strategic authority or control over the business.
- A significant loss of technology leadership.
- A dilution or loss of the skills (of people employed in the UK) needed to maintain that control and leadership.

At the moment, the evidence suggests that UK aerospace primes and first tier suppliers are still headquartered in the UK, still achieving technology leadership, and still basing this largely on the knowledge, skills and know-how of people they employ in the UK. The high level positions and work-shares that UK companies are winning on international collaborative programmes, combined with the growing proportion of technical, scientific and professional staff employed in the UK aerospace workforce, both suggest that fears of 'hollowing out', as we have defined it here, are premature.

At the same time, however, we know that:

- UK owned aerospace assets overseas are growing both in terms of strategic significance and scale. There are clear indications, too, that incentives to invest in higher-value-adding capacity in overseas locations are, in some cases, much more attractive.
- R&D spending is too low as proportion of turnover (relative to competitor countries).
- Skills shortages in key areas are threatening to weaken UK companies' capacity to win/do work in this country.

We also know that the process of globalisation is resulting in global sourcing, shifting lower-end machining and assembly work out of the UK to overseas manufacturers. This is exposing an increasing polarisation within the UK aerospace industry, as some companies adopt new manufacturing techniques and technologies whilst others continue to try to compete on cost. Long-term success will depend on the ability to exploit knowledge – this will be crucial in establishing competitive advantage. As the supply chain also looks at ways to add more value to their activities – by providing design, engineering and support services to customers, for example – this,

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too, will have profound consequence both for people management and skills development.
In so far as the UK industry can retain and build on its knowledge base in aerospace, it should be able to prevent the kind of hollowing out that many observers have feared is already under way. But this will depend on a combination of other factors being present, as outlined below.

Objective 6: Determine what aerospace industry leaders, observers and analysts see as critical in shaping future investment decisions in the UK

Industry representatives and experts all confirm what has emerged from the foregoing analysis – that Government support for R&D and the supply and quality of skills are critical factors shaping future aerospace investment decisions.

a) Research and development

As we have seen, compared with major competitors in the US, France and Germany, UK Government support for R&D has been declining over the last decade. The UK Government cannot assume that aerospace companies will remain based in the UK without continued Government R&D and launch investments, especially since our competitors provide relatively more funding. This is necessary to safeguard the UK economy and technology base as a whole, as UK companies seek to constantly develop new and improved technology, embedded in value-creating products.

In aerospace, R&TD is absolutely vital to ensure technology leadership and commercial exploitation. CARAD and Repayable Launch Investment must continue to be a major supporter of UK civil aerospace research and development, as both underpin the industry's long-term competitiveness. The extension of the R&D tax credit to large firms would also enable increased R&D activity throughout the industry. Moreover, it is only through research and development that the industry can respond to environmental concerns and thus design and produce solutions leading to lower emissions and less waste.

b) Skills supply

The future of the aerospace industry depends on tomorrow's workforce. Young people must therefore be encouraged to enter the industry, attracted by the prospect of exciting, rewarding and diverse career opportunities. Since these new entrants should be armed with relevant skills and qualifications in science and technology, funding is vital for training which matches the industry's needs. The supply and constant development of skilled and qualified labour is essential to ensure technology leadership and competitive advantage.
Investment in training for the existing workforce is equally necessary to develop technical and problem solving skills. Upskilling must be a key priority to ensure that employees are ready to face challenges in the changing working environment. As the industry faces skills shortages, the imperative is

even more pressing that unions, employers and training providers work together to drive policies for skills development of existing and future workers.

5.1 Policy recommendations

5.1.1 Globalisation and consolidation

- We have seen that, from the Union's point of view, the most significant features of change in the industry are the twin processes of globalisation and consolidation. There is a very valuable place and future for UK aerospace in the global industry, yet the environment is getting much more challenging. It is extremely important that the UK Government is made aware of the threats and opportunities associated with this evolving environment, especially the conditions that affect UK aerospace companies' ability to compete both effectively and globally.

The Union will clearly want to use the results of this report to strengthen its lobbying links with key partners in industry and Government (at every level – local, regional and national). The AEEU can take a lead in drawing renewed national attention to the implications of globalisation for the long-term wealth and employment creating potential of the industry.

- There is enormous value creation at all levels of the UK aerospace industry, within prime contractors and the supply chain. Yet high value-added manufacturing needs to be supported by continuous improvements in productivity, efficiency and innovation. Government support for such improvements is vital, requiring investment in skills and R&D to ensure global competitive advantage.

AEEU members have a central role in advancing this argument with Government and joining with other stakeholders in making the case for aerospace as a strategic wealth creating sector in the national economy.

- The issues raised in this report – which bring together much of what is currently known about the challenges and threats facing the UK aerospace industry – also pinpoint the need for much better intelligence about the dynamics and direction of change. There is a need for improved co-ordination, monitoring, communication and information exchange in order to build a stronger body of aerospace intelligence, not only within the union movement but also industry and Government.

The AEEU could explore, with partners, the feasibility of setting up a UK Aerospace Industry Observatory (UK-AIO) to monitor trends in investment decisions and flows, international trade and exports, employment and workforce development. UK-AIO would be used to inform all industry stakeholders – from corporate to community. In particular, the Observatory could investigate a number of questions arising from this study where it has been difficult to obtain information, such as the precise extent of offsets, outsourcing and workflows, overseas investments and the links between big procurement or investment decisions and the UK industrial base.

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5.1.2 The role of Government

- The future health of the industry is clearly dependent on continuing and growing support for R&D, yet we have seen that investments in research and technology are falling relative to major competitor countries. Continued and increased support via CARAD, Repayable Launch Investment and R&D tax credits for all aerospace companies is vital to help ensure a more attractive business environment for global investment. Support is necessary for the development and demonstration of new technologies to achieve cost-down production, for example, or greater operating efficiencies. R&D will also enable the industry to develop technology and products in response to environmental concerns.

The AEEU will use the results of this study to strengthen its lobby for increased Government support and for the creation of a more R&D 'investment-friendly' fiscal policy and environment.

- Export assistance either through the Export Credit Guarantee Department or other initiative must also be continued to ensure that industry receives adequate export assistance.
- It is clear that UK aerospace industry's technological lead must be upheld and supported through Government assistance in order to secure long-term success and prevent the kind of 'hollowing out' that many AEEU members fear is already underway. The Government should establish much clearer 'audit trails' linked to various forms of direct financial support and other commercial dealings with the industry – notably through CARAD, RLI and MoD procurement. These financial and commercial arrangements need to be accompanied by a system of monitoring or reporting that clarifies whether and what UK economic benefits flow from the monies invested. The proposed UK Aerospace Industry Observatory might be involved and given assistance by Government and industry to assess the implications and long-term effects for the UK industrial base.

5.1.3 UK aerospace industry supply chain

- It is vital that the Government is made aware of the role and situation of the 2,500 companies in the UK-based supply chain, which are vulnerable to the effects of globalisation and consolidation. Prime contractors are actively consolidating their supply chains and expect existing suppliers to take on higher levels of technical and financial risk. As prime contractors also become more vertically integrated, SMEs may find it more difficult to compete effectively.
- Initiatives such as Supply Chain Relationships in Aerospace (SCRIA) and the Lean Aerospace Initiative (LAI), which help companies improve relationships throughout the supply chain, must be supported to improve industry competitiveness.

Supply chain reforms have huge implications for working practices, employment levels, skills needs and workforce development. The Union has a direct interest in seeking to learn more about and influence the consequences of such changes for its members.

5.1.4 UK aerospace industry workforce

- It is imperative that more young people choose engineering as a career if the threat of skills shortages is not to become a critical, structural weakness. A partnership role exists for unions, training providers and industry to promote engineering, and specifically the aerospace industry, as a destination for school leavers and graduates. These partnerships can be pursued by strengthening the Union's input and representation at every level – from individual plants, through regional bodies to national committees.
- In order to create additional higher value in the industry, and to retain the core of UK aerospace capability in this country, it is clearly vital to increase skills in the labour force. The following initiatives are recommended for further consideration:
  - Continued partnership with the Engineering and Marine Training Authority (EMTA) on skills issues.
  - Unions have a role to play in negotiating with employers for the provision of education and training so that employees have the skills necessary to deliver technology innovations, improved products and services and lifelong employment. Union officials should consult with local colleges and Learning and Skills Councils as dialogue between unions, employers and local education and training providers is essential to further articulate and develop training needs.

The kind of training plan developed at Airbus might offer a blueprint for the partnership that can be established between Shop Stewards Committees and management.

  - For smaller firms, particularly in areas where there are strong aerospace clusters, there would be strong advantages in establishing a joint approach to training and education. Support is necessary from Regional Development Authorities (RDA), Local Learning and Skills Councils (LLSC) and the Small Business Services/Business Links to enable SMEs to join forces and achieve some economies of scale in developing shared training packages.
  - The AEEU might also want to strengthen its influence with regional aerospace consortia – such as in the North West, South West and South. Skills shortages and skills gaps are clearly issues upon which the Union and employers at this level can establish common ground.
  - Workplace learning has been given a boost by recent action placing Learning Representatives on a statutory footing, giving them a new legal right to take time off from their jobs to promote learning at work. AEEU representatives will be able to take advantage of this ruling to encourage employers to establish Learning Centres at work, for example, or to develop and run union training schemes, produce learning materials and encourage people in the workplace to get involved in training at every level, from basic skills to professional development.
  - Local AEEU representatives are encouraged to seek places on key local and regional boards and management committees, including those linked to local Education Business Partnerships, Local Learning Partnerships, local Learning and Skills Councils and the RDAs to ensure that training policies reflect local employment and industry needs.

One local union representative we interviewed was active on the board of his RDA, representing union and aerospace views at that level. The TUC promotes union involvement in LSCs, seeing the unique role unionists can play in *"… articulating employees' learning needs, building on the trust of their members to represent and negotiate those needs. Their ability to secure partnerships with employers and training providers to broker workforce development and their experience of promoting equal opportunities strategies are also seen as invaluable. Unionists also have skills in helping to deliver opportunities such as NVQs, Modern Apprenticeships, Investors in People, employee development, advice and guidance and individual learning accounts[53]".*

  - In partnership with local LSCs in key aerospace locations, websites could be developed, dedicated to aerospace training and employment. These could be used as a marketing tool to promote the industry to schoolchildren, detailing training and education links and courses for people in the industry and setting out future strategy for training.

Negotiations could include paid time off for workforce representatives to visit local schools and colleges, joining their employers in local campaigns to promote careers in engineering.

  - It is essential that the AEEU builds on its support for initiatives such as that being undertaken by BAE SYSTEMS with regard to workforce development. The Company has established strategic

[53]TUC (2000) Trade Unionists and LSCs: Your Chance to Influence the Education and Training Agenda. www.tuc.org, 26 May 2001
[54]www.bae-systems.com

relationships with universities in order to develop world-class centres of excellence in undergraduate aerospace engineering studies, to ensure that graduates are equipped for a career in the industry. It has also set up a Virtual University to support *"… staff education, training and development, the acquisition of new technologies, leadership development and the identification and deployment of world-class engineering and business best practice"*[54]. Since the 3,000 programmes are available online to employees, customers, partner companies and suppliers, this presents the opportunity for skills development and sharing of knowledge and expertise throughout the supply chain. Trade unionists could help to ensure that members, through the supply chain, make use of the skills development opportunities offered by the Virtual University.

Much of what we have suggested here is predicated on the notion of building stronger partnerships with other key stakeholders in the UK aerospace industry. In our view, real partnerships are about identifying (a) where the common ground is between the different parties, (b) what each partner can contribute – what they can bring uniquely to the table, and (c) treating each other as equals, with no single partner's agenda dominating the others'.

This report is suggesting that there is, potentially, a great deal of common ground between aerospace companies, the trade unions, local aerospace communities and Government (at every level):

- The threat of 'hollowing out' in UK aerospace is, according to our evidence, growing stronger although still some way off.
- All stakeholders in this country have a shared interest in maintaining the UK core – in preventing any further erosion in corporate control and presence in the UK, in maintaining technology leadership and in improving the skills base.
- The Union and employers can certainly join forces in pointing out the dangers ahead and in making it clear how and where Government support, for instance, can make a real difference.
- And all stakeholders have an interest in developing workforce skills and capability.

The Union can take a lead in building such partnerships by negotiating a presence and a voice for its members in key decision-making arenas and at every level – from the factory floor to the Boardroom, and from the local LSC to Government departments. Supported by vigorous and ongoing membership education campaigns, and using this report and other intelligence, the AEEU's influence and profile in the debate about the future of the UK aerospace industry can only grow.

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GLOSSARY

ABI	Annual Business Inquiry
AECMA	European Association of Aerospace Industries
AIRLINE	Aerospace Industry Regional and Local Authority Network
CARAD	Civil Aircraft Research and Technology Demonstration
COTS	Commercial off-the-shelf products
DASA	Defence Analytical Services Agency
DfEE	Department for Education and Employment
DoD	US Department of Defence
DPA	Defence Procurement Agency
DTI	Department of Trade and Industry
EADS	European Aeronautic Defence and Space Company
ECGD	Export Credits Guarantee Department
EMTA	Engineering and Marine Training Authority
GDP	Gross Domestic Product
GVA	Gross Value Added
JSF	Joint Strike Fighter
LAI	Lean Aerospace Initiative
LSC	Learning and Skills Council
MoD	UK Ministry of Defence
NGO	Non-Governmental organisation
NVQ	National Vocational Qualification
OCCAR	Organisation Conjointe de Cooperation en matière D'ARmament (Organisation for Joint Armament Co-operation)
RDA	Regional Development Agency
R&D	Research and Development
R&TD	Research and Technology Development
RLI	Repayable Launch Investment
SBAC	Society of British Aerospace Companies
SCRIA	Supply Chain Relationships in Aerospace
SME	Small to Medium Enterprises