

**EUROPEAN RETROSPECTIVE: THE EUROPEAN AEROSPACE
INDUSTRY 1970-2000**

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ABSTRACT

The success of Airbus Industrie in challenging Boeing's dominant position in the highly competitive civil airliner market has been widely reported. In the light of this success this paper reviews the progress made by the European aerospace industry in the last three decades of the twentieth century. In particular the position of Europe in relation to the US aerospace industry is analysed. As well as covering civil airliner production the study also considers the space and aero engine sectors. In order to explore the factors that have led to a European challenge, three organisations, each from different sectors of the industry, are analysed. The paper concludes that there has been a revival in the fortunes of the industry and its position within the world aerospace industry.

Keywords

Aerospace industry, collaboration, change, industry structure, performance and joint ventures

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INTRODUCTION

Aerospace is an industry of the twentieth century. It had its origins in the first decade of the century. By the middle of the century it was the biggest industry in the US, the world's biggest economy. In the second half of the century the growth of commercial aviation helped bring about one of the biggest changes in business - the spread of globalisation.

While many of the leading technological innovations in the aerospace industry, such as the jet engine¹ and the swept wing² were developed in Europe, when it came to applying the technology and the development of commercially viable products, it was the Americans who led. By the late 1960s the US had in Hayward³ words 'established a stranglehold over most of the market sectors'. In the closing years of the century, several commentators highlighted an emerging challenge from Europe. In the 1980s Yoshino⁴ noted a challenge to Boeing's domination of the commercial airliner market coming from Europe. In the 1990s Heppenheimer⁵, in a history of commercial aviation, devoted an entire chapter to what he termed the 'European Renaissance'.

It is developments in the European aerospace industry, that have led commentators to talk about a European revival and a European challenge to US dominance of the world's aerospace industry, that this paper seeks to analyse. It endeavours to use the vantage point of the start of the second aerospace century to reflect upon and take stock of the progress of the European aerospace industry over the last 30 years. The position of the European aerospace industry within the global aerospace market and in relation to its counterpart in the US is also explored. In the process, the changes that have taken place in the structure of the European aerospace industry are reviewed. Despite the high public profile of the European Airbus consortium⁶, the study is not confined to commercial airliners where a European revival has been most in evidence. Rather the study endeavours to gauge progress across the industry, including the

engine and space sectors. To this end the progress made by three European aerospace organisations, each from a different sector of the industry, is examined. This provides an opportunity to explore the extent of the European revival and the factors that have brought it about.

THE EUROPEAN AEROSPACE INDUSTRY IN 1970

In the 1960s the process of integrating Europe's aerospace interests was in its infancy. The leading aerospace companies in Britain, France, Germany and Italy, were largely separate unconnected entities and the concept of a 'European' aerospace industry was relatively new. The need for some form of integration was highlighted by the disparity in the scale of aerospace activities between Europe and the US. As figure 1 clearly shows, in the 1970s even when the turnover of the leading European aerospace nations was combined, the total was still dwarfed by the US. In 1970 the turnover of the US aerospace industry at 22.3 billion ecu was almost six times Europe's turnover of 4.0 billion ecu⁷.

Insert Figure 1

Nor were differences between Europe and the US confined to scale in 1970. The structure of the two aerospace industries also differed. Table 1 highlights differences in the relative size of the various sectors. The biggest difference between Europe and the US was in the space sector. Table 1 shows that in 1970 the space sector in the US was ten times the size of the space sector in Europe. With just 3.2 per cent of turnover, Europe's space sector was underdeveloped. In the US it formed a major element of the aerospace industry. This reflected the political importance of NASA and the Apollo programme. Some countries, principally France and Britain, had companies undertaking work in the space field, but the scale of work was small. Attempts at cooperation between European countries, such as the ELDO satellite launcher had proved a failure. As a result space comprised only a small proportion of the industry's turnover.

Insert Table 1

The differences were not confined to the space sector. Table 2 shows that the aeronautical part of the European aerospace industry, that is to say the non-space part, was much more dependent on the state than in the US. 58.3 per cent of aeronautical work in Europe was for the state while in the US the equivalent proportion was 51.5 per cent. The difference lay in the civil market. Table 2 shows that in the aircraft sector Europe had half the proportion of civil work of the US, the proportions being 8.4 per cent and 19.4 per cent. It was a similar story in the engine sector where the proportions were 9.0 per cent and 23.1 per cent.

Insert Table 2

In the aircraft and engine sectors in the US, commercial work for the civil sector was well developed, helped in no small measure by the size of the US domestic market⁸. American manufacturers dominated the civil airliner market. Between them they had 90 per cent of the market for civil aircraft by the mid 1970s⁹. In the engine sector US dominance was even more marked with a single firm, Pratt and Whitney having more than 90 per cent of the world market for civil jet engines¹⁰. European aircraft and engine manufacturers in contrast were much more dependent on the state as a major customer. Figure 2 shows that as late as 1980 military work still comprised two thirds of the European aerospace industry's turnover.

Insert Figure 2

Although comparable to the US in terms of the proportion of turnover going into exports (table 2), its weak position in the civil market, meant Europe had a high level of aerospace imports. Civil airliners, particularly long haul ones formed a very large part of this figure. This was evident in Europe's balance of aerospace trade during the 1970s. Between 1968 and 1973 Europe showed a deficit balance of aerospace trade amounting to \$4.5 billion¹¹.

The US aerospace industry was also more efficient. Table 3 shows that in 1970 the US produced six times the turnover with a workforce that was only three times the size. Europe's poor productivity reflected the production of a large number of aircraft types that sold in relatively small numbers¹². By 1974 the US aerospace industry had produced four types of airliner with sales in excess of 600, the point at which airliner programmes usually break even¹³. While only one European airliner, the Sud Aviation Caravelle, had sold more than 250. These poor results were a reflection of European aerospace manufacturers serving their own national market where commercial aviation was regulated and dominated by the state as a purchaser. As Muller¹⁴ has pointed out, until the end of the 1960s in Europe, 'the choice of products manufactured and the nomination of industry leaders were all very largely in the hands of their respective governments'. A consequence of targeting national markets was that European airliners were poorly suited to the needs of the world's airlines, especially US airlines serving the US domestic market which in the 1970s amounted to 35-40 per cent of global aerospace sales¹⁵. There were one or two bright spots. In the turboprop airliner market Fokker achieved 500 + sales of its F27 model in the 1970s, while in the executive jet market the ratio of European to US sales was one to two. The success of small European airliners like the F27 was reflected in Europe's share of the world market for short haul airliners that in 1975 stood at 13.7 per cent, compared to a 2.7 per cent share of the long haul airliner market¹⁶. Despite this, the civil airliner market of the 1970s was clearly dominated by the US.

Insert Table 3

30 YEARS ON

Figure 1 shows that in terms of turnover, the European aerospace industry has grown substantially over the last thirty years. The rate of growth has been much steadier than in the US where expansion has been more rapid and contraction more severe and more prolonged, reflecting the combined impact of the Reagan defence build-up and de-regulation of civil aviation of the 1980s. When measured in real terms the contrast with the US becomes starker. Whereas the turnover of the US aerospace industry increased by 5.8 per cent in real terms over the fifteen years between 1980 and 1995,

the turnover of the European aerospace industry increased by 28.8 per cent¹⁷. The effect of Europe's growth has been to narrow the gap between the European aerospace industry and its US counterpart to the point where at the start of the new century, the former, with a turnover of 62.2 billion ecu was two thirds the size of the latter with a turnover of 104.4 billion ecu¹⁸.

An increase in the scale of activity, as measured by turnover was not accompanied by growth in the size of the workforce. Employment in the industry fell during the course of the 1980s and 1990s. As a result there was a significant improvement in efficiency. Sales per employee which in 1980 stood at 65,400 ecu had risen to 147,500 ecu by 1988¹⁹. This level of efficiency rivalled that achieved in the US where sales per employee in 1998 stood at 170,700ecu.

There was a similar improvement in the aerospace balance of trade. From being massively in deficit in the 1970s, the balance became neutral for much of the 1980s and as the industry came out of recession in the early 1990s, Europe's aerospace trade balance swung into surplus.

Alongside the increase in the size of the European aerospace industry and an improvement in performance came a big change in the customer base. Figure 2 shows that the proportion of military to civil work, which in 1980 stood at two thirds to one third, steadily declined during the 1980s. By the end of the decade the proportions were equal. During the 1990s, with the ending of the Cold War and continued growth in air travel, the proportion of military work continued to decline, until by the end of the 1990s the proportion of military work was down to one third. These changes were reflected in the aerospace industries of individual countries. France with 32 per cent of its turnover generated from civil work in 1982 had 52 per cent civil turnover by 1991²⁰. Similarly Germany with 30 per cent of its employees engaged in civil work in 1970, saw this rise to 70 per cent by 1995.

The change in the proportion of civil/military sales reflects changes in the structure of the European aerospace industry, in terms of the importance of the sectors that make up the industry. Three organisations drawn from the sectors where major changes

have occurred are now examined in order to highlight the changes and the factors that have brought them about.

STRUCTURAL CHANGE IN THE EUROPEAN AEROSPACE INDUSTRY

Airbus Industrie

The growth of civil airliner manufacturing in Europe centres upon the Airbus programme. Formed in 1970 as a three nation consortium which Britain joined in 1979, thirty years later Airbus Industrie was challenging Boeing, the American market leader.

Figure 3 shows that Airbus made a comparatively slow start. Its first airliner, the wide-bodied, twin-jet A300 entered service in 1974, but by 1980 its total sales still only amounted to 292. The 1980s saw a major step forward as the consortium introduced the single aisle A320 that entered service in 1988. But by 1991 total Airbus deliveries still only came to 650²¹ the point at which individual airliner programmes generally became profitable. The comparatively low level of Airbus output reflected the consortium's modest progress in the 1980s. However, the Airbus order book signalled that the new decade was to see a change in Europe's position within the world airliner market. With more than 1,000 aircraft on order valued at \$71 billion²², Airbus had a market share of almost one third and significantly had pushed McDonnell-Douglas, once the world's leading producer of commercial aircraft²³, into third place.

Insert Figure 3

As the world's airlines came out of recession in the early 1990s, Airbus was able to close the gap (figure 3) between itself and its rival, Boeing. It was helped by the breadth of its product range. In only one market segment, wide-bodied jets with 400+ seats, did it not compete with Boeing. As the decade drew to a close Airbus narrowed the gap still further. By 1999 Airbus was on equal terms. With 476 orders to

Boeing's 391 in 1999, Airbus outsold its American rival (figure 3). It was a similar story with regard to the backlog of orders, where by the end of 1999 Airbus had 50 per cent of the total. In the same year the consortium delivered its 1000th A320 narrow-bodied jet. This airliner in its various forms has proved highly successful since production had been running for barely ten years. Furthermore, as table 4 makes clear, Airbus had achieved a high level of market penetration in the US. Given that the US had dominated the civil airliner market in the 1970s with a market share in excess of 90 per cent, the A320 had the unusual distinction, for a European aircraft, of having sold in greater numbers in the US than in Europe. Table 4 also reveals that by 1999 all three of Airbus's major airliner programmes, had, or were about to achieve, sales in excess of 600.

Insert Table 4

While the success of Airbus in challenging US dominance in the civil airliner market has been well publicised, the factors that have enabled the consortium to reach this position are perhaps less well known. Collaboration has been important. It lies at the heart of the success of Airbus Industrie in establishing itself as a major player in the civil airliner market. None of the major European aerospace manufacturers could have undertaken the development of the Airbus product range independently. Collaboration not only helped to provide the necessary resources, it also provided a large home market, that came close to matching that enjoyed by US manufacturers. However it would be wrong to see the success of Airbus solely in terms of the benefits of collaboration. Other features of the approach taken by Airbus have been important.

The Airbus consortium has enjoyed a very high level of political support. It has been the dominant aerospace programme in Europe over the last 30 years. As such it has enjoyed both financial and political support from European governments. Other collaborative aerospace programmes in Europe, most notably Concorde, have been supported in a similar manner but have not shared the success enjoyed by Airbus, suggesting there are other aspects of the Airbus approach that help to account for its success. A succinct summary of these other aspects is provided by Thornton²⁴ when he notes,

'the overriding political priority of ending American hegemony in a crucial economic sector was thus realized through technological expertise and commercial savvy.'

Reliance on technological expertise has not always been part of the Airbus approach. The first Airbus was 'technologically conservative'²⁵. This was quite deliberate since the consortium members reasoned that such conservatism was likely to be attractive for a product from a new and unproven undertaking. Nonetheless the A300 was innovative. The twin engine design differentiated the airliner from its three engined American rivals. With only two engines, the A300 offered the airlines the prospect of lower costs.

Anxious to differentiate its new single-aisle airliner in a similar manner in the early 1980s, 'Airbus took a technological leap'²⁶ with the A320. The A320 was the first civil airliner equipped with fly-by-wire technology. Though some leading industry figures²⁷ doubted the wisdom of employing the this new technology, unproven in commercial passenger carrying applications, nonetheless it offered considerable potential benefits. Without the need for mechanical controls, fly-by-wire technology offered substantial benefits in terms of weight reduction. For airlines this meant lower operating costs. Allied to computerised 'glass cockpit' systems, fly-by-wire also offered further benefits in terms of two person crews (instead of the normal three) and commonality between different models, with consequent reductions in training and operating costs.

In contrast to Airbus's bold strategy involving the use of technology to provide competitive advantage, McDonnell-Douglas took what at the time was the easier and less risky option. With two proven airliners that were selling well, the DC9 and DC10, McDonnell-Douglas opted in the 1980s for the cheaper and less risky strategy of developing derivative products. Although this worked well in the short term, over time the more technologically advanced Airbus designs eventually outsold them. As a result, McDonnell-Douglas slipped into third place in the civil airliner market and was

acquired by Boeing in 1996. For its part, Boeing did not embrace the new fly-by-wire technology until the 1990s when it developed the Boeing 777.

While it was a big gamble, the introduction of fly-by-wire technology was clearly a case of ‘wresting of the technological initiative from the industry’s dominant players’²⁸. But it was not a case of technological advance purely for the sake of technological leadership as was the case with Concorde. The use of fly-by-wire technology clearly fitted within the consortium’s overall strategy. It served to differentiate the A320 from its two well established rivals. The differentiation was linked to commercial factors, namely lower operating costs and increased flexibility. Hence the decision to go for fly-by-wire technology was in fact an example of ‘commercial savy’ on the part of the consortium.

The adoption of a strong commercial orientation or as Muller²⁹ describes it, ‘a switch to commercial logic’, was a feature of the Airbus consortium from the outset. It involved endeavouring wherever possible to meet the needs of customers by ‘offering airlines that people actually wanted to buy’³⁰. The demands of the market dictated the characteristics of the aircraft³¹ and this was supported by aggressive marketing along the lines of its American competitors³². This contrasts with the approach used by European aerospace manufacturers working independently where the approach had in the past been one of developing a new airliner and then persuading the airlines to buy it or developing an airliner for the national airline with little appeal in the wider market.

A key feature of Airbus Industrie’s more commercial approach to aerospace was the recognition of the advantages inherent in offering not a single airliner but a full line comprising a ‘family’ of airliners. Thus the first Airbus the A300, was followed by the A320 launched in 1983 and the A330/340 launched in 1989. Each series has involved derivatives, so that by 1999 the Airbus family amounted to eight members. For the airlines, a family of airliners meant lower unit costs in terms of equipment, maintenance and pilot training³³. For the consortium, a family meant that Airbus could match Boeing’s product range in every market segment, except very large airliners where Boeing retained a monopoly.

Arianespace

The very low level of activity in the space sector in 1975 (table 1) reflected the fact that space, until the 1980s was the preserve of superpowers like the US³⁴. Even the formation of the European Space Agency (ESA) in the 1970s did little to correct the situation. During the 1980s Europe began to make in-roads in the satellite field taking about one fifth of the market³⁵. The 1990s saw further progress as Europe's share rose to almost a quarter.

In one major part of the space sector, satellite launchers, the 1990s saw Europe make big strides. Arianespace, the organisation that took over operational responsibility for the European Space Agency's Ariane launcher³⁶, was set up in 1980. It comprised a consortium of European banks and industrial firms and was specifically charged with overseeing the commercial exploitation of the launcher. When the satellite launching capability of the US was seriously undermined by the Challenger disaster of 1986³⁷, Arianespace was well placed to exploit the growth in commercial telecommunications satellites that followed the de-regulation of telecommunications markets in the 1990s. In 1990 Arianespace took one half of the market for commercial satellite launches³⁸. As the decade proceeded Arianespace's market share increased. Over the period 1990-95 the company dominated the market for launching telecommunications satellites into geostationary orbit with a two thirds market share.

As with civil airliners, European expansion in the space sector was the result of a collaborative approach. Like Airbus Industrie, Arianespace involves international collaboration, the main participants being France and Germany. Again like Airbus Industrie the collaboration is between commercial concerns. The similarities do not end there for Arianespace's success has been exploiting the commercial potential of the Ariane launcher.

Rolls-Royce

While the more dramatic changes in the structure of the European aerospace industry have occurred in the aircraft and space sectors, there have also been important developments in the engine sector. From a situation where in the 1970s they were primarily manufacturers of military engines, two of Europe's engine makers have become a major force in the civil aero engine market. Just how these changes have come about is explored through an examination of the progress made by the British aero engine manufacturer, Rolls-Royce.

Although the development of the jet engine was pioneered by two European concerns, BMW in Germany and Rolls-Royce in Britain, by the late 1960s the market for commercial engines was dominated by Pratt and Whitney of the US. In the early 1970s there were many companies engaged in aero engine manufacturing spread across Europe, including Snecma and Turbomeca in France, MTU in Germany, Fiat and Alfa Romeo in Italy and Volvo Flygmotor in Sweden. But only one European company, Britain's Rolls-Royce, had the capability to design and develop jet engines for use in both military and civil sectors³⁹. The others were active in the military sector, but largely through manufacturing engines under licence.

For its part, Rolls-Royce was in poor shape in the early 1970s. Severe financial problems had forced it into public ownership in 1971. Figure 4 shows that even by the late 1970s it was the smallest of the world's 'Big Three' aero engine producers. Over the period 1976 to 1985 the company's market share averaged 13 per cent⁴⁰. A major factor behind this poor performance was the very limited scope of the company's product range. Although it had developed the high thrust RB-211 engine in the early 1970s in order to provide access to the developing market for wide-bodied aircraft, Rolls-Royce suffered from its commitment to the commercially unsuccessful Lockheed L-1011⁴¹. The limited nature of the company's product range is illustrated by the fact that in 1980 Rolls-Royce engines had applications on only four civil aircraft⁴². Inevitably this made it difficult for the company to expand its market share.

In order to broaden its product range and thereby offer an increased range of airframe applications, Rolls-Royce turned during the 1970s to the development of derivative engines. Based on the core of the RB211, the 524 engine which entered service in

1977 was a more powerful engine targeted at Boeing 747 applications. It was followed by the de-rated 535 engine for narrow-bodied airliners which entered service in 1983. Both engines shared the advanced technology features of the RB211, centred on two innovations, a three shaft configuration that was lighter and more easily maintained than conventional two shaft designs and a wide chord fan offering ‘outstanding fuel efficiency’⁴³. In the 1980s, Rolls-Royce developed another derivative engine, the Tay. This time some of the advanced technology features of the RB211 programme were applied to a completely different and much smaller engine. Transferring technology in this way again produced an engine that was quieter, more fuel efficient and more reliable⁴⁴, characteristics that appealed to the company’s airline customers.

Although Rolls-Royce’s ‘derivative approach’⁴⁵ of applying advanced technology developed as part of one engine programme to other engines, made a major contribution to extending the company’s product portfolio in terms of civil airliner applications, some market segments, especially newly emerging segments, demanded an entirely new engine. To develop products for these segments the company turned, during the 1980s, to international collaborative agreements. In 1983 the company established a joint venture with Pratt and Whitney of the US, the European engine producers MTU and Fiat and a Japanese consortium, to develop a new ‘10 tonne’ engine, the V2500. It was a competitor for the successful CFM56 engine produced by the Snecma-General Electric joint venture, CFM-International. Two further equity joint ventures established in the late 1980s to enable the company to tap new market segments were Williams-Rolls Inc., a joint venture with Williams International, the American manufacturer of small jet engines, set up to produce the FJ44 engine for a new class of small business jets, such as the Citationjet⁴⁶ and BMW Rolls-Royce GmbH a joint venture with the German car manufacturer BMW to develop an entirely new engine to power a new generation of regional jets.

These three joint ventures formed the next stage in the company’s strategy of broadening its product range to increase the number of aircraft applications and boost its share of the world market for commercial jet engines. Though they involved a different mode of operation and were associated with the development of entirely new engines, Rolls-Royce’s equity joint ventures continued the practice of transferring

technologies from one engine programme to another. The V2500 and BR700 engines for instance use the wide chord fan originally developed for the RB211 family⁴⁷. The use of equity joint ventures also fitted Rolls-Royce's strategy of increasing commercialisation. The company had made use of joint ventures before, but in the past they had formed part of inter-governmental agreements. As 'project-based joint ventures'⁴⁸, they were little more than co-production agreements for the supply of military engines. The equity joint ventures that Rolls-Royce entered into in the 1990s were driven by commercial rather than political motives. As autonomous commercial entities they not only make engines but market them and provide product support as well. Such is their autonomy that their products sometimes compete in the marketplace with the products of their parent company. The move to equity joint ventures fitted in with a broader process of commercialisation that saw the company privatised in 1987. The process of commercialisation also saw a major drive to improve productivity with the company shedding almost one third of its workforce over a six year period during the 1980s⁴⁹.

In the 1990s Rolls-Royce broadened its product range still further, but this time by quite different means, namely through acquisition. In 1995 the company acquired Allison, the American engine manufacturer. Allison had for many years been a subsidiary of the US car manufacturer, General Motors. Through the acquisition Rolls-Royce gained access to the rapidly growing market for engines to power small regional jets. Allison's newly developed AE3007 engine proved extremely popular with regional jet manufacturers like Embraer, whose RJ145 regional jet proved a market leader in the late 1990s.

Reviewing the company's progress in 1997, Rolls-Royce's chief executive, John Rose, commented 'we are now doing more business than we could have thought possible ten years ago'⁵⁰. This statement highlights the step change in the company's fortunes that had occurred during the 1990s. Figure 4 shows that after the recession of the early 1990s, aerospace turnover rose steadily after 1994, standing at almost \$6 billion by the end of the decade. This rise was matched by a steady increase in market share. As late as 1987 when the company was privatised, Rolls-Royce's market share was still only 12 per cent. But by 1990 market share had risen to 20 per cent. From

this point it climbed rapidly. By 1997 the company's overall market share had reached 34 per cent⁵¹. As its market share rose to one third, so Pratt and Whitney, the one time market leader was pushed into third place.

Insert Figure 4

Thus by the start of the twenty-first century Rolls-Royce was a very different company from thirty years earlier. It had retained its capability to design and develop both military and civil engines. It was no longer heavily dependent on the UK government for orders. It could now claim to be a 'full line' engine manufacturer with a product portfolio that stretched from engines that powered the smallest business jets to the largest wide-bodied airliners. There were few market segments where it did not have a major presence. More significantly it was now on equal terms with its American rivals.

DISCUSSION

Analysis of these three European aerospace organisations reveals that the European revival is by no means confined to the civil aircraft sector. Airbus may be the best known example of Europe's recent success in the aerospace field, but it is by no means the only one. Arianespace has become a major presence in the Space sector and Rolls-Royce has seen a revival in its fortunes. Growth has occurred across all the sectors of the European aerospace industry. The scale of the structural change is such that one can genuinely describe what has taken place not just as a European revival but a European renaissance.

How has this renaissance come about? Reviewing the leading European players in each sector of the aerospace industry reveals three major features of their competitive strategies. International collaboration features prominently in the competitive strategies of organisations in all three sectors. International collaboration has been a major feature of the changes that have occurred in all three sectors. International collaboration has been enormously helpful in getting round one of the key problems facing European firms in the 1960s and 1970s – a lack of demand brought about by

focussing on national rather than international markets. But there has been a big change in the nature of the collaboration. There has been a move away from what Muller⁵² describes as ‘alliances imposed by government’. The equity joint ventures to have emerged in the space and engine sectors owe little to government. They are commercial ventures designed to enable the participants to tap specific markets. They have a high level of autonomy and they are market-oriented. The Airbus consortium, while not a conventional equity joint venture has enjoyed a high degree of autonomy and the agreement of the partners to form Airbus Integrated Company⁵³ meant that by 2001, Airbus was operating as a conventional commercial undertaking.

Technology also features in the competitive strategies of European aerospace companies. For Airbus it was computer technology associated with fly-by-wire systems, while for Rolls-Royce it was wide chord fan technology. A common feature of the approach taken by European aerospace firms was the emphasis on the application of technology rather than the technology itself. Both Airbus and Rolls-Royce used technology to provide their products with competitive advantage in the marketplace. Hence technology was used to enhance products so as to provide commercial customers, namely airlines, with significant benefits, for which they would be willing to pay. The commercial application of technology is closely linked to the third feature of the competitive strategies seen in Europe, namely a much more commercial approach to aerospace. The most obvious instance of commercialisation is the way the civil market has been targeted in all three sectors. More specific manifestations would include the Airbus policy of developing a family of airliners designed to offer major benefits to the airlines in terms of lower costs associated with staffing, training and maintenance and Arianespace’s policy of ordering batches of launchers in order to gain volume discounts. While at Rolls-Royce commercialisation has taken many forms including extending the product portfolio, the ‘derivative approach’ to engine development, lowering the headcount and pursuing market share. Thus a more commercial approach or, as Muller⁵⁴ describes it, ‘market-led logic’, is very much in evidence right across the industry.

While collaboration, technology and commercialisation have been utilised by European aerospace organisations to enable them to compete effectively, these same

organisations have been helped by major changes in the commercial environment over the last 30 years. Sharply increased fuel prices in the early 1980s⁵⁵ had a major impact on the airlines⁵⁶. As a result fuel efficiency became a more important factor in airline procurement decisions. This was a major strength of Rolls-Royce's new RB-211 derived engines and afforded the company an important competitive advantage, particularly in the market for wide-bodied, long haul aircraft. It also helped Airbus because the twin-engine A300 was cheaper to operate than its three-engine American rivals. The 1980s also saw the airlines becoming much more price sensitive in procurement decisions as airline de-regulation in the US unleashed a period of intense price competition. Price competition over fares made US airlines much more aware of the value of lowering operating costs^{57,58}. This in turn made them more willing than in the past to consider buying foreign products. A third change in the commercial environment that helped Europe increase its market share was the rise of rapidly expanding markets particularly in South East Asia⁵⁹. In these new rising markets there was less loyalty to US aerospace manufacturers. Thus both Airbus and Rolls-Royce pursued the 'Silk Road'⁶⁰ winning major orders in South East Asia. By 1996 all the new Boeing 777 twin jets sold in South East Asia were Rolls-Royce powered⁶¹.

These changes in the commercial environment over the last thirty years have not so much undermined the position of dominant US firms, as reduced the barriers to entry that in the 1970s made it very difficult for European manufacturers to compete on equal terms. The new commercial environment enabled the newcomers to establish a bridgehead, upon which they then capitalised using competitive strategies involving international collaboration, technology and a more commercial approach to aerospace.

CONCLUSION

When the European aerospace industry of the 1990s is compared to its counterpart of the 1970s it becomes clear that there has indeed been a European revival. Whether measured in real terms or in relation to its competitors the industry is bigger and healthier. In size terms, the industry has seen growth in turnover, while in health terms the industry has turned a trade deficit in aerospace in the 1970s into a substantial surplus in the 1990s.

Given the high public profile of Airbus Industrie and its widely reported battles with market leader Boeing⁶², a European revival could well have been anticipated. What is surprising however is that, as this paper makes clear, the revival extends well beyond the manufacture of civil airliners. There has been a significant growth in the space sector with Arianespace taking a large share of the market for satellite launchers. Similarly European firms, in the form of Rolls-Royce and Snecma, have made major inroads in the civil aero engine market, a sector once dominated by the US.

What is also clear from the analysis is that although many of the policies that have brought about a turnaround in Europe's fortunes were implemented in the 1970s and 1980s, it was not until the 1990s that European aerospace really came to prominence in the world aerospace market. Some important changes took place in the 1980s, but in terms of markets, the really big changes did not occur until the 1990s. In all three sectors, civil airliners, aero engines and satellite launchers, it is the 1990s that stand out as a period when a serious challenge to US pre-eminence emerged.

Because the 1990s differ markedly from earlier decades, this suggests that a re-appraisal of the world aerospace industry, and the place of Europe within it, is overdue. If major strategic changes could be identified in the early 1990s^{63,64}, reviewing the whole decade leads to the conclusion that Europe's position within the world aerospace industry has changed in recent years and that there has been a European renaissance.

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Tables and Figures

Table 1
Aerospace Industry Turnover by Sector (1972/3)

Sector	EU (%)	US (%)
Aircraft	54.2	43.5
Engines	25.1	13.0
Equipment	17.5	15.3
Space	3.2	28.2
Total	100.0	100.0

Source: ECC (1975) *Action programme for the European aeronautical sector*, European Commission, Brussels

Table 2
Aeronautical Turnover by Customer Category (%)

	Aircraft	Engines	Equipment	Total
<i>EU</i>				
State	57.7	61.3	56.1	58.3
Civil Market (domestic)	8.4	9.0	24.0	11.4
Exports	33.9	29.7	19.9	30.3
	100.0	100.0	100.0	100.0
<i>US</i>				
State	45.6	52.3	67.5	51.5
Civil Market (domestic)	19.4	23.1	23.5	20.9
Exports	35.0	24.6	9.0	27.6
	100.0	100.0	100.0	100.0

Source: ECC (1975) *Action programme for the European aeronautical sector*, European Commission, Brussels

Table 3
Employment in the Aerospace Industry (1970-98)

Country	1970	1998
EU	438,770	422,484
US	1,166,000	612,000
Canada	35,800	66,870
Japan	25,600	34,761

Source: ECC (1975) *Action programme for the European aeronautical sector*, European Commission, Brussels; AECMA (1999) *The European Aerospace Industry: 1998 Statistical Survey*, European Association of Aerospace Industries, Brussels.

Table 4
Airbus Orders by Region 1970-1999

	A300/310	A320	A330/340	Total
Europe	213	616	177	1,006
N.America	210	847	126	1,183
Asia	232	242	141	615
Other	120	199	129	448
Total	775	1,909	573	3,252

Source: Allport, D, (1999) 'Airbus Industrie' *Air International*, Vol. 56, No. 6, pp i-xvi

Figure1

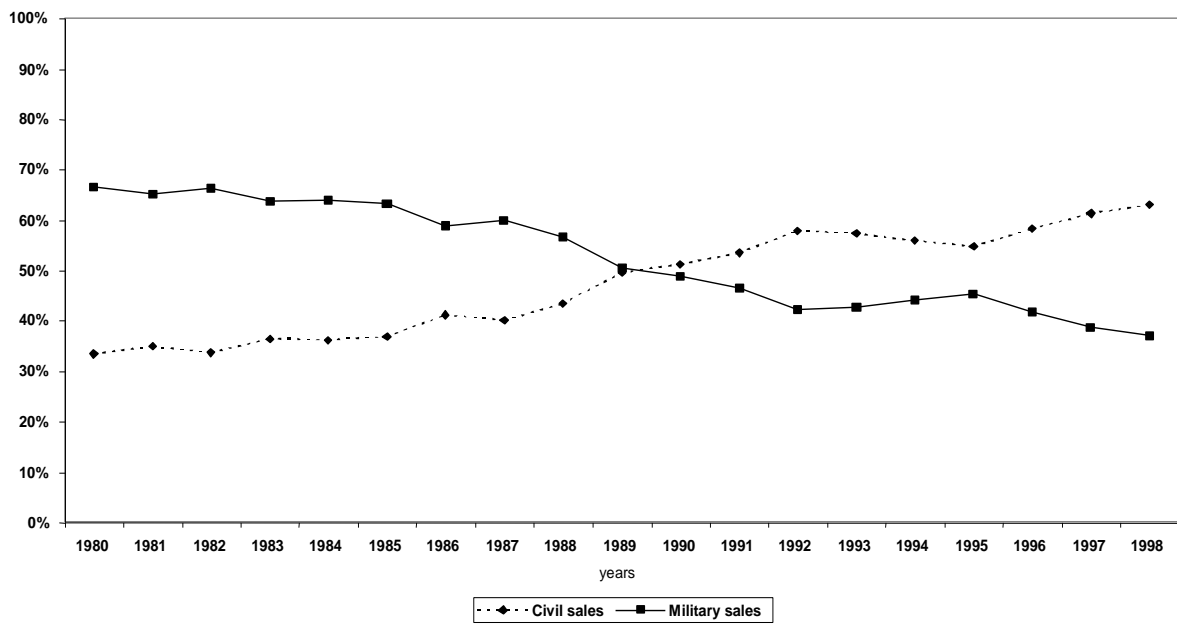
EU, US and Japan Aerospace Industries Turnover 1972-98



Source: European Commission (1996) *The European Aerospace Industry 1996: Trading Position and Figures*, European Commission, Brussels; AECMA (1999) *The European Aerospace Industry: 1998 Statistical Survey*, European Association of Aerospace Industries, Brussels.

Figure 2

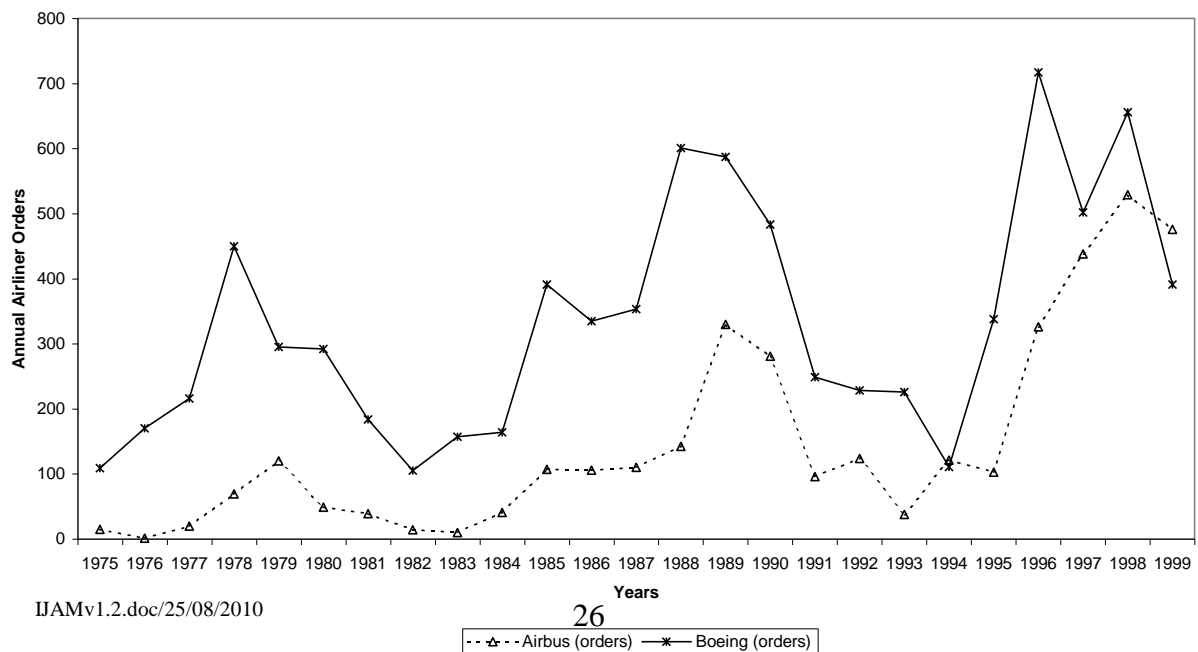
European Aerospace Industry: Civil/Military Sales 1980-98



Source: AECMA (1999) *The European Aerospace Industry: 1998 Statistical Survey*, European Association of Aerospace Industries, Brussels.

Figure 3

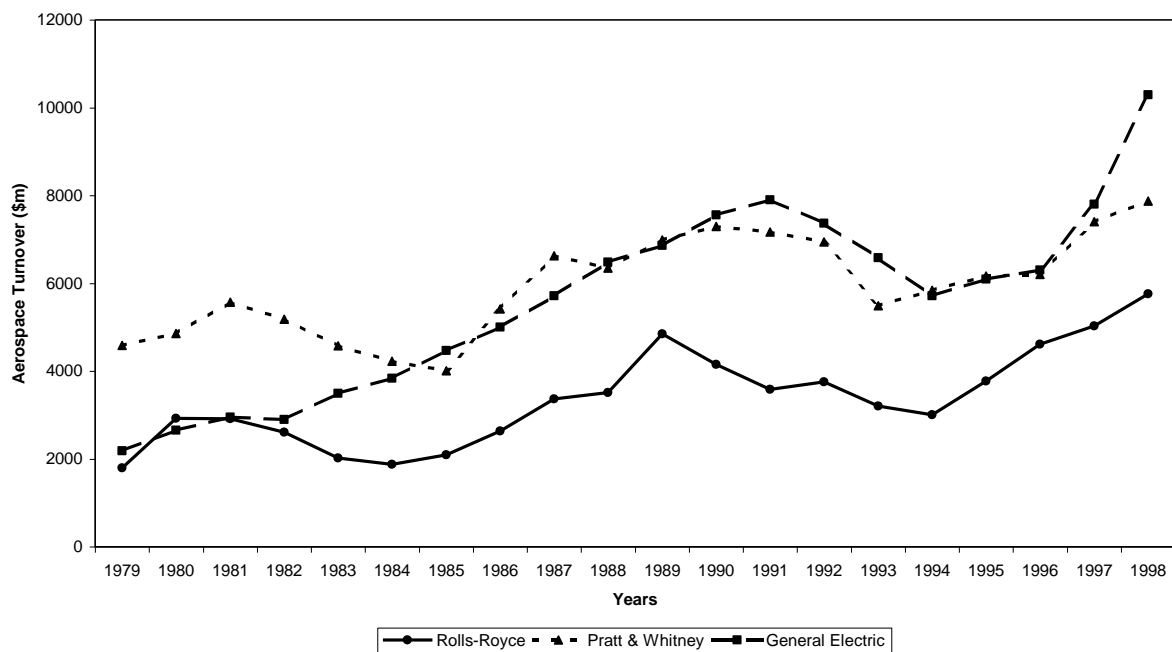
Airbus and Boeing Airliner Orders 1975-1999



Source: European Commission (1996) *The European Aerospace Industry 1996: Trading Position and Figures*, European Commission, Brussels; Allport, D, (1999) 'Airbus Industrie' *Air International*, Vol. 56, No. 6, pp i-xvi

Figure 4

Turnover of Aero Engine Manufacturers 1979-98



Source: European Commission (1996) *The European Aerospace Industry 1996: Trading Position and Figures*, European Commission, Brussels; Company Reports.

Biography

David Smith is Professor of Strategy at Nottingham Business School at Nottingham Trent University. Prior to this he worked at University College Northampton and the University of Derby. He currently holds the post of Director of Research at Nottingham Business School. He is actively involved in supervising doctoral students and teaches Innovation and Strategy on the BA Business Studies programme. Professor Smith's research interests cover a variety of aspects of Corporate Strategy including innovation, strategic alliances and inter-organisational networks. He is currently researching Business Networks as part of a major research project funded by the Department of Trade and Industry. For many years he has been actively involved in the delivery of management development programmes for organisations such as Rolls-Royce, Lucas Aerospace and the European Space Agency. Such work has complemented his research interest in the aerospace industry. He has published in a number of journals including the International Journal of Operations and Production Management, the Service Industries Journal and the European Business Review.