

# The state of engineering R&D in the UK

*Philip Ruffles in conversation with Sarah Powell*

### Abstract

**Purpose** – To determine the views of a distinguished member of the engineering community about the state of engineering R&D in the UK and how the various issues are being addressed.

**Design/methodology/approach** – The paper is based on an interview with Philip Ruffles CBE, Main Board Director for Engineering and Technology for Rolls Royce, until his retirement in 2001.

**Findings** – Traces the origins of today's problems to rapid and uncontrolled cost-cutting and change in the 1980s and 1990s, which opened up gaps in R&D. Also looks at some positive developments such as a greater focus on customers' needs, the fostering of relationships between industry and academia, university spin-outs and development of science and technology parks. Recognizes recent government initiatives and suggests that continuing economic development should encourage industry to invest and adopt a longer-term approach.

**Originality/value** – Outlines some of the concerns expressed as to the state of engineering R&D in the UK.

**Keywords** Industrial engineering, Research and development, United Kingdom

**Paper type** Viewpoint

### Spotlight on Philip Ruffles CBE

Philip Ruffles speaks to editor Sarah Powell about the state of engineering R&D in the UK and how the various issues are being addressed.

Philip Charles Ruffles had a long and distinguished career with Rolls-Royce which he joined as an apprentice in 1961 after graduating from Bristol University with a first class honours degree in mechanical engineering. In his early career he played a leading role in the development of the RB211 turbofan engine for "jumbo" airliners, followed by periods in helicopter engine development, technology and design before becoming Director of Engineering of the Aerospace Group in 1991 and Main Board Director for Engineering and Technology in 1997. He retired in 2001 but was retained by Rolls-Royce as Technical Adviser until 2004.

Mr Ruffles is a fellow of the *Royal Society*, the Royal Academy of Engineering, the Royal Aeronautical Society and the Institution of Mechanical Engineers, a member of the Council of the Royal Academy of Engineering and chairman of its Policy Committee, a board member of Diamond Light Source Ltd and a non-executive director of Domino Printing Sciences plc. He has served on many government committees and other bodies including the Council of the Royal Aeronautical Society, the Advisory Council for Aeronautical

Research in Europe and the Council of the Central Research Laboratories.

Philip Ruffles' numerous national and international awards include Honorary Doctorates from Bristol, Birmingham, Sheffield and city universities and a Fellowship from Imperial College. He is an Honorary Professor of Warwick and Birmingham universities. He was awarded the Royal Aeronautical Society Gold Medal and the Royal Academy of Engineering MacRobert Award in 1996 and the Prince Philip Medal from the Royal Academy of Engineering in 2001. In that year Mr Ruffles was also made a Commander of the Order of the British Empire (CBE).

### Spotlight

Concern is expressed in the 2003 Royal Academy of Engineering report, *The Future of Engineering Research*, as to the UK's future capacity to carry out world-class engineering research because of cuts in engineering R&D in both private and public sectors. Why has this occurred?

### Philip Ruffles

The Royal Academy report was reviewing the situation as of a couple of years ago, a situation stemming from a combination of factors arising over a time-span of some 10 to 15 years. In the mid-1980s, at the beginning of this period, there was a shift of emphasis under the Thatcher government to cutting out costs in many areas as taxation was reduced. University research funding was cut as was support for industry by the Department of Trade and Industry (DTI) and Ministry of Defence (MOD). Many government labs closed or were privatized. This policy continued through to the mid-1990s. Concurrently a programme of privatizations was launched and newly privatized companies were faced with having "to stand on their own two feet" in terms of realizing profit to

---

The Emerald Research Register for this journal is available at

[www.emeraldinsight.com/researchregister](http://www.emeraldinsight.com/researchregister)

The current issue and full text archive of this journal is available at

[www.emeraldinsight.com/0002-2667.htm](http://www.emeraldinsight.com/0002-2667.htm)



Aircraft Engineering and Aerospace Technology: An International Journal  
77/3 (2005) 243–246  
© Emerald Group Publishing Limited [ISSN 0002-2667]  
[DOI 10.1108/00022660510597278]

satisfy the city. This too led to a loss of R&D capacity. Meanwhile competitive and shareholder pressures led companies that were already in the private sector to seek to cut costs. Many corporate labs were closed as a consequence. Companies in general had to adapt working methods as they sought to identify new ways of developing technology and applying it to products.

The full significance of these concurrent changes was probably not recognized – hence the position as described by the Royal Academy report. There were also some positive developments but, when such enormous changes take place over a relatively short time-span, gaps inevitably open up and we have been struggling with these over the past seven or eight years. Many large companies in the UK such as GEC and ICI disappeared or completely changed shape. A new structure of industry emerged but growth has not always been easy, in part because of under-investment in R&D funding, and a skills shortage – the latter probably posing the biggest problem now.

It should be added that this situation was not unique to the UK (for example the closure of corporate labs also occurred elsewhere) – although certain parts were. A number of countries adopted the Thatcher approach to privatization, albeit more slowly. The USA was already very focused on the private sector but this was to some degree offset by the enormous amount of government support that went into and is still going into areas of R&D such as the US Department of Defense or the Department of Energy. Such levels of government support have not existed in the UK for many years.

## Spotlight

To what do you attribute the UK's poor track record in transferring R&D investment into profitable products and services?

## Philip Ruffles

A major problem has been a lack of focus on customers' needs. In the past many in British industry, and particularly researchers in the public sector, spent considerable money on R&D in the belief that any technology was saleable. There are, alas, many examples of British failures where manufacturers did not pay enough attention to the needs and requirements of customers. This has now changed enormously and can be seen as one of the beneficial results of the changes discussed earlier. The whole R&D infrastructure, from academia and industry, is now more focused on the market than it ever was in the 1980s.

Elsewhere there have been examples of good ideas emerging from academia only to be lost because of an absence of the appropriate industrial structure, i.e. a route to market to exploit them. Money spent on research can be wasted if there is no route to market. While the importance of having a route to market is now better understood our industrial base is smaller, which means we need to grow it back up on a broad front. This brings us into the whole area of industry/academia relationships and how to get industry and academia working together to shorten the timescale from the creation of the innovation or the knowledge to its actual exploitation, to ensure a competitive advantage.

Time is crucial in this process. Science and technology parks have made an important contribution, benefiting from direct connectivity back into a university, enabling them to get the product to market very quickly. Numbers of spin-out companies have increased enormously in the past 20 years, which is a very healthy development. Such companies can move far faster than large companies; but of course they are quite fragile in their early days and growth can be very difficult at this time. Small and medium-sized companies struggle on the one hand with shareholder pressures and on the other with not having sufficient resources to maintain an R&D team of sufficient size to acquire technology and develop products, or at least to identify people who can deliver the technology to them. The engineering director of a small company is frequently also the managing director, a dual role which leaves little time for concentration on such longer-term issues.

Meanwhile smallish companies that have not been the result of a spin-out from universities are less likely to benefit from links into academia and surrounding technological infrastructures. Here the Regional Development Agencies could make a big difference if they could get their act together.

Large companies such as Rolls-Royce work routinely with universities which in many ways act as their corporate research labs. Both sides benefit. The universities get “real” problems to work on and the companies get access to a level of intellectual capacity that they perhaps could not otherwise employ.

## Spotlight

In *The Future of Engineering Research* it is stated that the closure or privatization of many public research institutes and reduced public institutional funding for R&D compromise the government's ability to obtain impartial policy advice in areas such as communications, defence, transport and energy. Can you elaborate?

## Philip Ruffles

The most obvious example is electrical power generation and distribution. When the Central Electricity Generating Board (CEGB) existed, it not only ran all the power stations and the grid but also had enormous research labs to support its operations and to assist in the procurement of new equipment from industry. While it was perhaps not outward-looking enough, it was very competent in the way it procured its equipment from various suppliers. When it was dismantled the individual operating companies and the national grid only retained the R&D functions necessary to keep their power stations going, often depending upon their suppliers for ongoing technical support. Many of these suppliers no longer exist as they suffered from the rationalization described earlier. Meanwhile the government set up the regulator to control the market but did not retain any technical expertise. This means that there is no longer any genuinely impartial expertise available to government when considering future energy policy. Policymakers now depend on committees and advisers, neither of which are truly impartial either because they represent interest groups or because their organizations do not have critical mass. This means the current energy policy is fragile. To me energy is the biggest single example of

where we have got it badly wrong. Recently the Energy Research Centre was created to correct this problem and it remains to be seen whether its scope is broad enough to address the energy policy of the UK.

Defence is another potential area of concern. The privatization of the Defence Evaluation and Research Agency (DERA) and creation of QinetiQ has significantly reduced the technical expertise within the MOD although the MOD can still contract QinetiQ to perform work for it. Even so, this has led to dilution of the expertise in the MOD which has only retained a small team to manage research programmes – a team which, in my opinion, is not of sufficient size or competence to provide expert advice to guide procurement.

## Spotlight

What do you see as the UK's particular engineering strengths?

### Philip Ruffles

The two strongest sectors are aerospace and pharmaceuticals. However, in the medical sector, of which pharmaceuticals is part, there is concern that, while the UK is extremely strong in the medical and biological sciences, much medical development is underpinned by the physical sciences and engineering, and the current reduction in skills going into universities on the physical side may mean we will be unable to exploit our strengths on the biological side. Fortunately this problem has been recognized and is being addressed and the opportunities in physical sciences are being promoted.

Aerospace is also strong. The sector is dominated by BAE Systems including Airbus UK, Rolls-Royce, and other players including Smiths Group and Westland. This sector is likely to remain strong provided the UK economic environment is attractive for these companies to continue to invest here, as these companies all operate globally and have the option of developing their operations overseas. While Rolls-Royce has its headquarters in the UK, many of its operations are overseas. The headquarters of Airbus are in Toulouse and the UK arm of Airbus is quite small. On the military side, BAE Systems is strongly reliant on MOD procurement for its UK-based activities. However, given the appropriate economic environment, there is every reason to believe aerospace should prosper.

## Spotlight

Do you see the offshoring of engineering R&D or production as a positive or a negative development?

### Philip Ruffles

It is almost inevitable that if components can be made in a different part of the world at lower cost, industry is going to make them there. Failure to do so will lead to them being uncompetitive. We saw that with Dyson who clearly explained his decision to offshore production. When everybody else is offshoring, the only way of staying in business is to do the same. Over a period of time, of course, costs in these low-cost countries will rise but that will be over quite a long time by comparison with the time it takes to offshore.

In deciding what to offshore, the key factor is ownership and control of the intellectual property, i.e. R&D as it is this

that brings the best returns. What UK companies must do is continue to develop high technology products and to retain the critical intellectual property in the UK, and to manufacture those components which differentiate the product competitively and really have high added value. The rest can and should be offshored to get the costs right. A company might only make 20 percent of a product in the UK but, provided this is the 20 percent with the high technology content and high added value, it can still be very competitive. Also, offshoring can be a means of securing sales in the country concerned through offset or other mechanisms. In a global economy and faced with labour shortages, it is not feasible to manufacture everything in the UK. Technology too can be sourced globally. There is knowledge available around the world and we need to access it.

## Spotlight

The government's *Science & Innovation Investment Framework 2004-2014* sets a target of increasing the UK's R&D investment as a percentage of GDP from 1.86 percent to 2.5 percent by 2014, bringing it closer to the levels attained by France, Germany and the USA, and proposes to increase government science funding by \$1 billion. Has UK investment in R&D always been comparatively low?

### Philip Ruffles

I can only comment on the last ten or so years during which this has certainly been the case, as borne out by the R&D scoreboard published periodically. We have talked about the pressures from the city and shareholders on the one hand, lack of foresight in the boardrooms and shortage of skills in the R&D functions. However, if you look at the investment in acquisitions by British companies, it is interesting to note that it is greater than that of many other developed countries. There has been more interest in the UK in acquisitions than in the organic development of technology or product. One of the benefits of an acquisition is that it is a way to acquire technology quickly and it does not affect your bottom line, which R&D activity does. However the track record of acquisitions is not particularly good whereas R&D is less risky but longer in timescale.

Where money is spent on R&D in the UK, spending is probably more focused than, for example, in the USA. However, our focus can be rather short-term with greater emphasis on D than R. The USA has a longer-term focus encouraged by government funding up to and including 100 percent for some long-term projects – which eliminates risk. In the UK, 100 percent funding is never available so this drives a more risk-averse approach.

What is encouraging in the UK is that the current government is placing great emphasis on the importance of innovation and R&D which it is actively promoting through initiatives such as Tax Credits. These have not proved as effective an incentive as might have been hoped, notably because claiming is so complicated, but also because they were introduced at the same time as National Insurance was increased. However, when seen in the context of a ten year strategy announced to stimulate R&D, this initiative gives rise to optimism that the economic environment will change, enabling industry to respond by investing more in R&D leading to faster organic growth. However, the benefits are

likely to take some 10 to 15 years to be realized. The converse is that, if the environment is not right, companies will increasingly invest overseas.

## Spotlight

The introduction of the Research Assessment Exercise (RAE) and consequent reduction in or withdrawal of funding for all but the highest-rated UK university departments has been blamed for intensifying the closure or downsizing of science departments. Do you share this view?

## Philip Ruffles

It is very convenient to blame the RAE for the decline in research in some subjects but both academia and the government have contributed to these problems which go way beyond the RAE. Government has been buying its research at less than full overhead and academia has been prepared to sell its research at less than full overhead and so has been unable to balance its books. The consequence has been under-investment, most notably in facilities and infrastructure. The RAE only contributes something like 20 or 30 percent of funds for research and has served to focus the activity on fewer universities. Had this not occurred the position would most likely have been worse. The balance of research funding comes through the research councils and industry. The RAE alone really cannot be blamed for the closure of departments.

There is, however, no doubt in my mind that if you put universities into a market economy – which is more or less what has happened – then situations such as this will occur. There needs therefore to be some form of oversight or regulation to ensure that essential capabilities are not being lost contrary to the national interest. Such a precaution appears to have been overlooked. However, the Engineering and Physical Sciences Research Council (EPSRC) is now giving some thought to this and is deliberately funding certain capabilities such as heavy electrical engineering at certain universities. Electrical engineering became very weak a few years back but it is recovering. Some years ago there were also

concerns at a decline in materials sciences but action taken by one major university to address the issue has led this year to a record number of graduates in this discipline there. So highlighting problems is often part of the solution. In engineering, the issues have now been well aired and considerable efforts are being made to turn things round. As a result, I believe the situation will improve.

## Spotlight

What do you see as the major opportunities and threats for the engineering industries in the UK and globally?

## Philip Ruffles

At a trading level globalization is both a threat and an opportunity. It is an opportunity if you take it on board; it is a threat if you do not as domestic markets are no longer sufficient to generate volume sales. However, globalization also implies having global operations and here governments in particular find it quite difficult to know how to cope with industries in their countries that have operations in other parts of the world. Organizations have to think more broadly and dispassionately when it comes to deciding global business strategy.

In terms of threats, long-term or even perhaps not so long-term – perhaps over a 15 or 20 year timescale – climate change must be a worry combined in the longer term with increasing scarcity of fossil fuels. It will have a major impact on energy resources and costs will inevitably rise.

Also significant will be the impact of China on the global economy. If China continues to maintain its current growth rate of between 7 and 8 percent per annum, extrapolated out over 10 or 15 years, it will become a major driving force in the world economy. There will then be a much more balanced set of economies: Europe, America, and China. These changes in the balance of power pose interesting questions as to the impact on trade and world stability.

*The full version of this interview appears in Emerald now at [www.emeraldinsight.com/now](http://www.emeraldinsight.com/now)*