

Creating a High-Value Economy

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**Address to the Royal Society for the Encouragement of Arts,
Manufactures and Commerce**

10 November 2009

Introduction

Good evening, and thank you, Luke, for that warm introduction.

You recently used your column in the FT to express your admiration for those “...who manufacture things – in spite of all the obstacles” – so I know you are a supporter.

The RSA, of course, gives priority to “...bringing together different disciplines and perspectives, to bring new ideas and urgent and provocative debates to a mass audience.”

The author, Alexander Frater, was clearly struck by this. In his recent book *The Balloon Factory*, he recalled that ideas such as nationalising the railways and digging a Channel tunnel were first raised here at the RSA.

Apparently, one of the more controversial proposals came from an 18th century RSA member who aired the notion of offering a prize for the first person to cultivate a commercial opium crop in Britain.

But I hope not to be that provocative tonight.

Two years ago, when I gave the Gabor Lecture at Imperial College, my central thesis was that in Britain, governments of both parties had over many decades sought to encourage what has become known as a ‘post-industrial society’.

And they did so in the mistaken belief that this was the best way of developing a successful economy.

There was a widely held view that the UK should concentrate on creating ideas. Other, less fortunate countries could then engage in the unfashionable activity of manufacturing.

However, that presents a problem.

As I pointed out at Imperial, there are only three ways to create wealth – you can dig it up, grow it or convert something in order to add value. Anything else is just moving it about.

One of the real and, I think, under recognised problems of our becoming a post-industrial society is that the UK would as a result lose vital opportunities to create wealth – and, importantly, lose activities that spread across many regions and create jobs at all levels of employment.

So it was for all these reasons – and the fact that it is good business sense to have a portfolio – that I argued in favour of a more balanced economy, one in which advanced manufacturing should play an important role.

Since then, the global economic crisis has, of course, exposed the risks of our overdependence on one sector.

Encouragingly, there is the beginning of a consensus among politicians, economists and commentators that high-value-added goods and services are central to recovery and to building a prosperous UK economy.

A view that is, I think, supported by the more rapid recovery of countries like Germany, France, Korea or Singapore that have actively encouraged this balance.

This shift in opinion is positive. But we clearly have a long way to go to translate intent into reality.

So I'm not making a new argument tonight.

But I would like to take the argument a stage further and look at what it will take to succeed.

In doing that, I will talk about three central questions:

- What is high-value activity?
- Why does it matter?
- And what should we be doing to encourage it?

So what is high-value activity?

It involves what I call deep knowledge:

- It has a high research and technology content;
- It requires a profound understanding of the customer;
- It exploits both scientific and experiential intellectual property;
- It involves the definition of solutions that meet complex requirements;
- It requires well-developed systems integration skills;

- It involves managing data to inform responses to complex events; and
- It is difficult to do well.

I will try and bring it alive by looking at a Rolls-Royce product, but what I'm saying could apply equally to pharmaceuticals, electronics systems, nuclear or many other industries.

So I will take as my example the Trent 1000 engine we designed for the new Boeing 787.

The Trent 1000 has extraordinary demands placed on it.

- The engine must power an airliner weighing around 242 tons for distances of up to 9,500 miles. It flies at 37,000 feet and at a cruise speed of 567mph.
- It must start and operate at temperatures ranging from minus 60 to plus 40 degrees centigrade.
- And because bird strike is a threat to aero-engines in flight, it has to be able to withstand hitting a 5lb goose – and continue to provide thrust.
- So we have created an engine with a fan set that is almost 10 feet across, which means that at its tip the fan moves faster than the speed of sound.
- The engine draws in up to 1.25 tonnes of air a second – that's the equivalent of emptying a squash court of air in less than a second.
- As the air passes through the engine it is compressed to a fiftieth of its original volume and by the time the air leaves the nozzle at the back, it is travelling at around 900 miles an hour.
- And, of course, the final product must operate with complete predictability and safety.

Every engine requires new technologies, which is why we register around 350 patents a year – some for technology and others for the manufacturing process.

The task of bringing the 18,000 or so components together to create a complete engine involves managing the capabilities of your internal and external supply chain, and developing the systems to support that activity.

For me, this systems integration capability is one of the defining characteristics of high-value manufacturing.

And if you look in more detail at any one of the complex components, you will find the same story repeated.

They demand a wide range of skills, a complexity of relationships, a constant focus on quality and reliability and sophisticated systems integration.

Let me illustrate the point by taking just one small component. This is a 'single crystal turbine blade'.

- It's one of 66 in a Trent 1000 engine.
- It is grown in a vacuum furnace from a single crystal of a proprietary Rolls-Royce alloy.
- It operates in the high-pressure turbine, where gas temperatures are up to 1,600 degrees centigrade – that's around 200 degrees centigrade higher than the melting point of the alloy from which it is made.
- It delivers the same horse power as a Formula One racing car.
- Because of the extraordinary precision required to ensure maximum efficiency and safety, the blade's dimensions cannot be 'out' by more than 10 microns – that's 10 times less than the width of a human hair.
- Yet, for all its complexity, it travels seven million miles between major services.
- A component of this complexity demands the close involvement of an enormous number of parties outside Rolls-Royce: in this case 37 universities and research centres around the world, 35 large companies and 34 small or medium sized companies.
- Unsurprisingly, it is not cheap. In fact, this small component costs around \$10,000, the equivalent of over \$1,000 an ounce.

The single crystal turbine blade is a physical product, but exactly the same principles apply to software.

Sitting within each of our modern engines is the box you see in front of you: an 'engine electronic controller' or an EEC. It doesn't look glamorous but it houses a highly complex set of software which is, in effect, the engine's 'brain' – the conductor of the orchestra.

This one is for our new BR725 engine, which will power Gulfstream's G650 business jet.

- The EEC automatically controls the engine's operating parameters to deliver maximum efficiency. Within one fortieth of a second, it detects changes in the operating environment, such as rain or a demand from the cockpit for more thrust and within just one second, it automatically modifies the engine's behaviour in response to these signals.

- The environment in which our engines operate is one of the harshest known to electronics manufacturers. So, unlike the electronics in laptop computers or even medical devices, the EEC has to work at temperatures ranging from 60 degrees below freezing to the boiling point of water.
- It must also withstand lightning, cosmic radiation and fire.
- Yet it has a service life of over 30 years, compared to the three to five years we expect of a laptop.

Separate from the EEC is another piece of extraordinary software, the 'engine health monitoring unit'. This collects detailed data about the performance of the engine in flight and transmits that data to one of our operations centres.

We can use this information to communicate with and respond to our customers in real time. This is a good example of how high value manufacturing supports the most advanced services which only the manufacturer of the product can supply.

As with the turbine blade, the range of skills required to develop these systems is immense.

Having looked at a whole engine and at two different components, I hope that I have brought to life high value activity.

It is knowledge-intensive, rich in intellectual property, requires high level systems integration skills, demands and supports a highly skilled workforce and an extensive supply chain, has a close involvement with universities, high barriers to entry and creates significant converted value.

It is a slightly self-congratulatory statistic, but pound for pound an aircraft engine is six times more valuable than silver. Whereas pound for pound, a motor car has the same value as a hamburger.

But this gives a sense of the wealth creating capability of high technology manufacturing.

So, if that is what high-value manufacturing is, let's look at why it should matter to Britain.

The first and most crucial point is that high value activities create wealth.

It is no coincidence that the top three national economies in this year's Global Competitiveness Index – Switzerland, the US and Singapore – share many of the same characteristics: high levels of R&D investment, strong collaboration between industry and academia, the successful translation of research into marketable products and services, and flexible labour markets.

Advanced manufacturing can clearly produce wealth at a national level. But as I explained in my Imperial lecture, it is also particularly effective at extending that wealth to all parts of the country – indeed, far more so than is the case with financial services, the benefits of which tend to be limited to London and the south-east.

I mentioned the car and the hamburger. Let me bring it to life by explaining the impact another way.

If you look at Derby, Rolls-Royce's pay is 43 per cent above the East Midlands median. In the skilled works category, we pay 18 per cent more than Toyota and, in Sunderland, 12 per cent more than Nissan.

This wealth creating role is all the more important given the public sector's increasing dominance of our economy.

The number of public sector jobs has grown by around 16% over the last ten years, compared with a growth of just 4% in the number of private sector jobs. This during the longest period of sustained economic growth in our memory.

And of course the public sector, with its commercial salaries and defined benefit pensions, is an increasingly serious competitor to the private sector, with around 50 per cent of newly qualified graduates now going into public sector jobs.

Another benefit of Britain investing in high value activities is that they open up new choices for individuals, companies and the country as a whole.

When any company seeks to develop its capability in advanced sectors, whether aerospace, pharmaceuticals, medical diagnostics, nuclear power or information technology, the implications of failure are immense. So you hone your technologies, skills and processes to the highest levels, often operating at the very limits of what is possible.

The capabilities which you acquire are all transferable to other areas and therefore open up new opportunities for all those involved.

Let me illustrate what I mean.

Over the last 50 years, Rolls-Royce has worked with the Royal Navy to develop nuclear power for the UK's submarine programme. The capabilities and supply chains we have established, coupled with our safety critical aerospace experience, are enabling us to contemplate an entirely new business focussing on the civil nuclear sector.

The very wide range of skills which civil nuclear demands will in turn open up new opportunities for the company, and for those who work in this field, in other high value sectors.

These opportunities are not restricted to manufacturing – the ability of the manufacturing sector to create new service activities is also well documented.

In Rolls-Royce, over 50% of our revenues come from high value services based on our customer and product knowledge.

At a country level, the Singapore EDB, for example, has calculated that every \$1 worth of manufacturing activity creates 90 cents of related services.

As well as creating choices, high value activities are defensive, create significant barriers to entry and can therefore enable this country to respond more effectively to increasingly intense global competition.

Take China and India.

Both countries have, of course, already developed strong manufacturing sectors, with China's exports of manufactured goods now amounting to around \$1.2 trillion a year and India's, \$93 billion. Most people characterise this manufacturing as low value assembly but in fact China and India are already moving rapidly up the value chain.

China, for example, is deliberately targeting future growth sectors. Only last month it announced 20 new industry funds, seeded by government money but financed by private cash and bank loans, to move investment away from old industries into new sectors, such as the environment, software and IT.

As China and India develop in this way, they will create companies – as Japan did in the post war period of high infrastructure investment – that are effective, global competitors. With its 1.3 billion population, 118 cities with over 1 million people, a vast home market and huge infrastructure investments – over the next four days, China will consume as much steel as the UK does in a year – China is, as a result, Japan on steroids.

These changes have profound implications for the UK's competitive position and what we can afford to pay ourselves.

According to the National Science Foundation, the average salary of an engineering graduate in the UK is \$45,000, compared to \$16,000 in India and \$14,000 in China. At Rolls-Royce, we typically pay our engineers in India a salary of \$25,000, compared with the average salary for our engineers in the UK of \$66,000.

So it's not surprising as India moves up the value chain, that there is a strong incentive on UK companies to locate more engineering work in India.

It seems clear that Britain and the western economies will only be able to sustain their historically high salaries and expensive public services if we concentrate on the most advanced and technologically demanding activities, where both value added and barriers to entry are high.

And, finally, these high value activities allow us to be relevant. Given the scale of the markets represented by countries like India, China and Brazil and their own very significant capabilities, we must surely ask ourselves what can we do to make ourselves more relevant to these economies.

In the past, when wealthy, developing countries wanted to improve their infrastructure where did they go?

They came to Britain.

They did so because our companies and our capabilities were relevant to their needs.

But now they talk to Bombardier, Siemens and Alstom about high speed railways;

Alstom, Siemens and GE about power generation;

Areva, GE or Westinghouse about nuclear power;

Boeing or Airbus about aircraft;

Dubai Ports, Hutchinson Whampoa, AP Moller-Maersk or PSA Singapore about ports.

Britain is now too rarely at the top of their list.

And now, finally, I want to turn to the most difficult of my three questions: what should we be doing to encourage high value activity?

I should begin by saying that I am optimistic.

We start with a number of significant advantages:

- We have a long history of scientific and manufacturing excellence;
- Our manufacturing output remains the sixth largest in the world and we are capable of operating at technological levels that most emerging economies cannot currently achieve;
- Four of our universities are in the top 10 world university rankings for the third successive year;
- And we recognise that retaining the status quo is not an option.

But we do have to exploit these advantages.

So here are a dozen ideas for transforming this country's approach towards high value activity which I put forward as a basis for our later discussion:

First, we have to reframe the debate and change our attitude and language.

We must stop hiding behind the myth that Britain is a post-industrial economy, as if that was somehow a meaningful and praiseworthy ambition.

Undoubtedly, the economic crisis has accelerated that debate. Politicians and commentators are now positively embracing the notion that manufacturing should be an essential part of a balanced economy.

But, frustratingly, the wrong language is still being used: for instance, drawing a false distinction between the creative industries and manufacturing.

We must recapture the sense of excitement about science and technology that existed in the past.

There has to be a reason for young people to choose the sciences.

The inventions of the great 18th and 19th century engineers – people like James Watt or Humphry Davy – caught the imagination of the public. The sense of excitement that their inventions generated was palpable. Jenny Uglow described this vividly in her book *Lunar Men*.

Martin Rees, President of the Royal Society, made a compelling case in a recent *Times* article for encouraging both this sense of excitement and a more general understanding of science across the entire population:

“The applications and priorities of science,” he argued, “should not be decided by scientists alone. There are political, economic and ethical dimensions.

“All citizens need to address questions such as: is the world really getting warmer, and why?

“Should we build nuclear power stations – or windmills?

“Will there be designer babies?

“Will computers take over our thinking? “

As Martin points out, science is at the heart of all the biggest issues and advances of the 20th and 21st centuries. If that is not an exciting message to convey to young people, I don't know what is. But they also need to believe they can make a career out of the opportunity.

We should seek to create an educational and training system which equips this country with the skills it will need.

If you examine where Rolls-Royce locates its new investments, we are increasingly attracted to countries with high educational standards and strong vocational training such as the US, Germany, Scandinavia and Singapore.

In Britain, we must revisit past decisions and recreate technology colleges or their equivalent to improve vocational learning. Their curricula must be defined by industry's needs and provide the sort of well-educated workforce that can support the high value activities of the future.

In the context of the current debate about university fees, we should certainly consider a system of differential fees that encourage the study of engineering and the sciences.

We should also build on the success of the Advanced Manufacturing Research Centres, which are giving companies of all sizes access to state-of-the-art manufacturing technology.

We should be shocked by the speed with which our competitors are moving up the value chain.

As I explained earlier, China and India already have world-class companies operating at the highest levels of technology and at the top of the value chain.

They have space programmes, defence programmes, energy programmes and infrastructure programmes that will continue to pull through innovation, technology and capability. They have the market size to support the global companies of the future.

In this context we must use statistics that enlighten us rather than those which show us in a good light.

We've got to be ruthlessly honest about our performance as a country. And not choose comparators that flatter us or give a false sense of security.

Instead, we need to compare ourselves with the best in class and then identify the steps necessary to close the gap.

As George Waldon quoted from Arthur Koestler in the *Times* today, Britons tend to think that "...reality is an irritating word invented by foreigners."

We have to do more to secure and retain high value investment.

Most of our large, high value adding companies don't have to be here. Bear in mind that for most of them, Rolls-Royce included, this country generally accounts for 10% or less of their global revenues.

So they have no market size incentive to remain here.

Companies therefore need other reasons to locate in the UK, whether it is the strength of our science base, the quality of our people, our approach to innovation or government support.

Next, we have to accept that markets are not perfect. Therefore, governments have an obligation to make choices.

Whether we like it or not, other countries recognise that governments have a direct role to play in shaping and developing economic activity.

As John Kaye put it:

“Taken as a whole, market economies have proved far more effective than planned economies. But this does not imply that every individual market outcome is superior to every individual planned outcome.”

Peter Mandelson was quite right when he recently said that there should be less financial engineering and more proper engineering.

Perhaps there should also be less emphasis on social engineering and more on wealth creation.

We should promote wealth creation by pulling all the levers available to government.

For example, the health budget can be used to develop world-class pharmaceutical companies.

The defence budget can sustain a successful defence industry.

Energy policy can encourage investment in technologies where the UK is competitively advantaged, so that we have some prospect of affording the increased energy costs associated with the low carbon agenda.

We must get a better return from our £3.7 billion investment in the science budget.

The science budget is now funded from borrowed money and it is reasonable to expect it to do more to promote entrepreneurship and innovation and less to support the writing of learned papers.

The strength of our science base is a national asset which must play a more central role in developing the right people with the right vocational qualifications and in bringing forward technologies which can be commercially exploited.

A good example of what can be achieved is the Massachusetts Institute of Technology. A recent analysis of MIT's alumni by the Kauffman Foundation showed that they had founded around 26,000 companies, employing 3.3 million people and generating sales above \$2 trillion.

This is equivalent to the GDP of the world's 11th largest economy.

Interestingly, they actively incentivise and help the faculty create businesses.

We must change the way government operates so that it has the right people to support the process of wealth creation.

That means making the civil service more accountable for wealth creation and more commercial in outlook.

And, yes, it is vitally important that the next generation of MPs has some direct and relevant commercial experience.

More generally, we must enhance the business credentials of government by having an effective appointment system that ensures there is a regular and properly used influx of experience from business – as is the norm in most other competing countries.

We must look afresh at how we can professionalise the management of our cities and transform them into globally competitive hubs for the promotion of wealth creation.

In the future, I believe we will see the emergence of a global network of successful world cities. Britain has more than one city that should aim to be in that league.

Singapore is an example of what can be achieved. It is a city with no natural resources of its own but it has succeeded in creating a highly attractive business environment and a significant financial surplus.

And it is no secret that China, with at least 15 cities with over 4 million people, sends its mayors to Singapore to train them to run a city state.

This is not an amateur sport. We too could learn from what they have achieved.

Finally, we need to develop a much clearer and better articulated sense of direction and a better understanding of what we are seeking to achieve with our economy.

Business and government can then prioritise their investments more effectively and work together to address both opportunities and the areas where the UK is weak.

Let me give you an example of what I mean.

Here in Britain we are all agreed that our response to the issues of energy security and energy efficiency will profoundly influence this country's economic, industrial and social future. So what do we do?

We debate endlessly:

The new regulatory regimes that will have to be introduced;

The different ways we as consumers will have to modify our behaviour;

And the scale, speed and causality of climate change itself.

But there is far less debate on how precisely we will take advantage of the benefits expected to flow from the necessary industrial scale response to these challenges.

What do we really mean when we claim that Britain will become a leader in wind power? Do we mean that we will be the biggest manufacturer of wind turbines or the biggest importer or subsidiser?

The right question surely is what policy decisions will positively encourage technologies and capabilities which Britain can reasonably expect to sell to the global market?

And how can government and industry work together to ensure that early and successful investments are made in what are often high risk and uncertain technologies?

And what are the skills we agree we should be developing in our schools, technology colleges and universities if we are to respond to these industrial opportunities?

In short, what we need urgently is a well-coordinated energy, industrial and education policy to ensure that our new low carbon future is a benefit to us rather than a cost.

So that we can become an exporter of solutions rather than an importer of other people's ideas.

Conclusion

Ladies and gentlemen, I hope I have been provocative enough for the later debate.

Let me end, though, on an optimistic note.

We start with some real assets. If we focus effectively on exploiting these advantages, we can without doubt become a country which is recognised globally as a natural home for high value activity.

As a consequence, we will be a preferred location for more companies that compete effectively in international markets and where there is a shared understanding – whether in Whitehall, our board rooms, our schools and our universities – of where our competitive advantage lies.

Thank you all for listening so patiently and I look forward to the discussion.