Case Study on Rolls Royce Plc July 2020

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With no coherent long term strategy in place the case examines the failure during state ownership to address the challenges of a leading science and technology based international business.

Abstract

This case explores the challenges, the pitfalls and the achievements of Rolls Royce Plc in establishing the company as a world leader in turbo fan engine technology.[1] The tale which spans almost four decades from the early 1960s to the early 2000s leaves Rolls Royce today the second independent supplier of commercial turbofan power plants after General Electric of the US. The Rolls Royce RB211 engine (and derivatives thereof) is widely viewed as the leading technology in the industry.

It highlights some of the most fundamental challenges associated with the financing of high tech-innovation. It also illustrates well the law of unintended consequences.[2] In the process of developing the RB211 Rolls Royce was driven into bankruptcy in 1971. It re-emerged as a nationalised industry which survived the political vagaries of successive Labour and Conservative governments until 1987. As the financial outlook of Rolls Royce improved it was successfully privatised by a Conservative government. It is today a commercially successful global engineering and science-based business – a breathtaking alternative when compared with the manifest failure of so many other once famed British engineering and manufacturing businesses.

The case explores how Rolls Royce sustained the innovation process supporting the three shaft architecture supporting high thrust output despite many changes at board level. As they did so they faced intervention by the State and other public entities and lenders motivated to contain costs. They also faced changing perceptions of the power plant needs of the fast developing commercial airline industry in the US and Europe. But the devotion of Rolls Royce engineering decision takers managed to sustain the commitment to the RB211 technology.[3] They did so in a high fixed cost knowledge intensive industry, despite pressure throughout to secure technology and market sharing agreements with competitors. Had these pressures have been successful it would have left Rolls Royce in a subordinate role to its main American competitors rather than a market leader.

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[1] I am indebted to the insights in a paper written by Lazonick and Prencipe emtitled: Sustaining the Innovation Process (2009)

[2] This is a long dated concept often associated with Adam Smith's invisible hand in which competitive strivings mysteriously result in optimal outturns.

[3] Some argue that a unique feature of the Rolls Royce case is the culture of engineering excellence which pervaded all aspects of the company and its workforce.

Of the many lessons to be learnt from this case perhaps the most important of which is that to talk about businesses, business principles and their application as if they are generic to all industries is misconceived.

1. Historical overview of Rolls Royce

The business

Rolls-Royce Group plc is a major global power systems and services company headquartered in London with its principal manufacturing plant in Derby in the north midlands of England.[4] After General Electric (GE) it is the world's second-largest maker of high thrust turbo fan jet aircraft engines.

It also has major businesses in the marine and energy sectors. Through its defence-related activities it is the one of the world's largest defence contractors. It has a current order book of around $98bn. It is listed on the London Stock Exchange and is a constituent of the FTSE Index. Its share price was trading at around 980.00p level with a market capitalisation of £18.5bn in October 2018.

Rolls Royce was founded in 1906. It produced its first aircraft engines in 1914. Historically Rolls Royce is better known publicly for its iconic luxury motor car. As shown below the motor car division was sold in 1972 to another company after its nationalisation in 1971. This left Rolls Royce to focus on its *core business* establishing itself as a leading edge manufacturer of aircraft power plants.

The role of the company in WW1 and WW2

Around half the engines used by the Allies in WW1 were made by Rolls-Royce. By the late 1920s, aero engines accounted for most of Rolls-Royce's turnover. The last design in which Henry Royce, one of the founders, was involved was the Merlin aero engine. This was released in 1935. It represented a development of the engine which powered the record-breaking Supermarine S6 B seaplane to a speed of almost 400 mph in the 1931 Schneider Trophy. The legendary Rolls Royce Merlin engine remains a revered British icon.

The Merlin also powered many WW2 aircraft including the British Hawker Hurricane, the Supermarine Spitfire, the De Havilland Mosquito (twin-engine) and the formidable Avro Lancaster (4- engine) bomber. The early Merlins were used by the British Royal Air Force in the Battle of Britain. It also transformed the American P-51 Mustang into one of the best fighters of its time, its Merlin engine then built by the America firm Packard under licence. The Merlin engine is rightly considered as an important factor in the victory of the Allies. Over 160,000 Merlin engines were produced.[5]

In the post-WW2 period Rolls-Royce made significant advances in gas turbine engine design

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[4] It is not the same company as the luxury car maker which is now owned by BMW, a German company and manufactures the Rolls Royce auto brand in the south of England.

[5] The Rolls-Royce RB.41Nene was a 1940s British centrifugal compressor turbojet engine with around 6,000 lb of thrust. It is rumoured it was gifted by the British to the Soviets and eventually powered the famous Mikoyan-Gurevich Mig15a highly successful fighter Soviet aircraft used during the Korean war.

and manufacture. The Dart and Tyne turboprop engines were particularly important, enabling airlines to cut journey times within several continents. Jet airliners were introduced on longer services. The Dart engine was used in the Argosy Avro 748 (and its military variant the Andover), the Friendship, Herald and Viscount aircraft, whilst the more powerful Tyne powered the Vanguard. Many of these turboprops are still in service.

The arrival of jet engine technology

Rolls-Royce engines had traditionally borne numeric designations during development and then were assigned the name of a British river on delivery. The use of river names was introduced with the earliest Rolls jet engines to reflect their nature: *a steady flow of power* rather than *the pulses of a piston engine*. RB stands for *Rolls-Royce Barnoldswick* the latter being a former Rover plant north of Burnley in Lancashire. This facility was bought by Rolls- Royce in 1943 when it traded production of tank engines (the Merlin based Rolls Royce Meteor) for production of the first Whittle[6] jet turbine engines.

Amongst the jet engines of this period the RB163 Spey stands out. It powered the Trident, BAC 1-11, Grumman Gulfstream ll and the Fokker F28. Military versions of the Spey powered the Buccaneer S2 for the RAF, the Phantom F4K the F4M, and the Nimrod. The Spey was licence built by American Allison Engine Company[7] as the TF41 for the A-7 Corsair ll. Other types of military engines produced in the second half of the 20th Century include the Avon and Viper. These engines powered many of British aircraft of this period. The Conway low bypass ratio turbofan was used on some Boeing 707s and Douglas DC-8s, and all the Vickers VC10s as well as on the MkII variant of the Handley Page Victor bomber used by the RAF.

2. The arrival of the high thrust engine the RB211

The design philosophy behind the B211

During the late 1950s and '60s there was a significant rationalisation of the British aero-engine manufacturers. This culminated in the merger of Rolls-Royce and Bristol Siddeley in 1966. Bristol Siddeley, which had itself resulted from the merger of Armstrong Siddeley and Bristol in 1959, with its principal plant in Filton, near Bristol in the west of England. It had a strong base in military engines, including the Olympus which was chosen to power the Vulcan B1 and B2 bombers and eventually the Anglo French supersonic airliner, Concorde.

To fully see the significance of Rolls' strategy for the RB211 it is important to understand the significance of the turbo fan design preferred by Rolls and the reasons that were driving this forward. Rolls Royce was to realise by 1965 that the *drag penalty*[8] on the fuselage of larger aircraft, especially from aircraft engines, was less than had originally been assessed in European research. This led Rolls Royce engineers to the conclusion that a three-shaft engine architecture (rather than the more popular lighter weight two-shaft solution offered by Pratt and Witney and GE) would result in a much more powerful and fuel efficient engine in terms of thrust.

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[6] A reference to Frank Whittle who shared credit with the German Hans Von Ohain for independently inventing the turbojet engine (though some years earlier than the German). Whittle is hailed as the father of jet propulsion.

[7] Owned formerly by General Motors

[8] Drag is the aerodynamic force that opposes an aircraft's motion through the air. It is generated by every part of the aircraft including the engine(s).

It was this recognition which drove Rolls strategically to the development of the larger 50,000lb thrust engine - more than twice the output of turbo fan engines of the day. But moving from the lower output configuration increased the complications and uncertainties at the design and development stages – a major factor in the events that followed. A demonstrator programme was launched in July 1966. This revealed a number of mechanical problems related to the revolutionary design of the high thrust version. These were inherent to the three-shaft engine architecture. Shortages of finance led to the abandonment of the programme.

Though this was in some respects a false economy it opened the door to success in obtaining a major contract from Lockheed to power the Tri-Star aircraft with a lower thrust solution. This is a matter explored more fully in the following section. A potentially more serious diversion arose from the commitment to focus on developing a smaller three-shaft engine (the Trent). This held back progress in resolving the design problems of the larger 50,000lb thrust engine which was eventually to secure Rolls' fortunes as a globally successful engineering business.

3. Nationalisation privatisation and expansion

The government steps in

Having been selected as the sole engine supplier for the Lockheed Tri Star[8], Rolls-Royce found itself heavily committed to the developing the smaller version of RB211 engine, but ultimately developing a larger output model because of Lockheed's changing airframe specifications and the requirement for increased thrust.[9] The task was complex and progress was hampered by severe technical difficulties and ultimately by severe cash flow shortages. In May 1970 with development and launch costs escalating out of control. Rolls Royce then asked the IRC (Industrial Reorganisation Corporation) - a state-funded industrial development bank - for a loan of £10m to support the RB211 programme.[10] This was granted but on the basis of changes at board level.

A former Chairman of ICI, Richard Beeching, with a lifetime experience in the Chemicals industry (and none of the aviation industry!) was appointed to the board. A champion of the RB211 programme, Sir David Huddie resigned, to be replaced by Hugh Conway head of the Bristol division of Rolls Royce. Economies were exacted and the work force was cut by 3,500.
Financial difficulties continued, however, to mount. The original launch costs were estimated at £67m of which the government agreed to fund 70%, totalling £47m. These had been very seriously underestimated because of the problem of working with unproven technologies such as carbon fibres.

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[9] The Lockheed deal was understandably seen as a major step forward at the time following Rolls' failure in 1968 to secure the deal to power the first of the 747s which went to Pratt and Witney who were able to offer a more powerful engine. But there were complications ahead. First of all the order was won by price cutting on the part of Rolls. Second they were focused on a lower output engine (at 33,260lb thrust) which took their eye of the potentially much more important market for the 50,000llb thrust engine which eventually enabled Rolls to break into the 747 market by offering a cheaper, more fuel efficient alternative to any engine with the same output.

[10] The British IRC was created by the Labour government on its return to power in 1967 with the aim of restructuring UK industry. It provided finance to bring about desirable mergers between firms so as to make them more internationally competitive, British Leyland being one of its more famous cases. It invested directly in several high-technology firms. The subsequent Conservative government abolished it because of its belief that government-financed bodies should not be engaged in risky investment activities.

A revised estimate of launch costs for the RB211 totalling £135m was tabled. The government increased its contribution by a further £42m bringing its total investment to £89m. This represented 66% of the new total estimated costs. Further more modest contributions to the launch cost funds were made by the Bank of England and two clearing banks on condition that they were represented on the board of Rolls Royce. A total of £60m of new cash was put into the company. Notwithstanding, the company's financial circumstances continued to worsen. In the face of evidence that a further £110m would be required to prevent bankruptcy the new Conservative government decided on 4 February 1971 to put Rolls Royce into receivership.[11]

In order to save the company the prime minister of the Conservative government, Edward Heath, nationalised it. The much smaller automotive division was separated from the aircraft engine division in 1973 and sold as Rolls Royce Motors to Vickers. In assessing what had gone wrong one inescapable conclusion is that the focus of Rolls Royce's development effort had been lost because of the demand of two different projects with two different specifications called for by Lockheed and the European Airbus. Events were made worse by the cancellation – to save costs - of the demonstrator programme. Rolls Royce was also managerially and financially over-stretched by the acquisition and integration of Bristol Siddeley the engine maker – a defensive move aimed at protecting its position in the European aviation industry.

The Memorandum of Understanding between the British government and Rolls Royce stipulated that the government (as the sole shareholder) would maintain ultimate control over strategic planning and financial issues related to the launch of new engine development programmes. The government was however not involved in company's day to day operations though investment decisions above £25m had to be approved by government.

4. Privatisation restructuring and expansion- acquisitions and other ventures

Re-floating Rolls Royce

Rolls-Royce plc was privatised in 1987 by the government led by Margaret Thatcher. This formed a vital part of her policy of reducing government intervention in industry and spreading popular share ownership. In the run up to privatisation Rolls saw the accumulation of further losses with renewed pressure on management to cut costs and increase revenue. But by 1984 a recovery in the civil aviation sector began to unfold. Rolls posted substantial profits in 1985 and 1986.

The privatisation in 1987 raised £1.36bn with an additional government approved share issue which raised a further £283m. The government retained in perpetuity a 'golden share' which gave it power to veto any takeover attempt. Foreign ownership was limited to 15% of outstanding shares, later raised to 29.5%[12] and then to 49.5%. Once privatised Rolls Royce renewed its search for productivity gains through significant organisational restructuring, focusing on its core business, outsourcing, downsizing and cost cutting. The restructuring was

[11] A side-effect of this event was a change in the accounting regulations dealing with the capitalisation of expenditure on research. This practice had resulted in Rolls Royce systematically overstating its assets by capitalising rather than expensing R & D thus concealing the reality of its true cash position.

[12] A result of EU intervention

aimed at making civil airlines the central focus of its development strategy.[13]

The transition from public ownership to private ownership (as a publicly traded company) also forced a greater degree of financial accountability. This had the effect of tightening financial controls at all levels of the firm including the shop floor. There were also shifts in the balance of power from aircraft manufacturers to power plant manufacturers as airlines grounded older "spares hungry" engines in the search for more economical engines. This supported margins whilst at the same time highlighting the critical importance of R & D to competitiveness.

But there were setbacks dating back to the period prior to privatisation. Rolls Royce whilst in state ownership has been pressured to enter into two RRRS (Risk and Revenue Responsibility Sharing) agreements in 1984 with GE. This marked a fundamental change of strategy effectively forced upon Rolls Royce. It was welcomed at the time especially by the financial press. The impact was to again force Rolls away from its strategic ambition of developing the high thrust RB211 engine which it was convinced would be the dominant technology. This had the effect of excluding Rolls from the big-engine end of the market in the industry.

The RRRS GE debacle

The effect was to reduce Rolls to a subordinate role alongside GE. The RRRS was finally terminated by GE when in 1986 Rolls secured a £600m order from British Airways to power its new fleet of long range 747s. This was clear proof of the viability of the three-shaft architecture which Rolls had invested heavily in developing. GE argued that it was in breach of the RRRS. There is little doubt that this marked a major turning point for Rolls though it did not exclude later collaborative partnership agreements.

In the 1990s Rolls also embarked on an internal quality enhancing programme labelled Project 2000.This programme was inspired by then preoccupation of Japanese manufacturers with quality and value added. Rolls also reorganised itself into two types of business: one customer-facing with responsibility for identifying customer needs and the other with responsibility for delivering sub systems against cost and specification. This resulted in labour shedding throughout the period with a net reduction of some 20,000 employees over a ten year period.[14]

The acquisition trail

In 1988, Rolls-Royce acquired Northern Engineering Industries, (NEI), a group of heavy engineering companies mainly associated with electrical generation and power management, based in the North East of England. The group included Clarke Chapman, Reyrolle (now part of Siemens the German group) and Parsons (again now part of Siemens). The company was renamed Rolls-Royce Industrial Power Group. It was sold off piecemeal over the next decade as the company re-focused on its core aero-engine operations following the recession of the early 1990s.

In 1990 BMW and Rolls-Royce established the BMW Rolls Royce joint venture to produce the BR700 range of engines for regional and corporate jets. This includes the BR725 powering the

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[13] Organisational restructuring was pursued via several internal programmes relying on lean manufacturing, TQC total quality control) and business process re-engineering principles

[14] This represented 1/3rd of the company's workforce in 1990

Gulfstream G650. BMW subsequently withdrew from the venture and Rolls-Royce took full control of it in 2000, renaming it Rolls Royce Deutschland.

On 21 November 1994, Rolls-Royce announced its intention to acquire the Allison Engine Company an American manufacturer of gas turbines and components for aviation, industrial and marine engines. The two companies had a technical association dating back to WW2. Rolls had previously tried to buy the company when General Motors sold it in 1993, but GM opted for a management buyout instead for $370 million. Owing to Allison's involvement in classified and export restricted technology, the 1994 acquisition was subject to investigation to determine the national security implications. On 27 March 1995 the US Department of Defense announced that the *"deal between Allison Engine Co. and Rolls-Royce does not endanger [US] national security."*

The Allison acquisition, at $525 million (equivalent to £328 million), brought four new engine types into the Rolls-Royce civil engine portfolio on seven platforms and several light aircraft applications. Allison is now known as Rolls Royce Corporation part of Rolls Royce North America.

5. Strategic partnerships and other global achievements

Consolidation with the EU aircraft industry

In 1996 Rolls-Royce and Airbus Industrie signed a memorandum of Understanding specifying the Trent 900 as the engine of choice for the then A3XX, now known as the Aitrbus A380. Progress in its close business partnership with Airbus has been a powerful spur to the development of the Trent 900 and 1000 engines which power the Airbus A380 and A350 aircraft the Boeing Dreamliner and the 747 - 800.

Industrie Rolls-Royce has established a leading position in the corporate and regional airline sector through the development of the Tay engine, the Allison acquisition and the consolidation of the BMW Rolls-Royce joint venture. Optimized Systems and Solutions, (formerly known as Data Systems & Solutions) was founded in 1999 as a joint venture between Rolls-Royce plc and Science Applications International Corporation (SAIC). In early 2006, SAIC left the joint v venture agreement, making Rolls-Royce plc the sole owner.

Chronologically there were several other notable achievements as follows:

- On 6 April 2004, Boeing announced that it had selected both Rolls-Royce and General Electric to power its new 787. Rolls-Royce submitted the Trent 1000, a further development of that series. GE's offering is the GENX a development of the GE90.
- On 13 June 2004, Rolls-Royce was awarded a £110m deal with the British Ministry of Defence to supply engines for its C-130 Hercules transporter aircraft.
- At the 2005 Paris Air Show, Rolls-Royce secured in excess of $1 billion worth of orders. The firm received $800m worth of orders from Air China to supply its 20 Airbus 330 jets.
- In July 2006, Rolls-Royce reached an agreement to supply a new version of the Trent for the revised Airbus 350 jetliner. It is likely that the so-called Trent XWB will be significantly larger than the modified Trent 1000 intended for the original A350 proposal.

- In October 2006, Rolls-Royce suspended production of its Trent 900 engine because of delays by Airbus on the delivery of the A380. Rolls-Royce announced in October 2007 that production of the Trent 900 had been re-started after a twelve month suspension caused by delays to the A380.
- On 18 June 2007, Rolls-Royce announced at the 2007 Paris Air Show that it had signed its biggest ever contract with Qatar Airways for the Trent XWB to power 80 A350s on order from Airbus Industrie worth $5.6 billion at list prices.
- On 11 November 2007, another large contract was announced at the Dubai Airshow from Emirates Airline for Trent XWBs to power 50 A350-900 and 20 A350-1000 aircraft with 50 option rights. Due to be delivered from 2014, the order is potentially worth up to $8.4 billion at list prices
- In mid 2010 Rolls-Royce, in co-operation with other European manufacturers, have been selected as a major contractor for the R199 which in several variants power the Panavia Tornado and also for the E200 engine for the Eurofighter Typhoon.
- In January 2011 Rolls Royce announced new orders from Airbus for A380 aircraft and Trent 900 engines potentially worth about $7 billion.

This shows the Rolls-Royce Trent 900 on the prototype on the Airbus A380. This aircraft has four engines.

Evaluating the Case

Try to provide answers to the following questions:

1. Explain from your reading of the case the reference in the text to the concept of unintended consequences?
2. Why in the Abstract does the case speak about the problems of applying generic business principles as if their application is relevant in all industries in the same way?
3. Define the principal features of the RB211 and why it was eventually to emerge as the industry standard for high thrust turbo fan jet engines?
4. Explain why R & D in general and the development of the RB211 (50,000lb thrust) engine posed a constant financial challenge to Rolls Royce?
5. Why does the case suggest that the Lockheed power plant contract may have distracted Rolls Royce from its fundamental strategic goal at the time?
6. 'Rolls Royce needed access to abundant long term patient capital'. If you agree with this statement explain what it means?
7. What were strengths and weaknesses associated with the nationalisation of Rolls Royce?
9. Why did the Lockheed contract turn out to be so troublesome for Rolls Royce?
10. Explain why the RRSP with GE proved to be a serious strategic error for Rolls given its development ambitions?
11. What does the term customer-facing mean in the text?
12. Why was Rolls Royce convinced that the turbo fan market would eventually be dominated by larger thrust engines?
13. Why did Rolls elect for the three shaft architecture and what were the principal commercial arguments supporting it?
14. 'The demand for funding of £10m from the IRC was derisory given the overall launch costs of the RB211' Do you agree with this statement?
15. What are the main financial facts which show that the Rolls Royce budget for R & D to support the RB211 programme was out of control?
16. Why is Rolls Royce described as being in 'a high fixed cost, knowledge-intensive industry'?
17. Why in your view was the abandonment of the demonstrator programme a serious tactical error?
18. Why was the recovery in the civilian aircraft market so important to Rolls Royce in the early 1980s?
19. Why did the public listing of Rolls increase pressure for still greater financial accountability and what were the advantages Rolls gained?
20. What is the significance of the reference to "spares hungry" engines in the text?
21. How can the financing needs of high tech industries be met in short-termist financial markets where pay-back times are prohibitively short?
22. What does the term "core business", referred to in the text, mean?
23. Give examples of Rolls' commitment to technology enhancement through acquisition?
24. What do best practice accounting principles say about the expensing or capitalisation of R & D and what are the main issues?
25. Why was the US government concerned about the acquisition of Allison by Rolls?
26. Explain the concept of the golden share and its purposes in the case of Rolls Royce?

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