

other engineering companies to strengthen these competences. As navies around the globe shifted from piston engines to gas turbines, *RR* became the preferred supplier for more than 50 navies around the globe.

The dynamics of competition shifted at the beginning of the new millennium. The technological achievements of modern aero engines are truly amazing, even for engineers. Yet, power alone is not sufficient to stay ahead in the engine industry.

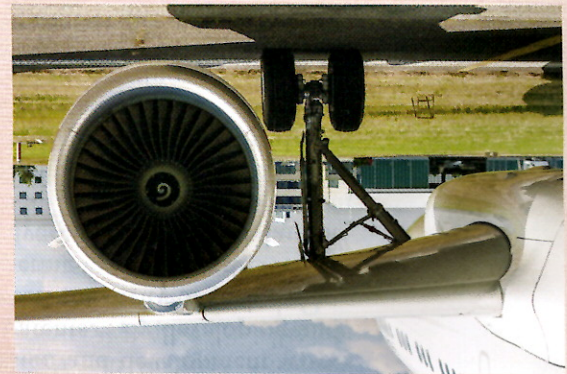
First, manufacturing and servicing of engines was becoming more integrated. *RR*'s engineers were monitoring engines in real time: data were directly transmitted from aircraft to the *RR* service centre, which would initiate corrections or send instructions for work to be done once the aircraft has landed. This new business model opened up new business opportunities for *RR* to exploit its competences.

Second, *RR* needed a global footprint for both manufacturing and service sites so as not to be too far from its main clients, the airline companies. Notably, *RR* built a new engine plant in Singapore to take advantage of skilled labour and government support available in the city-state.

Third, *RR* benefited from a shift in UK industrial policy. The importance of developing capabilities for the engineering sector was recognized by the UK government in 2008, and *RR* had such strong ties to the political establishment that it attracted 86% of the funds made available to developing new technologies.

Elsewhere, contacts to politicians, however, may have been too close: *RR* also became entangled in a corruption scandal in several countries.

The challenges of operating complex engines at the forefront of technology with high sunk costs in R&D and the highest safety requirements from airline regulators continue to challenge *RR*. In 2016, technical problems arose with the engines for the Airbus A380 and the Boeing 787 Dreamliner – the largest aircraft in the world. These engines thus required more inspections, maintenance and more replacement parts than forecast, for which *RR* was liable. This created significant pressures on *RR*'s cash flow.



engineers who took great pride in their history and their engineering skills. The pursuit of engineering excellence became the core of *RR*'s organizational culture.

In 1967, *RR* agreed to supply Lockheed's new aircraft with a new 'three shaft' engine that was cheaper to run and easier to maintain. However, the three shaft design was still an unproven technology, and it was difficult to raise capital for such a long-term and high-risk project. Moreover, *RR* encountered technological problems which caused delays and cost overruns. A turnaround plan was initiated, yet it was already too late. In 1971, *RR* went into receivership and was rescued by the UK state. The government appointed board members with a sharp eye on the company's finances. As one insider later described it, 'the first thing we had to learn was that the company was not just a playground for engineers to amuse themselves'.

New engine developments in the 1980s were building on the designs and technologies of the 1970s – and patents obtained back in the 1930s. The experience of the 1970s taught *RR* that the complexity of the technologies necessitated that new engine programmes be grounded in the R&D experience and in previously demonstrated technologies. Thus, *RR* pursued a strategy of continuous development of technologies. Eventually, *RR* turned profitable again. In 1987, after 16 years under government ownership and massive financial injections, *RR* was privatized.

After privatization, *RR* experienced spectacular growth as its decades-long investment in the jet engine technology finally paid off. Its market share in the global civil aircraft market grew from 5% in 1987 to 20% in 1990.

*RR* also expanded into related lines of business, such as ship engines and nuclear power, where its expertise in building engines to the highest standards was believed to be invaluable. *RR* acquired

Sources: (1) K. Hayward, 1989, *The British Aircraft Industry*, Manchester: Manchester University Press; (2) W. Lazonick & A. Prince, 2005, *Dynamic capabilities and sustained innovation*, I/C, 14: 501–542; (3) *The Economist*, 2009, Rolls-Royce: Britain's lonely high-flier, January 10; (4) P. Hollinger, 2017, US authorities reveal charges in Rolls-Royce bribery scheme, *Financial Times*, November 8; (5) P. Hollinger, 2018, Rolls-Royce chief will do whatever it takes to beat engine woes, *Financial Times*, May 2.