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Lecturer: Said Usman

Student Name: Marzena Beczek

Student Number: 2413128

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Introduction

Globalisation allows multinational companies to access international markets, technology and suppliers, but it also exposes them to geopolitical disruption and new regulatory pressures (Hill, 2022).

This essay examines Rolls-Royce Holdings plc, a UK-based multinational operating in civil aerospace, defence and power systems (Rolls-Royce Holdings plc, 2025a). Its operations depend on advanced technology, specialist employees and reliable access to parts and materials.

The essay critically assesses how artificial intelligence, supply chain disruption linked to the Red Sea and China-Taiwan tensions, and sustainability requirements such as the Corporate Sustainability Reporting Directive (CSRD) affect Rolls-Royce (European Commission, 2025). It considers their impact on market position, innovation, talent management and competitiveness before providing practical recommendations.

These issues represent key external influences within the PESTEL framework, particularly technological, political, economic, environmental and legal factors that shape Rolls-Royce's strategic decisions and competitive position.

Geopolitical Disruption and Supply Chain Exposure

Rolls-Royce depends on specialist components to manufacture new engines and maintain those used by airlines. Disruption to maintenance creates an immediate financial risk because Civil Aerospace generated £3.3 billion from services compared with £1.5 billion from original equipment in the first half of 2025 (Rolls-Royce Holdings plc, 2025b). Under TotalCare agreements, Rolls-Royce receives payments based on engine flying hours and benefits when engines remain operational (Rolls-Royce, 2017).

Parts shortages can therefore reduce aircraft availability, damage airline relationships and affect current revenue. However, delays to new engines remain important because they may weaken future growth and the company's reputation as a reliable supplier.

Red Sea disruption has forced commercial vessels to use longer routes around Africa, increasing transport costs and delivery times (UNCTAD, 2024). Delayed materials or components could extend Rolls-Royce's production and maintenance schedules. China–Taiwan tensions create a different risk because aerospace manufacturing and digital systems depend on semiconductors, whose production is concentrated in East Asia, particularly Taiwan (UK Government, 2023). However, exposure will vary between components and suppliers. Rolls-Royce should map where critical electronic parts originate before investing in expensive alternatives.

Diversifying every supplier would increase costs and management complexity. Rolls-Royce should instead use alternative suppliers and limited safety stocks for components whose absence could stop production or maintenance (Christopher, 2022). Switching suppliers is difficult because aerospace components must meet strict approval and airworthiness requirements (Civil Aviation Authority, n.d.). This requires procurement specialists, engineers and supplier-quality employees who can assess alternatives and maintain safety standards. Although recruitment and training create costs, insufficient expertise could lead to further delays, safety risks and reputational damage. Targeted diversification would therefore improve resilience without adding unnecessary costs across the entire supply chain.

AI, Engineering and Operational Innovation

AI creates practical opportunities for Rolls-Royce in manufacturing, engine monitoring and maintenance planning. The company uses predictive analytics and real-time information to identify problems and improve decisions. Optimised scheduling and digital inventory management have increased machine utilisation by 30%, providing a measurable benefit rather than only a planned improvement (Rolls-Royce, n.d.a). Better

use of equipment may reduce downtime, delays and operating costs, while analysis of engine data can support earlier maintenance and greater aircraft availability.

However, maintenance decisions depend on accurate and secure data. Incorrect information could produce a faulty prediction, causing an unnecessary inspection or missed warning. This is particularly serious in aerospace because errors may affect safety. Rolls-Royce uses the Aletheia Framework to assess accuracy, bias, transparency and governance in AI applications (Rolls-Royce, 2020). Nevertheless, experienced engineers must check unusual results and approve safety-related decisions. Connected systems also expose sensitive operational and design information to cyber threats. Rolls-Royce should therefore maintain human oversight and strong cybersecurity controls, even if this increases costs or slows automation (National Cyber Security Centre, 2023).

AI also changes workforce requirements. Engineers need digital skills, while AI specialists must understand aerospace operations and safety. AI and big data are among the fastest-growing skill areas, increasing competition for qualified employees (World Economic Forum, 2025). Recruiting specialists is expensive, while training existing engineers takes time but preserves valuable technical knowledge. Competitors can also adopt AI, so technology alone will not create a lasting advantage. Rolls-Royce will benefit only if skilled employees use it to identify faults earlier, reduce maintenance time and improve aircraft availability.

Sustainability, Aviation Transition and CSRD

Sustainability creates a strategic opportunity because fuel efficiency affects both airline costs and environmental performance. The Trent XWB uses 15% less fuel than the first Trent generation, while the UltraFan demonstrator is designed to achieve a 25% improvement compared with the first Trent (Rolls-Royce, n.d.b). Rolls-Royce has also completed 100% Sustainable Aviation Fuel (SAF) compatibility testing across all its in-production civil aero engine types (Rolls-Royce, 2023). These developments may

strengthen its market position as airlines face pressure to reduce fuel use and emissions. However, compatibility does not guarantee rapid decarbonisation because the environmental benefit depends on the availability and price of SAF, which Rolls-Royce cannot control alone.

Developing efficient engines and alternative technologies requires investment in research, testing and certification before revenue can be generated. Strategy therefore involves deciding where limited resources will create the greatest value (Whittington et al., 2023). Investment in UltraFan, hydrogen and other low-carbon technologies may strengthen Rolls-Royce's future position but reduce resources available for engine durability, maintenance capacity and supply chain resilience. The company should prioritise technologies with clear customer demand and measurable fuel savings rather than treat every environmental project as equally urgent. If public commitments develop faster than practical results, Rolls-Royce could lose trust among airline customers and investors.

CSRD may require Rolls-Royce's relevant European operations to provide detailed and comparable sustainability information (European Commission, 2025). Reliable reporting requires cooperation between engineering, procurement, finance and environmental teams. Rolls-Royce needs environmental engineers who understand products, reporting specialists who understand CSRD, and managers who can coordinate information across departments. Organisational performance depends on employees' ability to respond to change and work across specialised functions (Mullins and Rees, 2023; Daft, 2021). A separate reporting team might improve compliance but isolate sustainability data from operational decisions. Connecting reporting specialists with engineering and procurement would allow CSRD information to influence engine design and supplier selection. Reporting alone will not create an advantage; its value depends on whether the information improves performance.

Combined Strategic Impact on Rolls-Royce

Rolls-Royce faces a sequence of priorities rather than three separate problems. Supply chain disruption creates the most immediate pressure because delayed parts affect maintenance revenue, aircraft availability and airline relationships. AI can improve manufacturing and engine monitoring, but it depends on secure systems, reliable data and skilled employees. Sustainability presents a longer-term challenge as airlines demand more efficient technologies. Rolls-Royce must therefore balance current reliability with future innovation. Excessive investment in future projects could reduce resources for maintenance and supply problems, while focusing only on short-term performance could weaken its position in a lower-carbon aviation market (Whittington et al., 2023).

Talent management connects these pressures. Procurement teams must understand supply risks, digital engineers must interpret AI information, and sustainability specialists must connect emissions data with product decisions. Cross-functional coordination is therefore more important than simply recruiting additional employees (Daft, 2021). Rolls-Royce's market position will improve only if these skills produce reliable engine availability, lower fuel use and credible environmental progress. As competitors can also adopt AI and meet sustainability rules, competitive advantage will depend on how effectively Rolls-Royce combines innovation, employee capability and operational performance.

Recommendations

First, Rolls-Royce should identify components whose absence could stop engine production or maintenance. Each component should be assessed by delivery time, number of approved suppliers and exposure to disrupted transport routes. For the highest-risk parts, Rolls-Royce should approve an alternative supplier and maintain limited safety stocks. Supplier-quality engineers must confirm compliance before disruption occurs because aerospace components are subject to strict approval

requirements (Civil Aviation Authority, n.d.). The company should review supplier lead times, shortages and maintenance delays every quarter. This targeted approach would improve resilience without the cost of diversifying the entire supply chain (Christopher, 2022).

Second, Rolls-Royce should expand AI through controlled projects in engine monitoring and maintenance planning rather than introduce full automation. Engineers should retain final responsibility for safety decisions, while the Aletheia Framework should be used to review accuracy, transparency and accountability (Rolls-Royce, 2020). Each project should measure false warnings, missed faults, machine downtime and maintenance turnaround time before wider implementation. Cybersecurity specialists should test how operational and design data are protected (National Cyber Security Centre, 2023). A system should be expanded only when it provides measurable improvements without weakening safety or data security.

Third, Rolls-Royce should connect CSRD reporting with engineering and supplier decisions rather than treat it only as compliance. A cross-functional team should introduce common data requirements and first verify information from suppliers responsible for the greatest environmental impact. CSRD data should be used to compare the environmental and commercial value of engine-efficiency projects and SAF compatibility (European Commission, 2025). Rolls-Royce should publish measurable progress and explain delays. This would support investment decisions and reduce the risk of sustainability claims exceeding actual results.

Conclusion

This essay has shown that supply chain disruption, AI and sustainability create connected opportunities and risks for Rolls-Royce. Parts shortages present the most immediate threat to maintenance, aircraft availability and service revenue. AI can improve manufacturing and fault detection, but its value depends on secure data, skilled employees and human oversight. More efficient engines and SAF compatibility may

strengthen the company’s future position, although progress also depends on external fuel supply and effective use of CSRD information.

Rolls-Royce should therefore protect critical supplies, introduce AI through controlled projects and focus environmental investment on measurable customer value. Its competitiveness will depend on balancing current reliability with future innovation and connecting engineering, digital, procurement and sustainability expertise across the organisation.

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