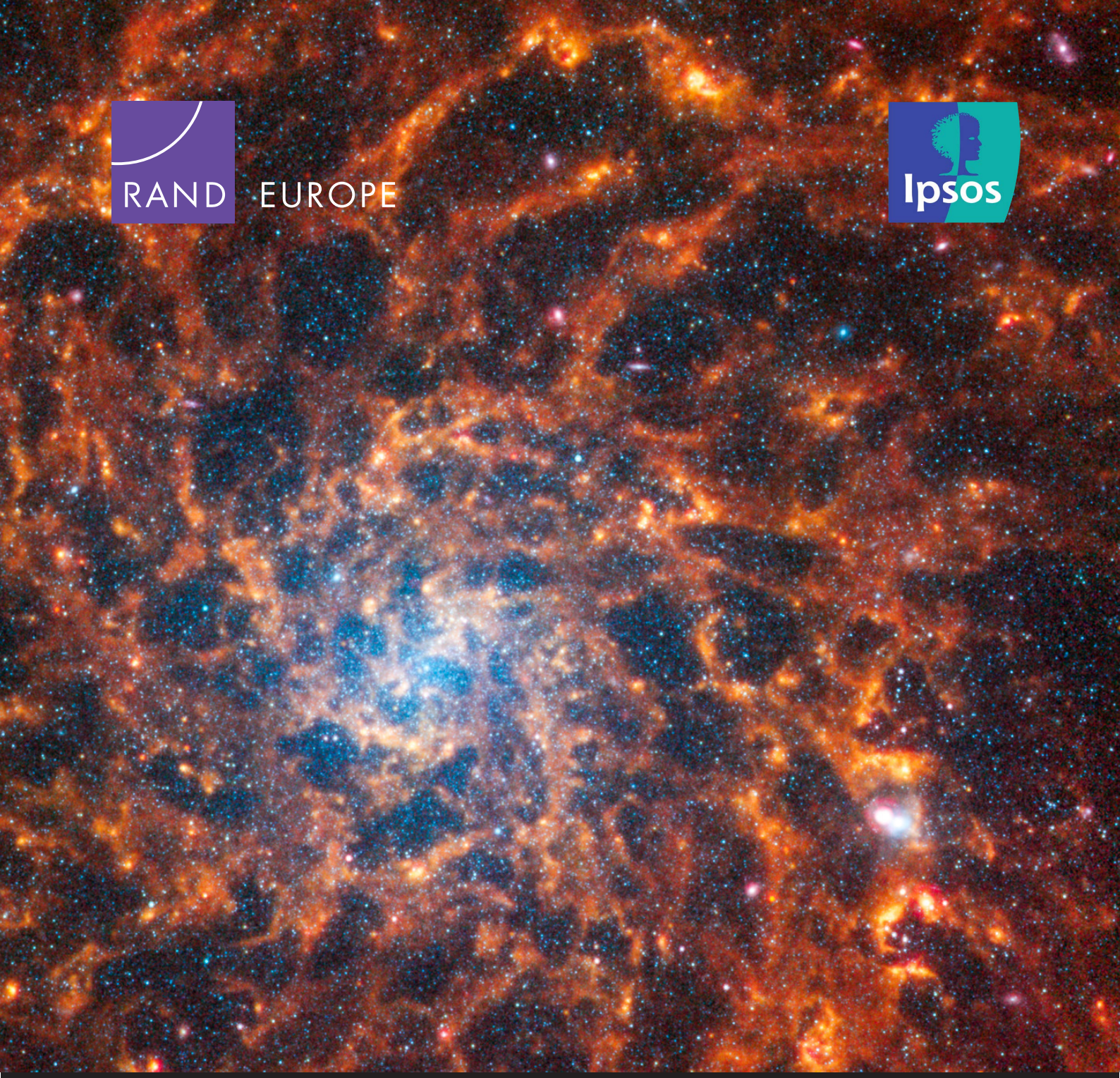


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Evaluating the benefits of the UK's investments in the European Space Agency

Executive summary

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The UK's investments in the European Space Agency (ESA) yield significant value to the UK economy, scientific and technical advancements and commercial success and boost the UK's reputation as a key player in space – more than could have been achieved without the UK's ESA membership. The UK is a leading nation in ESA, securing important contracts and mission leadership that lead to cutting-edge scientific and technical achievements. The UK Space Agency plays a major role in enabling those achievements.

However, the UK faces challenges in achieving the full potential of its ESA membership since its national capacity to manufacture, test and integrate complete missions is limited despite its strengths in early-stage technology and instrumentation development. Space-related decision-making and R&D functions (e.g. strategy, research funding and commercial support) are fragmented across government departments and agencies.

Clarifying the UK Space Agency's role and responsibilities would allow for a clear, flexible and innovative body to lead the UK's space goals more broadly and within ESA. It would also enable the UK Space Agency to proactively align with national interests, work across government departments and agencies, leverage the UK's strengths and address capability gaps.

Strong alignment across the government is needed to realise the benefits of ESA membership. This effort should focus on increasing space capability development, streamlining resources and building a whole-government approach to achieving domestic goals via ESA, including better exploiting downstream opportunities. It should set out a long-term national strategy/mission for the UK space sector and how it invests in ESA that industry, academia and other organisations know well and subscribe to.

Ultimately, very few of the benefits described here would be achievable outside of ESA, which gives the UK access to collaboration opportunities with leading European companies and technologies, a pooled resource from which to draw and significant positive value for public money.

Context

1. **The UK is a leading nation in ESA** as a founding member state and the fourth largest financial contributor after Germany, France and Italy. ESA represents a key mechanism through which the UK seeks to meet its space goals. The UK Space Agency commits 70–75% of its annual budget to ESA and, at the most recent ESA Council at the Ministerial Level in 2022 (CM22), the UK committed £1.84bn for the 2022–2027 period.

2. At CM22, the UK contributed €1.89bn to ESA across all programme areas, making up 11.2% of ESA's overall €16.92bn funding portfolio defined at the CM22 meeting. The UK's commitment included £615m for the mandatory core science budget and, notably, £315m for optional earth observation (EO) and climate programmes, representing a 45% budget increase supporting priorities highlighted in the **UK Space Agency Corporate Plan 2022–25.**[1] The UK's commitment to ESA secured several projects, including launching the UK-built Rosalind Franklin Mars Rover, the Vigil space weather mission and the TRUTHS climate laboratory.

[1] UK Space Agency. 2022. UK Space Agency Corporate Plan 2022-25.

3. Work to improve the UK's geo-return has been ongoing for the past several years, leading to a transformation in the portfolio. However, rigorous evaluation of UK Space Agency's spend into ESA is imperative to provide accountability for public funding, understand impacts and value for money, and support the development of work toward the next Spending Review, the CM25 investment round and beyond.

Conclusions

Direct financial return and economic benefits

1. The ESA convention mandates equitable participation amongst its member states, proportional to their financial contributions. This principle, known as geo-return, has been used as a primary indicator of the direct financial return from the UK's investments in ESA. As of Q4 2024, the **UK's geo-return return coefficient stood at 0.99**, meaning that for every €1 invested, the UK received €0.99 back in contract value, resulting in a deficit of €41.18m. This figure represents a reduction in the UK's geo-return deficit compared to historical figures.
2. **The UK's investments in ESA have resulted in significant benefits for the UK's growth, employment, productivity and private research and development (R&D) investment**. Our analysis of the benefits that ESA contract recipients experienced strongly suggests (subject to uncertainty) that they led to:
    - Growth in turnover and gross value added (GVA), with £1m of ESA contract funding leading to an average increase of **8.2% in firms' turnover and 6.7% in their GVA**.
    - Increased employment across total and R&D-specific employment, with £1m of ESA contract funding leading to an average increase of **3.3% in firms' total employment and 6.1% in their R&D employment**. These effects peak three to five years after the contract start date, with more limited evidence for long-term impacts.
    - Increased turnover per worker and GVA per worker, with £1m of ESA contract funding leading to an average increase of **4.9% in firms' turnover per worker and 3.9% in their GVA per worker**.
    - Increased private R&D spending, with £1m of ESA contract funding leading to an average increase of **6.6% in firms' R&D expenditure** – an effect that peaked after four years and dissipated by ten years after the contract start date.
3. **The direct economic return from every £1 spent on the UK's ESA contributions was £7.49.** Based on the 3.9% increase in GVA per worker for ESA contract recipients, we estimate the total aggregate economic impact of the UK's investments into ESA at £7.004bn. Based on its financial contributions to ESA between 2013 and 2022, the UK Space Agency's overheads and some additional costs, we estimate the overall costs associated with the UK's investments into ESA at £2.440bn. These benefits extend beyond contract recipients, with broader benefits expanding to wider communities based on geographic proximity and industrial connections. Wider spillover

benefits also occur, extending benefits beyond the space sector, although these are harder to quantify until new datasets on industry supply chain structures become available later in 2025.

Scientific and technological advancements

1. Through its diverse investments in ESA, **the UK has achieved significant scientific and technological advancements** across all technology domains and at various Technology Readiness Levels (TRLs) from early-stage 'blue-sky' technological development to on-orbit demonstration and commercial deployment. Companies consider a successfully delivered ESA contract indispensable in acquiring future investments, grants, and contracts.
2. The UK's extensive heritage in instrument development, e.g. magnetometers for space science missions such as the Solar Orbiter and the Jupiter Icy Moons Explorer (JUICE), makes **UK institutions competitive in ESA bidding processes. This effect extends beyond space science**. UK investments in ESA EO missions have resulted in critical technological advancements, notably for the instrumentation suite hosted on the UK-led climate observation and calibration mission TRUTHS. Advancements have also been made in human and robotic exploration and navigation, highlighting the strength of the UK's diverse industrial and academic base.
3. **Downstream exploitation and application development is a key strength for the UK, especially in EO and space weather**, but it is vulnerable to changing political and funding landscapes. Downstream exploitation of data derived from key space missions and programmes is a key benefit of the UK's investments in ESA, offering significant opportunities for the UK space sector to develop value-added services and applications with broader socioeconomic impact.
4. **Despite the UK's strengths in early-stage technology, instrumentation development and downstream data exploitation, its national capacity to manufacture, test and integrate an entire mission is limited**. The small number of industrial primes in the UK essentially restricts its ability to capitalise on these contracts when they arrive. This represents a key opportunity for the UK and underscores the importance of funding space sector investments throughout the development pipeline to enable UK stakeholders to benefit at all levels.

Industrial, reputational, inspirational and socioeconomic benefits

1. **UK involvement in ESA projects, programmes and missions has led to significant gains in industrial and commercial capabilities**. These include skills, behaviours, knowledge, tools, processes and infrastructure that industrial and commercial organisations require to achieve their goals, including growth, market expansion and bringing new technologies to market.
2. **Participation in ESA projects has elevated the UK's global standing within the space sector**, supplemented by specific areas of expertise. The UK holds substantial sway within ESA's governance structures and scientific advisory groups, leveraging its excellence in scientific research to empower UK researchers to significantly influence strategic choices and processes within ESA.
3. The UK has established itself as a **leading ESA member state in publication volume and influence in space science**. The UK's commitment to high standards and integrity in scientific

research has solidified its reputation, which it can leverage for key roles in missions across domains such as EO and space safety, the successful delivery of which further increases the UK's reputation.

4. **ESA programmes are key in enabling public outreach and science, technology, engineering and mathematics (STEM) engagement in the UK**. Several high-profile missions that the UK has contributed to through ESA, including JWST, Herschel, Euclid and Rosetta, have demonstrated space science's power in driving public engagement. Despite these successes, the UK lacks a national STEM engagement strategy to fully capitalise on public interest and excitement generated by space investments.
5. **The benefits of the UK's investments in ESA extend beyond the space sector**. The UK has played a central role in processing and distributing EO data, facilitating its use in climate science, disaster preparedness and environmental management. The availability of high-quality EO data has supported initiatives such as ESA's Climate Change Initiative (CCI), which has been instrumental in developing early warning systems and risk assessment tools for climate-related hazards, including floods, droughts and heatwaves.

The added value of ESA membership

1. **Most of the benefits realised through ESA would not otherwise have been possible**. Most stakeholders felt that they could not have accessed funds to support their projects or not achieved the same goals had the UK not invested in ESA. Participating in ESA also provides stability and consistency, with ESA's structured project management ensuring a general commitment to seeing a mission through to completion once initiated.
2. **ESA's collective funding model allows for the pooling of resources, enabling ambitious projects that might otherwise be financially unviable for single nations.** This model mitigates financial risk, promotes international collaboration and strengthens diplomatic ties among member states. Most stakeholders emphasised that most activities and missions the UK is presently engaged in would be impossible to recreate independently outside of ESA or would not achieve the same scale and complexity without ESA's collective resources and expertise.
3. **Nonetheless, national programmes remain vital for building robust UK capabilities**. This dual approach, leveraging ESA's resources while strengthening national capabilities, ensures that the UK can remain competitive within ESA and beyond. Moreover, the UK's engagement with ESA does not preclude the development of bilateral relationships and the pursuit of international partnerships beyond ESA, such as through the UK Space Agency's newly established Space Science and Exploration Bilateral Programme (SEBP).

Recommendations

1. **The UK's role and influence within ESA:** the UK Space Agency should take a more proactive approach in engaging with other member states to encourage participation in missions and projects representing key UK strategic objectives. The UK should seek to leverage its position as a

world leader in certain fields, such as space weather, and a major contributor to ESA's overall budget to align investments of other member states with its strategic objectives.

2. **Challenges in strategy implementation and clarity:** There is a perceived gap in translating the UK's overarching space strategy into detailed implementation within ESA. By identifying and prioritising specific areas of interest, the UK can align the objectives outlined in the National Space Strategy (NSS) and other key documents with clearly communicated investment decisions.
3. **A need for long-term strategic vision and stability:** A long-term view of ESA strategy is crucial for providing UK industry with clear targets and stability, essential for effective planning and investment. There is a call for more assertive UK industrial policy and structural changes to ensure consistent direction and support for specific technologies or applications, signalling long-term government commitment and allowing industry to align investments with national priorities.
4. **A need for cross-government alignment on space:** Stronger cross-government alignment is needed to maximise the benefits of the UK's ESA membership. Despite various initiatives to promote alignment, such as via a National Space Council, space policy, decision making, procurement and R&D functions are still fragmented and spread across different government departments and agencies, as well as the military UK Space Command. Better alignment on space capability development and strategy is needed to streamline resources and focus on a whole-government approach to achieving domestic goals via ESA. Clarifying the UK Space Agency's role and enhancing its technical capabilities could support efforts to proactively align UK national space interests, work across government departments and agencies, leverage the UK's strengths and address capability gaps.