

Institute of Physics Submission to Sir Adrian Smith's review of future frameworks for international collaboration on research and innovation

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Summary

- The Institute of Physics (IOP) supports efforts to explore and, if necessary, develop alternative funding frameworks should the UK be unable to associate with Horizon Europe. However, it is highly unlikely that a future UK funding framework could replicate the benefits the UK's physics community enjoys by virtue of the UK's membership of European Union funding frameworks. **The IOP's position is that the UK should associate fully with Horizon Europe, seeking the strongest and closest relationship with current and future EU research and innovation programmes.**
- **Engagement with the European Framework Programmes has been of significant benefit to the UK science and innovation community.** They enable ease of collaboration, researcher mobility within the EU, and access to globally recognised and world leading programmes that are an essential component in enabling the UK to meet its ambition of increasing R&D intensity to 2.4% of GDP by 2027. Engagement with Horizon Europe, with its pillars of Open Science (including the European Research Council, Marie Skłodowska-Curie Actions and research infrastructures), Global Challenges and Industrial Competitiveness, and Open Innovation will continue to support UK excellence in science and innovation.
- **Participation in European funding frameworks supports a depth and scale of international collaboration that would be virtually impossible to replicate in isolation.** Horizon 2020 is the biggest multinational research programme in the world with a budget of €80bn and Horizon Europe's budget is expected to exceed €100bn. This investment leads to impact, drives quality and competitiveness. The EU, with 7% of the world's population, is responsible for 24% of global expenditure on research, 32% of high impact publications and 32% of patent applications. Access to these funds, networks and supply-chains has been vital in supporting the dynamism, competitiveness and quality of the UK's science and innovation community.
- **International collaboration is crucial to the success, quality and competitiveness of the UK's research community.** A report by Elsevier found "a sustained upward trend in UK research productivity may be correlated with its continued increase in international research collaboration, an activity that is generally associated with greater citation impact than research co-authored institutionally or nationally, while its national inputs are broadly stable in relative terms."¹ The UK's European partners are central to this collaboration with 13 of the UK's top twenty countries for collaboration on co-authored publications being European Union

¹https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/660855/uk-research-base-international-comparison-2016.pdf

member states.² This is a reflection of the close relationships that have been built as a result of European funding frameworks.

- **Pursuing a UK only framework is likely to bring with it significant costs and would struggle to deliver the wider benefits, such as ease of collaboration, of European funding.** The UK received €1.35bn in research funding from Horizon 2020 programmes in 2016 alone, for example, accounting for around 3.1% of total UK R&D investment. However some fields are more dependent on European funding for example 30–43% of funding for UK space science comes from ERC grants, according to the Science and Technology Facilities Council. Additional costs would include administration, where the UK has benefitted from the economies of scale offered by the Horizon 2020 with the costs shared among Horizon participants. Other wider costs are likely to be incurred as the UK loses access to skills and investment as a result of being outside of European frameworks. The most cost-effective way forward for UK taxpayers is to ensure that the UK continues to retain access to European funding programmes, infrastructure and research staff.
- **Any UK alternative funding framework would need to replicate the structures and benefits of EU funding frameworks, as far as possible.** European frameworks provide long-term, stable and visible funding which are significant in scale and also provide a mature and familiar architecture, both of which help facilitate collaboration. In a scenario where the UK is unable to secure continued access to the EU's research and innovation programmes it will be necessary to put in place alternative domestic frameworks. These alternative frameworks should seek to, as far as possible, replicate the structures and features of EU research and innovation funding. They must also be designed to facilitate collaboration with the EU on a case-by-case basis and secure continued access to European networks and supply-chains.
- **The future of a UK funding framework for international collaboration, research and innovation should not be considered in isolation.** Other important decisions such as immigration reforms will impact the UK's ability to attract talent, innovate, boost productivity and drive competitiveness. For the UK to meet its 2.4% R&D target it will need to attract and retain global businesses and individuals who can provide the expertise, investment and skills needed. The UK's ability to attract and retain global talent will be impacted by the decisions currently being made regarding the future of the UK's immigration system.
- **The impacts on industrial as well as academic research must be taken into consideration.** The ability to access European funding and networks, and participate in supply chains, boosts competitiveness and enhances the attractiveness of UK businesses and subsidiaries to investors. Loss of access to these benefits could have an impact on private R&D investment and so the UK's ability to achieve its 2.4% target: UK technology companies may struggle to attract external investment into R&D projects or may be less able to make a business case for R&D activities due to a loss of access to EU structures, supply chains and markets; within multinational businesses, boards may prefer to undertake R&D activities within the EU rather than UK-based parts of the business. A UK framework would need to address and overcome these challenges.

²https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/801513/International-research-innovation-strategy-single-page.pdf

The structure and funding of an alternative framework

Funding for a new framework should be in addition to the money already committed to research and innovation and help take the UK closer to its 2.4% R&D target. To achieve maximum benefit, any UK-based alternative to the EU Framework Programmes should be a discrete and identifiable programme within the UK's broader science and innovation landscape.

A UK funding framework would need to be designed in a way that ensures it is administered independently and at arm's length from government and set over sufficiently large time horizons so as to provide confidence and stability to researchers and industry. While it makes sense to administer new programmes within the UKRI structure new funding must remain discrete. Channelling additional "replacement funding" through existing schemes and bodies risks undermining the distinct nature, purpose and benefits that European funding frameworks currently deliver.

Long timelines and stable budgets are especially important to the physics community where projects and infrastructure are developed over very long timeframes and as such confidence is needed that funding, and priorities, will remain consistent. A diversity of funding must be available for researchers at different career stages, across a range of disciplines (including multidisciplinary research) and for both challenge and discovery research. Funding rules should not dictate the structure or type of research and instead should be open and flexible to ensure it facilitates the best science and innovation.

While the EU Framework Programmes are implicitly multi-lateral, a future UK funding framework would likely need to rely more heavily on bilateral agreements and partnerships to help facilitate and support collaboration. Priorities (e.g. with whom to partner) should be driven by the science and innovation community's assessment of what is needed, but flexibility is highly desirable. Excellence leads to impact and this principle must be at the heart of any new UK funding programmes. It should be noted that the UK, while a member of European Union research and innovation infrastructures, has not been precluded from pursuing bilateral relationships with third countries. Indeed since 2014, the UK Research Councils have funded 4,254 international research and innovation collaborations totalling £3.3bn. This investment has supported a range of breakthroughs, collaborations and partnerships such as LIGO which saw the UK's participation in a global network of gravitational wave observatories.

A UK funding framework must be designed to facilitate close partnership with Europe researchers, institutions and businesses on a case-by-case basis when the UK's and EU's priorities and interests align. Without this ability to 'plug into' parts of the EU's research and innovation landscape, a key challenge for the UK may arise where the EU commits significant funds and attention to a given priority that the UK has also identified. The UK is unlikely to be able to compete with the EU in terms of funding but nor will it want to abandon a priority research field.

Supporting discovery led research

One of the most beneficial elements of the EU research and innovation funding architecture for the UK scientific and business communities has been the European Research Council (ERC). The programme plays an important role in UK science and innovation, supporting discovery research, generating breakthroughs and supporting scientific advancements and is one of the most important and prestigious forms of discovery funding available to UK researchers.

UK-based researchers received €1.665bn in ERC grants over FP7 2007 – 2013, which was 22.4% of the total budget for the programmes.³ Aside from its size, and the UK's research community's success in winning ERC grants, the ERC is widely regarded as the gold-standard for research fellowships. ERC awards are judged solely on excellence and are highly competitive, driving up standards. More than 70% of ERC projects, independently assessed, made scientific breakthroughs or major advances.⁴ The ERC also offers effective support in developing this research through proof of concept funding. ERC grants also offer support across the various stages of a researcher's career.

If the UK is unable to associate with Horizon Europe it will be necessary to create a similar programme to the ERC. A UK funding framework should, as closely as possible, replicate the ERC in its form and function. The key features that should be replicated are:

- **Excellence:** Applications for ERC funding are judged purely based on excellence. This drives up standards and increases the prestige of ERC grants which act as a globally recognised quality mark. Competition has also driven up standards and a successful UK ERC equivalent must be based on this principle to ensure it funds the highest quality research.
- **Openness:** The ERC is open to the global research community, provided they undertake research within the EU. This further increases competition and drives up standards and acts as an important magnet for the EU to attract research talent.
- **Support at all career levels:** The ERC provides support from the early stages of a career up to advanced grants for established researchers. This ensures the ERC supports a broad range of researchers and generates a sustainable pipeline of researchers for academia and industry.
- **No requirement for matched contributions:** The ERC does not require matched support from a host institution which ensures researchers do not have to deal with additional processes and bureaucracy and ensures greater innovation and flexibility.
- **Secure funding:** The ERC provides a diverse range of grants that are appropriate for a wide variety of researchers and projects. The size and duration of grants within a UK system should therefore also be designed to support a diverse range of research requirements
- **Independent peer review:** The independent and international peer-review process applied to ERC applications ensures ERC funding supports the highest quality research and increases the prestige of ERC grants. The UK might look to explore the option to use the existing ERC review processes to inform UK awards.
- **Autonomy:** The ERC's autonomy enables it to be agile and innovative in its support for blue-skies research. A UK equivalent must operate with significant autonomy.
- **Global leadership:** ERC advanced fellowships give researchers a global profile and place them in an international leadership position within their field. Having globally recognised researchers within the UK who are able to influence research agendas is an important benefit and something the UK should attempt to mirror and retain within a UK funding framework.

Any UK ERC equivalent will be in competition with the ERC. The UK would therefore need to develop an ERC equivalent that is more attractive to researchers, e.g. by providing larger grants and reducing bureaucracy. It should be structured to enable researchers to collaborate with global research projects and individuals, should they deem it necessary.

³ <https://royalsociety.org/topics-policy/projects/uk-research-and-european-union/role-of-EU-in-funding-UK-research/how-much-funding-does-uk-get-in-comparison-with-other-countries/>

⁴ <https://erc.europa.eu/projects-figures/facts-and-figures>

In order to safeguard this new discovery funding it would be important to ring-fence it within the new funding architecture. Funding for such a programme should be distinct and funds should be in addition to existing budgets and safeguarded to prevent budgets being used or converted over time to fund non-discovery research.

Facilitating international collaboration

The Framework Programmes have facilitated unprecedented levels of bilateral and multi-lateral collaborations in science and innovation providing a simple and well-understood route to build relationships between world-leading researchers, organisations and businesses.

The UK is currently able to pursue bilateral cooperation outside the EU on a case-by-case basis, for example the 2017 Memorandum of Understanding between Canada and the UK related to science, technology and innovation. Outside of the EU framework multi-lateral cooperation with EU member states would be significantly more complex.

Where the UK and EU's interests align it makes sense to seek to cooperate with the EU on key priority areas due to the size and scale of the EU's research landscape. As such consideration must be given to how a UK framework would operate alongside and with EU structures and frameworks. The identification of these priority areas must be determined by the needs and preferences of the UK's research and innovation community in a bottom-up process.

In support of efforts to build partnerships and deepen collaboration a UK programme should provide funding for activities such as travel and networking, in order to help remove barriers to cooperation. Similarly in designing a new framework for international cooperation consideration must be given to ways to avoid double jeopardy, where bids are subject to parallel UK and international peer review processes, and also how to ensure the UK is able to flexibly and quickly respond to new opportunities, for example where budgetary envelopes do not align.

The UK must continue to collaborate in European research infrastructure projects which are essential to many scientific fields where the cost and size of necessary infrastructure means collaboration is essential. The costs and risks often associated with large scale infrastructure projects require collaboration and the UK must remain committed to working with partners to develop new research infrastructure which provide valuable scientific discoveries and major breakthroughs. A commitment to funding and participating in international research infrastructures alone is not enough. This must be accompanied by funding to support experiments and researching order to fully exploit our access to research infrastructure.

Industry, innovation and boosting competitiveness

The UK's commitment to grow R&D investment to 2.4% by 2027 will require close collaboration between government, industry and academia – domestically and internationally. The UK has secured around €9.6bn in EC contributions and €2.3bn in contributions from the project partners themselves through EU Framework Programmes for research and innovation, (FP7 and Horizon 2020). Research from Technopolis, for the Royal Society, suggests that R&D expenditure, such as the EU Framework Programmes, has a significant 'crowding-in' effect, encouraging further private investment in R&D outside the programme.⁵ The European Commission has estimated that for every €1 spent on R&D by the European Commission, a further €0.74 will be invested by companies or other

⁵ <https://royalsociety.org/~media/policy/Publications/2017/2017-05-technopolis-role-of-EU-funding-report.PDF>

organisations in the wider EU economy.⁶ Applying this to the UK suggests that the UK unlocked around €16.6bn in research and innovation expenditure as a result of EU framework programmes up to 2017.⁷ This funding is crucial in helping the UK meet its 2.4% R&D target as is the wider support and innovation supported by EU frameworks.

Achieving 2.4% will require an approach that encourages and incentivises more investment from industry, as well as more government spending. A UK funding framework must help deliver this. EU research and innovation programmes provide industry with much more than financial support. They facilitate access to expertise and knowledge and networks; support collaboration; and help integrate supply chains, for example. These benefits must be replicated in any UK funding framework. Future and Emerging Technologies support are important in helping bring forward radical technological innovation in emerging fields, often where multilateral and multidisciplinary collaboration is necessary due to the nascent stage of certain technologies. Access to Innovative Training Networks is another important benefit that helps facilitate collaboration across industry and academia.

Attracting investment from overseas businesses will be crucial to meeting the UK's 2.4% target. Any UK funding framework that creates barriers or obstacles to collaboration and partnership with European programmes, networks and supply-chains could have a detrimental effect on the UK's ability to attract innovative businesses.

UK Industry has been successful in helping shape funding calls emerging from EU funding programmes due to the EU's openness and engagement with industry. The UK's photonics industry has been highly successful in this regard through participation in working groups and boards of stakeholders and close collaboration allows industry and academia to help frame and influence the calls that they need, define priorities and shape areas of focus. Any UK funding framework should replicate these structures.

The SME Instrument has been highly effective in helping smaller businesses and the EU's funding often provides funds at a level appropriate for smaller innovative businesses. Again there are benefits beyond finance that are highly valued by SMEs – access to coaching and advice are a particularly important element and one a UK funding framework should include. The competitiveness of SMEs is also likely to be significantly affected if a UK funding framework creates additional barriers to accessing knowledge networks, supply chains and support.

Discovery research is important for emerging industries in developing the technologies and innovation needed for commercial exploitation. Challenge funding is also important helping focus attention and efforts towards solving a given problem and exploiting opportunities. More attention should be given to supporting enabling technologies than current UK funding allows, particularly where there is a strategic imperative. This can be achieved through longer project timeframes to support the development of enabling technologies. Sensing and autonomous vehicles is a key example where the UK has a strong sensing industry but shorter time horizons often preclude the full exploitation of these strategic capabilities.

Immigration and mobility

The UK is home to world leading science and its successful science and innovation sectors depend on access to global talent. In 2016-17, 30% of all academic staff (61,580) came from outside the UK, rising to 33% of academic staff in STEM subjects. The proportions are even

⁶ <https://royalsociety.org/~media/policy/Publications/2017/2017-05-technopolis-role-of-EU-funding-report.PDF>

⁷ <https://royalsociety.org/~media/policy/Publications/2017/2017-05-technopolis-role-of-EU-funding-report.PDF>

higher for those on research-only contracts, with 48% staff from outside the UK, including 66% of mathematics staff.⁸ More than 13,000 scientists and engineers came from outside the European Union to work in the UK in 2014/15.⁹ These individuals bring new ways of thinking and different approaches that are valued by employers, supporting UK academic and industrial research and innovation.

A study by Rand Europe on the international mobility of researchers found that, in the UK, the proportion of researchers and doctoral candidates who are from outside the UK is rising. The study also suggested that mobility is associated with better international networks, more research outputs, higher-quality outputs and, for most, better career outcomes. Overall early career researchers prioritise availability of funding, positions and opportunities for career progression while more senior researchers place more value on research autonomy and personal life.¹⁰

Immigration reforms must set out plans to create an immigration system that allows the UK to attract and retain highly skilled people from the global talent pool. This system must be functional and welcoming to researchers of all levels of seniority; and must allow employers to select the best person for a specific role, regardless of where they come from. It must work for the talent of the future, as well as those whose careers are more established, and be favourable for international students.

A UK funding framework must be open to international applicants, who are willing to locate to the UK to undertake their research activities, this will help drive up competition, which helps improve standards and drive progress forward, build links and raise the profile and recognition of UK awards.

If the UK is able to attract talent using its international research and innovation programmes it would be a missed opportunity if efforts are not made to retain talent after completion of funded research activity. There should be a clear and simple route to remaining in the UK after the conclusion of funded research activity.

A UK funding framework must also support wider research mobility including supporting UK researchers to travel abroad for a period of time. The Marie Skłodowska-Curie Actions are a crucial route for researchers to move abroad for a period of time to develop new skills, build relationships and collaborate. Funding should also be in place to support academics in traveling abroad for short periods of time to, for example, attend meetings, conferences and conduct research.

About the IOP

The Institute of Physics is a leading scientific membership society working to advance physics for the benefit of all. We have a worldwide membership from enthusiastic amateurs to those at the top of their fields in academia, business, education and government. Our purpose is to gather, inspire, guide, represent and celebrate all who share a passion for physics. And, in our role as a charity, we're here to ensure that physics delivers on its exceptional potential to benefit society. Alongside professional support for our members, we engage with policymakers and the public to increase awareness and understanding of the value that physics holds for all of us. Our subsidiary company, IOP Publishing, is a world

⁸ <http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/science-and-technology-committee/an-immigration-system-that-works-for-science-and-innovation/written/84224.pdf>

⁹ <http://www.sciencecampaign.org.uk/asset/F50CF4C1-93C7-4F38-89E55D6BDBB70ED6/>

¹⁰ https://www.rand.org/content/dam/rand/pubs/research_reports/RR1900/RR1991/RAND_RR1991z1.pdf

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