

The role of European Union membership in UK science and engineering research



€8.8bn

of EU funding was allocated to UK research, development and innovation between 2007 and 2013.

50%

of the increase in funding for research in UK universities between 2007/08 and 2013/14 can be attributed to EU government sources.

“EU membership gives access to skills and expertise, to data, industry links and collaborations. Together we are stronger and so is the UK research base.”

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About EPC

The Engineering Professors' Council (EPC) has as its mission the promotion of excellence in engineering higher education research and teaching in the UK. We have over 6,500 members in virtually all of the UK universities that offer engineering programmes and are led by an elected Committee of the membership's professors and senior leaders.

First-class research is critical to innovation and industry in the UK, with a skilled workforce and a strong research base being considered vital for the UK's future prosperity. Investment in UK science and engineering creates a virtuous cycle, leveraging investment from industry¹, raising productivity², and creating more high-value jobs³. Science and engineering are also essential in producing more effective medicines, cleaner energy, generating new technologies, and tackling the major challenges facing our society now, and in generations to come.

The role of EU membership in UK science and engineering research is consequently not simply a question of importance to the UK science base, but to the UK public. As one piece in a wider puzzle, this report seeks to inform the current debate around the question of UK membership of the EU, by examining the role of EU membership in UK science and engineering research.

In addition to investigating the scale and scope of EU research funding, we conducted a survey to capture the views and experiences of over 400 researchers. Their responses were overwhelmingly positive, with 93% agreeing that EU membership is a major benefit to UK science and engineering. The report also showcases exciting examples of engineering research that illustrate the role that the EU plays in UK research through providing funding, and facilitating international and industry collaboration.

It is clear that EU membership interacts with UK science and engineering in a number of ways that are beyond the scope of this report. For example, EU regulation and legislation are significant factors influencing the UK research environment and policy more generally. Therefore, these are an important part of the overall context when considering the role of EU membership in UK science and engineering research.

Summary

- The UK receives a significant amount of money (€8.8bn between 2007 and 2013) from the EU for research, development and innovation.
- Some regions of the UK are more dependent than others on EU funding in maintaining research capacity and infrastructure, and as a result could suffer disproportionate adverse impacts if this source was withdrawn.
- The ability to attract academic staff to the UK through free movement of labour is important, particularly in science and engineering.
- The role and benefits of EU membership to UK research is considered by researchers to be broader than just the funding for research that EU projects bring to the UK. The improvement in quality, reach and impact, facilitated by EU collaboration and coordination, helps to solve “Grand Challenge” problems in a way that would be much harder for any one country to achieve alone.

The UK produces world leading science and engineering research^{4,5}

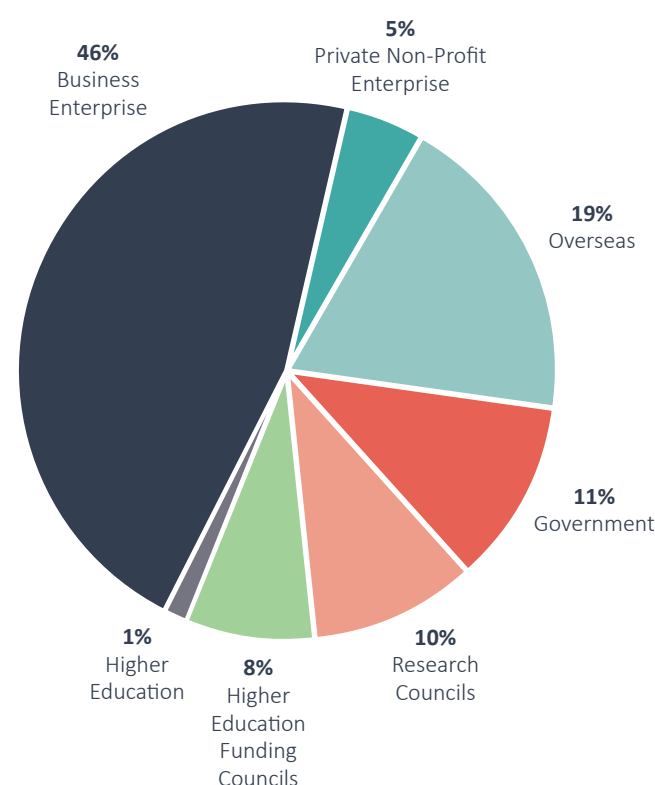
Despite the UK having a hugely productive research base the UK government is investing in science at a lower rate than the majority of the EU and OECD countries⁶. In 2013, the expenditure on research and development (GERD) performed in the UK was £29bn⁷ (Figure 1).

EU funding contributed €8.8bn to UK research, development and innovation between 2007 and 2013

Between 2007 and 2013, the UK received €48bn⁸ from the EU, of this, €8.8bn⁹ was for research, development and innovation. Over the same period, the UK contribution to the EU was €78bn⁸, of which €5.4bn¹⁰ was specified as being for the EU'S Research and Development (R&D) budget. The UK is a net contributor to the EU overall, but it is a net reciever of EU funding for research. €6.9bn of this research funding was through Framework Programme Funding (FP7)¹¹, and €1.9bn through European Structural and Investment Funds¹² (this includes the European Regional Development Fund and European Structural Funds; see Box 1 for further details on EU funding for research).

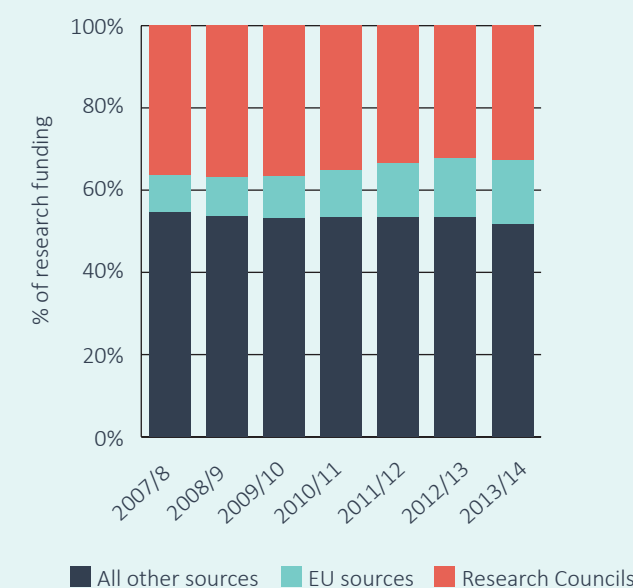
Many therefore say the UK does extremely well in attracting EU research funding. Certainly, the UK does better than it should considering what its fair share would be based on the ratio of its Gross Domestic Product (GDP) to the aggregate GDP of the EU¹³ as a whole. However, the UK still attracts less funding than that implied by measures of research excellence, such as Field Weighted Citation Impact.

Figure 1. Funding sources for research and development performed in the UK (GERD) in 2013 (expenditure totalling £29bn)



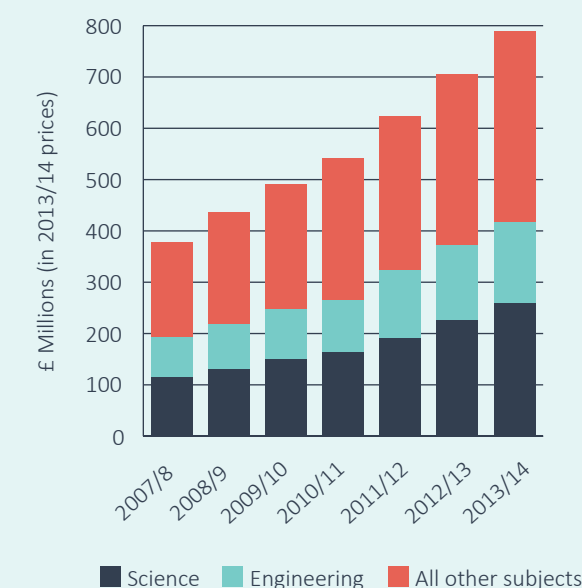
Source. Office for National Statistics, UK Gross Domestic Expenditure on Research and Development.

Figure 2. The proportion of research funding income to UK HEIs from different sources



Source: EPC-CaSE analysis of data drawn from the Higher Education Database for Institutions (HEIDI). The funding for research from Research Grants and Contracts and HEFCs is included in this. EU sources include that from government, industry and charity.

Figure 3. The research grants and contracts income to UK HEIs from EU sources for different disciplines



Higher Education Institutions (HEIs) are a focal point for excellent research in the UK

The university sector is a major asset to the UK, not least because it contributes over £73bn annually to the UK economy¹⁴. UK HEIs conduct high quality research; with the Research Excellence Framework (REF) in 2014¹⁵ reporting that 76% of all submissions were 'world-leading' or 'internationally excellent'.

Just over a quarter (26%¹⁶) of UK expenditure on R&D is in the higher education sector, with business R&D making up the majority of the rest. In 2013/14, the total spend on research across all subjects in UK HEIs was £7bn. This included £5.1bn from research grants and contracts from UK, EU and international sources, and £1.9bn contributed through the HEFCs¹⁷. See Box 2 for further information on funding for research in UK HEIs.

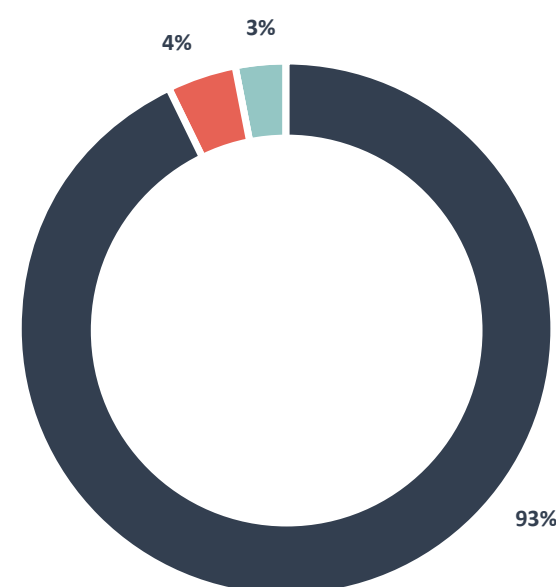
EU funding is of increasing importance to UK research

Overseas sources of funding for research in UK HEIs are significant, in particular those from the EU. In real terms, the funding from EU government sources more than doubled between 2007/08 and 2013/14 (Figure 2), while over the same time period UK Research Council funding increased by 7%, and recurrent research funding (allocated through the Higher Education Funding Councils (HEFCs)) declined by 2.2%. EU government sources of funding are therefore increasingly important to UK research, making up 10% of income in HEIs in 2013/14. Specifically, disciplines within science and engineering together attract over half (53%) of all research grants and contracts income from EU sources (Figure 3).

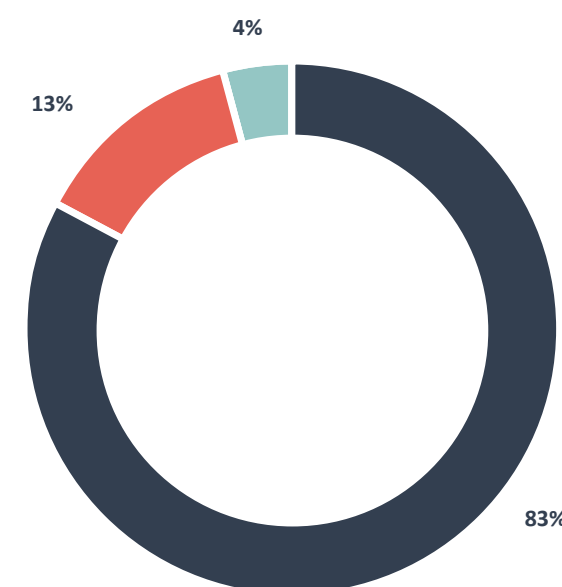
The figures indicating the importance of EU funding for UK research are borne out by the views of the research community (Figure 4). In our survey of UK researchers, EU funding was identified as being of increasing importance to UK science and engineering research. EU membership was considered to benefit the UK research environment and to fill a gap where funding for research may not otherwise be available.

Figure 4. Researchers' views on the benefit and importance of EU membership and funding to UK research

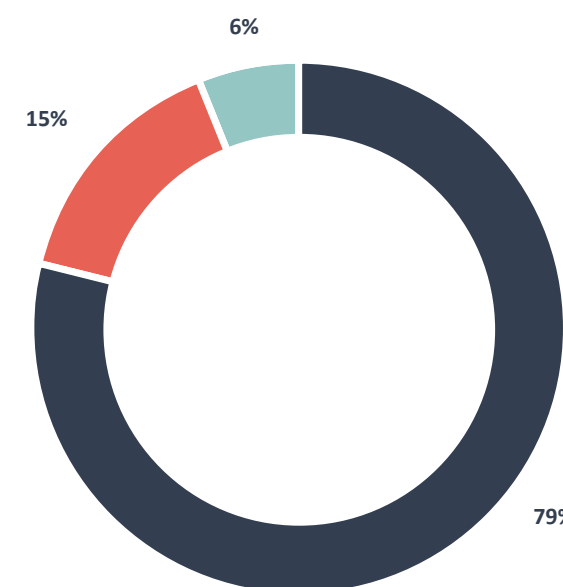
Source: Survey undertaken October, 2015 by CaSE and the EPC. 403 respondents from UK HEIs and industry.



- EU membership is a major benefit to UK science and engineering
- Neither agree nor disagree
- EU membership is a hindrance



- The importance of EU funding for UK science and engineering research has increased
- The importance of EU funding for UK science and engineering research has stayed the same
- The importance of EU funding for UK science and engineering research has decreased
- EU funding fills a gap where other funding isn't available



- EU funding fills a gap where other funding isn't available
- Neither agree nor disagree
- Disagree

Box 1. EU funding of research in Higher Education Institutions

The UK receives R & D investment from the EU through various routes, including:

- Framework Programmes: the current programme is Horizon 2020. The previous programme which ran from 2007 to 2013 was the 7th Framework Programme for Research and Technological Development (FP7). This includes European Research Council (ERC) grants which are allocated to individual researchers on a competitive basis through a peer review process which focuses on excellence. Also included in these Programmes are Marie Skłodowska-Curie Actions which support research training and career development, focusing on innovation skills. These include grants for all stages of a researcher's career, from PhD candidates, to highly experienced researchers, and encourage transnational, intersectoral and interdisciplinary mobility.
- European Structural and Investment Funds: this includes five funds, of these the most relevant to the UK research environment are the European Regional Development Fund (ERDF), and the European Social Fund (ESF). These funds address regional development and economic change and aim to enhance competitiveness and territorial co-operation throughout the EU; this includes providing substantial support for research and innovation. The level of funding and the types of projects that are funded differ from one region to another.
- Sectoral research and innovation programmes: programmes focusing on space and nuclear energy and coal and steel production.

Box 2. UK funding of research in Higher Education Institutions

UK government funding for science and engineering research in HEIs is largely administered through a dual funding system:

- The resource and capital budget for research which is largely allocated through the seven UK Department for Business, Innovation and Skills (BIS) administered Research Councils through research grants.
- The Higher Education Funding Councils for England^a, Scotland and Wales, and the Department for Employment and Learning (Northern Ireland) allocate 'recurrent funding' for teaching and research to HEIs. The main research funding method allocates 'mainstream quality-related research' (QR) funding based on research quality, and taking into account the volume and relative cost of research in different subject areas. QR funding provides the flexibility

and financial stability needed for making a long-term commitment to curiosity-driven research, and emerging research areas informed by institutional priorities.

Research grants and contracts (including EU funding) and the Higher Education Funding Councils make up 36% of total funding to HEIs^b. UK HEIs are particularly successful in winning EU funding receiving 71% of the UK's total FP7 funding^c.

- a In England quality related research will be delivered through a different funding body, as yet unknown
- b EPC-CaSE analysis of data drawn from the Higher Education Database for Institutions (HEIDI)
- c Seventh FP7 Monitoring Report, 2013

A look at EU funding in different disciplines

Changes to UK and EU investment are not uniform across disciplines. Variations in UK and EU research priorities over time, as well as shifting areas of UK research strength, are contributing factors to this. In the following section, we look more specifically at the disciplines of science and engineering.

Figure 5. Source of research grants and contracts funding for engineering in HEIs

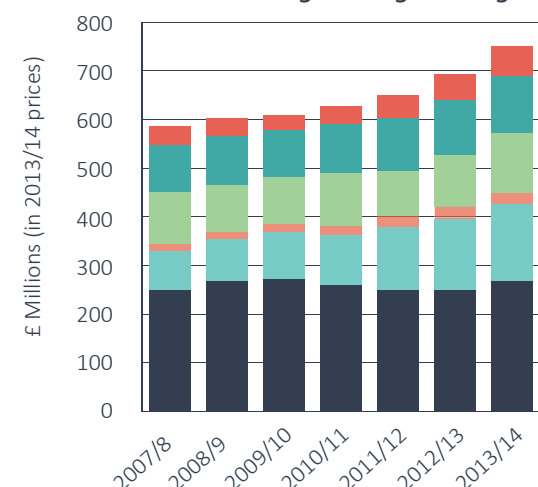
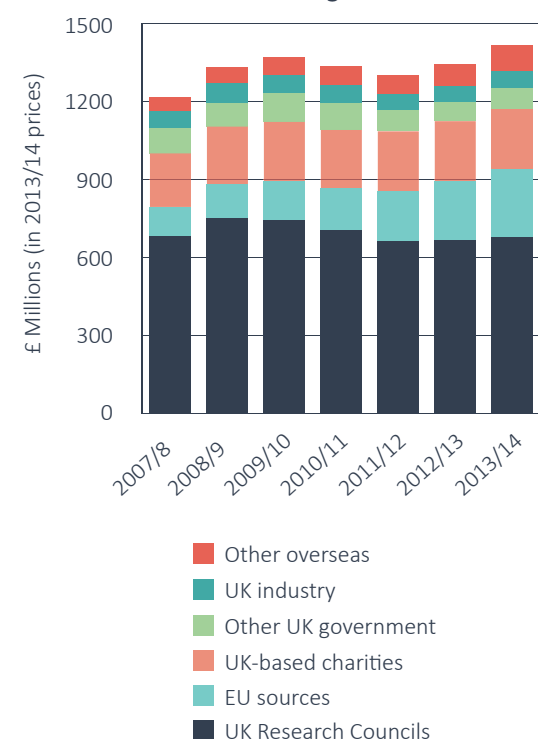


Figure 6. Source of research grants and contracts funding for science in HEIs



Source: EPC-CaSE analysis of data drawn from the Higher Education Database for Institutions (HEIDI), HEFCs funding is not included in this analysis.

Funding for engineering research in UK HEIs

Engineering received 15% of all research grants and contracts¹⁸ to UK HEIs, but 20% of the funding from EU sources, in 2013/14. The income to HEIs through research grants and contracts for engineering research (Figure 5) increased by 22% between 2007/08 and 2013/14. Nearly half (48%) of the increase in income for engineering research can be attributed to EU sources (Figure 7), the great majority of this being from EU government bodies (43%). In real terms, the amount of EU government funding for engineering in HEIs has doubled over this time, reaching £139m, and now represents 19% of total engineering research grant and contract funding. On the other hand, UK Research Council funding represents a declining proportion of the total funding for engineering research in the UK.

Engineering also receives a relatively large proportion of its income from UK industry (16%); when compared across all subjects the proportion of income from UK industry is only around a third of this (6%). EU industry funding represents 1.5% of the total funding in 2013/14 and only 1.1% across all subjects, indicating the importance of industry collaboration and links to engineering research.

Funding for science research in UK HEIs

The total spend on science¹⁹ research in HEIs in 2013/14 from all research grants and contracts (Figure 6) was £1416m (46% of this was in the Biosciences). Therefore, just under a third (28%) of the total amount spent on research grants and contracts in HEIs was spent on science. The total spend on science research in the UK has overall increased between 2007/08 and

Figure 7. Contributions to the increase (£164.1m) in engineering research grants and contracts income to UK HEIs 2007/8 - 2013/14

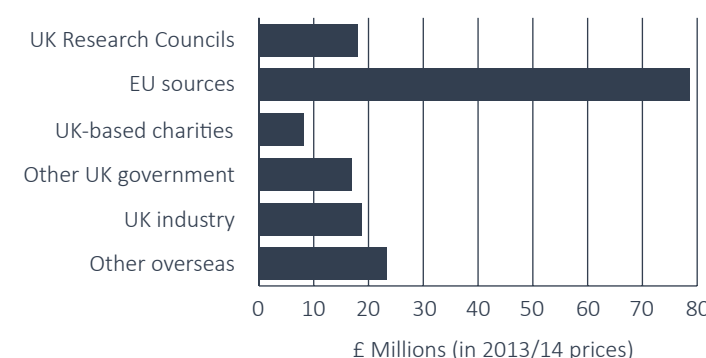
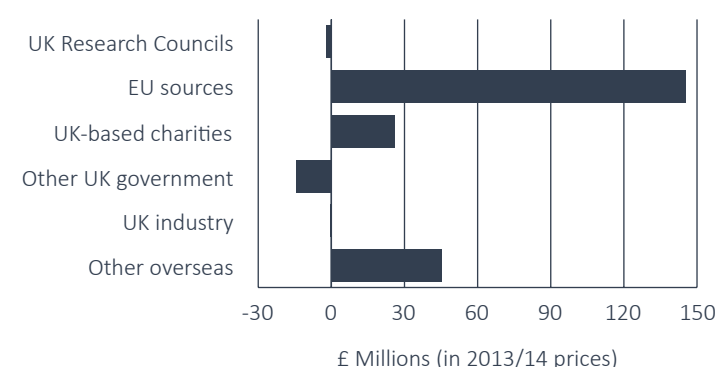


Figure 8. Contributions to the increase (£200.1m) in science research grants and contracts income to UK HEIs 2007/8 - 2013/14



Source: EPC-CaSE analysis of data drawn from the Higher Education Database for Institutions (HEIDI). EU sources includes that from government, industry and charity.

2013/14, although the increase has not been steady over this period.

The UK Research Councils alone in 2013/14 contributed nearly half (48%) of the funding to science, this has decreased from 56% in 2007/08. In real terms the contribution of UK Research Councils to science research funding has decreased by £2m between 2007/08 and 2013/14 (Figure 8). The amount of funding from UK central government bodies has also decreased in this period by £14m. EU government bodies in 2013/14 contributed 17% of the total research grants and contracts income for science in HEIs, increasing from 8% in 2007/2008. Nearly three quarters (73%) of the increase in funding between 2007/08 and 2013/14 can be attributed to EU sources.

Our analysis shows that in a period of static or reducing funding from other sources in the UK, EU investment has become an increasingly important source of income.

£267m

allocated to HEIs for engineering by Research Councils in the UK in 2013/14

£157m

allocated to HEIs from all EU sources for engineering in 2013/14

48%

of the increase in funding for engineering between 2007/8 and 2013/14 can be attributed to EU sources

£678m

allocated to HEIs for science by Research Councils in the UK in 2013/14

£260m

allocated to HEIs from all EU sources for science in 2013/14

73%

of the increase in funding for science between 2007/8 and 2013/14 can be attributed to EU sources

EU funding in HEIs has an impact on a national, but also a regional level

Research capacity and funding for research in HEIs varies across the UK (Figure 9). At the total level, funding for research in HEIs is concentrated in London (£1850m) and Yorkshire and the Humber (£812m). When the concentration of the various component sources of the funding are examined, the dependencies in each region can be seen to differ. The region receiving the most UK Research Council and HEFCs recurrent research funding is London (£900m), followed by the West Midlands (£411m), Wales (£381m) and Yorkshire and the Humber (£371m). For EU funding the pattern is similar; with London receiving (£176m), followed by Yorkshire and the Humber (£80m) and Wales (£79m).

However, when looking at the relative importance of each source of funding to a region, the picture looks quite different. The regions with greatest dependence on UK Research Council and HEFCs recurrent research funding are the East Midlands (65%) and the West Midlands (59%), the South West (59%) and Scotland (58%). Those with the greatest dependence on EU government funding are the South West (12%) and North West (11%), Scotland (11%) and Wales (10%).

There are also variations in regional reliance on EU funding by discipline, highlighting the complexity of the relationship between regions and research investment. For instance, for engineering research, the region with the greatest dependency on EU government funding is Wales (27%), followed by the North East (19%). When industry investment is considered, the East (2.3%) and the North West (2.4%), receive a greater proportion of their funding from EU industry when compared with other UK regions. The East also receives a high proportion of funding from UK industry (17%).

Evidence shows that public investment in R&D 'crowds in' private investment²⁰ and this seems

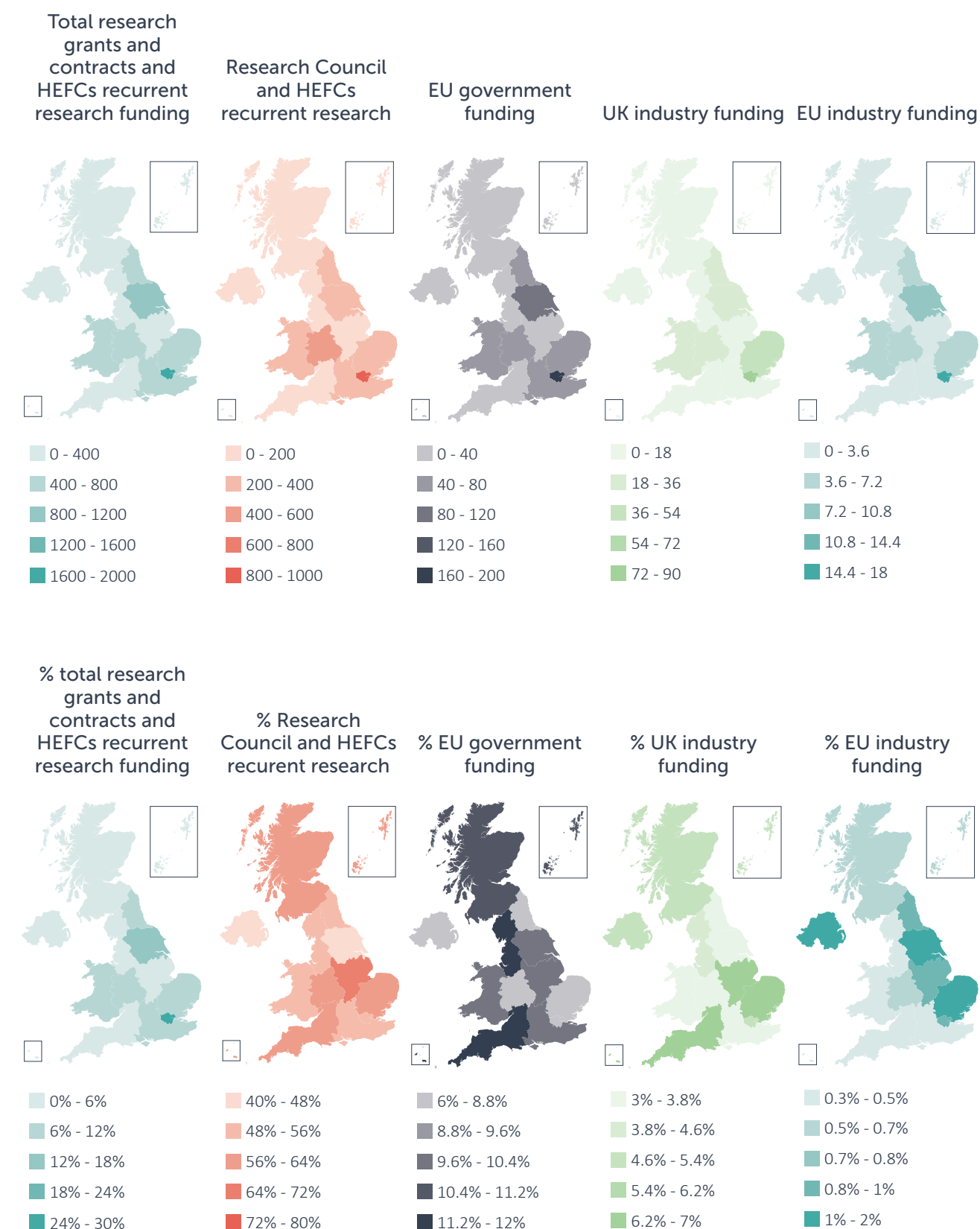
to be underlined by this regional analysis of EU funding; regions that receive a greater proportion of funding from the EU government also attract a greater proportion of EU industry investment. However, there are exceptions, with Wales receiving a large proportion of its funding for engineering from EU government bodies but a relatively small proportion from EU industry. This is likely to be due to the focus and priorities of the various sources of EU funding available, impacting on the way money is allocated to UK regions. All regions of the UK have received funding from the EU, with some EU funding being geared to support capacity building. As a consequence, Cornwall, parts of Wales, and the Scottish Highlands in particular have previously received significant funding as 'Less Developed Regions'²¹.

When considering regional differences, the different characteristics of the regions must be considered, for example, the density and size of the population, the scale of the research base and the concentration of industry. For example, Wales and London have, per person, the same level of EU government investment for engineering, despite the disparity in the headline figures.

Any changes or restrictions to UK access to EU funding would therefore disproportionately affect certain UK regions, with consequential impacts on the industries and businesses based there.

R&D performed by businesses in the UK (including EU investment) is a large proportion of the total R&D investment in the UK. This expenditure has a slightly different regional profile²² to that of HEIs, due to the distribution of industries across the UK. The South East, East and North West have the highest industry R&D investment, delivered through business.

Figure 9. Regional allocations of funding for research (across all subjects) in HEIs in 2013/14. The amount (£ Millions; top row) and the relative amount (%; bottom row) each funding source represents of the total funding for the region is indicated.



Source: EPC-CaSE analysis of data on research grants and contracts received by UK HEIs drawn from the Higher Education Database for Institutions (HEIDI) data and recurrent research funding data from the HEFCs.

How researchers view EU membership

In our survey, 93% of respondents agreed that EU membership is beneficial to UK science and engineering research. However, the importance of EU research programmes goes far beyond the funding.

EU funding influences the impact, reach and quality of UK science and engineering research

Researchers strongly agreed that the reach of research outputs is increased through EU membership (Figure 10) - an interesting perspective in a UK funding and policy context that has an increasing focus on effectiveness and impact. Critically, our survey respondents considered that the EU brings a longer term perspective to research, allowing major projects addressing complex questions to be supported, and providing a strong platform to enable strategic and mutually beneficial relationships with industry and charity partners to develop.

EU membership supports and maintains collaboration

Collaboration is essential to research, it allows sharing of expertise and equipment, facilitates cross-disciplinary work, enables complex global challenges to be addressed and increases the capability of researchers to commercialise innovations²³. A remarkably high proportion of respondents (95%) agreed that EU funding supports and maintains academic collaborations (Figure 11). This is important for UK research performance as international collaboration and researcher mobility have been found to be correlated with high research quality^{24,25}. Around half of UK publications are co-authored with international collaborators, and such papers are on average more scientifically-significant, receiving a greater number of citations by other authors²⁶.

Supporting universities in collaborating with industry and commercialising research is a focus of the current government²⁷, and two thirds of survey respondents (66%) said that EU membership supports new industry

collaborations. The UK has been ranked among the top five countries in the world on university-industry collaboration in R&D for the past four years²⁸, and our survey suggests that EU funding plays a role in supporting this.

Respondents to our survey highlighted that the EU supports cross-border collaboration by enabling access to specialist equipment and large international research facilities, and by facilitating the exchange of skills and knowledge between researchers. Over three quarters (76%) of respondents to the survey agreed that EU membership facilitated access to specialist skills, and 68% said it facilitated access to specialist equipment (Figure 12).

The strong agreement from survey respondents that the EU supports collaboration is matched by data showing that the UK collaborated with 120 different countries²⁹ through FP7 grants. The top collaborative links for the UK were with Germany, France, Italy, Spain and the Netherlands. The number of collaborators in EU funded projects, from countries outside Europe and the Associated Countries, is growing. The USA, Russia, China, Brazil and India were the biggest participants of this type in FP7³⁰.

The EU funding system offers a framework in which collaborations can be supported. It provides a single system for funding applications to be made and a network through which to find and identify new partners. This can provide simplicity and efficiency above what is provided by national systems. This support is valued despite criticisms being made by some researchers of the bureaucracy involved in the reporting requirements of EU grants.

Figure 10. Benefits EU membership brings to UK research

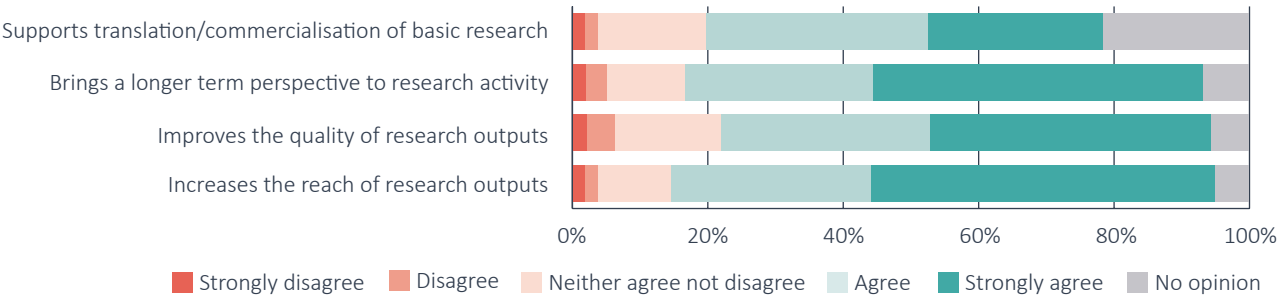


Figure 11. Role of EU membership in enabling collaboration with academia and industry

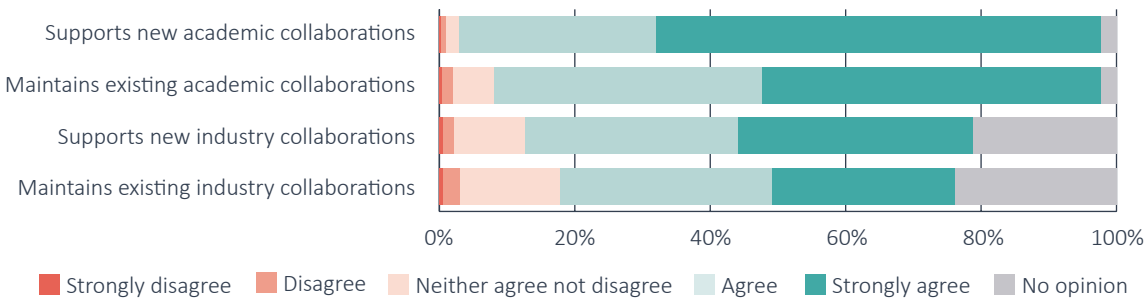
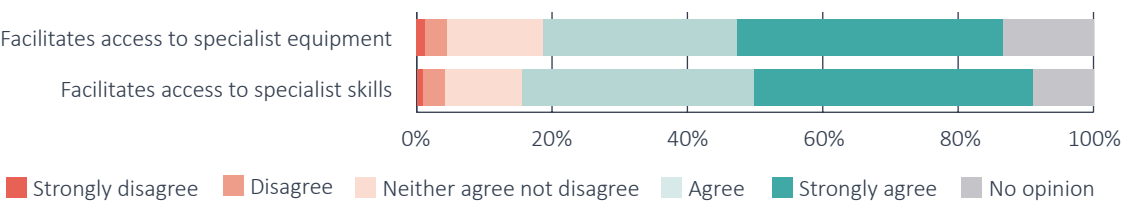


Figure 12. Role of EU membership in facilitating access to skills and equipment



Source: Survey undertaken October, 2015 by CaSE and the EPC. 403 respondents from UK HEIs and industry

As a member of the EU, the UK, as well as receiving funding for research, is able to influence the policy and decision making around EU research funding systems, including the priorities and thematic areas for research funding. There are some countries that have specific agreements in place, for example Norway, which is an Associated Country in Horizon 2020,^{31,32} that enable them to also have a voice in agenda or strategy setting. However, for the majority of non-member countries this is not the case.

EU membership enables researcher mobility

The ability of the UK to attract the best researchers in a field is critical to the maintenance of a solid UK research base. Specific EU projects encourage the international mobility of researchers and the UK is successful in obtaining these. For example, 3,454 researchers located in Britain were funded through Marie Curie Actions (see Box 2) between 2007 and 2014; transnational, intersectoral and interdisciplinary mobility

is encouraged through these actions. These can often be important building blocks in researchers' career development and facilitate the sharing of knowledge across international and sectoral boundaries.

Research is an international endeavour and academics from across the world undertake research in UK universities. Across all subjects a quarter (26.5%) of academic staff in UK HEIs are of non-UK nationality. In science and engineering disciplines, the academic researcher population is even more international than in other subjects (Figure 13). Engineering has a greater proportion of non-EU academics (20% compared with 9% across other subjects) and science has a greater proportion of non-UK EU staff (21% compared with 13% across other subjects).

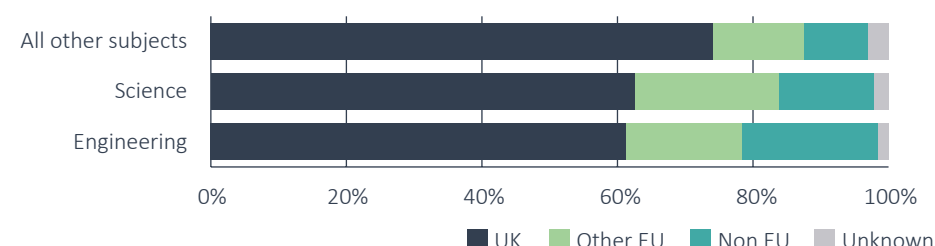
The number of non-UK EU nationals and international academic staff at UK HEIs has increased by 13% between 2007/08 and 2013/14. Over this time the number of non-UK EU nationals has doubled but the number of UK nationality staff has only increased by 3%.

EU funding supports academics in UK HEIs

A significant number of academic jobs in the UK depend in part on EU funding. In 2013/14 across all subjects over 5,000 Full Time Equivalent (FTE) academics relied on EU funding for part of their basic salary³³. 8.5% of academic staff on fixed term contracts were funded by EU government bodies, and 2.1% by other EU sources (including EU industry). A great proportion of academics with permanent contracts received their entire basic salary from the university (85%). In comparison, a smaller proportion of those on fixed term contracts are fully funded by the university (44%).

The proportion of academic staff funded through EU sources tends to differ depending on the discipline. For example, in engineering, EU funding appears to be particularly important as 18% of FTE engineering academic staff on fixed term contracts were funded by EU government sources and 4% by other EU sources. When permanent contracts are considered, the same is true, with 4% of engineering FTE academic staff being funded through EU government sources compared with only 1.2% across all subjects.

Figure 13. Proportion of academic staff by nationality and by discipline in UK HEIs in 2013/14



Source: EPC-CaSE analysis of data drawn from the Higher Education Database for Institutions (HEIDI).

93%
of researchers asked agreed that EU membership is beneficial to UK science and engineering research

95%
of researchers asked agreed that EU membership supports and maintains academic collaborations

76%
of researchers asked agreed that EU membership facilitated access to specialist skills

Stories of EU funding in practice

The numbers tell their own story but to illustrate the role EU funded projects play in the UK research environment a number of case studies from across the engineering disciplines were collected. These range from projects tackling touch screen technology, to detecting landmines and improving border security. These examples are a small sample demonstrating the range of benefits EU funding and collaboration can bring to the UK research environment, and the UK more broadly.

Improving border security through facial recognition

3D FACE: 2006-2009, €11m, 15 partners from 7 countries

PIDaaS: 2014-2016, 9 partners from 6 countries

Key benefits projects provided: Enabling continued collaboration of UK researchers with EU partners, Addressing cross-border questions, Providing a network for researchers

The Intelligent Interactions group at the **University of Kent**, whose research includes addressing issues around security and biometrics, has a long standing history of involvement in both EU and UK funded projects. Both funding sources have been interdependent, and critical, to their on-going research and have allowed collaborations to develop with researchers from other institutions over time. The University of Kent was a partner in the 'BioSecure' FP6 Network of Excellence which lasted from 2004 to 2007 and included 30 core partners across the EU. 'BioSecure' addressed a range of scientific and technical challenges around biometric technologies, as well as international standardisation and regulatory questions.

The University of Kent and other partners of BioSecure have continued to collaborate through EU funded projects to address cross-border issues including '3DFACE' on face recognition technology in self-service border controls, and 'PIDaaS', which aims to create a secure authentication system for mobile devices

through digital fingerprint scanning, and voice and face recognition. As well as providing a joined up route to funding collaborative projects in biometrics, the links between researchers through EU funding routes have provided a useful network for early career researchers and have enhanced technology transfer to industry.

Detecting landmines and remotely exploring other planets

SWIPE: 2013-2015, €2m, 5 partners from 5 countries

D-BOX: 2013-2016, €9.9m, 21 partners from 11 countries

Key benefits projects provided: Enabling expertise to be applied to different disciplines through industry partners, Ensuring continued collaboration with partners, Funding research in a field for which UK funding is limited

The **University of Leicester** has been involved in several EU funded projects which have allowed their research in how to process data from multiple sensors to be used in different applications. This has been made possible through association with different industrial partners. 'SWIPE' investigated how to remotely collect information from other planets by dropping small wireless sensor nodes from a satellite onto the surface of the planet. 'D-BOX' then applied the University of Leicester's expertise to automatically detect landmines in minefields and mine-suspected zones, safeguarding those helping to remove landmines as well as protecting local populations.

Throughout these projects there have been strong industry links for the university, particularly with Airbus Defence and Space, who coordinated 'D-BOX' and were a partner in 'SWIPE', this has allowed the University to successfully apply for other funding in conjunction with Airbus Defence and Space, including from the European Space Agency. The EU funded projects have also enabled masters and PhD students to get involved in applied research. The UK funding streams have not tended to focus on space as a research area and so this gap in funding has been filled in part by the EU funding systems.

Utilising different funding sources to maximise impact in photonics research

Aston Institute of Photonics Technologies
Key benefits funding provided: Enhancing industry links and technology transfer, Increasing collaboration

The Aston Institute for Photonic Technologies (AIP), at **Aston University**, pursues cutting edge technology relating to high-capacity optical communication systems, lasers and fibre-based optical devices for various sensing applications. Their work spans basic science and engineering through to the creation of prototype devices and system demonstrators. AIP cultivates an environment where academics and engineers work side-by-side on the most challenging, high-impact research, solving industrial problems and developing new technologies.

Over the last 5 years, AIP was successful in winning research and industrial grants of more than £18.4m, with around half coming from European grants. Where EU funding is concerned, the more fundamental work at the Institute tends to be supported by the European Research Council. For example, an ERC Advanced Investigator Grant supported research into ultra-long fibre lasers and led to development of fundamentally new concepts for telecommunications and laser applications. EU funding is also regularly used to exploit a particular line of research by enabling collaboration with appropriate industrial partners (i.e. The Integrated Project, 'DISCUS',

which is working with fibre optic and wireless communication technologies to design the internet networks of the future).

Over £500,000 of ERDF funding has enabled the institute to promote the use of photonic technologies to over 100 SMEs in Birmingham and the West Midlands, by offering free consultancy and business support. This has helped to raise awareness in these local businesses of how photonics can fundamentally change their existing technologies and has helped these businesses to grow.

The Institute has seen great benefit from participation in over 20 Marie Skłodowska-Curie Actions, and other European exchange schemes. These schemes have enabled the brightest young researchers from around the world to work at AIP, bringing with them new knowledge and skills, enhancing AIP activities in fields of high industrial relevance, and establishing new international research and industrial collaborations.

Enabling industry to adopt new microscopy techniques

Plymouth Electron Microscopy Centre (PEMC): 2010-2015, £579,960 of ERDF funding for the £1.3m project

Key benefits funding provided: Enabling links between industry and academia, Facilitating technology transfer to industry

Plymouth Electron Microscopy Centre (PEMC) is a collaboration between **Plymouth University** and JEOL UK (a supplier of electron microscopes) creating a world-class centre for materials characterisation and analysis in the **south west** of the UK.

Electron microscopy allows for accurate and precise analysis of natural and synthetic materials and is a key technology for businesses operating across a wide range of sectors, including advanced engineering and manufacturing, aerospace, biomedical, marine and food. Despite being a relatively mature technology, electron microscopy is generally only used by larger firms, due to the cost and complexity of the instrumentation.

Thanks to funding received through the European Regional Development Fund (ERDF) PEMC has been able to provide 121 companies with 12 hours of free technical support in analysis and imaging. This initiative has opened the technology up to a whole new market previously unaware of the business benefits it can offer. The interactions have, for example, allowed businesses to streamline production processes, improve quality control, identify the cause of contamination and failures and compare materials, increasing productivity and lowering costs.

Specifically resulting from these interactions are two Knowledge Transfer Partnerships (KTPs) which have been established between Plymouth University and local companies, Langage Farm and New Generation BioGas. After receiving PEMC's support, Langage Farm has been able to make significant improvements in the production of its soft cheese product and now sell it to a major supermarket.

Next generation touch screen displays

PROTOTOUCH: a Marie-Curie Action, Initial Training Network, 2013-2017, €4m, 10 partners from 7 countries

Key benefits project provides: Facilitating complex multidisciplinary research, Training the next generation of interdisciplinary researchers

The aim of PROTOTOUCH, a project coordinated by the **University of Birmingham**, is to develop next generation touch screen displays which, for example, would have buttons which would press and release like those on a real keyboard. Additional tactile feedback from a touch screen device would considerably enhance ease of use and user experience.

However, the development of these technologies presents a huge challenge for researchers, particularly given the practical constraints of such devices, including cost, power and size. Therefore, PROTOTOUCH brings together an inter-disciplinary, cross-nation, network of experts in tactile displays, computer simulation, cognitive and neural

science, psychophysics, information processing, materials science and medical rehabilitation to address these challenges.

Critically, PROTOTOUCH will provide training for eleven Early Stage Researchers and four Experienced Researchers. Due to the format of this EU funded project the new cohort of researchers will be able to adopt new approaches to overcome the challenges of designing next generation touch screen devices. The researchers will be trained to have the appropriate expertise in tactile displays, as well as having the ability to communicate across disciplinary boundaries. These researchers will be able to benefit from the synergistic approaches applied here to continue to solve problems across the engineering-life science interface in the future.

Improving the safety of helicopters

HeliSafe TA: 2003-2007, €4.8M, 12 partners from 7 countries

Key benefits project provided: Enabling access to specialist facilities and skills, Ensuring direct transfer of knowledge to industry

EU funded research has improved the simulation of helicopter crashes, to enable safety improvements to be made to helicopters to save the lives of those inside. In this research, computer simulations developed at the **University of Coventry** informed helicopter crash tests which were performed in Italy at the Italian Aerospace Research Centre (CIRA). Crash tests are very expensive and the project allowed the researchers to complete these due to its scale, and by using the expertise of all the partners.

As a result of the project, the industry partners, including the engineering company TASS, have been able to adopt more efficient and economically beneficial practices, and offer improved products for crash simulation to the automotive and aerospace sectors. For Autoflug GmbH, a German company who coordinated the project, the computer simulation is now used to support and enhance new product design.

We asked researchers to let us know their views on the role that EU membership plays in science and engineering research in the UK

"Today's research is of a scale that cannot be undertaken by a small team, and EU research funding allows larger consortia, bringing together relevant Industry and academic partners to provide the deep skill as well as breadth required."

"Scientific research is a global endeavour, and it thrives if the top people can collaborate and share their facilities and resources freely without being constrained by national boundaries."

"Whilst the UK punches above its weight with respect to science and engineering research it still needs to be part of the formal combined EU science and engineering community in order to ensure global competitiveness."

"EU membership provides incentives to collaborate within the EU. International collaboration is extremely productive."

"Countries are picking winners and choosing areas of national importance. Where there are needs outside of these areas there is the need to fund those needs. Since we do not cover everything in the UK we need experts elsewhere. The EU can fund this."

"Whilst international collaboration is perfectly possible with any country, the existence of the established political mechanisms across the EU massively improves the chances of strong multilateral co-operation."

"We all have the same technical challenges - we don't need to all solve them individually."

"The administration of EU projects is honest but also pragmatic, permitting you to work in a way to get the best results, but also ensuring a high standard of ethics and audit."

"EU membership strongly supports academic mobility and helps the UK to recruit the best talent internationally and allows early career researchers from the UK to gain experience working with leading experts outside the UK."

"EU membership is of great symbolic significance. In the age of globalisation, where doctors' work without borders, and scientists collaborate internationally, it is counter-productive to increase the sense of separation from the rest of the world in any form."

"Enables the UK to benefit from the large range of expertise and equipment available across the EU."

"Without the investment from the EU into fundamental research many world class research projects could not have gone forward."

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- 8 EU expenditure and revenue 2007-2013, European Commission
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- 10 Science, Engineering and Technology (SET) statistics, Office for National Statistics, 2013
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- 18 HESA data on Research Grants and Contracts to UK HEIs, this does not therefore include funding through the Higher Education Funding Councils, or that allocated to research institutions.
- 19 HESA data, Science includes, Bioscience, Chemistry, Physics, Earth, Marine and Environmental and Mathematics
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- 21 Current categories for UK region eligibility for ERDF and ESF EU Structural Funds, 2014-2020
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- 31 Norway's affiliation with European Research Programmes, Technopolis Group, 2012
- 32 Associated Countries, European Commission, 2015
- 33 Data from HESA on academic staff funding