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Evaluation of EPSRC's investment in Healthcare Impact Partnerships

Final report

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Executive summary

The Healthcare Impact Partnership Scheme

The Healthcare Impact Partnership (HIP) Scheme was introduced in 2013 to enable the progression of previously funded EPSRC research outputs towards impact within a healthcare application. To date, 36 HIPs have been funded across five calls, representing a total investment of just over £31m. The scheme is open to academics who have held one or more EPSRC research grant(s) and supports preclinical and precompetitive research projects, from basic or applied research to early proof of concept and scale up research. HIP applicants are required to partner with both business and clinicians, and all partners are expected to make significant direct or in-kind contributions towards the project.

Evaluation of the HIP scheme

EPSRC commissioned an external review to understand the value and impact of the HIP scheme (funded between 2013 and 2019) and provide evidence as to whether the scheme continues to address a need. The evaluation was carried out by Technopolis between January and March 2020. The evaluation aims were to:

- capture the full breadth of outputs, outcomes and impacts emerging from HIPs (***impact evaluation***)
- identify ***enablers and barriers*** of effective translation
- assess the effectiveness of the call processes and identify opportunities for improvement (***process evaluation***)
- review the advantages/disadvantages, as well as outputs and outcomes, of the HIP grants compared to the EPSRC's standard-mode grants under the Healthcare Technologies theme

We employed a **mixed-methods approach**, comprising desk research, primary data collection (survey and interview programme), and case study development.

Impact evaluation

Inputs to projects included funding and prior research that the HIP was building on. Funding included EPSRC funding as well as leveraged investment (both financial and in-kind) from partners. Award values ranged from £262,740 to £1,660,068 with a median value of £893,010 and total leveraged funds (mostly in-kind contributions) per project ranged from £24,000 to £1,096,000, with a median of £110,093. Among the 32 PIs for whom we have data on previous EPSRC grants, 26 (81%) have held grants associated with the Healthcare Technologies theme. Thus, most EPS researchers funded under the HIP scheme had been previously involved in healthcare-related research.

The total number of partners per project ranged from 1 to 8 (median 3), reported clinical partners i.e. hospital/NHS trust partners per project ranged from 1 to 3 (median 1). It should be noted that clinical partners did not become a requirement until the 2016/17 call.

The following outputs and outcomes were reported based on data from ResearchFish, the survey and interviews. Information on outputs and outcomes was not available uniformly across all HIPs, hence the total number of HIPs (n) against which each output/outcome was normalised differed. Moreover, all but 9 of the HIPs are still ongoing including 7 HIPs funded under the 2018/19 call that have just started.

- 26 (79%, n=33) projects have research findings already
- 27 (90%, n=30) projects reported an improved understanding of the nature and scale of the potential for the technology under investigation to be used in health applications
- 144 publications were reported from 21 HIPs (median 5 per grant), of which the majority (110) were journal articles. Of these, 105 journal articles have been cited at an average of 10.6 citations per article
- 98 dissemination activities took place across 16 HIPs (average 3.8 activities per HIP, n=26), 71 (72%, n=98) of which were participation in workshop or similar and talk/presentation
- At least 25 partnerships (83%, n=30) reported outputs related to increased interest and capacity to be involved in translational research and cross-sectoral collaborations. 26 (87%, n=30) partnerships reported that the HIP contributed to their and/or their team members' professional development
- 3 research tools, 14 technical products/software, 1 database and 7 patents were reported. Patents were for devices, novel biomaterials and their production methods, and drug delivery methods. One HIP contributed to the development of an ISO standard for testing the performance of hip replacements
- 5 new collaborations were created and 13 partially existing collaborations reinforced
- 17 (70%, n=24) technologies have advanced along the TRL scale based on scoring by the study team of technologies for which information was available

As outcomes related to commercialisation and uptake into guidelines or clinical practice have not yet been achieved, no economic or health impact can be seen as yet. This is also due to the maturity and stage of the research, as most HIP projects are still ongoing. In addition, the scope of the research funded under the HIP scheme is not expected to progress a technology/approach far enough along the TRL scale to realistically allow health and economic benefits to accrue.

Overall, the HIP scheme has been successful in engaging EPS researchers and facilitating cross-sectoral collaboration with industry and clinical stakeholders for the purpose of applying EPS research to healthcare. Technologies have progressed along the translational pathway and desired outputs and outcomes have emerged.

Enablers and challenges

The main challenges experienced in the implementation of HIP projects included technical challenges, adapting to the needs and ways of working in different sectors, staff turnover and recruitment, managing a large team and the long time needed for ethical approval and IP agreements. Conversely, the main enablers include involvement of different sectors, previous experience of working together, geographical proximity of partners, common objectives providing a focus for research and access to expertise and/or facilities through partners.

Process evaluation

The HIP scheme is unique and fills a gap in the research landscape according to stakeholders. Achieving impact from research and progressing towards a healthcare application are the main motivations for researchers to apply to the scheme. On the whole, the HIP participants were satisfied with the scope and funding on offer. No specific barriers or disadvantages were identified. The call and management processes were viewed favourably by the research community except for application timelines which was a source of dissatisfaction for some. A funding gap was identified between the HIP scheme and other follow-on funding, which could negatively impact on further development of the technology/approach in question.

Comparison with standard-mode grants

The main value of the HIP lies in its ability to galvanise cross-sectoral collaboration across the academic, industry and clinical sectors, allowing commercial and healthcare needs to remain at the centre of technology development from the earliest stages. This increases the likelihood of adoption and thus the potential for eventual economic and health impact. In this way, it offers value over and above standard-mode grants, especially in terms of accelerating potential impact from EPS research. The requirement to build on a previous EPSRC grant however limits competition and selection of new ideas from a large talent pool compared to standard-mode grants. Conversely, standard-mode grants are more suitable for basic research and appear to take longer to yield impact.

Analysis of ResearchFish data suggests certain outputs and outcomes emerge slower and in fewer numbers from standard-mode grants compared to the HIPs.

- 28 of the 59 (47%) standard-mode grants reported key research findings compared to 17 out of 26 HIPs (65%)
- 200 publications were reported from 38 standard-mode grants (median 3 per grant) compared to 144 publications from 21 HIPs (median 5 per grant). The average number of journal articles per project was 4.6 for standard-mode grants compared to 5.6 for HIPs. Journal articles have been cited at an average of 6.7 citations per article, while HIPs have on average 10.6 citations per journal article
- Standard-mode grants reported more research tools and databases compared to HIP grants (5 vs 3 and 5 vs 1, respectively) but fewer technical products or software (10 vs 14). Interestingly, no patents were reported for standard-mode grants, but a spin-out was, contrasting with 7 patents and no spin-outs for HIPs.
- The majority of PIs (75%, n=59) in standard-mode grants do not report any collaborations in ResearchFish in contrast to 65% of PIs (n=26) in HIP grants

Points for consideration

We suggest EPSRC consider the following points with regard to a future iteration of the scheme in order to maximise the likelihood of achieving its desired objectives.

1. **Support networking activities prior to calls for proposals to create new collaborations** across the academic, industry and clinical sectors and spark new ideas for translation through cross-sectoral discussions
2. **Enhance competition and diversify the pool of applicants** by removing the requirement for a previous EPSRC grant to be eligible for funding under the HIP scheme. While HIPs increase the potential for impact from EPSRC research, this restriction decreases competition and perhaps also access to diverse ideas
3. **Further facilitate engagement of industry and clinical partners** – Lack of time and funds can inhibit effective and timely engagement of clinical and industry partners with the academic team. Better communication of the availability of funding for clinicians and activities such as market opportunity assessments and early stage commercial exploration might enable better and more engagement from clinicians and industry stakeholders in HIPs
4. **Make efforts to ensure continuity of the funding pathway** beyond the HIPs to enable further development of promising technologies, for example, through mapping funders (including industry) and their programme activities to identify funding gaps. EPSRC could consider filling these gaps, for example, through a new joint programme with other UKRI funders or providing small grants for further development of the technology

1 Introduction

1.1 Health technology needs and the case for intervention

In the context of an ageing population and increasing cost of healthcare, novel technologies and materials can be used to deliver better quality of life as well as safer, more effective and affordable healthcare. Health technology has the potential to improve prediction, diagnosis, treatment and management of disease; enable healthier choices; and allow older people and those with disabilities to maintain independent lives for longer[1]. In addition, new products and services can contribute to growth in jobs and industries resulting in economic growth.

Engineering and physical sciences (EPS) research can underpin new or improved health technologies and applications. However, firstly fundamental discoveries have to be 'translated' into practical applications, that is, a translational gap between basic research and clinical application (often called the 'valley of death') has to be traversed.

To enable efficient and effective translation, research outputs have to a) address a need, and b) be suitable for implementation (e.g. adaptable to current practice; able to incorporate into current technologies). To reach the end-user, most research outputs also need to be taken up by industry for commercialisation. As such, the academic, industry and healthcare sectors comprise the main stakeholders in health technology development and cross-sectoral research partnerships can facilitate 'launching' of EPS research outputs onto the right translational research path.

The EPSRC funds basic and applied research in EPS, including early stage, proof-of-concept studies. Hence, programmes supporting the initial translation of EPS research for use in health are fully within its remit. Furthermore, research demonstrating how a set of scientific principles can be used to address a healthcare challenge aligns with the EPSRC's goal to "research and innovate", with its strategy of "accelerating impact", and with its stated prosperity outcome "healthy nation"[2,3]. Besides, EPSRC already has a thematic focus in this area in the form of the "healthcare technologies" theme.

1.2 The EPSRC Health Impact Partnership scheme

1.2.1 Aim

The Healthcare Impact Partnership (HIP) Scheme was introduced in 2013 to **enable the progression of previously funded EPSRC research outputs towards impact within a healthcare application**.

Underlying this goal is the desire to[4]

1. progress research outputs along the TRLs to a stage where they are eligible for follow-on funding, especially from public (mainly MRC and Innovate UK within UKRI) and charity sources

[1] National Information Board and Department of Health and Social Care (2014) Personalised health and care 2020. Available at: https://www.gov.uk/government/publications/personalised-health-and-care-2020

[2] https://epsrc.ukri.org/newsevents/pubs/strategic-plan-2015/

[3] https://epsrc.ukri.org/about/plans/deliveryplan/prosperityoutcomes/health/

[4] Based on interviews with EPSRC staff, January 2020

2. engage EPS researchers, both those that normally work in the healthcare space and those that do not, in research activities to accelerate impact
3. establish meaningful cross-sectoral collaborations between academic, industry and clinical sectors at the outset so as to facilitate TRL progression and boost likelihood of impact

1.2.2 Scope of activities

To date, 36 HIPs have been funded across five calls (a pilot call in 2013/14, followed by four annual calls from 2015/16 to 2018/19), representing a total investment of just over £31m. The scheme is open to academics who have held one or more EPSRC research grant(s) awarded through standard mode, fellowships or calls for proposals, and supports preclinical and precompetitive research projects, from basic or applied research to early proof of concept and scale up research[5].

While the scheme is primarily focussed on research, other activities which are part of the 'pathway to impact'[6] can also be funded, such as patient and public involvement (PPI), project-specific marketing assessments and early stage commercial exploration. However, projects aimed at product development and clinical trials are excluded. Research results are to be placed in the public domain.

For the first three calls, partnerships were limited to specific research capabilities (e.g. advanced materials, nanotechnology, novel computational and mathematical sciences), technologies (e.g. disruptive technologies for sensing and analysis, medical devices, novel imaging technologies) or health needs (e.g. antimicrobial resistance). However, on reflection it was felt that a focus on specific topics would restrict the number of researchers who could apply as to be eligible, applicants would need to have had a previous EPSRC grant[7]. Secondly, it limits the range of technology and application domains that can be engaged in translation for healthcare. Therefore, the two most recent calls were broader in scope, requiring only that HIPs should contribute "to at least one of the Healthcare Technologies Grand Challenges[8]" namely

- **Developing Future Therapies:** Supporting the development of novel therapies with technologies to enhance efficacy, minimise costs and reduce risk to patients
- **Frontiers of Physical Intervention:** Restoring function, and optimising surgery and other physical interventions to achieve high precision with minimal invasiveness
- **Optimising Treatment:** Optimising care through effective diagnosis, patient-specific prediction and evidence-based intervention
- **Transforming Community Health and Care:** Using real-time information to support self-management of health and wellbeing, and to facilitate timely interventions

HIP applicants are required to partner with both business and clinicians, and all partners are expected to 1) make significant direct or in-kind contributions towards the project, and 2) contribute their expertise to promote the HIP's impact in the healthcare sector (e.g. by ensuring the research addresses an unmet clinical need and/or offers significant added value over current or alternative healthcare solutions). Involvement of clinicians was made mandatory from the 2016-17 call following feedback from the community that clinical engagement in the

[5] Calls for proposals 2016-17 onwards

[6] https://epsrc.ukri.org/funding/applicationprocess/preparing/writing/resourcesimpact/

[7] Based on interviews with EPSRC staff, January 2020

[8] https://epsrc.ukri.org/research/ourportfolio/themes/healthcaretechnologies/

early stages accelerates impact[9]. Collaboration with other user organisations (charities, not for profit etc.) is also strongly encouraged.

1.2.3 Programme Management and Governance

The Healthcare Technologies team is responsible for the management and delivery of the scheme. The Head of the Healthcare Technologies theme is the budget owner and signs off on any investments/grants.

There is no formal governance structure for the scheme. However, the Strategic Advisory Team of the Healthcare Technologies theme provides advice on an ad hoc basis.

1.2.4 Funding process[10]

Two features of the HIP scheme mark significant departures from the standard mode of funding: (1) the requirement for industry and clinical partners, and (2) only previous EPSRC grantees are eligible for funding.

Each cycle of funding starts with the drafting of a call for proposals document. A potential call is first discussed with the Strategic Advisory Team. Based on the advice received, the Healthcare Technologies team drafts a call document, which is reviewed by the EPSRC's peer review team in terms of whether the assessment criteria are fair; equality, diversity and inclusion requirements are met; and the funding process and criteria is clearly explained.

Once approved the call document is set up on EPSRC's grant system and published on the website. The call is also advertised through social media, networks and the EPSRC's regular university brief.

As a first step, applicants have to fill in a short survey (Intention to Submit) and those that meet the eligibility criteria are invited to submit a full application[11]. The full proposal requires among other documentation a case for support (including team track record, review of previous grant and forward vision, partner engagement plan), a pathways to impact plan, work plan, justification of resources requested and statements of support from project partners. The full proposals are assessed on

- impact generated from their previous EPSRC funded grant
- quality of the proposed research
- suitability of the proposed research team
- understanding of the underpinning clinical need
- alignment with EPSRC's Healthy Nation outcomes
- requested resources and management plan
- strength of the envisaged collaboration
- appropriateness of the planned pathway(s) to impact
- extent to which further support will progress the previously funded research towards translation

[9] Interviews with EPSRC staff, January 2020

[10] Drawing on interviews with EPSRC staff (January 2020) and call for proposal documents

[11] The pilot call (2013) required an outline proposal instead of an intent to submit and a prioritisation panel advised which proposals were to be invited to the full stage.

The full applications are sent out for peer review by the relevant EPSRC portfolio manager. Each application is sent to around four reviewers, including one applicant-nominated reviewer, with expertise across fields related to the project, to enable a full assessment of the proposed research. If sufficiently positive comments are received, applicants are invited to respond to peer reviewers' comments. Following this process, a prioritisation panel of around 10 experts is convened covering the subject areas of the proposals as well as industry and clinical expertise. In the panel meeting, each proposal is presented by three speakers – one reviewing quality, one who is an expert on the topic and one commenting on the impact. All panel members also have access to the grant proposal document, the peer reviews and applicant's response to the reviews. Based on this information and discussion during the meeting, the panel collectively agrees on an overall score (out of 10) and rank for the proposal across all the assessment criteria. A ranked list of proposals is the main output from the panel meeting.

EPSRC makes the final decision on which proposals to fund. Usually, this involves funding the top-ranked proposals that can be accommodated within the budget available.

1.3 Objectives of the evaluation

EPSRC's Healthcare Technologies theme commissioned Technopolis to evaluate the Healthcare Impact Partnership (HIP) Scheme between January and March 2020.

The evaluation explored the value and impact of the HIP scheme (funded between 2013 and 2019) to provide evidence as to whether the scheme continues to address a need. The evaluation aims were to:

- capture the full breadth of outputs, outcomes and impacts emerging from HIPs (***impact evaluation***) including an assessment of the value of the HIP scheme to various stakeholders
- identify/learn about factors that contribute or prevent effective translation of engineering and physical sciences into healthcare environments *(**enablers and barriers*** of effective translation), such as the 'ingredients' of a well-functioning HIP
- assess the effectiveness of the call processes and identify opportunities for improvement (***process evaluation***)
- review the advantages/disadvantages, as well as outputs and outcomes, of the HIP grants compared to the EPSRC's standard mode grants supporting similar research

This evaluation is expected to inform future investment decisions in the healthcare technologies theme and support EPSRC's impact-oriented funding, e.g. by identifying opportunities to improve outcomes from future investments.

2 Evaluation approach and methodology

We structured the evaluation into four tasks:

- An **impact evaluation**, to assess progress against the indicators set out in the evaluation framework. This focusses on outputs, outcomes and impacts of the HIPs (taking account of the timeframe that can be expected for these to accrue), the value the partners are deriving from the partnership, and any benefits to the wider health technology research community. This task included identification of enablers and barriers.
- A **process evaluation**, to assess whether the scheme's processes are effective and provide the necessary support/direction to achieve the programme's outputs, outcomes and impacts. This focusses on the design and inputs to the programme
- A **comparison of EPSRC investment into the HIPs and standard mode grants** under the Healthcare Technologies theme, to identify whether there are differences in the level of outputs and outcomes, and to assess the advantages/disadvantages as viewed by researchers/beneficiaries
- Development of a set of **in-depth case studies**, combining insights from the three preceding tasks and extending the information gathered to highlight progress made, and to better understand the added value of the HIP scheme, its enabling factors and barriers, and its potential for achieving outcomes and impact in the future.

2.1 Evaluation Framework

We created a fairly comprehensive evaluation framework that could be adopted for future evaluations. It should be noted however that owing to the level of maturity of the projects (75% of the projects are still ongoing), and thus the limited scope of this evaluation, it was not possible to populate all the indicators.

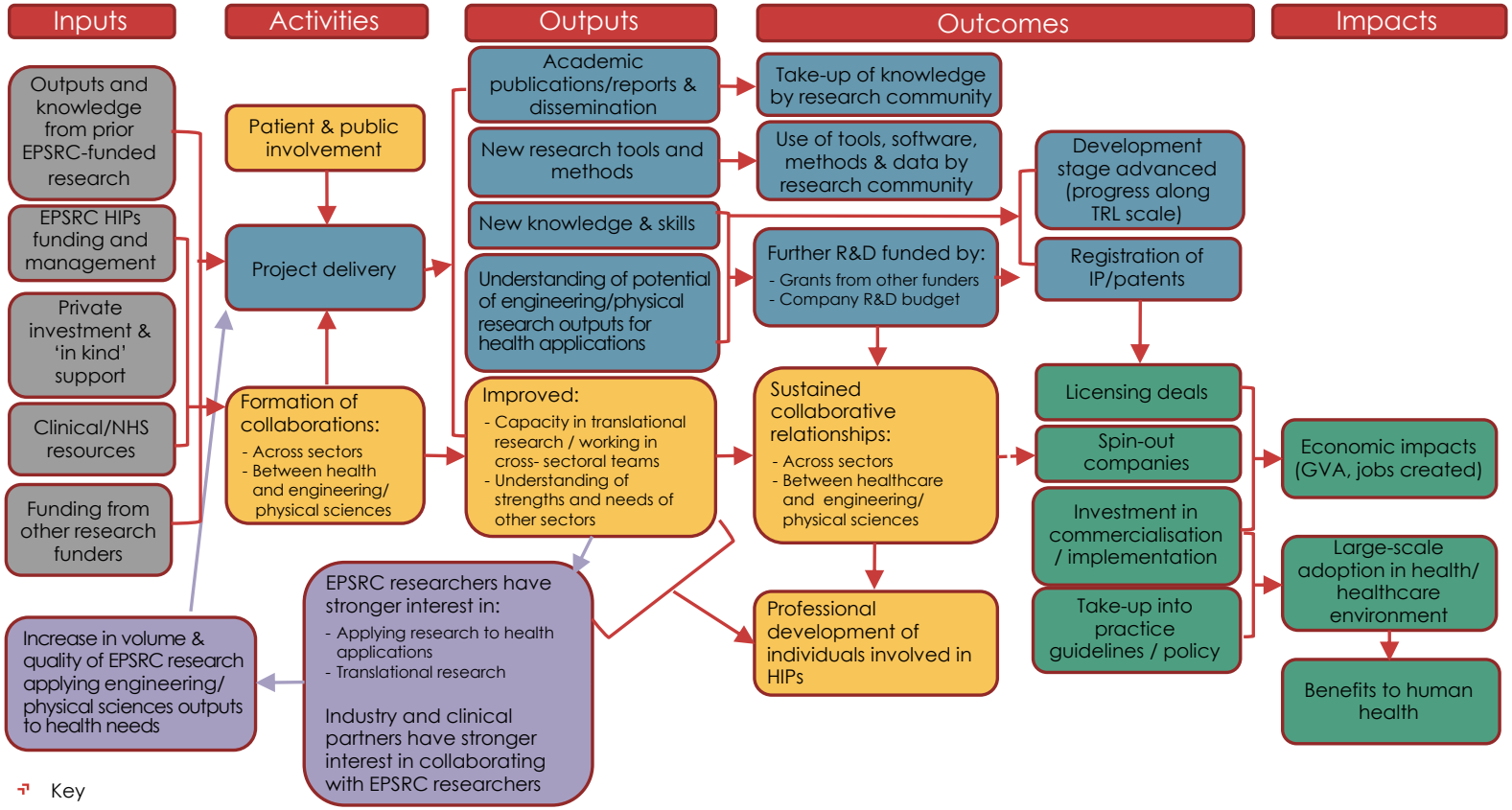
2.1.1 Impact evaluation framework

Our impact evaluation approach was based on a programme logic model (PLM, see Figure 1), describing the causal process by which the EPSRC's inputs into the HIP scheme are expected to deliver outputs, outcomes and impacts to achieve the scheme's objectives. This PLM was based on the document review and orientation interviews with EPSRC stakeholders. Based on this model, we set out indicators for the key outputs, outcomes and impacts of the HIPs.

Outputs are the immediate results of the intervention activities. Outputs, associated indicators, and proposed sources of evidence are summarised in Table 1. This also includes indirect effects on the level and quality of future EPSRC healthcare technologies research.

Figure 1 Programme logic model for Health Impact Partnerships

- **Needs**
  - Unmet clinical needs and/or potential for improvement of current healthcare solutions (eg improved clinical outcomes; reduced cost)
  - Engineering and physical science research has potential for improving human health and wellbeing through development/improvement of health(care) technologies. Development and adoption of solutions requires a cross-sectoral and cross-disciplinary approach.



- Key
  - Blue: Research domain
  - Yellow: Wider research environment
  - Green: Commercial / healthcare domain
  - Purple: Indirect effect on EPSRC healthcare technologies research

Table 1 Evaluation framework - outputs

Outputs	Indicators	Source of evidence
Research findings which enhance understanding of the potential of EPS output(s) for health applications	Number and percentage of projects resulting in an improved understanding of the nature and scale of potential for the technology under investigation (including 'no potential') Number and percentage of projects reporting research findings	• Principal investigator (PI) and HIP partner interviews & survey • ResearchFish analysis
Dissemination of research findings	Number of publications Number, type and reach of dissemination activity undertaken (e.g. talks, media, etc.)	• ResearchFish analysis
New or improved: • research tools and methods • technical products/software • databases and research materials	Number and type of research tools and methods developed / improved Number and type of technical products/software developed / improved Number and type of databases and research materials developed / improved	• ResearchFish analysis • PI and HIP partner interviews & survey
Other new or improved technical/subject knowledge	Nature of new technical/subject knowledge developed / improved, not directly related to main aim of the HIP project *[qualitative]*	• PI and HIP partner interviews & survey • ResearchFish analysis
Improved capacity to work in cross-sectoral teams	Number of partnerships with researchers/partners reporting improved capacity to work in cross-sectoral teams	• PI and HIP partner interviews & survey
Improved knowledge of the translational research pathway	Number of partnerships with researchers/clinicians reporting improved translational research skills	• PI and clinician partner interviews & survey
Enhanced EPS researcher interest in applying their research to health applications	Number of partnerships with researchers reporting enhanced interest in applying their research to health applications	• PI interviews & survey
Enhanced EPS researcher interest in translational research activities	Number of partnerships with HIP PIs/research group members reporting enhanced interest in translational research activities	• PI interviews & survey

2.1.1.1 Outcomes

Outcomes are results of an intervention that are intermediary steps arising from the outputs 'on the way' to achieving the intended impacts of an intervention. Outcomes, associated indicators, and proposed sources of evidence are summarised in Table 2.

Table 2 Evaluation framework – outcomes

Outcomes	Indicators	Source of evidence
Take-up of findings / knowledge by other research projects	Number of times publications have been cited in peer-reviewed literature Number of partnerships with researchers/partners reporting take-up of knowledge by wider research community	• Bibliometric database e.g. Scopus • PI and HIP partner interviews & survey

Use of tools, methods, databases and/or software by research community	Number of partnerships with researchers/partners reporting take-up of developed/improved tools, methods, databases and/or software by wider research community	• PI and HIP partner interviews & survey • Desk research / targeted online searches
Further R&D of HIP technology	Number of HIP technologies with follow-on research funding from other funders	• ResearchFish analysis • PI and HIP partner interviews & survey
Registration of new IP/patents	Number of new IP/patent registrations from HIPs	• ResearchFish analysis • PI and HIP partner interviews & survey • Desk research / targeted online searches
Advancement of technology along TRL scale	Number of HIP technologies advanced along TRL scale	• PI and HIP partner interviews & survey
New or strengthened sustained collaborative relationships	Number of collaborations between partners in the EPS and health technology research communities who had not previously worked together Number of partnerships reporting continued collaboration beyond HIP duration	• Document review: proposals • PI and HIP partner interviews & survey • ResearchFish analysis • Desk research / targeted online searches • PI and HIP partner interviews & survey
Professional development of individuals involved in HIPs	Number of partnerships with researchers/partners reporting that the HIP had supported their or team members' professional development	• PI and HIP partner interviews & survey • ResearchFish analysis
Commercialisation of HIP research outputs	Number of licensing deals Number of spin-out companies Number and level of investment in commercialisation / implementation of developed technology (post-R&D) Number of products entering the market	• ResearchFish • PI and HIP partner interviews • Targeted online searches and database analysis
Uptake into healthcare practice / guidelines	Number of partnerships with influence on healthcare practice / guidelines	• ResearchFish analysis • PI and HIP partner interviews • Desk research / targeted online searches
Increased volume of applications for EPSRC healthcare technologies funding	Number of HIP PIs applying for further healthcare technologies research funding	• ResearchFish analysis • PI interviews

2.1.1.2 Impacts

The long-term objective of research projects funded through the HIP scheme is to bring about economic benefits and improvement of human health. These impacts can be expected to arise in the long term, e.g. 5+ years after the conclusion of a project. While a scheme such as the HIPs, if successful, can be expected to contribute to these impacts, it is likely that these would accrue beyond the timeframe of the current scheme. Therefore, while we aimed to

identify evidence of contribution to impacts from the HIPs where possible, any such evidence was expected to be limited at this point in time.

Impacts, associated indicators, and proposed sources of evidence are summarised at the end of this section in Table 3.

Table 3 Evaluation framework – impacts

Impacts	Indicators	Source of evidence
Economic impacts	Number of jobs created Increase in turnover of relevant firms Increase in valuation of relevant firms	• PI and HIP partner interviews • Desk research / targeted online searches
Large-scale adoption of technology by end-users (eg in healthcare setting)	Number of partnerships with researchers/partners reporting adoption of technology	• PI and HIP partner interviews & survey • Desk research / targeted online searches
Benefits to human health	Number of individuals benefitting from technology in healthcare settings Level of health benefit to end-user Level of cost savings to healthcare system	• PI and HIP partner interviews • Desk research / targeted online searches

We payed particular attention to two aspects:

- Value of HIP project to different stakeholders
- Enablers of & barriers to progressing HIP research outputs/technologies

We analysed the evidence gathered to establish whether certain provisions during the research design and implementation or characteristics and ways of working of the partnership can be linked to enhanced outputs, outcomes and impacts, and to what degree. Conversely, we looked for common factors that have prevented progress along the translational pathway and hindered effective collaboration, and whether these could have been foreseen or addressed prior to the HIP award.

2.1.2 Process evaluation framework

To achieve its objectives, the HIP scheme needs to be designed and delivered in a way that can identify and support high quality research projects and effective partnerships. These elements were assessed as part of a process evaluation, whose findings in turn can identify underlying enablers and barriers to achieving the programme goals (impact evaluation).

The evaluation questions and sources of evidence for the process evaluation are presented in Table 4.

Table 4 Process evaluation – evaluation questions and sources of evidence

Evaluation question	Sources of evidence
Design *Attracting high-quality proposals* • Which aspects of the scheme's design parameters make it more attractive to researchers than other funding sources?	• PI and HIP partner interviews & survey

• Are there aspects of the scheme's design parameters and requirements that are barriers to attracting relevant high-quality proposals? • If yes, how could these be addressed? <u>*Maximising outcomes and impacts*</u> • Which aspects of the scheme allow the funded research to achieve a higher level of outcomes and impacts compared to other funding sources? • What improvements to the scheme's current design could be made to increase the level of outcomes and impacts? • What additional activities could the scheme support to achieve its aims?	
Call process • Does the call process follow suitable processes? (e.g. level of information provided, promotion, timelines, proposal submission requirements) • Are there aspects of the call process that could be improved?	• Interviews with EPSRC staff • PI and HIP partner interviews & survey
Scheme management • Are the scheme's management processes adequate? (e.g. contracting, grant administration, monitoring) • Are there aspects of the scheme's management that could be improved?	• PI and HIP partner interviews & survey • Interviews with EPSRC staff

2.1.3 Comparison of EPSRC investment into the HIPs and standard mode grants

The EPSRC already supports EPS research towards applications in health and care under its Healthcare Technologies theme. Therefore, in deciding the future of the HIP scheme, evidence on whether it offers any added value over and above standard-mode grants under the Healthcare Technologies theme needs to be considered. In particular, any differences in the level of outputs and outcomes realised as well as potential for impact need to be understood.

Evaluation question	Indicators	Source of evidence
How do the outputs and outcomes of the HIPs compare with outputs and outcomes of comparable projects of EPSRC's standard mode portfolio?	• Number of outputs: publications, research methods, tools, products, software • Number of outcomes: IP, spin-outs, policy influence, further funding (incl. comparison of level)	• ResearchFish analysis • Bibliometric data
What factors may contribute to existing differences?		• PI interviews & survey
What are the main advantages and disadvantages of HIPs compared to standard-mode grants?		• PI interviews & survey

2.2 Methodology

We employed a **mixed-methods approach**, involving multiple strands of data collection and analysis, which cut across the different evaluation questions. This provided us with evidence from multiple sources and perspectives, allowing us to triangulate data and verify our findings.

Our methodology comprised desk research, primary data collection (survey and interview programme), and case study development. In this section, we provide detail on how these methods were implemented.

2.2.1 Desk research

Portfolio and outputs and outcomes analysis was conducted based on the grants, proposals and ResearchFish data shared by EPSRC. Analysis included descriptive statistics and cross-tabulations of data using MS Excel.

Bibliometric analysis of publication outputs was performed using the Scopus database. This included analysis of the output types, subject areas, author affiliation and funders data, as well as citations per year of publication.

Comparison of HIPs and standard-mode grants was conducted based on ResearchFish data shared by the EPSRC and bibliometric indicators. Standard-mode grants were identified as grants belonging to the Healthcare Technologies theme and funded between 2013-2019 under the Standard Research 1F and Healthcare Technologies Investigator-led calls.

Review of documentation included strategy and call for proposals documents as well as documentation on individual HIPs, such as proposals and pathway to impact documents. For HIPs that reported outputs/outcomes or encountered challenges and were hence unable to advance (barriers), we extract information on potential underlying factors in the nature of the partnership, the design of the research project (e.g. the level of PPI), and the planned pathway to exploitation (e.g. assessment of the existing IP landscape).

Additional desk research to gather further information on outputs and outcomes provided in the survey and interviews. This included targeted online searches, e.g. websites of project teams and associated industry partners, news releases from universities, and funders' websites. This also included an analysis of patent records to cross-reference any patent numbers cited in ResearchFish and/or in primary data collection.

2.2.2 Primary data collection

Primary data collection comprised **interviews and a survey** to update and extend data contained within ResearchFish, and enquire about additional aspects to be covered by the evaluation, including rationale for the scheme and its requirements; how the partnerships were created; challenges and barriers encountered during HIP implementation; any adjustments that were made to the original research plans or team (and why); how partners and patients/the public were involved in the design and implementation of research; the value of the HIP scheme in the wider translational research funding landscape (e.g. complementarity/overlaps with other funding opportunities, comparison with EPSRC standard mode); and how the scheme's design, call process and management could be improved.

2.2.2.1 Interviews

Interviews consisted of orientation interviews with 4 EPSRC representatives and 1 member of the Strategic Advisory Team as well as 21 interviews with principal investigators (PIs, n=13) and project partners (n=8).

The interviews were semi-structured allowing interviewers the flexibility to probe responses and deepen understanding of key points that emerged in the course of discussion. The interviews were conducted by phone or videoconference.

The distribution of interviews across the interviewee type and call is shown in Table 5 below.

Table 5 Distribution of interviewees

Call	Principal Investigators	Industry Partners	Clinical Partners	Academic Partners
2013	3	0	0	0
2015	3	1	0	0
2016	5	3	2	1
2017	1	1	0	0
2018	1	0	0	0
Total (21)	**13**	**5**	**2**	**1**

2.2.2.2 Survey

The survey was conducted using SurveyMonkey software, which is fully compliant with GDPR.

Since the overall population was relatively small, despite our original plan to distribute the survey only to HIP grantees not consulted by interview, we also gave PIs and partners the option to fill in the survey before participating in a shorter interview.

We received survey responses from 31 individuals representing 26 projects. The majority of respondents reported their role in the project to be academic lead (71%, n=21), other responses received are from clinical partners (14%, n=5), academic collaborators (10%, n=3), and industry partners (5%, n=2).

2.2.3 Case study development

We developed 5 in-depth case studies. The case studies focus on individual HIPs and trace the pathway from proposal to outcomes and impacts (if any), highlight any challenges encountered, and enablers that made project implementation smoother or improved outcomes. To this end, information gathered through the other methods was extended in targeted online searches. Where interviews were conducted, we requested explicit consent of investigators to use their interview responses and develop a case study of their research. The case studies are presented as a separate annex to the report.

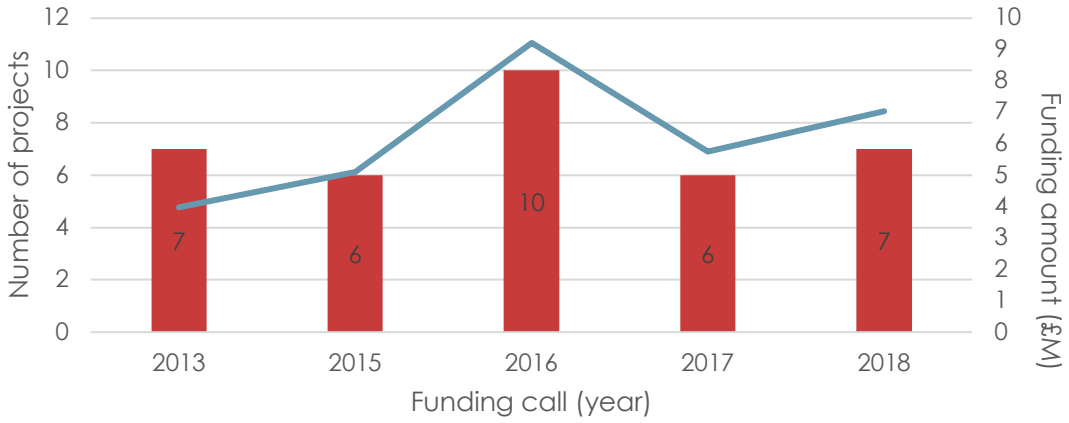
3 Impact evaluation

3.1 Inputs

3.1.1 Funding

Funding includes both EPSRC funding as well as leveraged investment (both financial and in-kind) from partners. Between 2013 and 2018, 36 projects were funded under the HIP scheme with award values ranging from £262,740 to £1,660,068 with a median value of £893,010 and an average project duration of 38 months. A breakdown of projects and funding amount per funding call is given in Figure 2. A total of 35 principal investigators (PIs) were awarded grants with one PI receiving two grants.

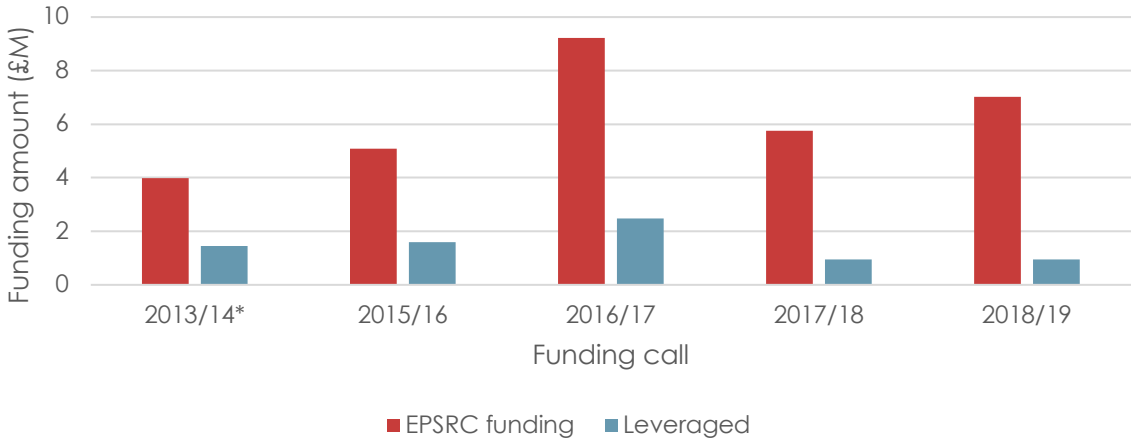
Figure 2 Number of projects and total funding amount per funding call



Source: Technopolis analysis of EPSRC grant data

The value of leveraged funds (financial and in-kind contributions from partners) by call ranged from approximately £2.5M (Call 2016/17) to £950,000 (Call 2017/18).

Figure 3 Leveraged vs EPSRC funds



Source: Technopolis analysis of EPSRC grant data

* Leveraged fund information was not available for one grant (EP/L024772/1).

Leveraged funds accounted for between 12% and 27% of the total project value (EPSRC plus leveraged funding). Total leveraged funds (in-kind plus in-cash contributions) per project ranged from £24,000 to £1,096,000, with a median of £110,093. In-kind contributions accounted for 91% of the total leveraged funding. The largest proportion of contributions were from Industry/Commercial partners, accounting for 55% and 99% of the total in-kind and in-cash contributions, respectively.

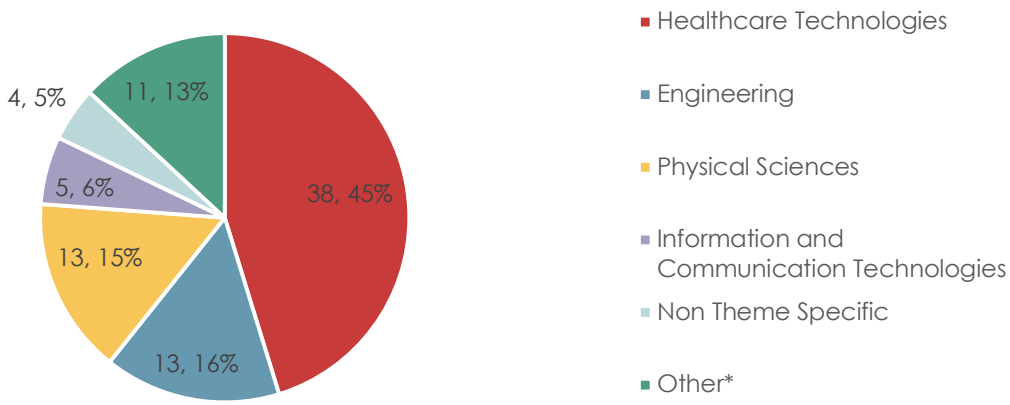
3.1.2 Prior research

The HIPs are underpinned by knowledge, skills and research outputs obtained from preceding EPSRC-funded projects. The number of qualifying EPSRC grants held by HIP grantees[12] ranged from 1 to 7, with a median of 2 grants.

Among the 32 PIs for whom we have data on previous EPSRC grants, 26 (81%) have held grants associated with the Healthcare Technologies theme. Thus, most EPS researchers funded under the HIP scheme had been previously involved in healthcare-related research.

Further analysis of the 84 grants listed across all 32 PIs, confirmed that the theme most commonly associated with prior grants was Healthcare Technologies (45%, 38 of 84) followed by Engineering (16%, 13 of 84) and Physical Sciences (15%, 13 of 84) (Figure 4).

Figure 4 Funding themes of prior PI grants



Source: Technopolis analysis of Qualifying Research data

All lead researchers interviewed had also been active in applying EPS research to healthcare prior to involvement in the HIP. About half of the PIs interviewed viewed their HIP as building on a programme of work, while the other half were building on work done in a specific previous EPSRC grant. Two PIs were building on "Challenging Engineering" grants and were complimentary about that grant scheme.

[12] Please note that data were unavailable for four HIP grants.

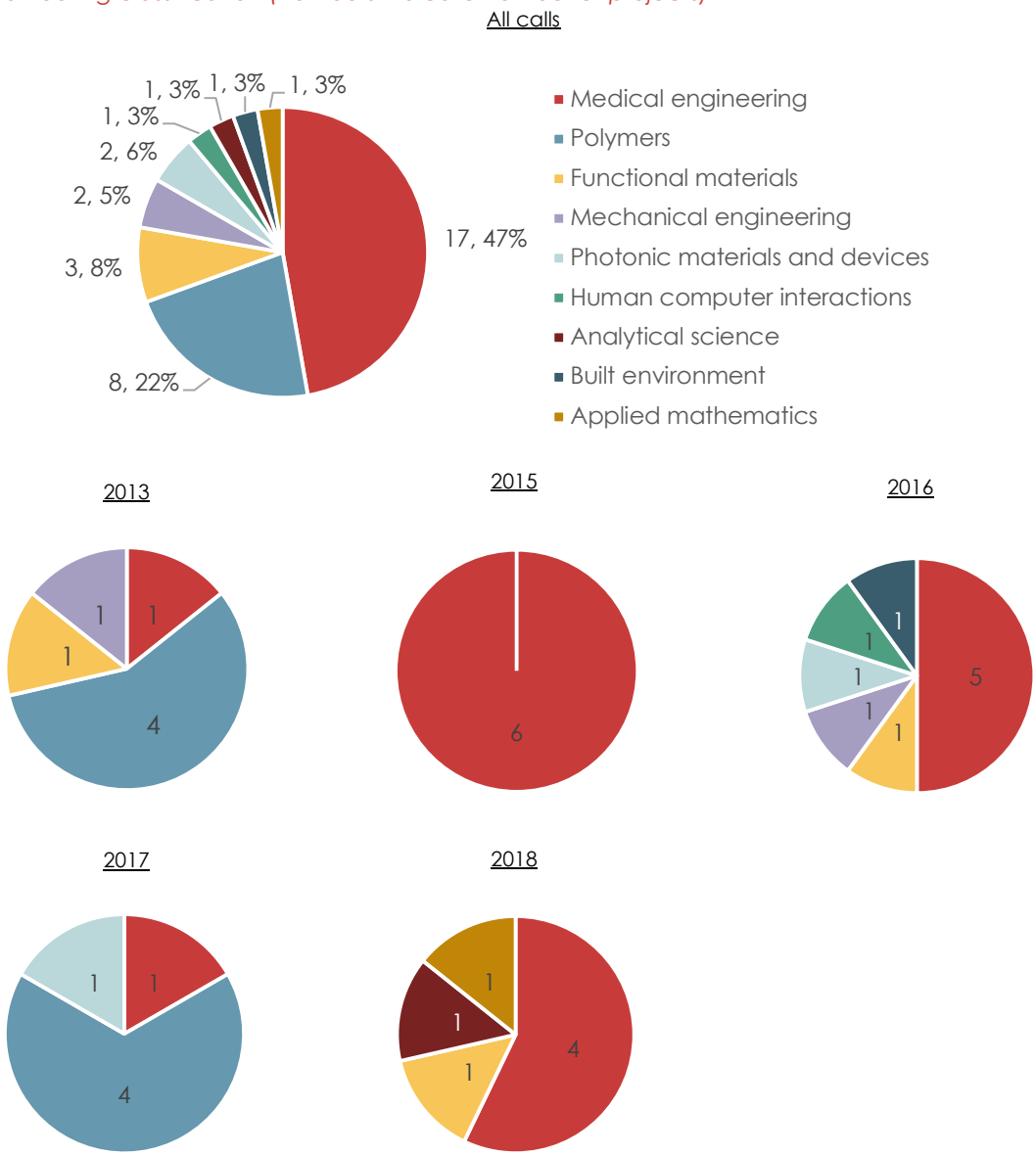
3.2 Activities

3.2.1 Research

In terms of the thematic focus of the funded projects, the majority of projects (47%, 17 of 36) were classified as 'Medical engineering' projects (Figure 5). The next most frequent classifications were 'Polymers' (22%, 8 of 36) and 'Functional materials' (8%, 3 of 36).

Medical engineering was also the most common routing classification for each funding call with the exception of the 2013/14 and 2017/18 calls where the most common routing classification was 'Polymers'. It should be noted that 'advanced materials' was a priority topic for the 2013/14 call. The 2015/16 funding call focussed on 'Disruptive Sensing and Analysis and Medical Device Design and Innovation' resulted exclusively in 'Medical engineering' projects.

Figure 5 Routing classification (numbers indicate number of projects)

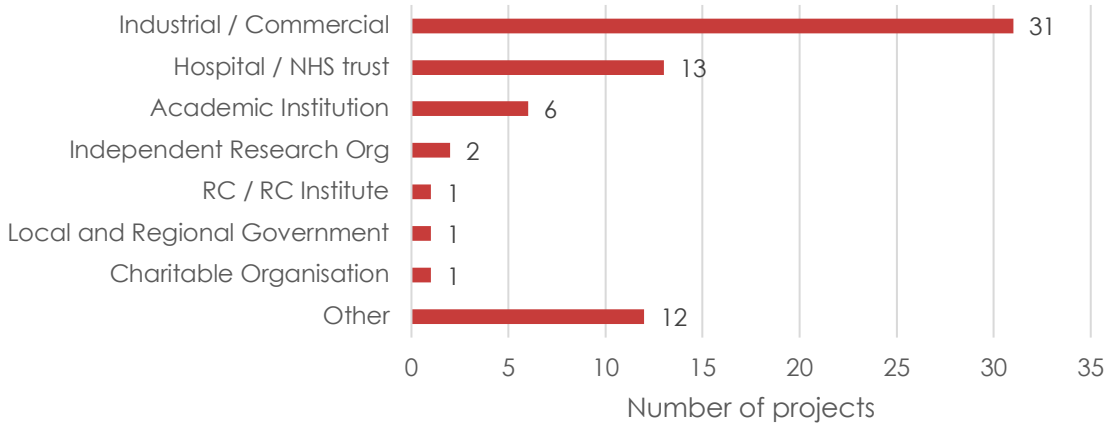


Source: Technopolis analysis of EPSRC grant data

3.2.2 *Collaborative working*

The total number of partners per project ranged from 1 to 8 (median 3). 89% of projects (31 of 35[13]) had industry/commercial partners (Figure 6), with the number per project ranging from 1 to 5. Clinical partners i.e. hospital/NHS trust partners were reported for 37% (13 of 35) of projects, with 1 to 3 such partners per project (median 1). The other category included a mix of research technology organisations, charities, government organisations, educational institutions, individuals and companies.

Figure 6 Number of projects by partner type



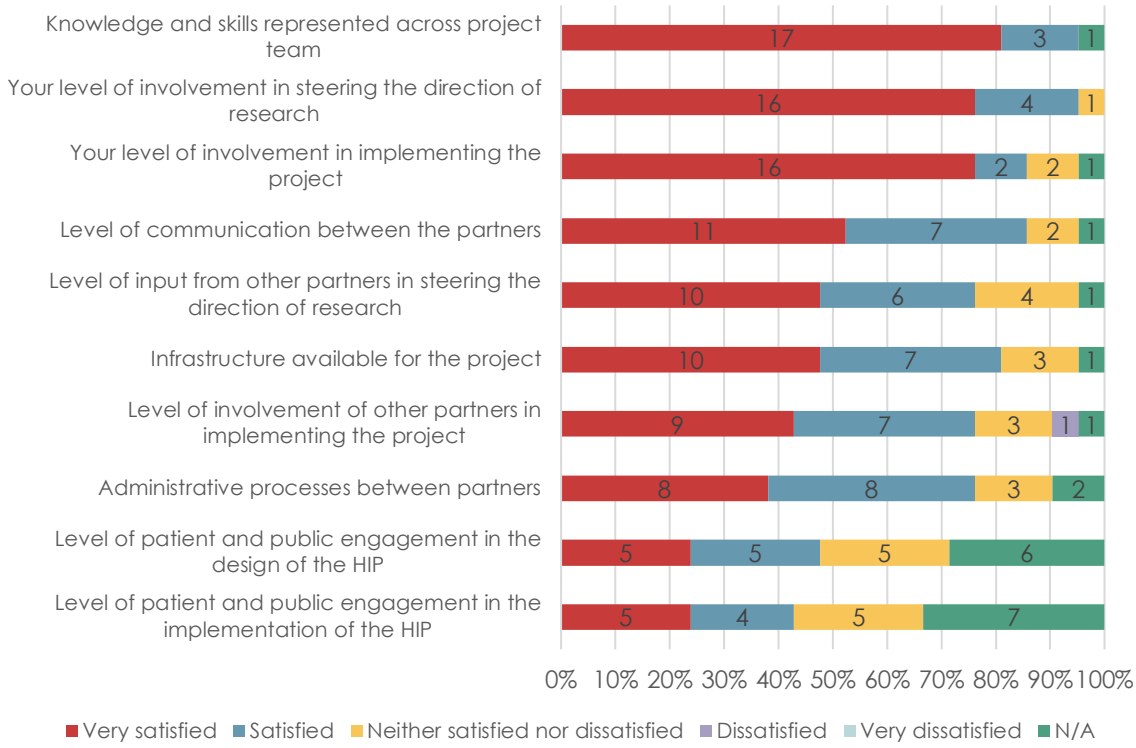
Source: Technopolis analysis of EPSRC grant data

The vast majority of survey respondents (at least 87%, 27 of 31) reported being a key contributor in both the design and implementation of the project, with two clinical and two industry partners each reporting an ad hoc or limited contribution in one or both aspects.

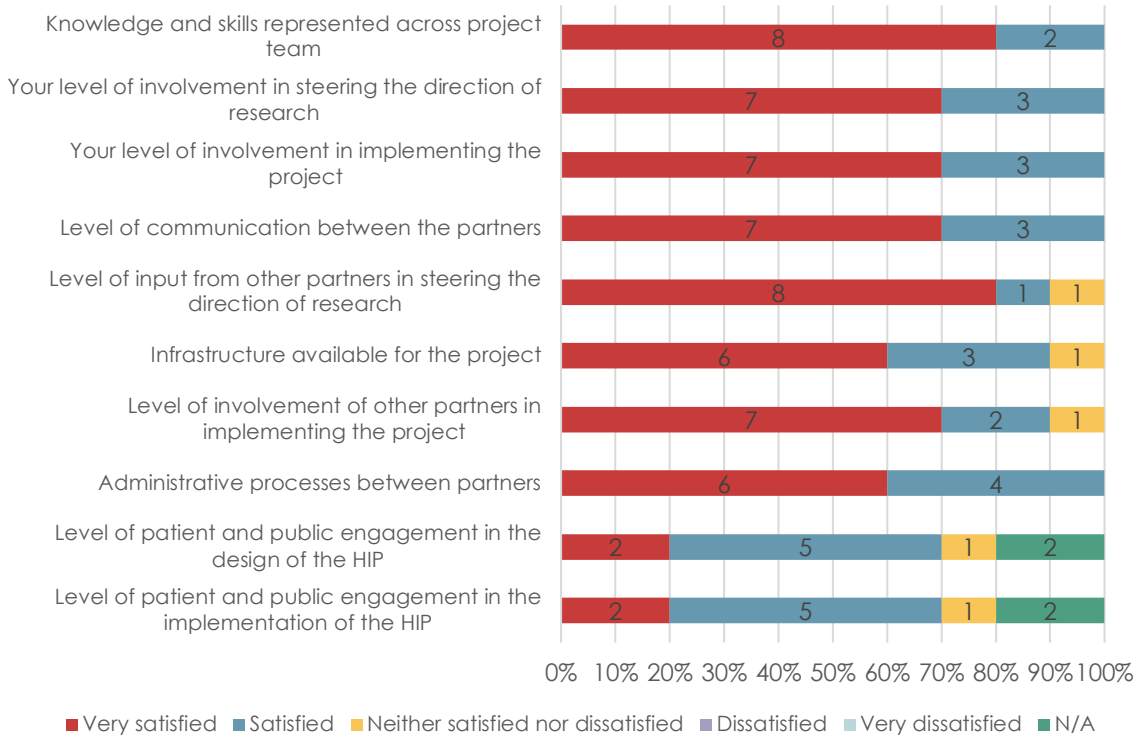
The majority of survey respondents (76% or more of PIs and 90% or more of the partners) were very satisfied with various aspects of the HIP collaboration, especially with their level of involvement in steering the direction of research and implementing the research, as well as the knowledge and skills represented across the project team (Figure 7). They were also largely satisfied with communication, infrastructure and administrative processes between partners.

[13] One project did not report partner data and is therefore removed from this analysis.

Figure 7 Extent of satisfaction with aspects of project collaboration (a, PIs; b, partners)
(a)



(b)



Source: Technopolis analysis of survey data

3.2.3 *Public and patient involvement (PPI)*

According to the PIs interviewed (13 HIPs), most projects did not have explicit PPI but about a third mentioned that they planned to involve healthy volunteers and/or patients to test their technology/device is working. However, where PPI was included, about half of the projects had not yet reached the testing stage. Responses to the survey were also mixed in relation to satisfaction with the level of patient and public engagement (Figure 7).

When this aspect was explored in interviews, HIP partners commented that clinical partners adequately represented the patient/user perspective and that the research being conducted in the HIPs was at too early a stage to require formal and direct patient and public involvement.

3.3 Outputs, outcomes and impacts

Outputs and outcomes data were obtained through ResearchFish, survey and interviews. Where possible data were aggregated across these three sources. As such, all but three HIPs (from 2018/19 call) were covered to a certain extent by at least one source. Information on outputs and outcomes was not available uniformly across all HIPs depending on the data source, hence the total number of HIPs (n) against which each output/outcome was normalised differed.

ResearchFish data were available for 26 of the 36 projects. Where possible, any outputs, outcomes and impacts that pre-date the award were excluded from these data.

3.3.1 *Research findings*

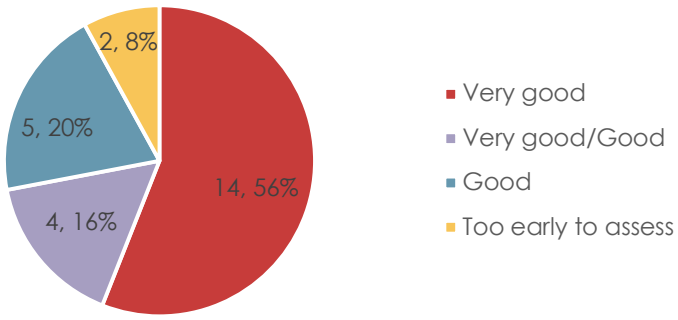
Indicator: 26 out of 33 HIPs (79%) have research findings [Source: ResearchFish, survey, interviews]

Of the 26 projects covered in the survey, respondents from 20 reported that their HIP project has resulted in research findings. In one instance, the industry partner's and academic lead's responses were conflicting, therefore the academic lead's response was selected. From ResearchFish and interview data, another 6 HIPs out of 7 reported research findings. In total, therefore, 26 out of 33 HIPs have research findings.

Indicator: 27 projects (90%, n=30) resulted in an improved understanding of the nature and scale of potential for the technology under investigation [Source: survey, interviews]

The majority of survey respondents for each project felt that the potential of the technology/ approach under development for further progress and impact was either 'very good' or 'good' (92%, 23 of 25). Four projects are coded as both very good and good as different respondents from the project gave different responses (Figure 8). All interviewees except one stated that they had a better understanding of the potential of the technology for use and impact as a result of the HIP.

Figure 8 Potential of the technology/approach under development for further progress



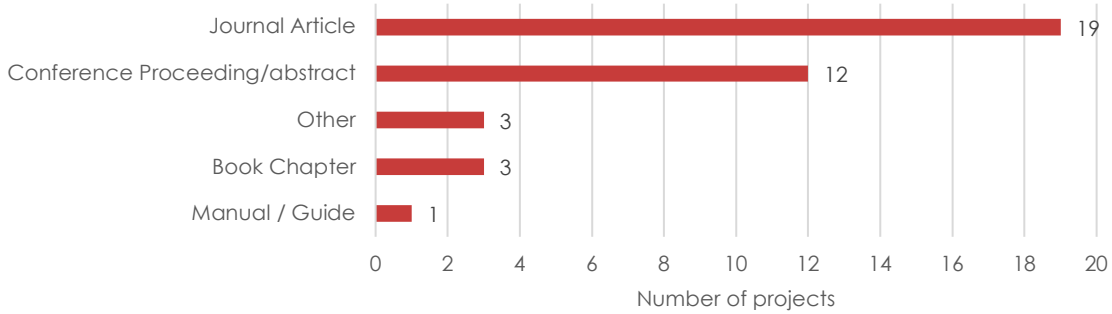
Source: Technopolis analysis of survey data

3.3.2 *Dissemination*

Indicator: 144 publications from 21 HIPs (median 5 per project) [Source: ResearchFish]

The majority of PIs (81%, 21 of 26) reported publications in ResearchFish. The number of publications per project ranged from 1 to 20 with a median of 5 publications. The majority of PIs (73%, 19 of 26) reported at least one journal article (Figure 9). Conference proceedings/abstracts were reported by about half of the PIs (46%, 12 of 26).

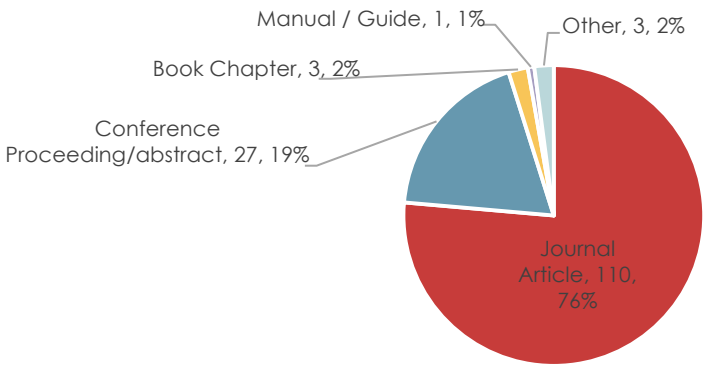
Figure 9 Publication types reported by PIs



Source: Technopolis analysis of ResearchFish data

Of the 144 publications reported, the majority were journal articles (76%, 110 of 144), followed by conference proceedings/abstracts (19%, 27 of 144) (Figure 10).

Figure 10 Proportions of publication type



Source: Technopolis analysis of ResearchFish data

Indicator: 98 dissemination activities across 16 HIPs (average 3.8 activities per HIP, n=26), 71 (72%) of which are participation in workshop or similar and talk/presentation. Majority of dissemination activities (56 of 98, 57%) have international reach. [Source: ResearchFish]

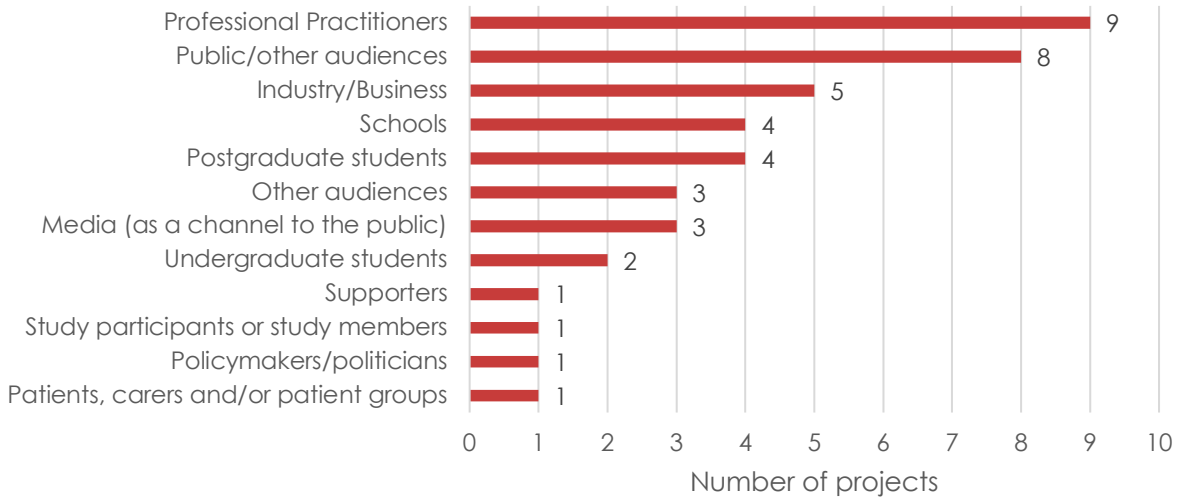
Sixteen projects reported dissemination activities in ResearchFish. The most frequently reported form of dissemination across the 16 projects was 'Participation in an activity, workshop or similar' (69%, 11 of 16) followed by 'A talk or presentation' (63%, 10 of 16)(Figure 11).

Figure 11 Form of dissemination

Source: Technopolis analysis of ResearchFish data

The reported dissemination activities targeted a range of audiences, most frequently professional practitioners (56%, 9 of 16 projects) and public/other audiences (50%, 8 of 16 projects) (Figure 12).

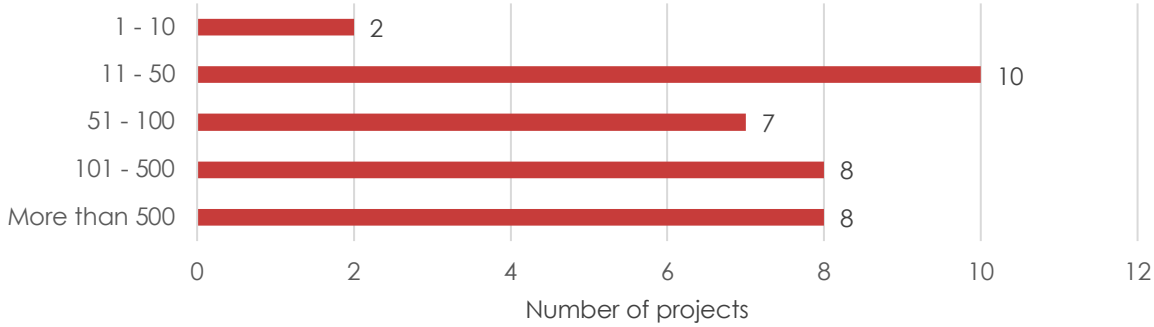
Figure 12 Primary audience of dissemination activities



Source: Technopolis analysis of ResearchFish data

Audience size varied, with most projects (63%, 10 of 16) reporting at least one dissemination activity with an audience size between 11 – 50 (Figure 13). Half the projects (50%, 8 of 16) had a dissemination activity with an audience of more than 500 people.

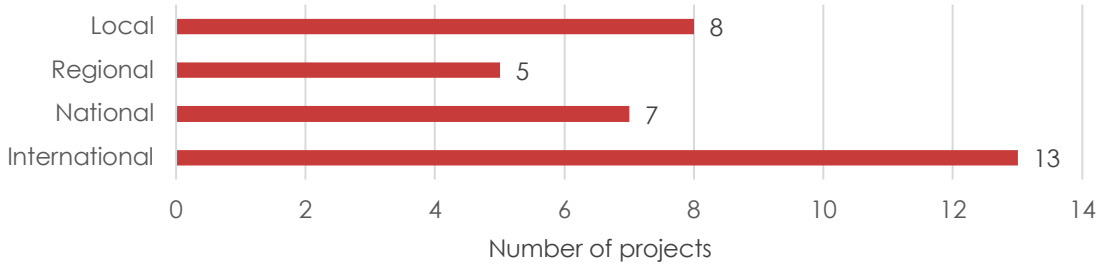
Figure 13 Audience size of dissemination activity



Source: Technopolis analysis of ResearchFish data

The majority of projects reported dissemination activities that had an international reach (81%, 13 of 16) (Figure 14). Other activities were spread between local, regional and national reach.

Figure 14 Geographical reach of dissemination activity



Source: Technopolis analysis of ResearchFish data

3.3.3 *Outputs related to research environment*

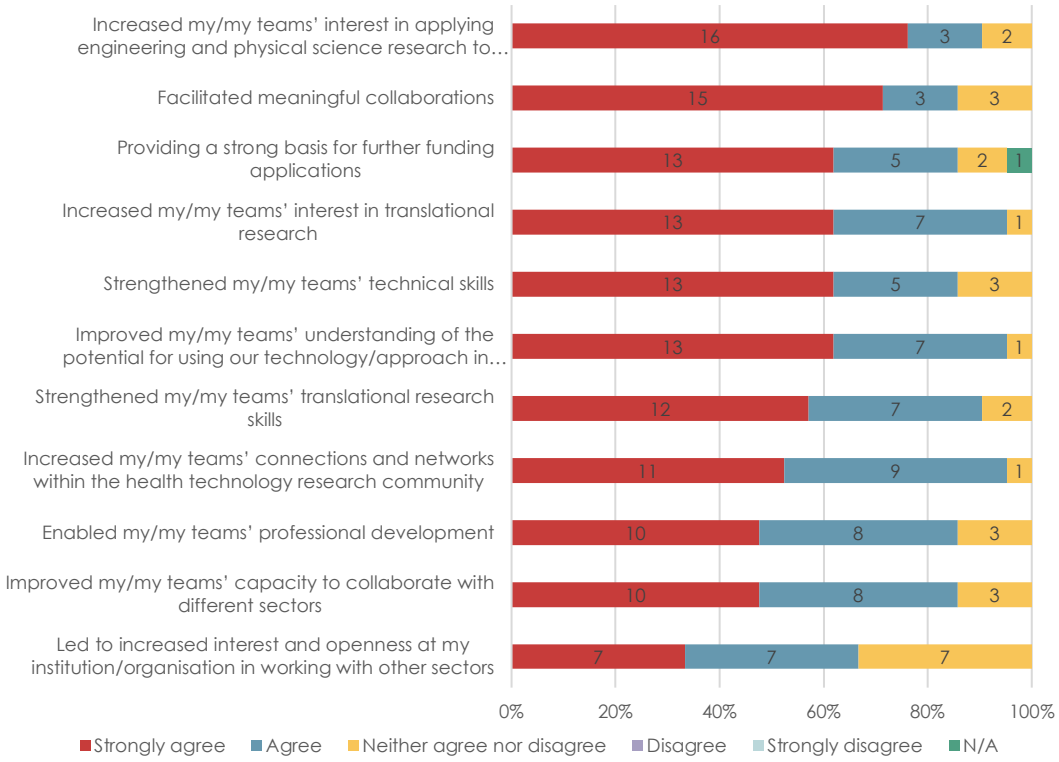
Indicators [survey, interviews; n=30 partnerships]:

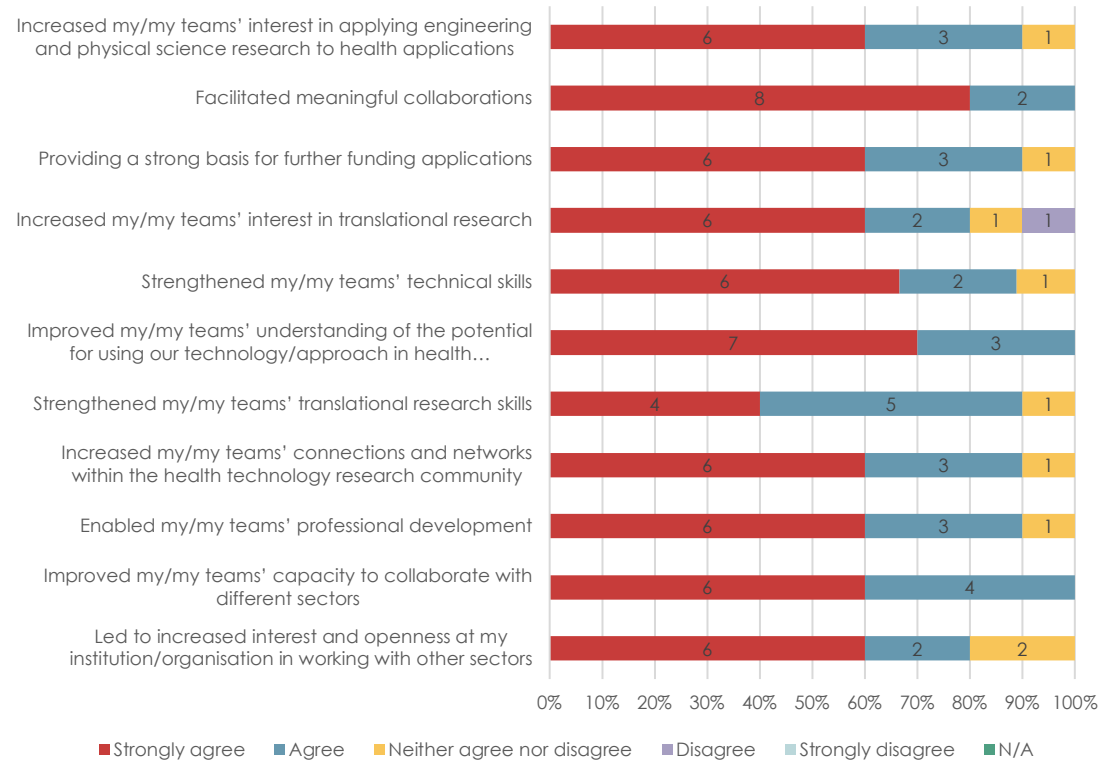
- 25 (83%) partnerships reporting improved capacity to work in cross-sectoral teams
- 26 (87%) partnerships reporting improved translational research skills
- 25 (83%) partnerships with researchers reporting enhanced interest in applying their research to health applications as a result of the HIP
- 25 (83%) partnerships with researchers reporting enhanced interest in translational research activities as a result of the HIP

In the survey, the majority of PIs strongly agreed that the HIP has increased personal and team interest in applying EPS research for health applications, and has facilitated meaningful collaborations (76% each, 16 of 21, Figure 15). The highest level of uncertainty (33%, 7 of 21 respondents neither agreeing or disagreeing) was around whether the HIP had led to increased interest in and openness to working with other sectors within the respondent's organisation. Nevertheless, responses from both PIs and partners were overall highly positive with regard to HIPs leading to increased interest, skills and capacity for conducting translational research and collaborating with other sectors (Figure 15).

All interviewees reported skills and knowledge development for team members including better understanding of the needs of other sectors and the translation process. Exposure to how other sectors work as well as development of interdisciplinary and technical skills was found to be beneficial to both postdoctoral researchers and PhD students, whether they were directly involved in the project or not. Similarly, clinicians and industry partners also improved research skills and knowledge of cutting-edge academic research. Clinicians particularly also benefited from learning more about the translational pathway and medical product development.

Figure 15 Degree of agreement regarding skills and knowledge outputs from the HIPs (%)among PIs (top panel) and partners (bottom panel)





Source: Technopolis analysis of survey data

3.3.4 *Other reported outputs*

Indicators [ResearchFish]:

- 3 research tools developed/improved including new models for testing and assay methods
- 14 technical products/software developed/improved including devices, non-imaging diagnostic product, imaging software, simulation software and automation system
- 1 annotated database with ultrasound and acoustic data from child speech therapy sessions and tools to visualise and process the data
- New technical knowledge was developed in terms of requirements and revised methods for application of the technology/approach under development in a real-world setting

A range of other outputs were reported by PIs in ResearchFish. A brief summary of these is presented in Table 6.

Table 6 Other reported outputs

Output/outcome	Total number reported	Number of projects reporting output/outcome
Medical products	8	3
Research tools	3	3
Artistic creative	1	1
Research database	1	1
Software	6	1
Other	1	1

Source: Technopolis analysis of ResearchFish data

3.3.5 *Take up or further development of outputs*

Indicators:

- 105 journal articles have been cited 1116 times in peer-reviewed literature at an average of 10.6 citations per article [Scopus]
- 6 of 30 (20%) partnerships reporting take-up of knowledge by wider research community [Survey, interviews]
- 1 of 30 (3%) partnerships reporting take-up of database by the wider research community [Survey, interviews]
- 17 (70%) HIP technologies have advanced along the TRL scale from 24 partnerships [Survey, interviews]

105 of the 110 journal articles were recognised in Scopus, of which 52 are open access and 16 have no citations to date. The summary of citations accrued for journal articles are shown in Table 7 below.

Table 7 Citation summary for journal articles attributed to HIP grants in ResearchFish

Publication year	2013	2014	2015	2016	2017	2018	2019
Number of publications	1	5	18	16	23	39	3

Total citations	6	325	199	197	184	203	2
Average citations	6	65	11	12	8	5	1
Citation range (min-max)	6-6	8-204*	2-29	0-70	0-24	0-29	1-1

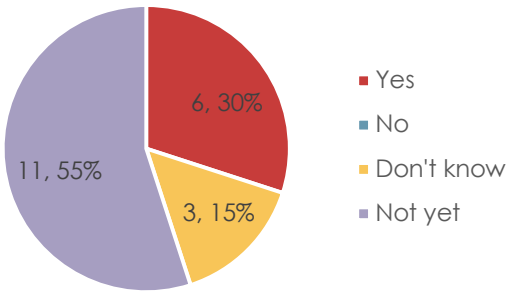
Source: Technopolis analysis of Scopus data

* Top citation: Uptake and retention of microplastics by the shore crab carcinus maenas; Watts A.J.R., Lewis C., Goodhead R.M., Beckett S.J., Moger J., Tyler C.R., Galloway T.S. Environmental Science and Technology. Field-Weighted Citation Impact[14] = 6.5

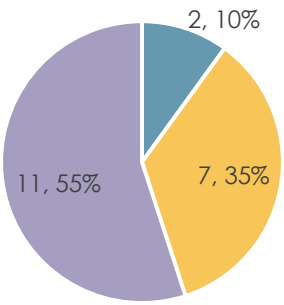
Of the 20 projects reported to have findings in the survey, 30% (6 of 20) reported that others had used the new knowledge generated (e.g. in patent application, commercial evaluation, and research) and 45% (9 of 20) reported the technology/approach under development had progressed along the translational research pathway (e.g. pre-clinical or clinical trial, informing regulatory requirements). However, the most common response was that these outcomes had not yet been achieved (Figure 16).

Figure 16 Reported research outcomes by project

(A) Others used the new knowledge generated by the HIP

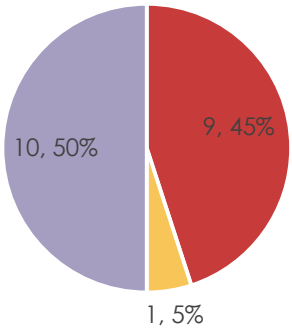


(B) Others used research outputs generated by the HIP (such as tools, databases, software, methods etc.)



[14] Field-Weighted Citation ImpactField-Weighted Citation Impact shows how well cited this document is when compared to similar documents. A value greater than 1.00 means the document is more cited than expected according to the average. It takes into account: (i) The year of publication; (ii) Document type, and (iii) Disciplines associated with its source. The FWCI is the ratio of the document's citations to the average number of citations received by all similar documents over a three-year window. Each discipline makes an equal contribution to the metric, which eliminates differences in researcher citation behaviour.

(C) The technology/approach under development progressed along the translational research pathway



Source: Technopolis analysis of survey data

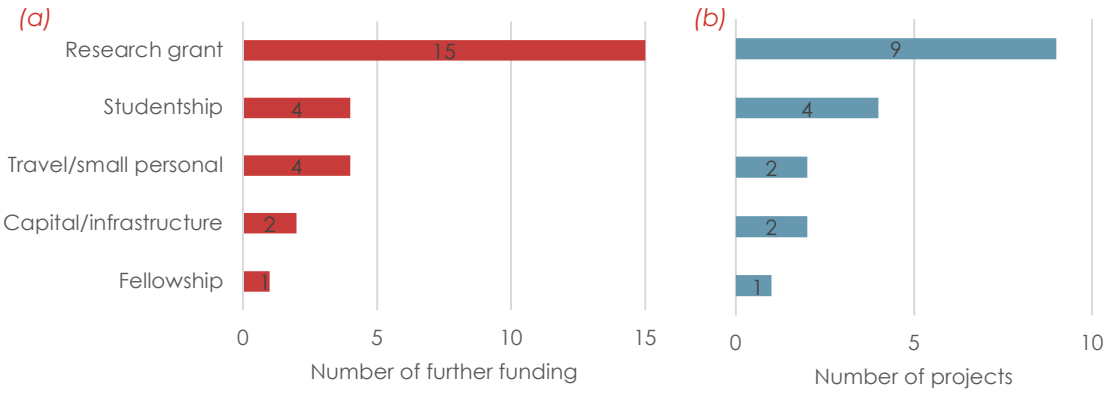
The study team scored the current technology readiness level (TRL) of technologies being developed in 24 projects based on information available in the interviews and survey. Of these, 7 (29%, n=24) were at TRL 2 (initial development, Table 12 in Appendix A) either in the process of establishing early proof of concept or prototypes, 9 (38%, n=24) were at TRL 3 (refinement not in humans/testing environment) and one (4%, n=24) in TRL4 (refinement in humans/operational environment) undergoing initial clinical trials. With many of the projects still ongoing, further progress along the TRL scale can be expected.

It is not possible to differentiate between follow-on funding and other funding in the data available from the survey and ResearchFish. Moreover, as these are self-reported data, it is difficult to confidently attribute the acquisition of any funding directly to the HIP. Most of the projects however are still ongoing and are not at the stage to apply for funding for further development of the technology/approach. Hence, it was not possible to populate the indicator "Number of HIP technologies with follow-on research funding from other funders". However, across ResearchFish and the survey, 18 HIPs reported further funding.

In ResearchFish, 10 PIs reported further funding ranging from 1 – 9 (median 2) instances per project. Research grants accounted for the majority (90%, 15 grants across 9 projects,

Figure 17).

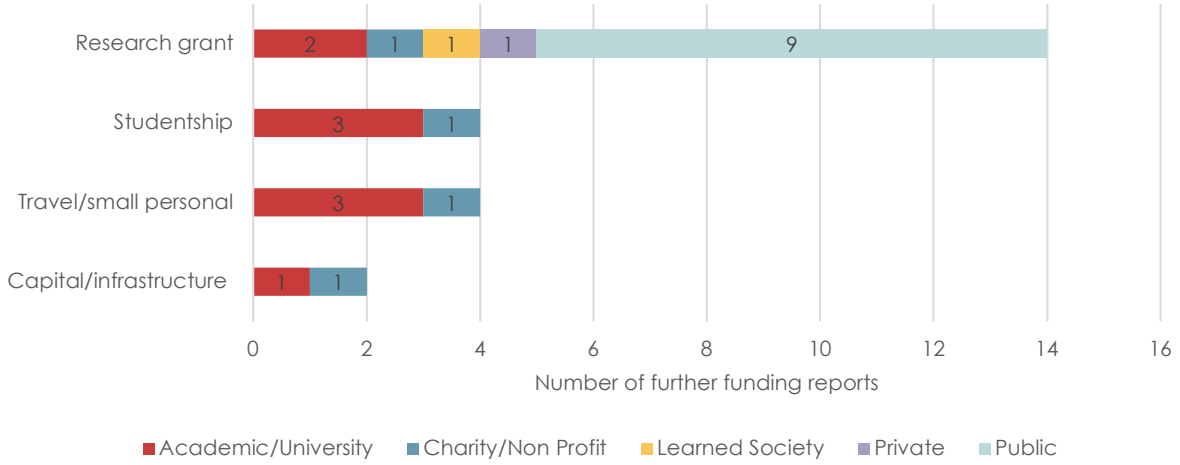
Figure 17 Type of further funding reported by (a) total count and (b) count per project



Source: Technopolis analysis of ResearchFish data

Funding sector was not known for two further funding cases. Across the remaining 24 cases, public funders and academic/university funders, each accounted for over a third of the reported funding (38%, 9 of 24 grants each) (Figure 18). Research grants were primarily from public funders (64%, 9 of 14 research grants) with EPSRC accounting for 6 and Innovate UK, Research Councils UK and NIHR/HEFCE accounting for the remaining 3. Both studentships and travel/small personal funding were primarily funded by academic/university sources (75%, 3 of 4).

Figure 18 Count of further funding type by funding source sector



Source: Technopolis analysis of ResearchFish data

Public funders accounted for the majority of all further funding, accounting for 78% of the total funding amount reported (Table 8). Charity/non-profit, Private and Learned Society sectors accounted for comparatively small amounts (<2% of the grand total).

Table 8 Amount of further funding per funder sector

Funding sector	Number reported	Median (£)	Range (£)	Total (£)	% of grand total
Public	9	370,000	10,000- 5,752,646	12,414,425	78.0
Academic/University	9	75,000	1,000 – 1,880,000	2,977,198	18.7
Charity/Non-profit	4	18,230	9,980 – 199,714	256,154	1.6
Private	1	250,000	n/a	250,000	1.6
Learned Society	1	10,000	n/a	10,000	0.1
			Grand total	**15,907,777**	

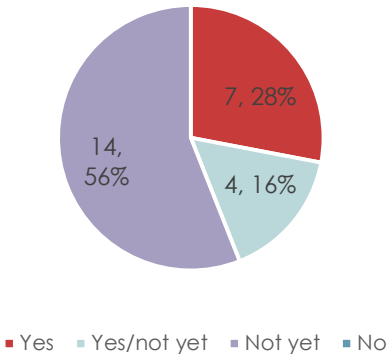
Source: Technopolis analysis of ResearchFish data

The survey analysis also shows that the majority of HIPs have not yet led to further project funding (56%, 14 of 25, Figure 19). For four projects, different respondents noted different outcomes – funding secured and funding not yet secured – perhaps owing to the fact that one respondent received funding but the others did not. While the likelihood of securing further

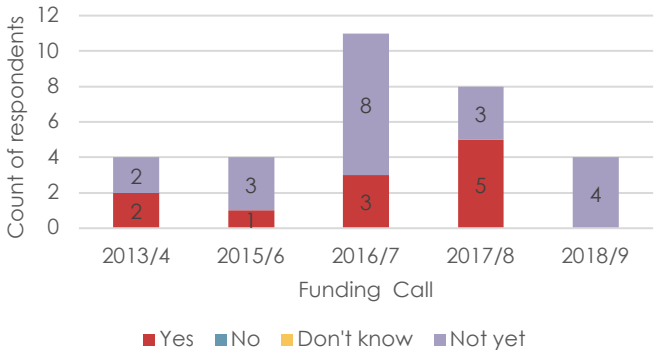
funding is expected to be higher for projects funded under older calls, interestingly more instances of further funding were reported for the 2017/18 call (across 6 projects) than the 2016/17 call (across 7 projects). However, the survey response rate is not uniform across the calls (Figure 19), so a robust comparison is not possible. Moreover, as discussed earlier, further funding may represent additional funding, not attributable to the HIP. In the interviews, PIs stated their intention to either leave further development of their technology to industry or to apply for follow-on funding from sources such as UKRI (e.g. MRC, Innovate UK, Strengths in Places Fund), NIHR or Wellcome Trust.

Figure 19 Further funding secured due to the HIP project by (a) project and (b) respondent and call

(a)



(b)



Source: Technopolis analysis of survey data

Indicator: 7 new patent applications or registrations from HIPs [ResearchFish; n=26 projects]

ResearchFish data shows 7 reports of patents from 6 projects. Some of the reported patents were not considered in the analysis as they preceded the grant date. The patents reported in ResearchFish related to devices, novel biomaterials and their production methods, and drug delivery methods. Interviews provided further details. In one case, the technology has been developed into a prototype device and negotiations are ongoing with a company for further development and manufacturing. Two of the interviewees reported new patent applications being developed.

3.3.6 *Outcomes relating to the research environment*

Indicators:

- 15 (50%, n=30) partnerships reported continued collaboration beyond HIP [Source: survey, interviews;]
- 5 new collaborations due to the HIP and 13 partially existing collaborations reinforced [Source: survey, interviews; n=30]
- 26 (87%, n=30) partnerships reporting that the HIP had supported their or team members' professional development [Source: survey, interviews]

Similar numbers of survey respondents indicated that their HIP project was based on an existing or partially existing collaboration (Figure 20). In cases where a new or partially existing partnership was reported, new partners were identified most commonly through networking

events (32%, 6 of 19 respondents) or recommendation by a shared contact (26%, 5 of 19 respondents) (Figure 21).

In the interviews, we again found that the partners had either previously worked together or were already known to each other. Many had longstanding collaborations with either their industry or clinical partners.

Figure 20 Origin of partnership/collaboration

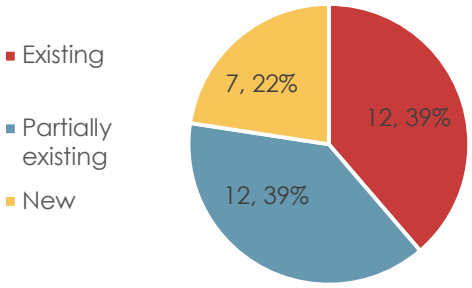
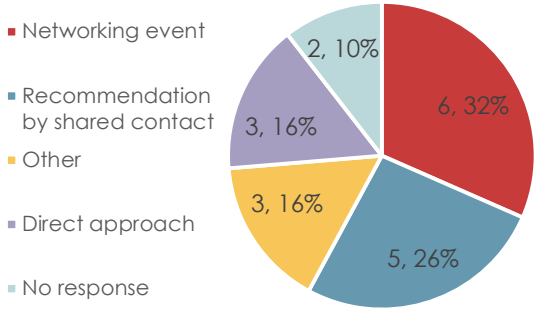


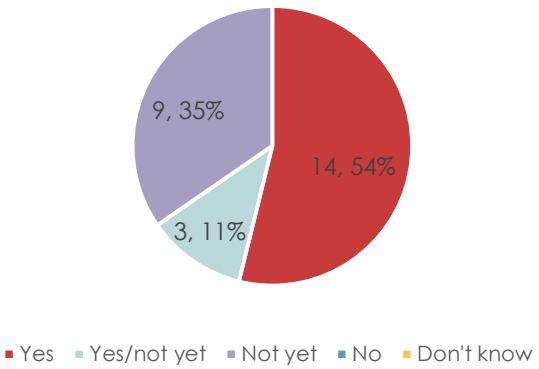
Figure 21 How project partners were identified



Source: Technopolis analysis of survey data. N.B. Numbers represent number of survey respondents

Other collaborative projects with the project partners were also reported for the majority of HIPs in the survey(54%, 14 of 26) (Figure 22). Respondents gave differing answers (yes as well as not yet) for 3 HIPs. In the interviews and survey, several PIs indicated that they were submitting funding applications with their HIP partners to funders such as EPSRC, Innovate UK, NIHR, universities and charities.

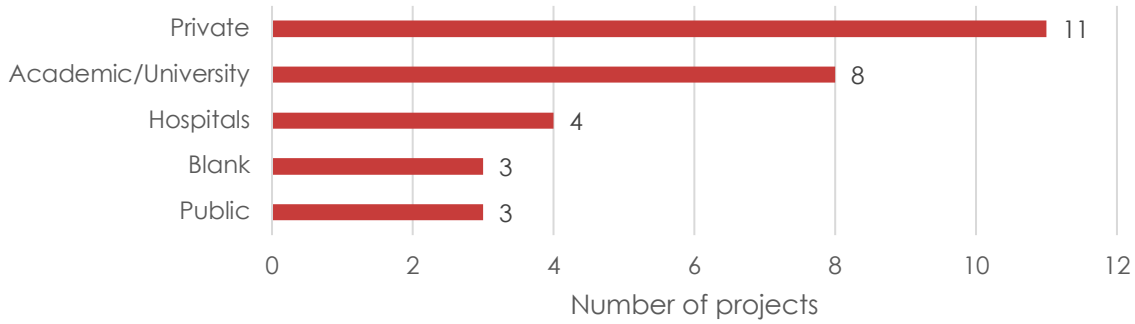
Figure 22 Further collaborative projects with HIP project partners



Source: Technopolis analysis of survey data. N.B. Numbers represent number of projects

Collaborations were reported by 17 out of 26 PIs in ResearchFish. The overall number of collaborations was 36, with 1 to 5 collaborations (median 2) reported per project. Two-thirds of all collaborations were made under a formal agreement (67%, 24 of 36). The most frequently reported collaboration was with the private sector (65%, 11 of 17) followed by the academic/university sector (47%, 8 of 17) (Figure 23).

Figure 23 Count of projects per collaboration sector



Source: Technopolis analysis of ResearchFish data

Career progression in academia or industry was also reported for junior members of the research team in the interviews. For instance, several PIs reported that their postdoctoral researchers were applying for fellowships and PhD students as well as postdoctoral researchers were finding jobs in industry. In one instance, involvement in the HIP led a clinical fellow to pursue a PhD. Survey responses also indicated that HIPs were leading to increased professional development for respondents and/or their team members – 86% of PIs (n=21) and 90% of partners (n=10) agreed or strongly agreed that this was the case (Figure 15).

3.3.7 Other outcomes

7 policy-related outcomes were reported from 2 HIPs in ResearchFish. However, these were all in the form of membership of a guideline or advisory committee, or participation in a national consultation. No change in guidelines was reported apart from one HIP contributing to a new International Organization for Standardization (ISO) standard for testing the performance of hip replacements.

As outcomes related to commercialisation and uptake into guidelines or clinical practice have not yet been achieved, no economic or health impact can be seen as yet. This is also due to the maturity and stage of the research, as most HIPs are still ongoing.

Ten PIs reported recognition-type outcomes in ResearchFish. The number of recognitions per project ranged from 2 to 14 with a median of 2. The most frequently reported recognition was 'Research Prize' (60%, 6 of 10) followed by 'Personally asked as a keynote speaker to a conference' and 'Prestigious/honorary/advisory position to an external body' (50%, 5 of 10, each) (Figure 24).

Figure 24 Reported recognitions

Source: Technopolis analysis of ResearchFish data

3.4 Value of HIP project to different stakeholders

According to interviewees, while the academic partners were most actively involved in running the project and conducting the research, industry and clinical partners provided advice in both the design and implementation phase on aspects such as the market for the technology and the clinical, technical, manufacturing and regulatory requirements. The input was usually provided to the research team on an ongoing basis by individual partners with periodic meetings for all the people involved in the project. Patient and public involvement tended to be restricted to feedback on the technology being developed. The patient view was typically represented by clinical partners (if any) in the design and implementation phase. Nonetheless, according to interviewees, early engagement with industry and clinicians ensures that the end-user and production needs are considered early on, enabling greater likelihood of economic and health impact.

Across the interviews and the survey, PIs and partners cited the main value of the HIP as enabling the three-way cross-sectoral collaboration which helped them to work towards applying EPS research and technologies in a real-world, healthcare setting. It also enabled them to consolidate their research programme and provided a platform to get further funding to develop their technology/approach for practical use.

3.5 Challenges and enablers

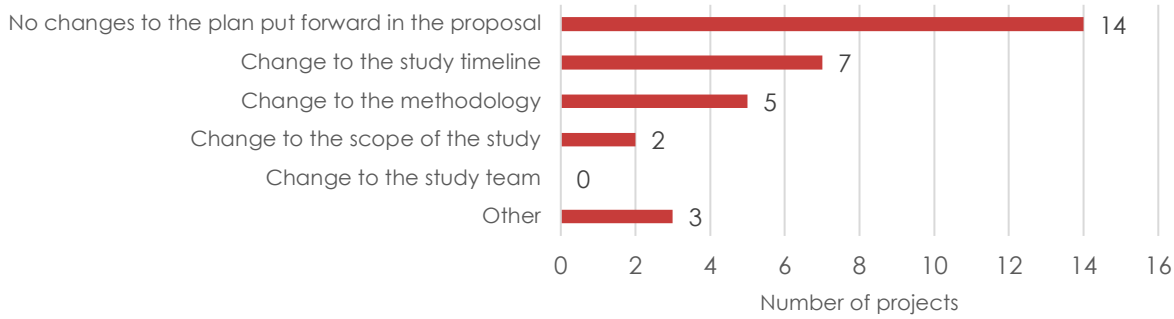
According to interviewees, some of the challenges experienced in the implementation of HIP projects included technical challenges, adapting to the different needs and ways of working in different sectors, staff turnover and recruitment, and managing the competing availabilities of a large team. More time spent on getting ethical approval and IP agreements than anticipated led to delays in several projects. In two projects, changes in industry partners created challenges.

Conversely, previous experience of working together, geographical proximity of partners, and having common objectives were highlighted as enablers of progress towards the desired outcomes by interviewees. In the survey, PIs reported that the collaboration between different sectors was helpful in driving the research forward by providing new perspectives, knowledge transfer opportunities and focus. Access to resources (e.g. expertise, facilities, material) from partners was also mentioned as a helpful aspect. Across the survey and interviews, partners mentioned that access to cutting edge research and ideas from academia, good communication and rapport as well as shared motivation acted as enablers.

Of the 26 projects covered in the survey, representatives from 17 reported that there were no changes to the plan as put forward in the proposal. However, there were four instances where both PIs and partners from the same project reported different adjustments. In two cases the industry/clinical partner reported no changes, but the PI indicated there were, presumably because partners were not involved in all aspects of the project. In one case different changes were reported by the PI and partner, and in another case the PI reported no change and the clinical partner reported an extension to the study timeline. The clinical partner went on to explain that the change had only recently been implemented which may explain the discrepancy in the answers. For cases where 'no changes' was selected in addition to a change, the response has not been counted towards the 'no change' total.

The most common reported change was to the study timeline (27%, 7 of 26), followed by the methodology (19%, 5 of 26) (Figure 25).

Figure 25 Changes made to plan put forward in proposal

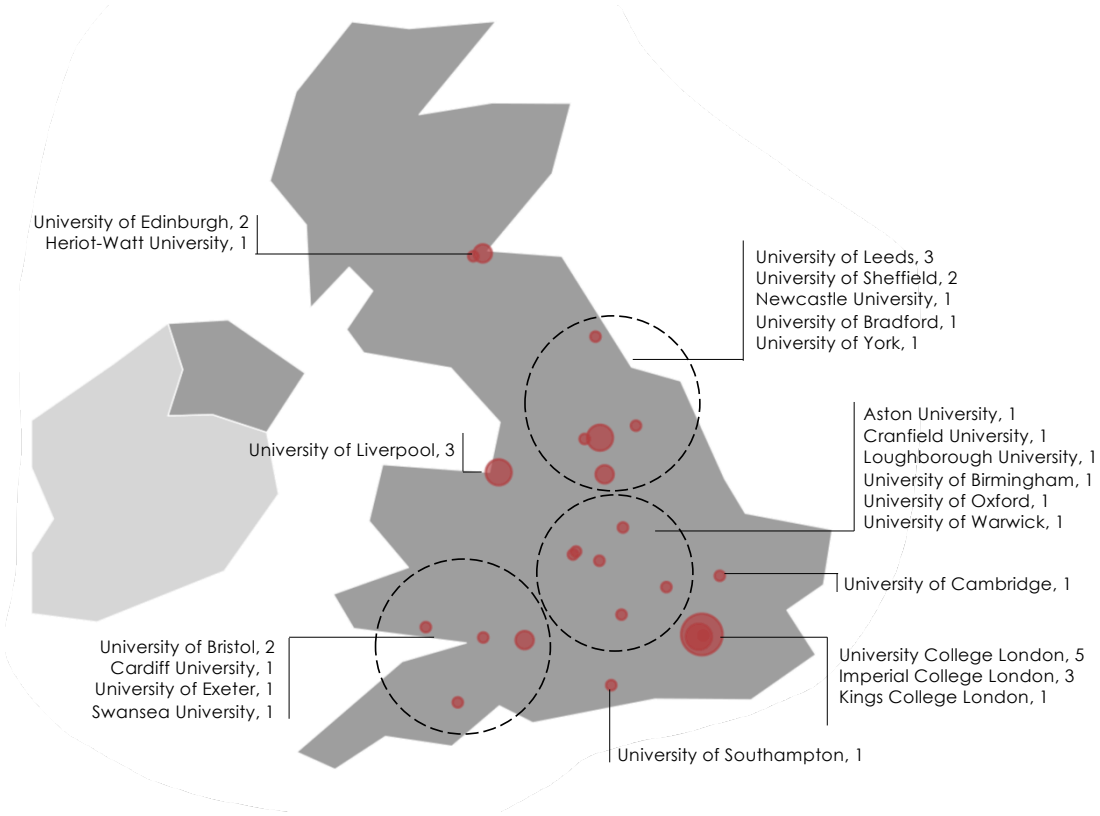


Source: Technopolis analysis of survey data

The most common reasons for changes included to improve the study/research outcomes and staff moving into different roles. Other reasons included problems with industry partners and unavailability of key chemical reagents. Among the HIPs discussed in interviews, only minor changes were made to the technical approach and timeline owing to changes in priorities or understanding based on findings and learnings from the project.

To see if there was a concentration of grants in one region, we analysed grant data. Analysis showed that the awarded institutions are quite diverse with the median number of grants awarded to each institution equalling one. University College London received the highest number of grants (n=5), followed by the University of Leeds, University of Liverpool and Imperial College London with three grants each (Figure 26).

Figure 26 Location of principal investigators of HIP grants



Source: Technopolis analysis of EPSRC grant data

4 Process evaluation

Across interviewees and survey respondents, the HIP scheme's design, call process and management were viewed very favourably. Overall, PIs were positive about the HIP scheme with the majority selecting 'Very satisfied' for all but two aspects in the survey (Figure 27). Across all specified aspects, at least 86% of PIs and 60% of partners were either 'Very satisfied' or 'Satisfied'.

4.1 Design

The PIs interviewed stated that achieving impact from their research and progressing research towards a healthcare application were the main motivations for applying to the scheme. In their view, the scheme enables EPS researchers to take the first step to translation and early involvement of industry and clinicians, both key stakeholders for the development of healthcare applications. On the whole, the HIP participants interviewed were satisfied with the scope and funding on offer, stating that both were suitable for their needs. No specific barriers or disadvantages were identified. All interviewees advocated continuation of the HIP scheme.

When asked about their motivations for applying to the HIP scheme in the survey, around 50% of PIs (52%,11 of 21) identified wanting to move their technology further along the developmental pathway as their main motivation. Many PIs (38%, 8 of 21) stated that the HIP grant was a good fit for their needs and a small number (19%, 4 of 21) highlighted the opportunity to partner with industry and clinical partners. The translational focus was also appreciated, but two respondents were not satisfied with the budget on offer. From the partners' perspective, collaborating with the researchers involved, meeting a medical need and developing technical solutions were the main motivating factors for getting involved. Many respondents commented that the scheme had been highly useful for their research and should continue.

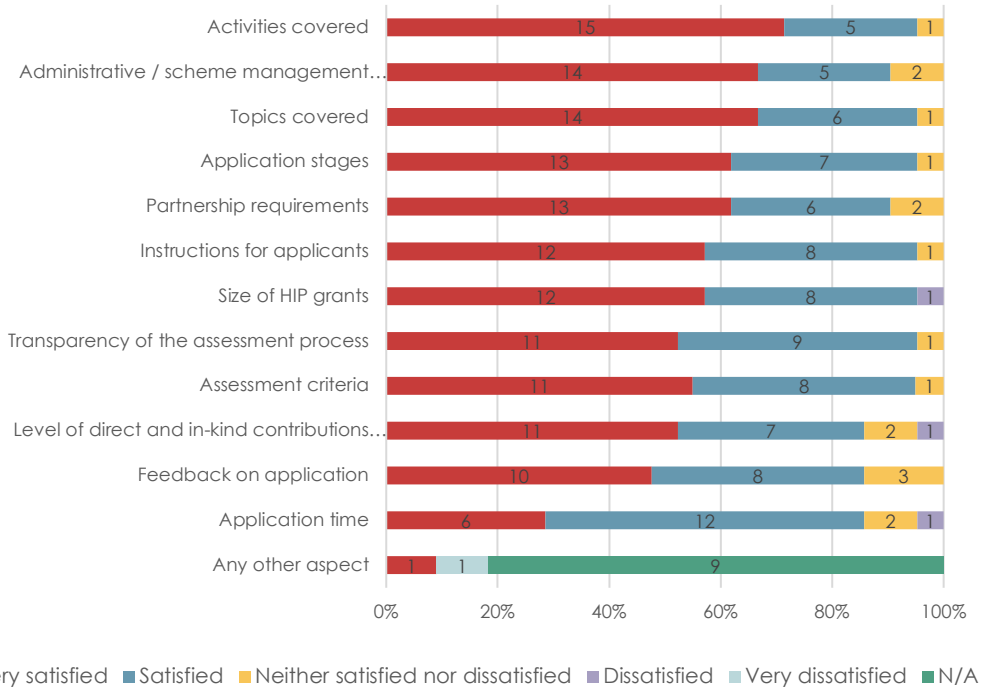
Other benefits that were noted included the fact that the scheme helped derisk investment into new technologies and covered higher TRLs, thus increasing interest and involvement of industry partners. A couple of PIs noted that the restricted nature of the scheme, i.e. the fact that a previous EPSRC grant is needed, lowers competition and gives them a greater chance of success.

One PI mentioned that their work while healthcare-related, does not naturally fit into the 'healthcare technologies' theme. Nevertheless, they submitted an application, which was successful. While this points to the flexibility of the current design, some relevant research might not be submitted or excluded due to the perception of the scope of the theme.

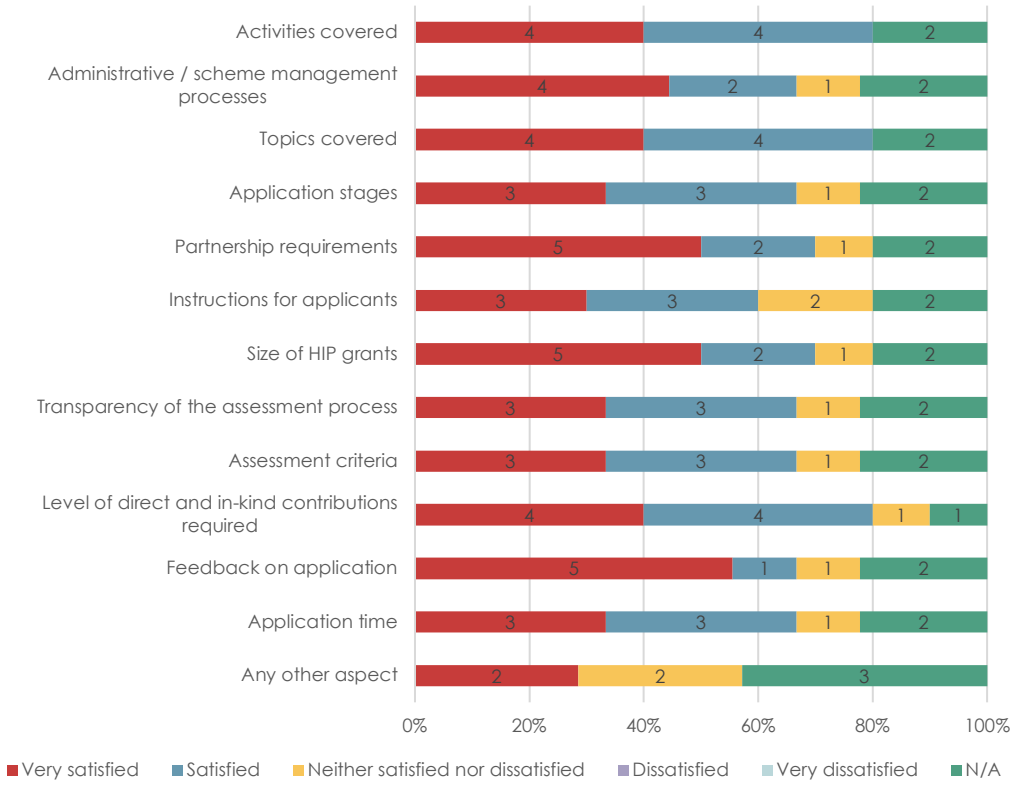
Survey respondents were most appreciative (highest 'very satisfied' responses) of design aspects such as the type of 'activities covered' in the HIPs (61%, 19 of 31 respondents) and 'topics covered' and 'partnership requirements' (58%, 18 of 31 respondents each) (Figure 27).

The consensus across interviewees was that the HIP attracts high-quality applications. However, one PI pointed out that excluding non-EPSRC research might also mean that the best ideas are not eligible for funding, while another PI commented that linking the HIP to one grant in a specified timeframe was artificial and unhelpful. Furthermore, interviews with EPSRC staff and our analysis in the previous chapter suggest that there is limited disciplinary diversity in the applications and very few proposals from EPS researchers who had not applied their research in a healthcare setting.

Figure 27 Satisfaction with various aspects of HIPs scheme (a, PIs; b, partners)
(a)



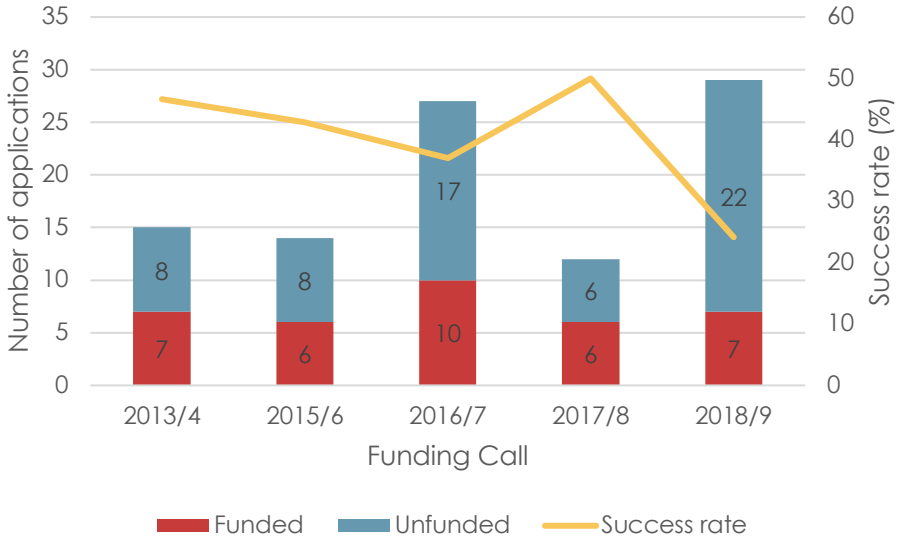
(b)



Source: Technopolis analysis of survey data

According to EPSRC grant data, the success rate of applications varied for each call ranging from 50% of applications to 24% (Figure 28). The highest number of applications were received in response to the 2018/19 call where 29 applications were received. The lowest number was 12 applications for the 2017/18 funding call.

Figure 28 Success rates



Source: Technopolis analysis of EPSRC grant data

Suggestions to improve the scheme's outcomes and impacts included the need for a national meeting or network of grantees facilitated by EPSRC to share outcomes and experiences; better publicity of the scheme outside academic circles; support for NHS ethical approvals, market research, consortium building, knowledge transfer and skills training (especially for postdoctoral researchers); and small follow-on funds to bridge translational gaps. One suggestion was to consider expanding the scheme into sectors beyond healthcare. A further point was made regarding costing clinician and SME participation accurately, possibly providing some funds to cover their time to ensure better and more regular engagement. One industry partner from an SME highlighted that they do not have funds for research and as such they need to be sufficiently convinced that any engagement in research activity will likely have a commercial benefit, which is difficult to judge considering where HIPs projects lie on the translational pathway.

Despite the fact that the HIP scheme fills a gap in the funding landscape, several interviewees were worried that a funding gap remains between the HIP scheme and other downstream funding, for instance to the point at which another grant scheme or industry can support further development. Consequently, the scheme's ability to facilitate economic and health benefit may be compromised if outputs from HIP projects are unable to progress to the market.

4.2 Call process

The HIP call process follows standard EPSRC processes and is based on peer review. Owing to the interdisciplinary nature of the projects and the variety of technology types being

developed, despite the ambition to recruit reviewers and panellists with the relevant expertise, it has often proved challenging[15].

The PIs were overall satisfied with the call process (across both interviews and the survey). In the survey, aspects concerning call processes such as assessment criteria, instructions for applicants, application stages, feedback on application, and transparency were seen as largely satisfactory by PIs, even though there were fewer 'very satisfied' responses compared to those for the scheme's design (Figure 27a). The only aspect that received some negative comments in both the interviews and survey was the application timeline. A number of PIs appreciated the feedback on their application and found it very useful.

4.3 Scheme management

The 'light-touch' post-award grant management was appreciated by PIs in interviews. They liked that EPSRC "let them get on with it" and was flexible around extensions when unforeseen delays occurred. This view was replicated in the survey where 67% (14 of 21) of PIs were 'very satisfied' with the administrative/scheme management processes.

4.4 Alternative sources of funding

Across the survey and interviews, most respondents felt that the HIP scheme fills an important gap in the landscape and is not easily replaced by another scheme. When asked where they would apply for funding if the HIPs scheme did not exist, the most common response was that they did not know where else they could have applied for the same project. The nearest alternatives would include standard mode-EPSRC grants, followed by MRC (e.g. Biomedical catalyst), NIHR (e.g. Invention for Innovation scheme), Innovate UK, Wellcome Trust and Horizon 2020 funding. However, the focus and approach of the project would have to be adjusted to meet the remits of the other funders.

[15] Orientation interview with EPSRC staff

5 Comparison with standard-mode grants

5.1 Differences between the HIP scheme and standard mode

The main differences between the HIP scheme and standard-mode grants are the requirement in the HIP scheme for involvement of industry and clinical partners and the emphasis on impact generation. As such, the HIP scheme is more focussed and interdisciplinary compared to standard mode. In addition, the HIP scheme requires the PI to build on a previous EPSRC grant, which limits competition compared to standard-mode grants.

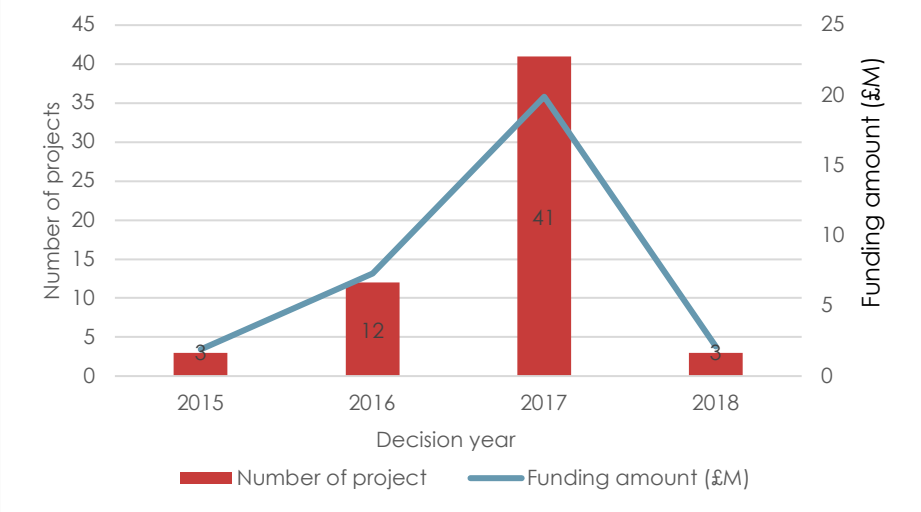
According to interviewees, by 'forcing' cross-sectoral collaboration, the HIP scheme fosters partnering with industry and clinicians, both key stakeholders for the development of healthcare applications. In this way, it offers value over and above standard-mode grants, especially in terms of accelerating potential impact from EPS research. This was echoed in the survey where the majority of respondents (72%, 18 of 25) highlighted the interdisciplinary focus, bridging academia, clinicians and industry as a major strength of the scheme.

Standard mode is seen as a better fit for basic research and trying out new ideas since it is less focussed and less restricted. Moreover, the types of research questions answered and mix of stakeholders involved differ between the two modes. The research questions will be more fundamental than applied in standard-mode grants and there is likely to be less involvement of non-academic stakeholders. As such, the timeline to impact can be expected to be longer for standard-mode grants.

5.2 Comparison of grant portfolio, outputs and outcomes

The majority of standard-mode projects (69%, 41 of 59) in the comparator portfolio were funded in 2017. The average project duration was 39 months. The value of projects funded ranged from £45,000 to £1,770,000, with a median of £450,000.

Figure 29 Number of projects and total funding amount per decision year



Source: Technopolis analysis of ResearchFish data

HIP award values range from £262,740 to £1,660,068 with a median value of £893,010 and an average project duration of 38 months. **Thus, HIPs tend to be larger grants compared to standard-mode grants.**

The 59 standard-mode grants spanned 30 host institutions. The institution receiving the most grants was Imperial College London which received 7 grants, followed by King's College London with 6, and University of Oxford and University College London with 5 each.

36 HIP grants span 23 institutions. Thus, there is **greater diversity in location among HIPs** and less concentration in the London-Oxford-Cambridge 'golden triangle' (30% versus 45% of grants respectively).

5.2.1 Research findings

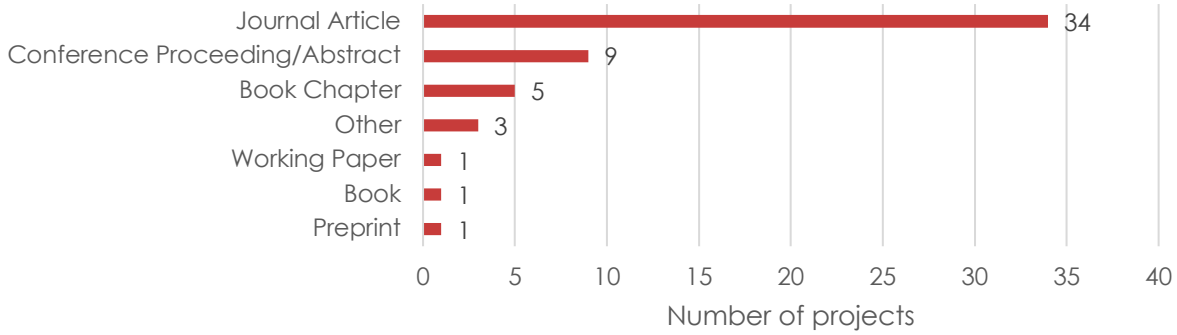
28 of the 59 standard-mode grants reported key research findings in ResearchFish (47%).

17 out of 26 HIPs (65%) reported key research findings in ResearchFish, which suggests that this **output is faster or more likely in the HIP scheme**.

5.2.2 Dissemination

The majority of standard-mode grant PIs reported publications (64%, 38 of 59). The number of publications per project ranged from 1 to 18 with a median of 3 publications. The majority of PIs (89%, 34 of 38) reported at least one journal article publication.

Figure 30 Publication types reported by PIs (standard-mode grants)

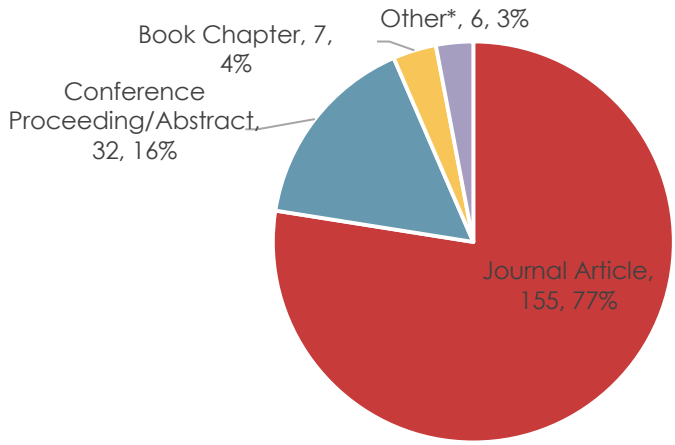


Source: Technopolis analysis of ResearchFish data

Overall, 200 publications were reported; the majority were journal articles (78%, 155 of 200, average 4.6 per project), followed by conference proceeding/abstracts (16%, 32 of 200).

144 publications were reported from 21 HIPs. The number of publications per project ranged from 1 to 20 with a median of 5 publications. Looking at peer-reviewed publications i.e. journal articles, the average number per project was 5.6 for HIPs. Thus, **HIPs lead to more publications per project** compared to standard-mode grants. This could be because HIPs are building on previous projects so the timeline to findings and publications may be shorter, or researchers are attributing publications originating from previous projects to the HIPs.

Figure 31 Proportions of publication type (standard-mode grants)



Source: Technopolis analysis of ResearchFish data

*Other includes other, working paper, book and preprint

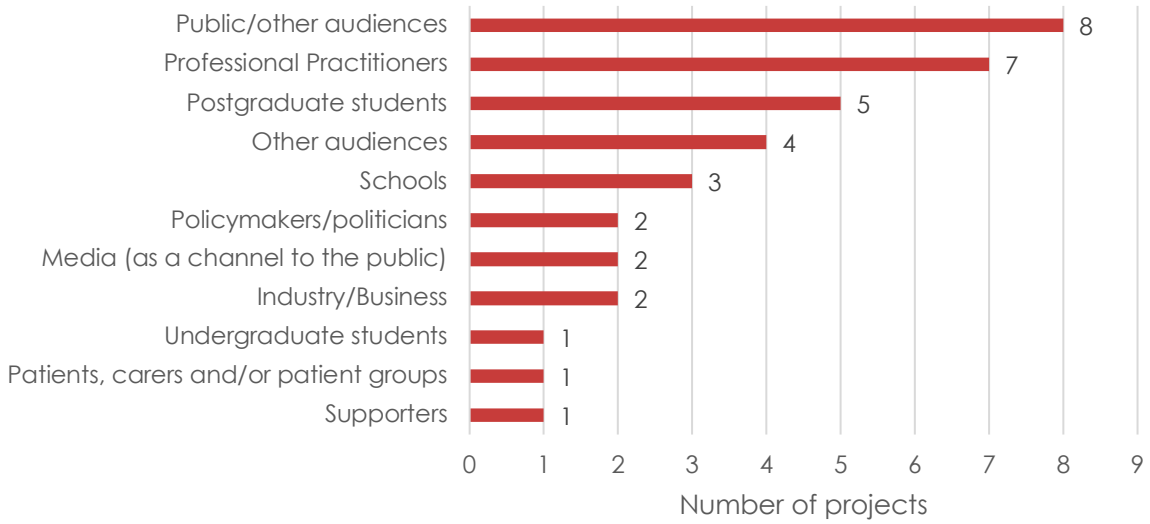
15 standard-mode grant PIs reported dissemination activities. The most frequently reported form of dissemination was 'Participation in an activity, workshop or similar' (67%, 10 of 15 projects), followed by 'A talk or presentation' (60%, 9 of 15 projects) (Figure 32).

Figure 32 Form of dissemination (standard-mode grants)

Source: Technopolis analysis of ResearchFish data

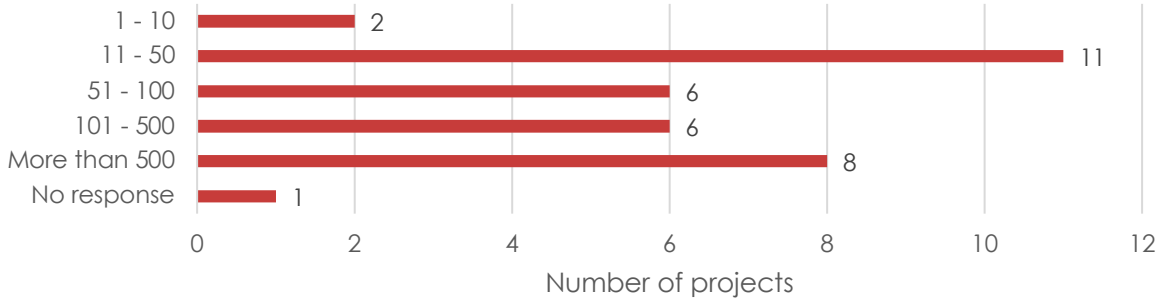
The reported dissemination activities targeted a range of audiences. The most frequently reported were public/other audiences (53%, 8 of 15) and professional practitioners (47%, 7 of 15 projects) (Figure 33). Audience size varied, with most projects (73%, 11 of 15) reporting at least one dissemination activity with an audience size between 11 – 50. Half the projects (53%, 8 of 15) had a dissemination activity with an audience of more than 500 people.

Figure 33 Primary audience of dissemination activities (standard-mode grants)



Source: Technopolis analysis of ResearchFish data

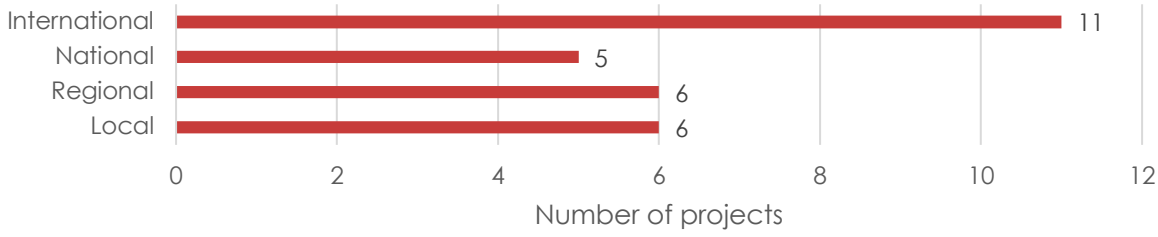
Figure 34 Audience size of dissemination activity (standard-mode grants)



Source: Technopolis analysis of ResearchFish data

The majority of projects reported dissemination activities that had an international reach (73%. 11 of 15, Figure 35). Other activities were quite evenly spread across local, regional and national audiences.

Figure 35 Geographical reach of dissemination activity (standard-mode grants)



Source: Technopolis analysis of ResearchFish data

98 dissemination activities were cited in ResearchFish across 16 HIPs, 71 (72%) of which were participation in workshop or similar and talk/presentation and the majority (56, 57%) of which had an international reach. The numbers are **fairly similar for the standard-mode grants** at 107 dissemination activities across 15 projects, 83 (76%) of which are participation in workshop or similar or talk/presentation and 56 (52%) of which have an international reach.

5.2.3 Other reported outputs

A range of other outputs were reported for standard-mode grants in ResearchFish. A brief summary of these is presented in Table 9.

Table 9 Other reported outputs (standard-mode grants)

Output/outcome	Number reported	Number of projects reporting output/outcome
Research tools and methods	5	5
Software	7	3
Medical Products, Interventions and clinical trials	3	3
Research database	5	2
Other	2	1
Artistic/creative	1	1

Source: Technopolis analysis of ResearchFish data

Research materials and tools reported included tools to assist in physiological assessment/ outcome measures and to improve research infrastructure. One method has helped to accelerate cardiac MRI and is currently being used by other researchers both within and outside the PI's institution.

Software outputs included the development of a motion correction technique for 2D images of the heart, creation of an algorithm to allocate projects to students based on preferences, and tools to aid the analysis of MRI brain scans. Both the motion correction technique and MRI analysis tools are reportedly being evaluated for clinical applications.

Medical product outputs included two diagnostic tools and one support tool for medical intervention. The support tool, a hydrostatic bioreactor for tissue engineering regenerative medicine, was co-developed with a company that has since been bought out. The design has led to further EPSRC funded projects and is being replicated by other companies. One of the diagnostic tools has been disseminated to clinical sites and is undergoing animal trials, the other has had a prototype developed and is awaiting clinical testing pending ethics approval.

Research database outputs include a database used to develop the Student-Project Allocation algorithm, a collection of models that could be used to match junior doctors to foundation posts, and a model to assess disease peripheral arteries.

Standard-mode grants reported more research tools and databases compared to HIP grants (5 vs 3 and 5 vs 1 respectively) but fewer technical products or software (10 vs 14). Considering more than twice as many standard-mode grants are covered in ResearchFish compared to HIPs, the **output numbers for HIPs are greater**. This is expected as HIPs are targeted towards creating products for the healthcare market, unlike standard-mode grants.

5.2.4 *Take up or further development of outputs*

146 of the 155 journal articles reported by standard-mode grant PIs were recognised in Scopus, of which 92 are open access and 32 have no citations to date. The summary of citations accrued for journal articles produced in standard-mode grants is shown in Table 10 below.

Table 10 Citation summary for journal articles attributed to standard-mode grants in ResearchFish

Publication year	**2016**	**2017**	**2018**	**2019**
Number of publications	5	53	57	31
Total citations	85	539	287	63
Average citations	17	10	5	2
Citation range (min-max)	7-39	0-140*	0-30	0-19

Source: Technopolis analysis of Scopus data

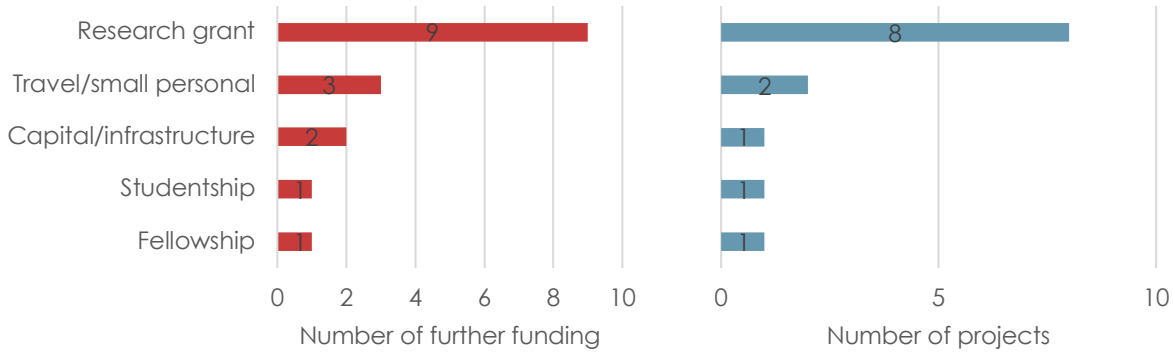
* Top citation: Materials for additive manufacturing, Bourell D., Kruth J.P., Leu M., Levy G., Rosen D., Beese A.M., Clare A. CIRP Annals - Manufacturing Technology. Field-Weighted Citation Impact[16] = 21

146 journal articles from standard-mode grants have been cited 974 times in peer-reviewed literature at an average of 6.7 citations per article. HIPs have on average 10.6 citations per article, thus **journal articles from HIPs appear to be cited more**. Publications from HIPs grants appear earlier compared to standard-mode grants (not before 2016). This might be because standard-mode grants are basic research grants testing new ideas/concepts while HIPs are building on previous work. However, it is also possible that PIs are attributing related publications originating from previous grants to the HIPs in ResearchFish.

11 standard-mode grant PIs reported further funding with a range of 1 – 3 (median 1) further funding instances per project. The most frequently reported funding type was research grants with 8 PIs (73%, n=11) reporting a total of 9 grants (Figure 36).

[16] Field-Weighted Citation ImpactField-Weighted Citation Impact shows how well cited this document is when compared to similar documents. A value greater than 1.00 means the document is more cited than expected according to the average. It takes into account: (i) The year of publication; (ii) Document type, and (iii) Disciplines associated with its source. The FWCI is the ratio of the document's citations to the average number of citations received by all similar documents over a three-year window. Each discipline makes an equal contribution to the metric, which eliminates differences in researcher citation behaviour.

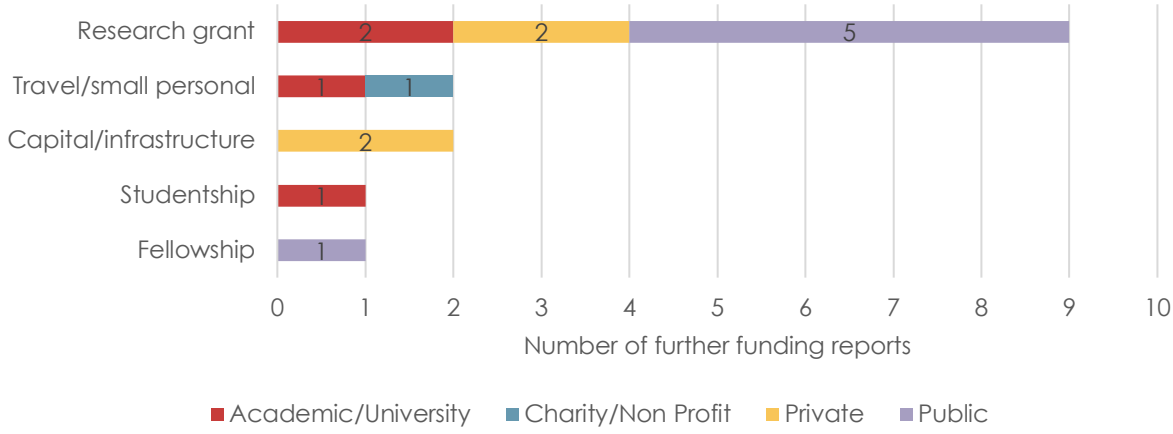
Figure 36 Further funding types (a) total count and (b) count per project (standard-mode grants)



Source: Technopolis analysis of ResearchFish data

The most frequently reported funding sector was the public sector accounting for over 40% of reported funding (6 of 15 grants) (Figure 37). Research grants were primarily funded by Public funders (56%, 5 of 9 research grants) with EPSRC accounting for 3 of the 5 publicly funded grants. Innovate UK and National Science Foundation (NSF) accounted for the remaining two. The fellowship grant was also awarded by EPSRC.

Figure 37 Count of further funding type by funding sector (standard-mode grants)



Source: Technopolis analysis of ResearchFish data

Public funders accounted for the majority of all further funding, accounting for 96% of the total funding amount reported (Table 11). Academic/University, Private and Charity/non-profit sectors accounted for comparatively small amounts (all <2% of the grand total).

Table 11 Amount of funding per funder sector (standard-mode grants)

Funding sector	Number reported	Median (£)	Range (£)	Total (£)	% of grand total
Public	6	1,103,280	190816 – 5,752,646	13,935,426	96.3
Academic/University	4	55,350	3300 – 160,000	274,001	1.9
Private	3	89,674	70077 – 100,000	259,751	1.8
Charity/Non-profit	1	1292	n/a	1,292	<0.01
			Grand total	**14470470.3**	

Source: Technopolis analysis of ResearchFish data

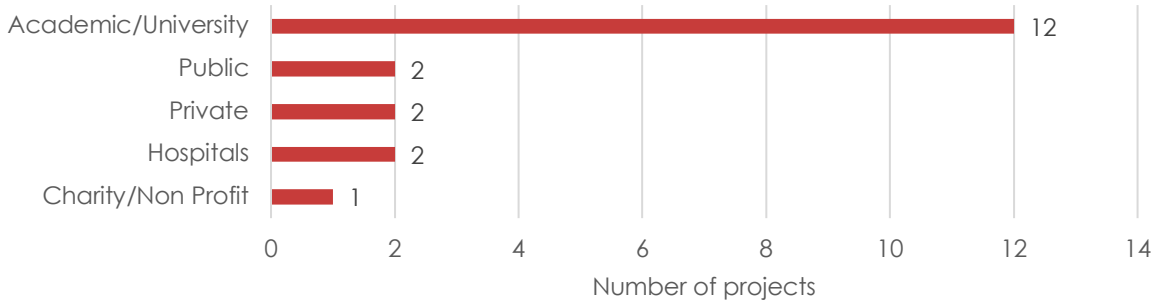
The number of PIs reporting further funding is proportionally lower for standard-mode grants (11 out of 59 {18%} vs 10 out of 26 {38%}). However, the **number of grants and total amount captured are similar** (16 vs 15 and £14M vs £16M respectively).

Interestingly, no patent applications or registrations were cited for standard-mode grants, which suggests that **HIPs appear to provide a better environment for IP development compared to standard-mode grants**.

5.2.5 Outcomes relating to the research environment

Collaborations were reported for 15 standard-mode grants. The overall number of collaborations was 50 with a range of 1 to 16 collaborations (median 2) reported per project. Two-fifths of all collaborations were made under a formal agreement (38%, 19 of 50). The most frequently reported collaboration was with Academic/University (80%, 12 of 15) (Figure 38).

Figure 38 Count of projects per collaboration sector (standard-mode grants)



Source: Technopolis analysis of ResearchFish data.

The most commonly reported partner contribution was expertise, including expertise in subject matter, technology and processes (87%, 13 of 15). This was followed by partners conducting some aspect of the research, for example data analysis, using specialist techniques, and validation (53%, 8 of 15). Other common contributions reported by PIs were access to specialised equipment, data acquisition and recruitment.

17 out of 26 PIs (65%) reported 36 collaborations (average 1.4 per grant, n=26) for HIP grants in ResearchFish. In comparison, 50 collaborations (average 0.85 per grant, n=59) have been cited by 15 PIs (25%, n=59) for standard-mode grants. However, some PIs report HIP project partners as collaborators while others do not. It is also not clear if the collaborations are additional to the HIPs collaborations. Therefore, it is difficult to make robust conclusions from these data. However, with the majority of PIs (75%) in standard-mode grants not reporting any

collaborations, it appears that the **HIP scheme encourages collaboration more readily** because of its requirements.

5.2.6 *Other outcomes*

One project reported a spin-out, Odin Medical Ltd. At the time of reporting the company had a small number of employees (1-4) and it was too early to report key achievements. The company seems to have grown since with 18 team members listed on its website.[17] However, it is not clear how many of these are actual company employees.

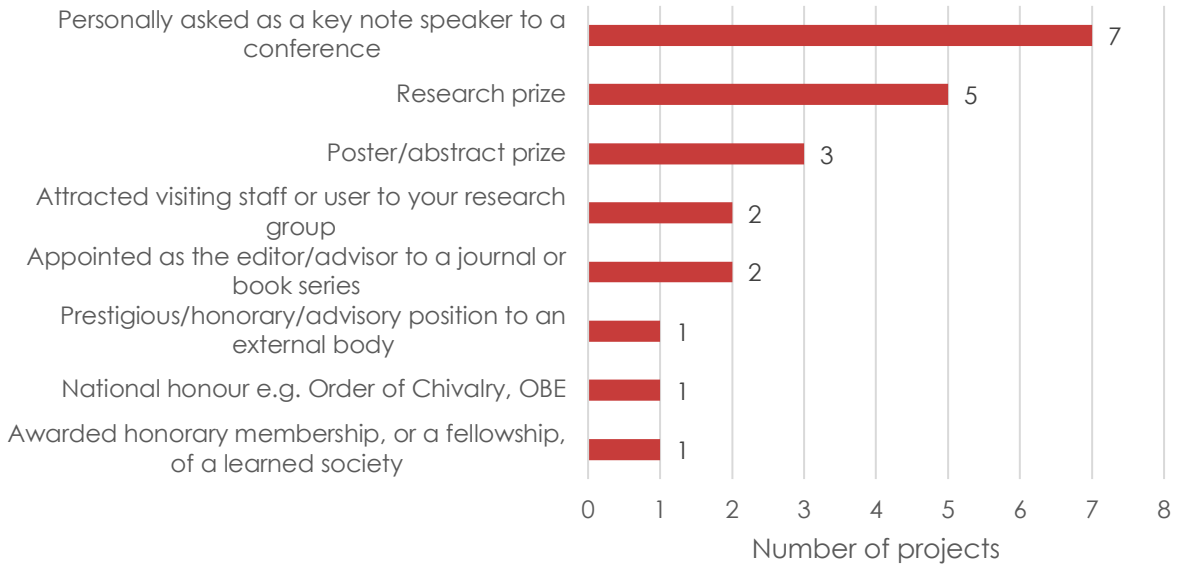
The single report of a policy outcome was an interview with the PI on a dental news site. As such, while this might have the potential to influence policy, it is not a policy outcome per se.

Recognition-type outcomes were reported for 11 standard-mode grants. They ranged from 1 to 47 per project with a median of 3. The most frequently reported recognition type by project was 'Personally asked as a keynote speaker to a conference' (64%, 7 of 11) followed by 'Research Prize' (45%, 5 of 11) and 'Poster/abstract prize' (27%, 3 of 11) (Figure 39).

In the project with 47 reported recognitions, over half (51%, 24 of 47) were requests to be a keynote speaker at a conference', while about a third were cases of visiting staff or user being attracted to the research group (34%, 16 of 47).

One spin-out was reported for a standard-mode grant, suggesting that economic impact can also emerge from this grant type. In comparison, no spin-outs were reported for HIP grants.

Figure 39 Reported recognitions (standard-mode grants)



Source: Technopolis analysis of ResearchFish data

[17] https://odin-vision.com

6 Conclusions and points to consider

Between 2013 and 2018, EPSRC funded 36 projects under the HIP scheme, representing a total investment of about £31m. Based on the evaluation objectives, we developed an evaluation framework and chose relevant methodology to explore the outputs, outcomes and impacts of the projects and relevant enablers and barriers; the value of the scheme to stakeholders; effectiveness of and possible improvements to the call processes; and how the scheme compares to standard-mode grants. Following analysis of primary and secondary data and triangulation of the results, we arrived at the following conclusions and points for consideration.

6.1 Conclusions

1. The HIP scheme has been successful in engaging EPS researchers and facilitating cross-sectoral collaboration with industry and clinical stakeholders for the purpose of applying EPS research to meet healthcare needs. However, most of the EPS researchers funded were already active in this space, so the scheme is not bringing new EPS researchers into the field.
2. While the partnerships are mostly building on existing or partially existing collaborations, these are meaningful collaborations with most industry and clinical partners providing key contributions in the design and implementation of the projects and benefitting from access to the academic knowledge base. The contributions are mostly in-kind and in the form of expertise and knowledge, or access to facilities.
3. Most HIPs have successfully created a research environment that has enabled relevant outputs and outcomes such as research findings, scientific publications, improved translational capacity and skills, and patents to emerge. Most have also led to a better understanding of the potential of the technology/approach being developed and some new research tools/methods, software, databases and technical products have been created.
4. As most of the projects are still ongoing, many outcomes and impacts, especially in the economic and health domain, have yet to be realised. In addition, the scope of the research funded under the HIPs is not expected to progress a technology/approach far enough along the TRL scale to realistically allow health- and economy-related benefits to accrue. Nonetheless, several HIPs have been successful in progressing technology to TRLs 2 and 3, with further progress possible in unfinished projects.
5. The main challenges experienced in the implementation of HIP projects included technical challenges, adapting to the needs and ways of working in different sectors, staff turnover and recruitment, managing team members' availabilities and the long time spent on ethical approval and IP agreements. Conversely, the main enablers include previous experience of working together, geographical proximity of partners, common objectives providing a focus and access to expertise and/or facilities through partners.
6. The HIP scheme is considered unique and fills a gap in the research landscape – the research it funds is not effectively covered by alternative sources. Its design (including requirements, scope and available funding), call processes and management processes are viewed favourably by the research community. No major weaknesses were identified in the scheme. However, there remains concern as to how the translational pathway can be successfully navigated beyond the HIP scheme and where funding for further development can be acquired.
7. The main value of the HIP lies in its ability to facilitate cross-sectoral collaboration across the academic, industry and clinical sectors, allowing commercial and healthcare needs to

remain at the centre of technology development from the earliest stages. This increases the likelihood of adoption and thus the potential for eventual economic and health impact. In this regard, the HIP scheme has a different role compared to standard-mode funding – to support applied and interdisciplinary research with a mid-term view of socio-economic impact. Analysis of ResearchFish data suggests that the HIP scheme does indeed fulfil this role and leads to quicker and more outputs and outcomes such as publications, citations, technical products and patents. However, this difference may also reflect the nature of the project – HIPs are building on previous research, while standard-mode grants may investigate new ideas and concepts.

6.2 Points to consider

Overall, the HIP scheme fills an important gap in the healthcare research funding landscape and is valued by the project participants. Moreover, there continues to be a demand for the scheme, and hence our view is that the scheme should continue.

Based on feedback from HIP participants and our own analysis, we suggest EPSRC consider the following actions in future iterations of the scheme to maximise the likelihood of achieving the desired objectives.

1. **Support networking activities prior to calls for proposals to create new cross-sectoral collaborations** – Our analysis shows that in most cases, the various HIP partners had worked together previously or were at least known to each other. As such, it appears that HIPs are not enabling many de novo collaborations. It is possible that some EPS research with good potential for impact may not make it to proposals for want of industry and/or clinical partners. Therefore, EPSRC could consider supporting networking events or sandpits before annual calls for proposals to allow potential collaborators across the academic, industry and clinical sectors to meet. Such events may also help spark or progress ideas for translation through cross-sectoral discussions around what EPS research outputs are available, what the health/clinical and commercialisation needs are, and how EPSRC research could be translated to meet those needs.
2. **Enhance competition and diversify pool of applicants** – The requirement for a previous EPSRC grant within a specified time period to qualify for HIP funding restricts the pool of researchers who can apply and hence lowers competition. Further, this evaluation shows that most funded PIs had held a previous Healthcare Technologies grant, and thus EPS researchers who have not previously been active in the healthcare space are not necessarily being brought into the field. Admittedly, the HIPs increase the potential for impact from previous EPSRC-funded research; however, it is not necessary that the best ideas will originate in previous EPSRC research. Therefore, if the objective of a future HIP scheme is to fund ideas with the most potential for impact and encourage new EPS researchers to apply their findings for healthcare, the requirement for a previous EPSRC grant could be relaxed to increase the number and possibly also the quality and diversity of applications. Conversely, if the objective is to provide a pathway for impact for EPSRC-funded research, the requirement for a previous EPSRC grant should remain, but the necessity to have the grant during a specific time period should be removed.
3. **Further facilitate engagement of industry and clinical partners** – Several HIP participants noted in interviews that clinicians are hard-pressed for time and have difficulty engaging more frequently with the research team. Nonetheless, their contribution was considered crucial for steering technological development towards health and clinical needs, for helping with data collection and testing, and preparing for clinical trials. Therefore, it needs to be communicated better that clinicians' time can be costed in the proposal and that this needs to be realistic in terms of the actual time they are likely to spend on the project.

Similarly, industry partners especially those from SMEs often do not have the resources (time or money) to engage in research collaborations. While potential for commercial return is the main consideration when engaging in such partnerships, the potential risk is still high when the technology/approach is in early development. However, current EPSRC terms do not allow industry/commercial partners to receive any funding from the grant with the exception of funding for providing services or equipment that will go through a formal procurement process audited by the host research organisation. Nonetheless, applicants need to be made aware that certain activities such as market opportunity assessments and early stage commercial exploration can be funded if formal procurement is undertaken or if external organisations (excluding the partners) are delivering them.

These clarifications regarding the availability of funding for clinicians and for certain activities might enable better engagement, and may encourage more clinicians and industry stakeholders to become involved in HIPs.

4. **Make efforts to ensure continuity of funding pathway** – For the HIPs to have impact, technologies will need to be developed to the point that they can be widely adopted in the healthcare system. However, mid- to late-stage translation is outside the remit of the HIP scheme. Hence, there is a risk that promising technologies do not get further developed. As such, in any future iteration of the HIP scheme, EPSRC should map out the pathway for further development of the technology, considering other funders (including industry) and funding programmes in the landscape and their remits. EPSRC could consider filling any remaining gaps, for example, through a new joint programme with the more health-oriented funders or Innovate UK, or small grants for further development to the point they become eligible for other funding sources.

Appendix A Approach for the review of the EPSRC Health Impact Partnership scheme

A.1. The HIP programme logic model

A PLM provides a structured approach to look at a programme or intervention. It is based on the idea that there is a linked chain of logic that shows how the inputs to an intervention (e.g. funders' budget, programme management) and the resulting activities (e.g. research projects, stakeholder engagement) are expected to produce immediate outputs (e.g. new evidence, skills and collaborations). These in turn are connected to medium-term outcomes (e.g. change in local practices) and longer-term outcomes (e.g. change in practices beyond the project site) and eventually the realisation of the objectives – the impacts (e.g. improvement in health of target population). Anticipated outputs, outcomes, and impacts can be linked to a set of indicators that evidence whether, and to what degree, the programme is progressing against its objectives. It should be noted that while a PLM is helpful for testing causal links and assumptions, it represents a simplification of the effects of a programme. Over the course of an evaluation, further important factors and links may emerge; this important 'learning' is presented as part of the evaluation and can serve to refine the PLM further.

In addition, a PLM can help identify spill-over effects that do not directly relate to the objectives of the scheme but support the research environment within which the programme takes place and can enhance future activity. For example, exposure to a certain type of research activity (in the case of the HIPs, cross-sector collaboration in the health technology space) may change academic researchers' knowledge of – and motivation to – engage in similar research in the future, which in turn may be reflected in a shift in the types of grant applications to research funders. Similarly, experience of collaboration can also impact on industry's and clinicians' thinking about research needs.

It should be noted that we do not expect the HIPs to have achieved the entire gamut from Inputs to Impact, as the required timeframe goes much beyond the lifetime of the scheme (and the majority of partnerships are ongoing). The current evaluation determines the 'how far' the funded research has advanced within the model; later evaluations can then use the same approach to trace further progress.

A.2. Evaluation Framework

A.2.1. Impact evaluation framework

A.2.1.1 Inputs

Delivery of the HIP scheme absorbs a number of inputs:

- Funding: This includes EPSRC funding as well as investment from company partners (both financial and in-kind), and clinical/NHS resources used as part of the research (e.g. facilities, time). Other research funders may also have provided co-funding.
- Support functions: The EPSRC provides resources for management of the scheme. This includes call preparation and publication, the proposal review process, contracts and financial transfers, and monitoring and evaluation.
- Prior research outputs: The starting point for HIPs are research outputs from preceding EPSRC-funded projects. The HIPs are also underpinned by relevant knowledge and skills developed by researchers as a result of the prior EPSRC grant.

A.2.1.2 Activities

Activities carried out by HIPs are:

- Research implementation, data collection and analysis to understand the potential for development of a technology/approach for use in health applications
- Collaborative working of academic partners with an EPS focus and clinical and industry partners with a healthcare focus, to integrate insights and combine expertise from across sectors

  It is assumed that collaborative working across sectors will lead to research projects with improved and accelerated progress towards later development stages and implementation/adoption by the end-user.
- Involvement of patients and/or the public (PPI) in the research (optional)

  It is assumed that PPI provides HIPs with valuable insights into the reality of living with a disease or condition, allowing the development of the technology/approach to be tailored accordingly.

The extent to which these activities have occurred within the HIPs has been determined as part of the data collection phase, combining a review of the proposal and pathway to impact documents with primary information from survey and interviews of HIP partners.

A.2.1.3 Outputs

Outputs are the immediate results of the intervention activities. We have grouped the HIPs outputs into two categories – scientific outputs, and outputs relating to the research environment. Outputs, associated indicators, and proposed sources of evidence are summarised in Table 1. This also includes indirect effects on the level and quality of future EPSRC healthcare technologies research.

Scientific outputs

- Research findings which enhance understanding of the potential of EPS output(s) for health applications: The HIP scheme's primary objective is "to progress previously funded EPSRC research towards impact within a Healthcare application". In order to yield findings that meet this aim, these collaborative projects hence need to be appropriately planned and implemented.

  Indicator: Number and percentage of projects resulting in an improved understanding of the nature and scale of potential for the technology under investigation. This includes a conclusion of 'no potential', as this also contributes to steering future research efforts into other avenues, thereby avoiding unnecessary R&D costs and time spent.
- Dissemination of research findings: HIP project results are reported in the literature to enable take up by other research groups. This includes publications relating to the primary aim of the project, as well as (potentially) other publications covering further aspects investigated. Important insights may also be reported via other types of publications, such as media articles and blog posts, or in trade journals (grey literature). Equally, dissemination may be through talks and presentations, participation in working groups or media interviews.

  Indicators:
  - Number of publications
  - Number, type and reach of dissemination activity undertaken (e.g. talks, media appearances, etc.)
- Other types of research outputs: Other outputs of HIP projects may include:

- New or improved research tools and methods
- New or improved technical products/software
- New databases
- Other new or improved technical/subject knowledge (not directly related to main aim of HIP project)

These outputs can support future research activity, as individual researchers, research institutions, and the broader research community are better equipped and informed to plan and conduct their research projects.

Indicators:

- Number and type of research tools developed/improved
- Number and type of technical products/software developed/improved
- Number and type of databases developed/improved
- Nature of other new technical/subject knowledge developed/improved [qualitative]

Outputs relating to the research environment

Planning and implementation of HIP projects involve bringing together inputs and expertise from all partners, across sectors.

It is assumed that this represents 'on-the-job' training for individuals actively involved in the HIP, which in turn leads to improvement of individuals':

- Capacity to work in teams spanning sectors and disciplines

  Indicator: Number of partnerships with researchers/partners reporting improved capacity to work in cross-sectoral teams
- Knowledge of the translational research pathway

  Indicator: Number of partnerships with researchers/clinicians reporting improved translational research skills

Indirect effects

The HIP research experience and resulting improvements in individuals' knowledge and capacity can have an indirect effect on partners' interest and motivation to:

- Continue applying their research to health applications

  Indicator: Number of partnerships with partners reporting enhanced interest in applying their research to health applications as a result of the HIP
- Lead / being involved in translational research activities

  Indicator: Number of partnerships with HIP partners reporting enhanced interest in translational research activities as a result of the HIP

A.2.1.4 Outcomes

Outcomes are results of an intervention that are intermediary steps arising from the outputs 'on the way' to achieving the intended impacts of an intervention. For the HIP PLM, outcomes are grouped into three categories: 1) scientific outcomes and 2) outcomes relating to the research environment (as for outputs) and 3) outcomes relating to the commercial or healthcare

domain. Outcomes in categories 1) and 2) can be expected to accrue within a shorter timeframe, while category 3) outcomes are likely to take longer to realise.

Outcomes, associated indicators, and proposed sources of evidence are summarised in Table 2.

Scientific outcomes

- Take-up of findings / knowledge by the wider research community: The HIP research results are used by other research groups to inform their own research projects. This can involve both positive results (e.g. a study to extend the HIP project's findings to another technology) or negative results (e.g. adaptation of a project based on the HIPs finding that a particular approach is not suitable).

  HIP researchers may also be aware of other groups conducting research on a similar technology/approach, that have drawn on the HIP's research findings.

  Indicators:

  - Number of times publications have been cited in peer-reviewed literature
  - Number of partnerships with researchers/partners reporting take-up of knowledge by wider research community

- Use of tools, methods, databases and/or software by research community: New or improved research outputs can be used by other groups to underpin or inform their research projects. This use can be difficult to trace; some peer-reviewed publications may report on the new tool, method etc, and can hence be captured by the citation analysis (see above). HIP researchers may also be aware of other groups that have made use of these research outputs.

  Indicators: Number of partnerships with researchers/partners reporting take-up of developed/improved tools, methods, databases and/or software by the wider research community

- Further R&D of HIP technology: HIP projects focus on fundamental or early-stage translational research, setting technologies or approaches off on their journey towards impact. Further progress requires additional investment, and HIP research demonstrating high potential for further development may be able to secure R&D funding, from public or private sources.

  Indicators:

  - Number of HIP technologies with follow-on research funding from other funders
  - Number of HIP technologies developed further via company R&D budget

- Registration of new IP/patents: HIP projects might lead to the development of new technology or knowledge that can be protected through patents or other intellectual property. The level of patenting depends on baseline levels of technical development and the extent of any foreground IP at the start of the project.

  Indicator: Number of new IP/patent registrations from HIPs

- Advancement of technology along TRL scale: The development pathway for new technologies is often described in terms of technology readiness levels (TRLs). HIPs support research into new technologies in the early TRL stages, from basic research through to early stage, proof of concept studies. Further progress along TRLs is required to bring technologies to a point where they can be placed on the market and adopted.

  Table 12 sets out one approach which can be applied to EPSRC-funded translational research, providing details for the type of progress in early TRL stages of healthcare

technologies (TRL1-3). Development then moves on to TRL 4 (Refinement in humans/operational environment) and TRL 5 (Multi-site evaluation / early Phase III trial). We used the evidence collected in this study to assess the timeline for progress of a technology or approach along the TRL scale and examine underlying factors that accelerate (or delay) this journey.

Indicator: Number of HIP technologies that have advanced along the TRL scale

Table 12 Technology Readiness Levels, adapted to healthcare technologies / underpinning technologies

TRL	Devices[18, 19] (diagnostic, therapeutic)	Software, infrastructure or process[18]	Support tools[19](Assays, tests, surgical procedure, imaging)
TRL 1: Product definition	Scientific research findings are reviewed and assessed	Identification of need for process efficiency or novel solution	Active monitoring of scientific knowledge base
	Development of hypotheses and experimental designs	Development of hypotheses and experimental designs	Development of hypotheses and experimental designs
	Use of computer simulation or virtual platforms to test hypotheses	Evaluation of concepts that might be implemented to address identified need	Identification of links between disease in humans and animals
	Identification of technologies, materials, and processes to address a health or diagnostic problem	Identification of potentially practical solutions addressing particular needs	Potential biomarkers and disease mechanisms investigated
TRL 2: Initial development	Development of functional prototypes	Formulation of system application	Exploration of assay components via prototypes and screening
	Identification and evaluation of critical technologies, critical design features needed, and components		Identification and evaluation of critical technologies and components
	Early proof of concept in laboratory models including in vivo studies	Testing of system application in laboratory environment	Initial characterisation and optimisation of tool
TRL 3: Refinement (not in humans) testing environment	Iteration and elimination of prototype designs based on user feedback; Integration of critical technologies	Integration and preliminary testing of components for efficiency and reliability	Design finalised
	Initial bench testing, in vitro and in vivo testing	Development of system architecture considering reliability, scalability, operability, security, etc.	Selection of appropriate candidate reference and QC (quality control) reagents
	Demonstration of proof of concept in relevant laboratory / animal models	Development of other system components if required	Selection of QC criteria
	Identification/development of animal models, test methods and endpoints for further studies	Testing of system in relevant testing environment	Integration of critical technologies and components (including hardware and software)
	Initial IP search for patentability and to refine prototype configuration	Initiation of verification, validation & accreditation	Initial intellectual property search for patentability

[18] Swelife 2016: https://swelife.se/wp-content/uploads/2016/08/TRL-guide.pdf. Accessed 3 Dec 2019

[19] NIH/NHLBI TRL guidelines 2016 https://ncai.nhlbi.nih.gov/ncai/resources/techreadylevels Accessed 3 Dec 2019

TRL	Devices[18, 19] (diagnostic, therapeutic)	Software, infrastructure or process[18]	Support tools[19](Assays, tests, surgical procedure, imaging)
	Development of scalable & reproducible manufacturing process amenable to Good Manufacturing Practice		Development of a scalable & reproducible manufacturing process aligned to regulatory guidelines (as needed)

Source: Adapted from Technopolis analysis for MRC (MRC Translational Research Evaluation 2008-2018)

Outcomes relating to the research environment

- New or strengthened collaborative relationships: HIP partners may continue to collaborate, or increase the level of collaborative activity compared to pre-HIP levels. This can take a variety of forms, from informal information exchanges and advisory functions, to joint working on projects beyond the HIP award.

  The assumption is that in this way, the HIP has a sustained effect on the research community, bringing actors from different sectors and disciplines together, thereby improving the effectiveness and efficiency of the research ecosystem.

  Indicators:

  - Number of partnerships reporting continued collaboration beyond HIP duration
  - Number of collaborations between partners in the EPS and health technology research communities who had not worked together prior to the HIP
  - Number of joint proposals and funded collaborative projects beyond HIP duration
- Professional development of individuals involved in HIPs: Involvement in HIP projects not only leads to a range of scientific outputs (see above), but also enhances researchers' knowledge and skills to work in the translational research space across sectors and to participate in collaborative relationships beyond the duration of the HIP.

  The assumption is that these factors support researchers' professional development. This can involve career advancement within their current sector or movement across sectors.

  Indicators: Number of partnerships with partners reporting that the HIP had supported their or team members' professional development

Outcomes relating to the commercial or healthcare domain

- Commercialisation of HIP research outputs: As the technology or approach advanced by the HIP progresses, this may lead to a range of commercial outcomes:
  - Licensing deals: The marketing and logistical costs associated with onward development may be externalised through licensing agreements with industry, where firms assume responsibility for further R&D, manufacturing, logistics and marketing

    Indicator: Number of licensing deals
  - Spin-out companies: Researchers involved in the HIP may 'spin-out' or create a new entity, with the objective of commercially exploiting the intellectual property generated

    Indicator: Number of spin-out companies
  - Investment in commercialisation / implementation of developed technology, and products entering the market: HIP technologies / approaches are likely to require further investment to enter the market; the commercialising entity may draw on internal or external sources to do so (eg venture capital investment).

Indicator: Number and level of investment in commercialisation / implementation of developed technology

Number of products entering the market: In the late stages of the TRL scale, the HIP technology / approach has advanced to the stage that it can be launched on the market (TRL 6: Product launch / Implementation trials)

Indicator: Number of products entering the market

- Uptake into practice guidelines or standards: Once new or improved technologies have entered the market, they can be taken up into healthcare guidelines or inform regulatory and industry standards.

  It is assumed that the new or improved technology is suitable for integration with current processes (eg fit with operational constraints).

  Indicator: Number of partnerships with influence on healthcare practice guidelines or standards

Indirect effects

- Increase in the volume of applications for EPSRC health technology funding: Enhanced capacity and interest/motivation of engineering and physcial science researchers as a result of working within the HIP team may incentivise them to continue their research in this space, leading to an increase in the volume and quality of applications for EPSRC health technology funding.

  Indicators:

  - Number of HIP PIs applying for further EPSRC Healthcare Technologies research funding

A.2.1.5 Impacts

The long-term objective of research projects funded through the HIP scheme is to bring about economic benefits and improvement of human health. These impacts can be expected to arise in the long term, e.g. 5+ years after the conclusion of a project. While a scheme such as the HIPs, if successful, can be expected to contribute to these impacts, it is likely that these would accrue beyond the timeframe of the current scheme. Therefore, while we aimed to identify evidence of contribution to impacts from the HIPs where possible, any such evidence is expected to be limited at this point in time.

Impacts, associated indicators, and proposed sources of evidence are summarised in Table 3.

- Economic impacts: Commercial exploitation of the developed technology can be expected to lead to economic benefits.

  The long term nature of the product development cycle creates some challenges in understanding the economic value of translational research projects that have been funded. The impact of HIP funding may be visible in turnover and economic output (gross value added, GVA); alternatively the value of the firm may be captured in investors' (risk-adjusted) expectations when equity investment is made.

  Economic benefits can also manifest in the number of jobs created as a result of the HIP technology.

  Indicators:

  - Number of jobs created

- Increase in turnover of relevant firms
- Increase in valuation of relevant firms

- Large-scale adoption of technology by end-users (e.g. in healthcare setting): The main social benefit associated with the HIP scheme are the impacts on human health resulting from the introduction of new or improved technologies or approaches into healthcare practice. This requires large-scale adoption of the developed product.

  It is assumed that the new or improved technology is suitable for large-scale integration into the healthcare system (e.g. end-users such as health professionals are trained and motivated to adopt it) and is affordable (i.e. within the end-user's budget).

  Indicator: Number of partnerships with partners reporting large-scale adoption of technology in healthcare settings
- Benefits to human health: Ultimately, new or improved healthcare technologies should lead to improvement in human health, e.g. by enabling diseases to be diagnosed, treated or managed more effectively and/or cost-effectively.

  Given the long-term nature of these types of outcomes, it may be difficult to capture these effects at this point in time. However, findings form HIP projects and any follow-on research may provide an indication of the potential for health benefits, e.g. based on health benefits to research participants or cost-savings for the health service compared to 'business as usual' observed as part of the studies. Any cost-savings in the health system can then be deployed to other healthcare delivery pathways.

  Indicators:
  - Number of individuals benefitting from technology
  - Level of health benefit to end-user
  - Level of cost savings to healthcare system

A.2.2. *Process evaluation framework*

To achieve the goals set out in the PLM, the HIP scheme needs to be designed and delivered in a way that can identify and support high quality research projects and effective partnerships. These elements are assessed as part of a process evaluation, whose findings in turn can identify underlying enablers and barriers to achieving the programme goals (impact evaluation).

We have grouped process evaluation questions for this study into three categories, scheme design, call process and scheme management. These are briefly described in the following section; the evaluation questions and sources of evidence are presented in Table 4.

A.2.2.1 Design of the scheme

We gathered information on HIP beneficiaries' views and experiences with the overall design parameters of the scheme. This examined 1) factors that may attract or dissuade researchers to apply to the scheme ("attracting high-quality proposals") and 2) whether the scheme's design is optimised to achieve the expected level of outcomes and impacts, and whether there are any improvements that would lead to a higher level. This included aspects such as the scope of the scheme (subject areas and activities supported), the size of grants, and partnership and co-funding requirements.

A.2.2.2 Call process

The call process determines whether applicants that fit the existing parameters and requirements of the scheme are able to submit proposals at an operational level (e.g. timelines, clarity and level of information provided in call text). We examined the HIP scheme's call processes from the point of view of both, the beneficiaries and EPSRC staff.

A.2.2.3 Scheme management

The EPSRC invests resources in terms of staff time and expenses to deliver the scheme, such as contracting, grant administration and monitoring. The evaluation examined which aspects of scheme management work well or work less well for applicants and EPSRC staff, and what improvements could be made.

Appendix B Primary data collection - Consultation tools

B.1. Interview questionnaires

B.1.1. Interview questionnaire: HIP project leads / principal investigators (PIs)

The EPSRC, as funders of the Health Impact Partnership scheme, have commissioned us to conduct a review to understand the value and impact of the HIPs and the ongoing need for such a scheme.

As part of this review, Technopolis Ltd is consulting with researchers, industry and clinical partners, and other stakeholders involved in the scheme. Your participation in this interview will help us gather evidence on the outcomes achieved and provide you with the opportunity to inform discussions on the future design of the scheme.

- For this interview, I would like to focus on the award [*XXX*], funded under Call [XX] of the HIP scheme, which ran from [month / year] to [month / year].

  OR for PIs with more than one award: I am aware that you were PI on more than one HIP-funded award. In the interview I will set aside a few minutes to talk about any other awards you have been involved in, but in the interest of time, we will probably need to focus on one award.

  We preliminarily selected [*XXX*] for this, as it completed earlier than the other HIP awards (some of which may still be active), and there has been more time for any outcomes and impacts to accrue. However, do you think it would be better to focus on a different award?
- I have reviewed the proposal documents and Researchfish output data for the project in preparation for this interview, so I am to some degree familiar with the research project. [review multiple if PI has more than one award]

Consent/confidentiality (2.5 mins)

To confirm, may I request your permission for the following:

- We will report this information, such as data, opinions and views expressed, and any analysis we carry out as part of the evaluation study in aggregate to the EPSRC. Where your contribution may be identifiable, e.g. due to the nature of the research topic, we will ask for your permission to include this information in the report. Do you agree to this?
- Can I have your permission to audio record the interview? The recording will be used only to ensure that we transcribe details correctly. It will not be provided to anyone outside of Technopolis, and will be destroyed as soon as we have completed analysis of the whole set of interviews.

Thank you, I have now started the recording. We will focus on award [*XXX*].

Project background (pre-implementation)

Project aim

- Can you briefly describe the primary aim of the project, at its outset, and what you hoped to achieve?
  - What was the health need the research sought to address, or the health application the project was developing technology for?

  - What was the engineering / physical sciences technology to be developed?
  - Who were the expected main beneficiaries or end users of the health application the research targeted?
- How did the HIP research relate to your previous work?
  - Had you worked with industry and clinical partners before? What was your level of experience with translational research?
  - What were the EPSRC-funded research outputs on which the HIP research was based?

  [*Note to interviewer: HIPs are intended to be based on outputs from prior EPSRC-funded research – find out if this is the case and/or if research funded from other sources has (also) contributed*]
- What motivated you to apply for a HIP grant?

  [Note to interviewer: try to probe further in-depth if get mundane responses such as "the opportunity to engage in the healthcare partnership scheme"]
- Could you briefly describe the broader research landscape and who are the main institutions or companies conducting research in this area?

  [Note to interviewer: try to keep this brief, capture context of the research area and how the HIP fits within this]

Project team

- How was the partnership team organised? Please describe the HIP team. Who were the partners – clinical, industry, other academic groups?
  - Had you worked with these partners before?
    - If yes: Could you briefly outline your prior collaboration?
    - If no: How did the partnership proposal come about? How did you identify these partners?
- What were the roles of the collaborators in the delivery of the project?
  - What skills, infrastructure or capabilities did they contribute to the project?
- What did the partnership look like in the implementation phase of the research? How did you interact with the HIP partners over the course of the HIP?
  - Were there any issues?
  - Were there any specific enablers of collaborative working?
- Did you involve patients and/or the public in the design, implementation or dissemination of the project and its findings?
  - If yes, who did you engage with and how? E.g. interactive workshops, online fora, targeted meetings etc.
  - What were the project aspects you sought input on?
  - How did this support the research and outcomes? Were there any issues?

HIP experience

Adjustments and challenges

- Was the project plan adjusted after the start of the HIP? If yes, why?
  - Did the actual project team differ from the team described in the HIP application? If yes, why?
- Did you encounter any challenges? If yes, what were they?

  e.g. issues with collaboration and communication; issues with equipment or infrastructure; administrative issues

Learning from design and implementation phase

- In hindsight, is there anything you would change about how the partnership and project were designed and conducted? E.g.
  - Project design: change in the scope of the study, the specific health application addressed, the experimental method employed
  - Team: Additional or different partners and expertise
  - Other changes, such as stakeholders engaged; conduct of a pilot study

Training and skills

- Do you think the HIP contributed to skills development for your group? For your clinical and industry partners?

  If yes, what were the main skills or capabilities developed? E.g.
  - Research / technical skills (eg new methods)
  - Skills related to team working, working across sectors
  - Research translation skills and knowledge (eg related to IP, industry standards)
  - Understanding of strengths and motivation of other sectors (clinicians, industry)

  Can you describe the scale of this benefit? [incl. number of staff trained]
- To what extent has the HIP supported career development and progression for research team members? Can you provide examples?
- Did the HIP have an effect on your or your team members' interest in applying engineering and physical science research for health applications?
- Did the project influence your work in other ways – e.g. approach to research design, collaboration with industry or clinicians, project management, reputational impacts? If yes, please provide examples of this influence.

Summary question

- What has been the main value of the HIP project to you and your work?

HIP award outputs

Research findings

- Could you summarise the key findings of the HIP project?
  - Did the project answer the research question(s) it originally set out to address?

- Have these findings led to a better understanding of the technology's potential for use in health applications?
  - If the project did not lead to a better understanding, why not? What happened?
- Has the partnership yielded any additional findings or technical/subject knowledge (incl. not anticipated at the outset of the project)?

Project outputs – [Note to interviewer: keep very short, verify ResearchFish entry]

- *Publications* - Did you publish the findings of the HIP-funded research?

  How many publications stemmed from the project? Which of these do you consider the key outputs?
- *Tools and databases* - Were any new research tools or databases developed as part of the HIP-funded project?

  Do you know if these continue to be used?
- *Technical products/software* - Were any technical products or software developed as part of the HIP-funded project?

  Do you know if these continue to be used?
- *Methods* - Did the project develop new methods?

  Do you know if these continue to be used?
- Are you aware if others have taken up the findings and outputs of the HIP, or any tools, products or methods developed as part of the research?
  - If yes: Could you provide examples?

HIP outcomes and impact

Further development of technology/approach

- Since completing the HIP, what attempts have you or others made to take forward the work programme or findings? Is the technology/approach tested by the HIP being developed further?
  - If no, why not? E.g.:
    - Motivational factors associated with the PI or competing research priorities
    - Gaps in fundamental knowledge/incorrect initial assumptions that prevent further development activities
    - Intellectual property issues blocking further development of the technology
    - Gaps in institutional capabilities or skills to progress to larger scale programmes of activity
    - Insufficiently conclusive results from development activity undertaken to date
    - Concerns regarding the suitability/value of the underlying technology
    - Concerns regarding the potential costs of onward development activities
    - Disengagement of critical collaborative partners
    - Changes in the commercial context or competitive landscape – e.g. the emergence of a superior competing technology
    - Adoption side issues

- Are you considering further development in the future? What would this require? Are there any clear challenges/barriers?

  - If yes:
    - Who is leading further development – your group, the partnership, or someone else? Please explain.
    - Have you secured further funding?

      If yes, what is the funding source and budget?

      If no, are you planning to apply for further funding? Which funding stream/funders will you target?

Further collaboration

- Have you collaborated, or are you collaborating, with the HIP team, or some of the partners beyond the HIP-funded project?

If yes:

- What has been the effect of the HIP on this collaboration? Do you think you would be collaborating if you had not received HIP funding?
- Please describe how you are collaborating

  E.g. regular information exchange and advice; joint proposals; secured joint funding; collaboration extended to other research groups at my institution; extended networks
- Could you describe the project or projects you are collaborating on? [*Note: may have been covered above*]

If no:

- Why not? Are there specific challenges?
- Do you intend to or would you be open to collaborating with the HIPs partners in the future? If no, why not?

Progress along TRL scale

- To what extent has the HIP technology/approach been developed further? What stage has it reached?

If it has progressed:

- Can you summarise the progress and current stage for me?

  [*Note to interviewer: if progress has been achieved, use TRL table to determine to which stage research has advanced*]
- What is the future outlook for further progress and impact?
- Have there been steps towards commercialisation?
  - Patents / IP
  - Licensing deals
  - Spin-out companies (number of jobs created?)
  - Investment to bring technology/product onto market. If yes: Could you explain in more detail?

E.g. source of investment, level of investment, parties involved

- Are technologies or products developed on the market or in use?
  - If yes: Could you explain more? e.g. scale of implementation, level of commercial benefit, number of jobs created?
  - Have the findings of the HIPS-funded project led to any health benefits for users? If yes, how many people have benefitted, and what is the nature/scale of benefit?

If it has NOT progressed:

- Do you think the HIP research findings have the potential for further development, commercialisation and impact? Within what timeframe?
- In hindsight, what could have increased the HIP-funded research's potential for impact?

  [*Note to interviewer: may have been covered in 'hindsight' questions above*]

Other outcomes and impacts

- Were there any other outcomes or impacts from the HIP? e.g.
  - Any wider improvements in the capacity of your institution to deliver, or in the perception of engaging in, translational research?

Design of the HIP scheme and funding landscape

- Thinking back to when you applied for a HIP award, were there any aspects of the scheme's design and requirements you feel were problematic and could be improved?

  If yes, how could these be addressed?
- Are there aspects of the call process that worked well? What aspects do you feel could be improved?
- What improvements to the scheme's design could be made to increase the level of outcomes and impact? For example, are there any additional activities the scheme could support to help it achieve its aims?
- Are the scheme's management processes adequate?

  Are there aspects of the scheme's management that could be improved?
- What alternative sources of funding for the type of research supported by the HIP scheme are you aware of?
- What do you consider the main strengths of the HIP scheme, setting it apart from:
  - EPSRC standard-mode grants
  - Other similar funding programmes / sources of funding?
- Compared to the HIP scheme, what are the advantages of:
  - EPSRC standard-mode grants
  - Other similar funding programmes / sources of funding?
- Are there currently any gaps in the research funding landscape relevant to the technology/approach developed by the HIP that you think function as a barrier to progress along the translational research pathway?

  If yes, what are the main gaps? *E.g. Gaps in:*
  - Types of research funded

- Types of support for critical activities, such as commercialisation support/consultancy, consortium building, knowledge transfer
- Funding for critical research infrastructure
- Funding for training and skills development
- Insufficient level of funding available

Final comments and close

- Do you have any other comments about the HIPs or any suggestions to the EPSRC?

Thank you very much for your time and insights; this is extremely helpful to inform the study.

We would like to also gather views and insights from HIPs clinical and industry partners. **Would you be willing to share with us the names and contact details of your clinical and industry partners?** We would contact them to either schedule an interview, or invite them to participate in our survey. If you would prefer not to share contact details, I can forward the invitation emails to you, which I would ask you to forward to your partners.

Also, if there are any clarification questions or additional aspects to check with you, may I contact you again? I will make sure to keep any questions as brief as possible.

Thank you again.

B.1.2. Interview questionnaire: HIP clinical partners

The EPSRC, as funders of the Health Impact Partnership scheme, have commissioned us to conduct a review to understand the value and impact of the HIPs and the ongoing need for such a scheme.

As part of this review, Technopolis Ltd is consulting with researchers, partners and other stakeholders involved in the scheme. Your participation in this interview will help us gather evidence on the outcomes achieved and provide you with the opportunity to inform discussions on the future design of the scheme.

- For this interview, I would like to focus on the award [*XXX*], funded under Call [XX] of the HIP scheme, which ran from [month / year] to [month / year].

  OR for clinical partners on more than one award: I am aware that you were involved in more than one HIP-funded award. We selected [*XXX*] for this, and have already spoken to Dr/Prof [lead PI name].

  However, I will set aside a few minutes to talk about any other HIPs you have been involved in and your experience with these.

Consent/confidentiality (2.5 mins)

To confirm, may I request your permission for the following:

- We will report this information, such as data, opinions and views expressed, and any analysis we carry out as part of the evaluation study in aggregate to the EPSRC. Where your contribution may be identifiable, e.g. due to the nature of the research topic, we will ask for your permission to include this information in the report. Do you agree to this?

- Can I have your permission to audio record the interview? The recording will be only used to ensure that we transcribe details correctly. It will not be provided to anyone outside of Technopolis, and will be destroyed as soon as we have completed analysis of the whole set of interviews.

Thank you, I have now started the recording. We will focus on award [*XXX*].

Project background (pre-implementation)

Interviewer: Start by briefly summarising the project aim and outline the research to be conducted, to set the scene for the following questions, eg: "I have spoken to Dr [xx], as the lead PI for the HIPs grant, and understand that the aim of the project was to [xx]. The partnership investigated how [technology] can be used in [health application]. Is that correct?"

- Could you describe your role in the partnership and research activity?
- How did the HIP research relate to your previous work?
  - Had you worked with engineering/physical science academic researchers and industry partners before? What was your level of experience with this type of translational research?
- What motivated you to become involved in the HIP project?
- Could you briefly describe the broader research landscape and name the main institutions or companies conducting research in this area?

  [Note to interviewer: try to keep this brief, capture context of the research area from the clinical partner's perspective and how the HIP fits within this]

HIP experience

Project team

Interviewer: Summarise project team to set context for following questions, eg: "Your partnership included [xx] at [university of xx], as well as [industry partner]. Is that correct?"

- What did the partnership look like during the implementation of the research?
  - How did you interact with the HIP partners over the course of the HIP?
  - Were there any issues? Were there any specific enablers of collaborative working?

Adjustments and challenges

- Was the project plan adjusted after the start of the HIP? Did you encounter any challenges? If yes, what were they?

  e.g. issues with collaboration and communication; issues with equipment or infrastructure; administrative issues

Public and patient involvement

Interviewer: Summarise public and patient involvement from PI interview information, eg: "Professor [xx] described the PPI activities for this project to me [patients were engaged in a series of workshops….]."

- How did this support the research and outcomes? Were there any issues?

If no PPI described by PI:

- I understand that there were no PPI activities for this project. Do you think this would have supported the research and outcomes?

Learning from design and implementation phase

- In hindsight, is there anything you would change about how the partnership and project were designed and conducted? E.g.
  - Project design: change in the scope of the study, the specific health application addressed, the research method employed
  - Team: Additional or different partners and expertise
  - Other changes, such as stakeholders engaged; conduct of a pilot study

Training and skills

- Did the HIP lead you to develop new skills?

  If yes, what were the main skills or capabilities developed? E.g.
  - Research / technical skills (e.g. new methods)
  - Skills related to team working, working across sectors
  - Research translation skills and knowledge (e.g. related to IP, industry standards)
  - Understanding of strengths and motivation of other sectors (clinical partner, industry)
- To what extent has the HIP supported your career development and progression?
- Did the HIP have an effect on your interest in working with engineering and physical science researchers on applying their findings to health applications?
- Did the HIP influence your interest in translational research?
- Did the project have an impact on your work in other ways – e.g. collaboration with industry, reputational impacts? If yes, please provide examples.

Summary question

- What has been the main value of the HIP project to you and your work?

HIP award outputs

Interviewer: Summarise what you already know, eg:

"I heard from Prof/Dr [lead PI] that the research led to [xx]. This can now be used to develop the [technology] further." OR

"I heard from Prof/Dr [lead PI] that the research showed that [the technology] is not suitable for further development." OR

"I heard from Prof/Dr [lead PI] that the main question of the research could not be addressed because of [xx]."

- So would you say that the HIP research findings have / have not *[use as appropriate]* led to a better understanding of the technology's potential for use in health applications?
  - If the project did not lead to a better understanding, why not?

- Were there any other findings of particular interest to you and your work?
- Are you aware if others have taken up the findings and outputs of the HIP, or any tools, products or methods developed as part of the research?
  - If yes: Could you provide examples?

HIP outcomes and impact

Further development of technology/approach

Interviewer [if relevant]: "I understand that after the completion of the HIP grant, the technology has been developed further, and is now being [tested/piloted/implemented]…."

- Have you been, or are you, involved in the further development?

If no:

  - Why not? E.g.:
    - Competing priorities / lack of time
    - Disengagement of critical collaborative partners
    - Changes in the commercial context or competitive landscape – e.g. the emergence of a superior competing technology
    - Adoption side issues
  - Are you considering being involved in further development in the future? What would this require? Are there any clear challenges/barriers?

If yes:

  - What is your role in further development activities?
  - Have you secured further funding?
    - If yes, what is the funding source and budget?
    - If no, are you planning to apply for further funding? Which funding stream/funders will you target?
- What do you think is the future outlook for progress and impact of the technology/approach?
  - Have technologies developed, or insights gained, from HIP research influenced healthcare practice or public health guidelines? If not yet, do they have the potential to do so?

    [Note to interviewer: probe on clinical impact, eg impact within NHS]
- In hindsight, is there anything that could have increased the HIP-funded research's potential for impact?

  [*Note to interviewer: may have been covered in 'hindsight' questions above*]

Collaboration

Have you collaborated, or are you collaborating, with the HIP team, or some of the partners beyond the HIP-funded project?

If yes:

- What has been the effect of the HIP on this collaboration? Do you think you would be collaborating today if you had not been part of the HIP?
- Please describe how you are collaborating

  E.g. regular information exchange and advice; joint proposals; secured joint funding; collaboration extended to other people at my organisation; extended networks
- Could you briefly describe the project or projects you are collaborating on? [*Note: may have been covered above*]

If no:

- Why not? Are there specific challenges?
- Do you intend to or would you be open to collaborating with the HIP partners in the future? If no, why not?

Other outcomes and impacts

- Were there any other outcomes or impacts from the HIP? e.g.
  - A change in your institution's attitude towards working in partnership with engineering/physical scientists from academia and industry?
  - Increased participation in R&D networks, supporting your and your institution's wider research aims?

Design of the HIP scheme and funding landscape

- Are there aspects of the overall design of the HIPs scheme that you feel could be improved? For example, that would facilitate participation by clinical partners?

  E.g. funding for specific training, longer timeframes/increased budget
- What improvements to the scheme's design could be made to increase the level of outcomes and impact? E.g.

  Are there any additional activities the scheme could support to help it achieve its aims?
- From your experience, are the scheme's management processes adequate? Are there aspects that could be improved?

  [Note to interviewer: Clinical partner may have had little involvement in management]
- What do you consider the main strengths of the HIP scheme?
- Are there any disadvantages compared to other funding programmes? What are these?
- Are there currently any gaps in the research funding landscape relevant to the technology/approach developed by the HIP that you think function as a barrier to development of health applications?

  If yes, what are the main gaps? *E.g. Gaps in:*
  - Types of research funded
  - Types of support for critical activities, such as commercialisation support/consultancy, consortium building, knowledge transfer
  - Funding for critical research infrastructure
  - Funding for training and skills development
  - Insufficient level of funding available

Final comments and close

- Do you have any other comments about the HIPs or any suggestions to the EPSRC?

Thank you very much for your time and insights; this is extremely helpful to inform the study. We will consult other HIP-funded researchers and stakeholders over the next weeks. If there are any clarification questions or additional aspects to check with you, may I contact you again? I will make sure to keep any questions as brief as possible.

B.1.3. Interview questionnaire: HIP industry partners

The EPSRC, as funders of the Health Impact Partnership scheme, have commissioned us to conduct a review to understand the value and impact of the HIPs and the ongoing need for such a scheme.

As part of this review, Technopolis Ltd is consulting with researchers, partners and other stakeholders involved in the scheme. Your participation in this interview will help us gather evidence on the outcomes achieved and provide you with the opportunity to inform discussions on the future design of the scheme.

- For this interview, I would like to focus on the award [*XXX*], funded under Call [XX] of the HIP scheme, which ran from [month / year] to [month / year].

  OR for industry partners on more than one award: I am aware that you were involved in more than one HIP-funded award. We selected [*XXX*] for this, and have already spoken to Dr/Prof [lead PI name].

  However, I will set aside a few minutes to talk about any other HIPs you have been involved in and your experience with these.

Consent/confidentiality (2.5 mins)

To confirm, may I request your permission for the following:

- We will report this information, such as data, opinions and views expressed, and any analysis we carry out as part of the evaluation study in aggregate to the EPSRC. Where your contribution may be identifiable, e.g. due to the nature of the research topic, we will ask for your permission to include this information in the report. Do you agree to this?
- Can I have your permission to audio record the interview? The recording will be only used to ensure that we transcribe details correctly. It will not be provided to anyone outside of Technopolis, and will be destroyed as soon as we have completed analysis of the whole set of interviews.

Thank you, I have now started the recording. We will focus on award [*XXX*].

Project background (pre-implementation)

Interviewer: Start by briefly summarising the project aim and outline the research to be conducted, to set the scene for the following questions, e.g.: "I have spoken to Dr [xx], as the lead PI for the HIPs grant, and understand that the aim of the project was to [xx]. The partnership investigated how [technology] can be used in [health application]. Is that correct?"

- Could you describe your and your company's role in the partnership and research conducted?
- How did the HIP research relate to your previous work?
  - Had you worked with engineering/physical science academic researchers and clinical partners before? What was your and your company's level of experience with this type of translational research?
- What motivated your company to become involved in the HIP partnership?
- Could you briefly describe the broader research landscape and name the main institutions or companies conducting research in this area?

  [Note to interviewer: try to keep this brief, capture context of the research area from the clinical partner's perspective and how the HIP fits within this]

HIP experience

Project team

Interviewer: Summarise project team to set context for following questions, eg: "Your partnership included [xx] at [university of xx], as well as [clinical partner]. Is that correct?"

- What did the partnership look like? How did you interact with the HIP partners over the course of the HIP?
- Were there any issues? Were there any specific enablers of collaborative working?

Adjustments and challenges

- Was the project plan adjusted after the start of the HIP? Did you encounter any challenges? If yes, what were they?

  e.g. issues with collaboration and communication; issues with equipment or infrastructure; administrative issues

Public and patient involvement

Interviewer: Summarise public and patient involvement from PI interview information, e.g.: "Professor [xx] described the PPI activities for this project to me [patients were engaged in a series of workshops….]."

- How did this support the research and outcomes? Were there any issues?

If no PPI described by PI:

- I understand that there were no PPI activities for this project. Do you think this would have supported the research and outcomes?

Learning from design and implementation phase

- In hindsight, is there anything you would change about how the partnership and project were designed and conducted? E.g.
  - Project design: change in the scope of the study, the specific health application addressed, the research method employed
  - Team: Additional or different partners and expertise

- Other changes, such as stakeholders engaged; conduct of a pilot study

Training and skills

- Did the HIP lead you to develop new skills?

  If yes, what were the main skills or capabilities developed? E.g.
  - Research / technical skills (e.g. new methods)
  - Skills related to team working, working across sectors
  - Research translation skills and knowledge (e.g. related to IP, industry standards)
  - Understanding of strengths and motivation of other sectors (clinical partner, industry)

  Were any of these unexpected?
- Did the HIP have an effect on your interest in working with engineering and physical science researchers on applying their findings to health applications?

Summary question

- What has been the main value of the HIP project to you and your company?

HIP award outputs

Interviewer: Summarise what you already know, e.g.:

"I heard from Prof/Dr [lead PI] that the research led to [xx]. This can now be used to develop the [technology] further." OR

"I heard from Prof/Dr [lead PI] that the research showed that [the technology] is not suitable for further development." OR

"I heard from Prof/Dr [lead PI] that the main question of the research could not be addressed because of [xx]."

- So would you say that the HIP research findings have / have not *[use as appropriate]* led to a better understanding of the technology's potential for use in health applications?
  - If the project did not lead to a better understanding, why not?
- Were there any other findings of particular interest to you and your company?
- Are you aware if others have taken up the findings and outputs of the HIP, or any tools, products or methods developed as part of the research?
  - If yes: Could you provide examples?

HIP outcomes and impact

Further development of technology/approach

Interviewer [if relevant]: "I understand that after the completion of the HIP grant, the technology has been developed further, and is now being [tested/piloted/implemented]…."

- Has your company been involved in the further development?

If no:
  - Why not? E.g.:

        - Competing priorities / lack of time
        - Intellectual property issues blocking further development of the technology
        - Changes in the commercial context or competitive landscape – e.g. the emergence of a superior competing technology
        - Adoption side issues
        - Insufficiently conclusive results from development activity undertaken to date
        - Concerns regarding the suitability/value of the underlying technology
        - Concerns regarding the potential costs of onward development activities
    - Are you considering being involved in further development in the future? What would this require? Are there any clear challenges/barriers?

If yes:

- What is your company's role in further development activities?
- How is this follow-on work funded?
    - What is the funding source and budget?
    - Have you, or are you planning to apply for further funding from external sources? Which funding stream/funders will you target?

- Have there been steps towards commercialising the HIP research outputs? [if relevant]
    - Patents / IP or licensing deals
    - Investment to bring technology/product onto market. If yes: Could you explain in more detail?

      E.g. source of investment, level of investment, parties involved
- How far are technologies or products developed from entering the market?
    - If already achieved: Could you explain more?
        - How many people have benefitted, and what is the nature/scale of benefit?
        - What does this mean for your company in terms of commercial opportunity?
        - Were any jobs created?

      What is the future outlook for the technology/product?
    - If no: What do you think is the future outlook for the technology/approach, its commercial benefit and impact on health?

      Within what timeframe could these be achieved?
- In hindsight, is there anything that could have increased the potential for impact of the HIP-funded research? [*Note to interviewer: may have been covered in 'hindsight' questions above*]

Collaboration

Have you collaborated, or are you collaborating, with the HIP team, or some of the partners beyond the HIP-funded project?

If yes:

- What has been the effect of the HIP on this collaboration? Do you think you would be collaborating today if you had not been involved in the HIP?

- Please describe how you are collaborating.

  E.g. regular information exchange and advice; joint proposals; secured joint funding; collaboration extended to other people in my company; extended networks

- Could you briefly describe the project or projects you are collaborating on? [*Note: may have been covered above*]

If no:

- Why not? Are there specific challenges?
- Do you intend to or would you be open to collaborating with the HIPs partners in the future? If no, why not?

Other outcomes and impacts

- Were there any other outcomes or impacts from the HIP? e.g.
  - Did the HIP influence your company's capacity to, or attitude towards, collaborating with academic and/or clinical partners?
  - Did your company's R&D team benefit from skills/technical knowledge acquired as part of the HIP?
  - Did the HIP increase your participation in R&D networks, supporting your company's R&D operations?
  - Did the HIP lead to any recruitment?

Design of the HIP scheme and funding landscape

- Are there aspects of the overall design of the HIPs scheme that you feel could be improved? For example, that would facilitate participation by industry partners?

  E.g. funding for specific training, longer timeframes/increased budget

- What improvements to the scheme's design could be made to increase the level of outcomes and impact? E.g.

  Are there any additional activities the scheme could support to help it achieve its aims?

- From your experience, are the scheme's management processes adequate? Are there aspects that could be improved? *[Note to interviewer: Industry representative may have had little involvement in management]*
- What do you consider the main strengths of the HIP scheme?
- Are there any disadvantages compared to other funding programmes? What are these?
- Are there currently any gaps in the research funding landscape relevant to the technology/approach developed by the HIP that you think function as a barrier to development of health applications?

  If yes, what are the main gaps? *E.g. Gaps in:*

  - Types of research funded
  - Types of support for critical activities, such as consortium building, knowledge transfer
  - Funding for training and skills development
  - Insufficient level of funding available

Final comments and close

- Do you have any other comments about the HIPs or any suggestions to the EPSRC?

Thank you very much for your time and insights; this is extremely helpful to inform the study. We will consult other HIP-funded researchers and stakeholders over the next weeks. If there are any clarification questions or additional aspects to check with you, may I contact you again? I will make sure to keep any questions as brief as possible.

B.2. Survey

The EPSRC has commissioned Technopolis to conduct an independent review of the Health Impact Partnership (HIP) scheme to understand the value and impact of the HIPs and the ongoing need for such a scheme**.**

As part of this review, we are conducting a survey of principal investigators and partners of the HIPs funded to date. Your participation will help us gather evidence on benefits derived from the partnerships, challenges encountered, and the potential for health and commercial outcomes and impacts. It will also give you the opportunity to inform discussions on the future design of the scheme.

The survey should take around 15-20 min to complete. All responses and associated personal information will be treated in the strictest confidence, in line with legislation on data protection. Information will only be reported in an aggregate and anonymised form to EPSRC; where answers could be attributable, we will ask your permission before sharing the information.

Thank you for taking the time to complete the survey – your participation is extremely important to inform the study.

Before you begin, please make sure that your browser is maximised. It's easy to navigate through the questionnaire: just click on the answer or answers that apply for each question. You may need to use the scroll bar to see the next question. To continue, click on the next button at the bottom of each page.

Please click 'next' to enter the survey.

About you

Last name

First Name

HIP role: *Academic lead, Academic collaborator, Clinical partner, Industry partner, Other – please specify* [drop-down menu]

Institution/organisation

HIP grant number and title [drop-down menu]

Research activity

- Was the HIP based on an existing collaboration/partnership(s)? [drop-down menu]
  Yes, the academic, clinical, and industry partners had collaborated previously

Only some of the partners had collaborated previously, other partners were new

No, the partners had not collaborated previously

- If no, how did you identify the HIP partners / how did you get involved in the HIP? [drop-down menu]

  Direct approach as a result of literature / online search

  Recommendation by shared contact

  Networking event

  Other – please specify [open text box]

- What motivated you to apply for/participate in a HIP?

  [open text box]

- Your role in the HIP

	Key contributor, input on a regular basis / on specific aspects	Ad hoc contributor, occasional input	Involvement limited, input on a small number of occasions
To what extent were you involved in designing the HIP research project?	☐	☐	☐
To what extent are/were you involved in the implementation of the HIP research project?	☐	☐	☐

- Did you make any major adjustments to the project plan after the start of the HIP? (select all that apply) [drop-down menu]

  No changes to the plan put forward in the proposal

  Change to the scope of the study

  Change to the methodology

  Change to the study team

  Change to the study timeline

  Other – please specify [open text box]

If changes were made, please describe them and explain how they have helped to address the challenges encountered.

[open text box]

- To what extent are you satisfied or dissatisfied with the following aspects of the HIP collaboration?

	Very dis-satisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied	N/A
Knowledge and skills represented across project team	☐	☐	☐	☐	☐	☐
Level of communication between the partners	☐	☐	☐	☐	☐	☐
Infrastructure available for the project	☐	☐	☐	☐	☐	☐
Your level of involvement in steering the direction of research	☐	☐	☐	☐	☐	☐
The level of input from other partners in steering the direction of research	☐	☐	☐	☐	☐	☐
Your level of involvement in implementing the project	☐	☐	☐	☐	☐	☐

The level of involvement of other partners in implementing the project (availability of staff / time)	☐	☐	☐	☐	☐	☐
Administrative processes between partners	☐	☐	☐	☐	☐	☐
The level of patient and public engagement in the design of the HIP	☐	☐	☐	☐	☐	☐
The level of patient and public engagement in the implementation of the HIP	☐	☐	☐	☐	☐	☐

- What is working/has worked particularly well in the HIP collaboration and why?

  [open text box]
- What was/has been the main challenge encountered in the HIP collaboration?

  [open text box]

Value of the HIP

- To what degree do you agree or disagree with the following statements regarding your participation in the HIP?

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	N/A
The HIP has improved my/my team members' understanding of the potential for using our technology/approach in health applications	☐	☐	☐	☐	☐	☐
The HIP has facilitated meaningful collaborations	☐	☐	☐	☐	☐	☐
The HIP has strengthened my/my team members' technical skills	☐	☐	☐	☐	☐	☐
The HIP has strengthened my/my team members' translational research skills	☐	☐	☐	☐	☐	☐
The HIP has improved my/my team members' capacity to collaborate with different sectors (academic/clinical/industry)	☐	☐	☐	☐	☐	☐
The HIP has enabled my/my team members' professional development	☐	☐	☐	☐	☐	☐
The HIP has increased my/my team members' interest in applying engineering and physical science research to health applications	☐	☐	☐	☐	☐	☐
The HIP has increased my/my team members' interest in translational research	☐	☐	☐	☐	☐	☐
The HIP has increased my/my team members' connections and networks within the health technology research community	☐	☐	☐	☐	☐	☐
The HIP is providing a strong basis for further funding applications	☐	☐	☐	☐	☐	☐
The HIP has led to increased interest and openness at *my institution/organisation* in working with other sectors (academic/clinical/industry)	☐	☐	☐	☐	☐	☐

- What is/has been the main value of the HIP project to you and your work?

  [open text box]

HIP research outputs and outcomes

We are HIP resulted in any research findings? Please note we are aware that your HIP may be ongoing (or may have started only recently).

Yes

No

[If no, skip the questions in grey]

- Please summarise the findings.

  [open text box]
- Have others used the new knowledge generated by the HIP?

  Yes

  No

  Not yet

  Don't know

  If yes, please provide more detail. [open text box]
- Are you aware of any research outputs such as publications, tools, databases, technical products, software, IP/patents, research materials and methods *not yet reported in ResearchFish*? If yes, please specify the type and number.

  [open text box]
- Have others used research outputs generated by the HIP (such as tools, databases, software, methods etc.)?

  Yes

  No

  Not yet

  Don't know

  If yes, please provide more detail. [open text box]
- Has the technology/approach under development progressed along the translational research pathway?

  Yes

  No

  Not yet

  Don't know

  If yes, please provide more detail. [open text box]

- How do you rate the potential of the technology/approach under development for further progress and impact?

Very good	Good	Neither good nor bad	Limited	Unlikely	Too early to assess
☐	☐	☐	☐	☐	☐

- Has the HIP led to other collaborative projects with the partners in addition to the HIP-funded research?

  Yes

  No

  Not yet

  If yes, please provide more detail. [open text box]

- Has the HIP provided the basis for any further project funding?

  Yes

  No

  Not yet

  If yes, please provide more detail including the funder of the new project. [open text box]

Design of the HIP scheme and funding landscape

- To what extent were you satisfied with the following aspects of the HIP scheme?

	Very dis-satisfied	Dis-satisfied	Neither satisfied nor dis-satisfied	Satisfied	Very satisfied	N/A
Topics covered	☐	☐	☐	☐	☐	☐
Activities covered	☐	☐	☐	☐	☐	☐
Size of HIP grants	☐	☐	☐	☐	☐	☐
Partnership requirements	☐	☐	☐	☐	☐	☐
Level of direct and in-kind contributions required	☐	☐	☐	☐	☐	☐
Instructions for applicants	☐	☐	☐	☐	☐	☐
Application time (between call launch and closing date)	☐	☐	☐	☐	☐	☐
Application stages (e.g. intention to submit, full proposal)	☐	☐	☐	☐	☐	☐
Assessment criteria	☐	☐	☐	☐	☐	☐
Transparency of the assessment process	☐	☐	☐	☐	☐	☐
Feedback on application	☐	☐	☐	☐	☐	☐
Administrative / scheme management processes	☐	☐	☐	☐	☐	☐
Any other aspect, please specify _____	☐	☐	☐	☐	☐	☐

- What do you consider the main strengths and weaknesses of the HIP scheme?

  [open text box]

- What are the advantages and disadvantages of HIP grants compared to EPSRC standard mode grants?

  [open text box]
- If the HIP scheme did not exist, what alternative sources of funding could you have applied for to conduct the same research?

  [open text box]

Close

- Do you have any other comments about the HIPs or any suggestions for the EPSRC?

Thank you very much for your time and insights; this is extremely helpful to inform the study.

If there are any clarification questions, may we contact you? If yes, please provide your email address:

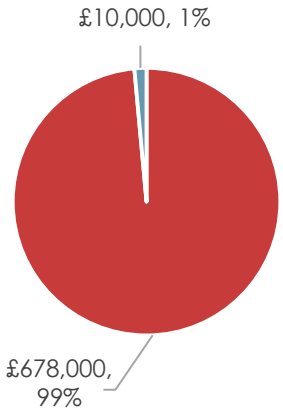
Your contact details will not be shared outside the study team, and will be deleted on completion of the study. Full details on how the study team will handle your data are available at http://www.technopolis-group.com/privacy-policy/.

C.1. HIP portfolio analysis

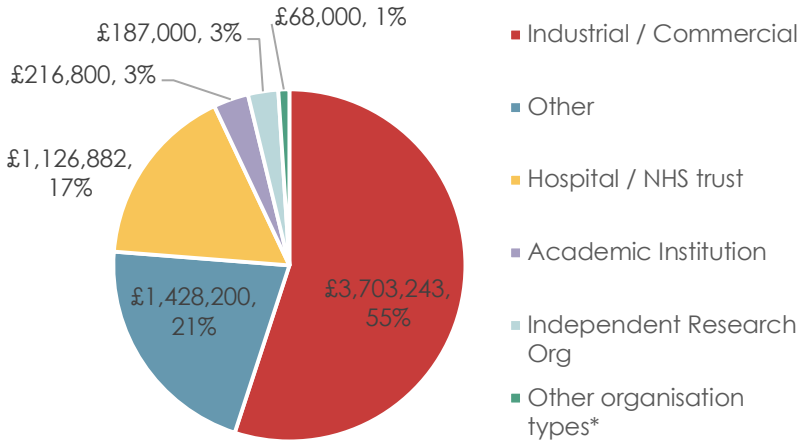
The largest proportion of partner contributions were from Industrial/ Commercial partners (Figure 40) accounting for 55% of the total in-kind and 99% of in-cash totals, respectively. 'Other' and Hospital / NHS trust were the next biggest contributors making up 21% and 17% of the total in-kind contributions, respectively.

Figure 40

A) In-cash



B) In-Kind



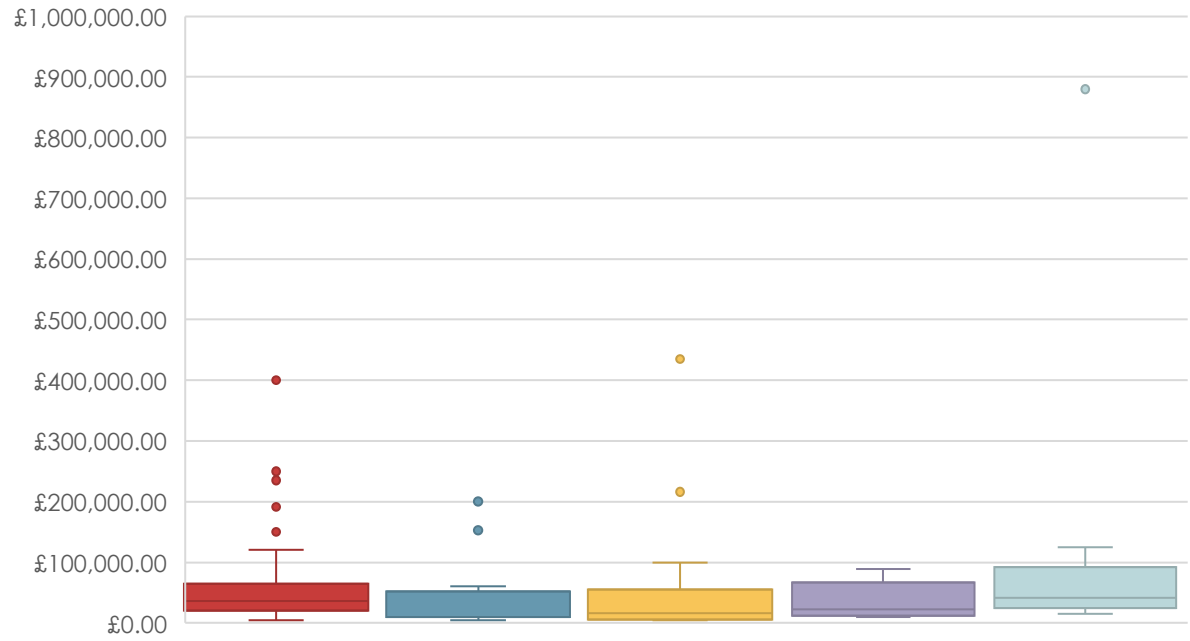
Source: Technopolis analysis of EPSRC grant data

*Other organisation types include Research Council/ Research Council institute, Charitable organisation and Local and regional government with contributions valued at £40,000, £18,000, and £10,000, respectively.

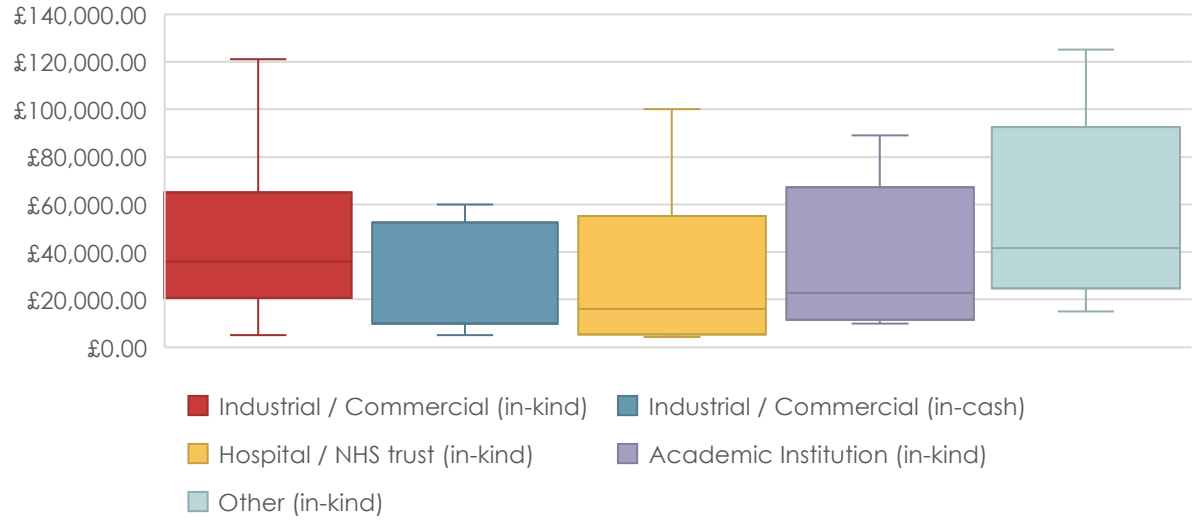
The range of funds contributed by contribution and organisation type is show in Figure 41. The largest single contribution was an in-kind contribution from a partner categorised as 'Other' valued at £880,000.

Figure 41 Box and whisker plots of the contributions per partner and contribution type. Panel A displays all values. Panel B displays the plots with outliers removed.

A)



B)



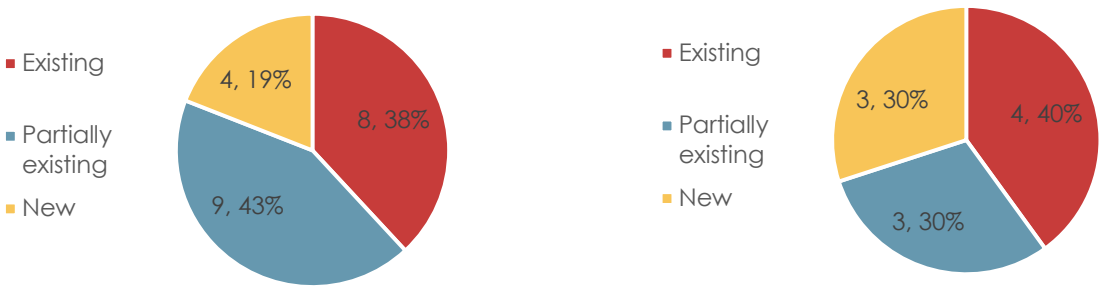
Source: Technopolis analysis of EPSRC grant data

C.2. HIP survey analysis

Most PIs indicated that their HIP project was based on an existing or partially existing collaboration/partnership (38%, 8 of 21; and 43%, 9 of 21, respectively) (Figure 20). By comparison, similar numbers of partners reported the collaboration was new (40%, 4 of 10), partially new (30%, 3 of 10), and existing (30%, 3 of 10).

Figure 42: Respondents who indicated their project was based on an existing partnership/collaboration (A) PI responses, (B) Partner responses

A) B)

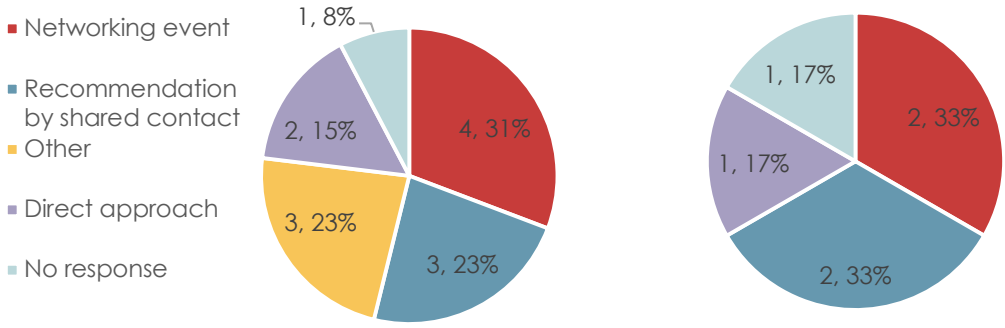


Source: Technopolis analysis of survey data

Of the PIs who reported a new or partially existing partnership (13), the most commonly reported way the new partners were identified was through a Networking event (31%, 4 of 13), followed by Recommendation by shared contact (23%, 3 of 13), and Other (23%, 3 of 13) (Figure 43). Other reasons included known contacts with no history of collaboration and previous supervisory relationship. Equal numbers of partners reported meeting collaborators through a Networking event and through Recommendation by shared contact (33%, 2 of 6 each) (Figure 43).

Figure 43: How project partners were identified. (A) PI responses, (B) Partner responses

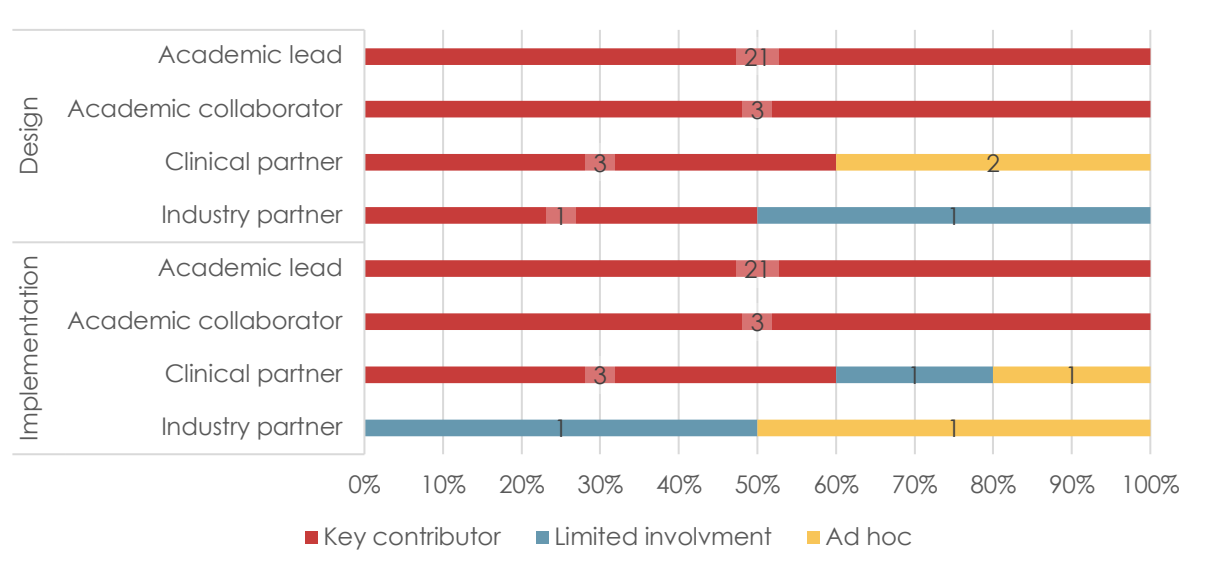
(A) (B)



Source: Technopolis analysis of survey data

All PIs (100%, 21 of 21) and academic collaborators (100%, 3 of 3) reported being a key contributor in both the design and implementation of the project. Results were more mixed among clinical and industry partners (Figure 44).

Figure 44 Reported roles in implementation and Design of HIP project

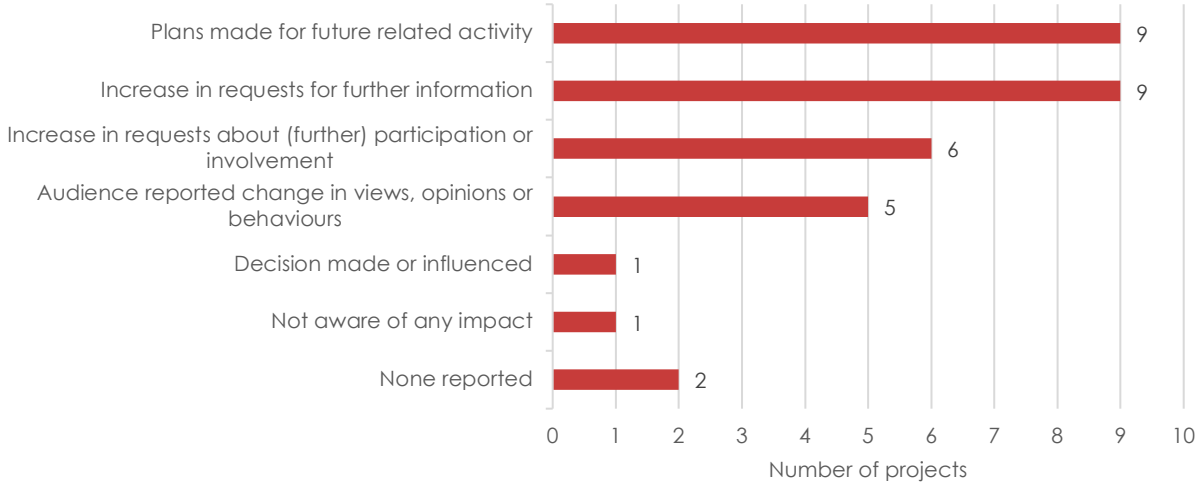


Source: Technopolis analysis of survey data

C.3. HIP ResearchFish analysis

Over half of the PIs reported the most significant outcome of their dissemination activities as 'Plans made for future related activity' (56%, 9 of 16) and/or 'Increase in requests for further information' (56%, 9 of 16) (Figure 45).

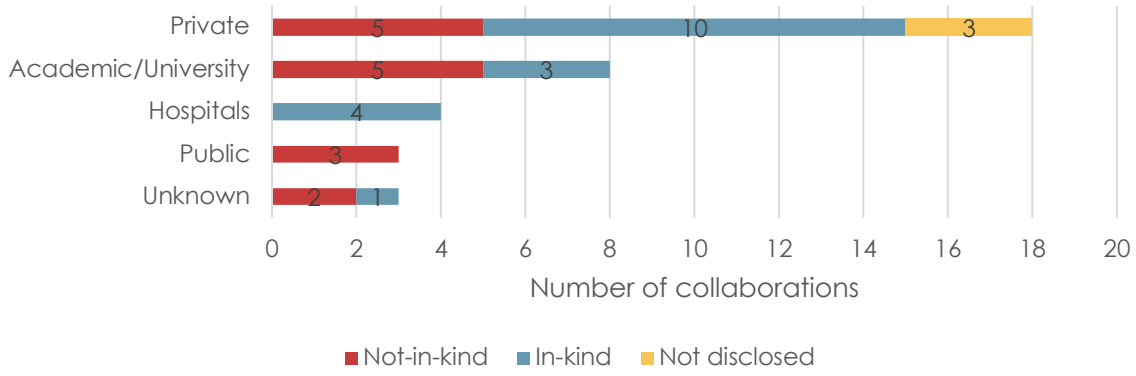
Figure 45 Most significant outcome of dissemination



Source: Technopolis analysis of ResearchFish data

Of the 18 collaborations with the private sector, the majority reported in-kind contributions (56%, 10 of 18) (Figure 46). Collaborations with the academic/university and public sectors were primarily financial contributions with the exception of hospitals for which all four collaborations reported in-kind contributions.

Figure 46 Type of contribution by collaboration sector



Source: Technopolis analysis of ResearchFish data

C.4. Standard-mode ResearchFish analysis

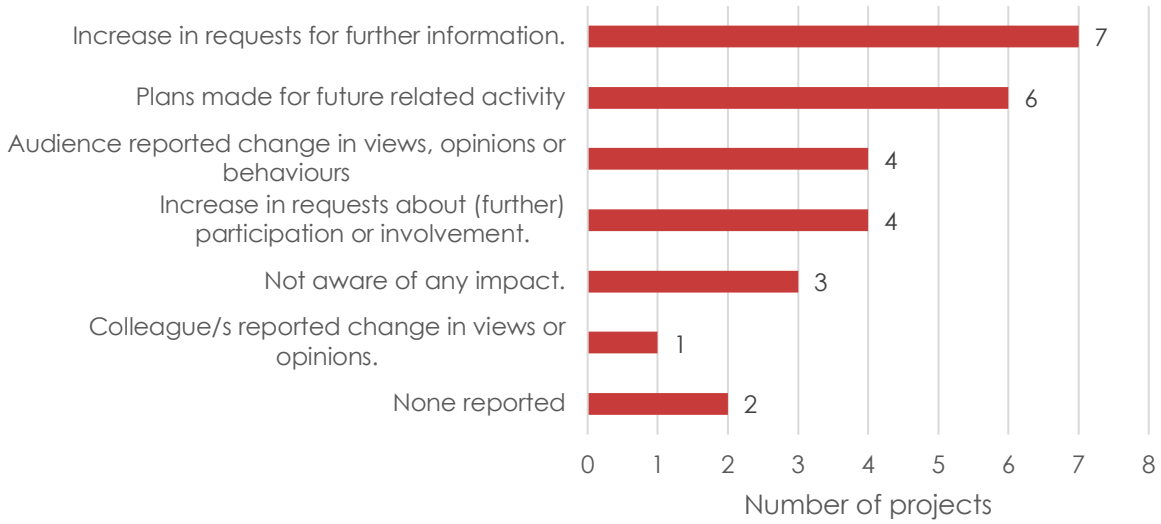
Table 13 List of PI institutions with more than one grant

Institute	Number grants
Imperial College London	7
King's College London	6
University of Oxford	5
University College London	5
University of Cambridge	4
University of Glasgow	2
University of Edinburgh	2
University of Sheffield	2
Keele University	2
University of Birmingham	2
University of Bath	2
Cardiff University	2

Source: Technopolis analysis of ResearchFish data

As to the most significant outcome of the dissemination activities, the most commonly selected outcome was 'Increase in requests for further information'(47%, 7 of 15), followed by 'Plans made for future related activity' (40%, 6 of 15).

Figure 47 Most significant outcome of dissemination (standard-mode grants)



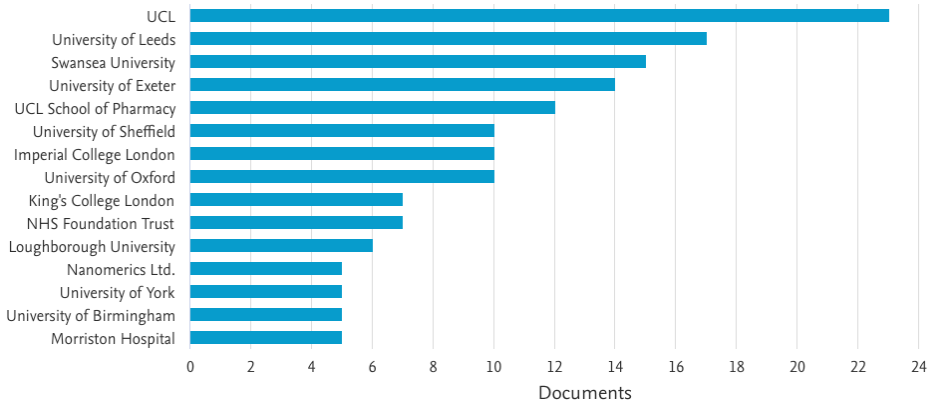
Source: Technopolis analysis of ResearchFish data

C.5. Bibliometric analysis (Scopus)

The analysis of journal articles through Scopus also provided some further information on the nature of the articles, which is presented below for both the HIPs and standard-mode grants.

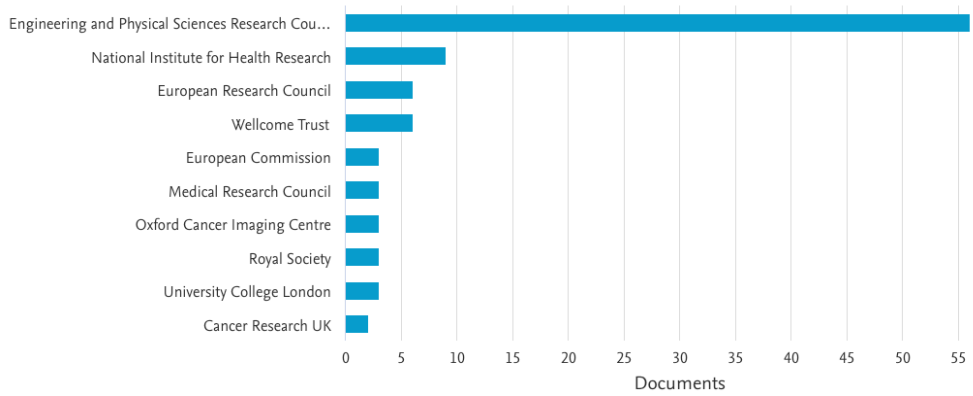
C.5.1.HIPs

Figure 48 Count of journal articles (documents) by affiliation



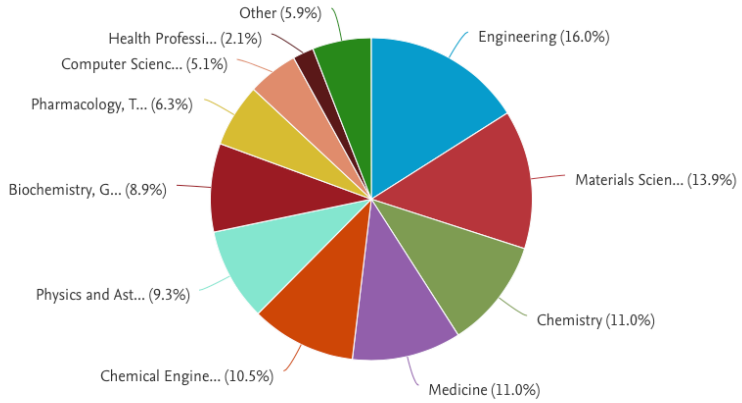
Source: Scopus analysis of ResearchFish data

Figure 49 Count of articles (documents) by funding sponsor



Source: Scopus analysis of ResearchFish data

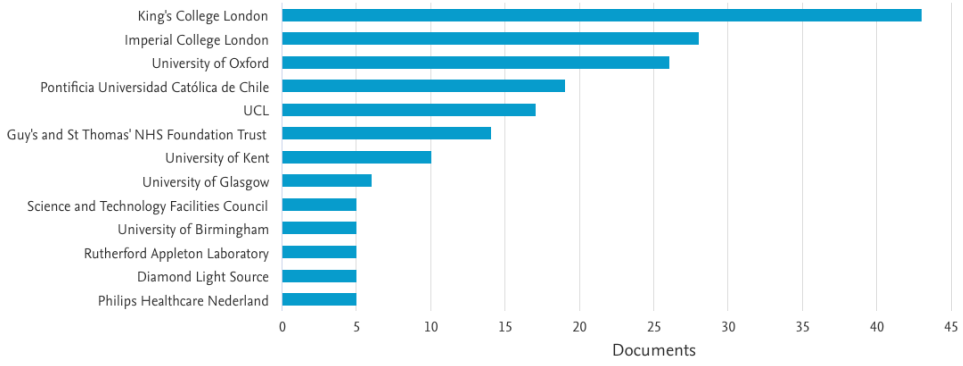
Figure 50 Proportion of journal articles (documents) by subject area:



Source: Scopus analysis of ResearchFish data

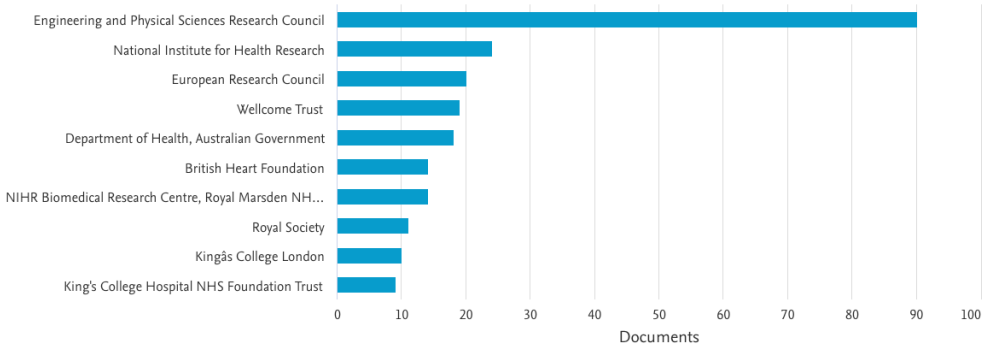
C.5.2.Standard-mode grants

Figure 51 Count of journal articles (documents) from standard-mode grants by affiliation



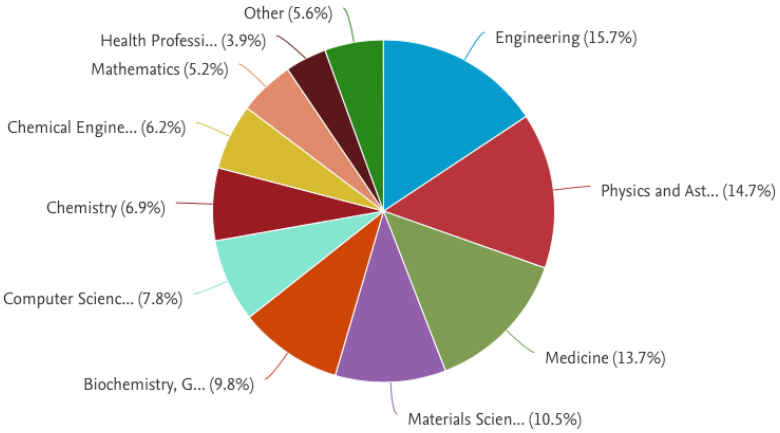
Source: Scopus analysis of ResearchFish data

Figure 52 Count of journal articles (documents) from standard-mode grants by funding sponsor



Source: Scopus analysis of ResearchFish data

Figure 53 Proportion of journal articles (documents) from standard-mode grants by subject area:



Source: Scopus analysis of ResearchFish data

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