

March 2023

Evaluation of the EPSRC Prosperity Partnerships Programme



EXECUTIVE SUMMARY



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Executive Summary

The programme

The Prosperity Partnerships programme is EPSRC's flagship mechanism for supporting strategic business-led research partnerships between leading UK based businesses and their academic partners.

The programme aims to enable businesses and academic groups to strengthen and deepen existing research relationships into long-lasting partnerships and accelerate the generation of economic benefits from fundamental research. It supports large-scale co-developed programmes of early-stage research targeting key industrial challenges. Industrial partners are required to make a substantial financial commitment to each partnership, contributing 50% to the costs as a cash investment. While the Prosperity Partnerships are focused on early-stage R&D (TRL1-3),¹ they are expected to provide benefits for the businesses involved (new products, services, process efficiencies, etc) as well as driving wider economic benefit and addressing major societal challenges.

Prosperity Partnerships programme objectives



The evaluation

Impact and Process Evaluations of the EPSRC Prosperity Partnerships programme were conducted between September 2022 and February 2023. The impact evaluation aimed to determine the extent to which Prosperity Partnerships programme has achieved its objectives since its inception in 2017 and to identify and quantify the outcomes and impacts generated. The process evaluation assessed programme implementation and the extent to which the programme design supported and enabled the delivery of the intended outcomes and impact.

The overarching approach to the evaluation of the programme was a theory-based evaluation using mixed methods to collate, collect and analyse data from a range of evidence sources. It included: a desk-based review of programme documentation and data; interviews with programme staff; surveys and interviews with academic and industry lead partners; interviews with senior university and business decision-makers and 15 in-depth impact case

¹ Technology-readiness levels <https://www.ukri.org/councils/stfc/guidance-for-applicants/check-if-youre-eligible-for-funding/eligibility-of-technology-readiness-levels-trl/>



studies of successful Partnerships. High survey response rates were achieved (75% of academic partners and 70% of industry partners).

Programme activity and investment

EPSRC designed a programme sufficiently attractive to academics and businesses. Since 2017 EPSRC ran four open calls and attracted 132 applications and funded 47 Prosperity Partnerships between some of the UK's top performing research universities and key UK based businesses.

The Partnerships were funded for up to 5-years and started at various points since 2017. The Partnerships funded under the first call (round 1 Partnerships) were due to complete in 2022 but extensions were given in time (not budget) due to the pandemic and, as yet, no Partnerships have finished.

- **A total investment in £337m** in the 47 Prosperity Partnerships, **securing £167m cash investment from businesses** (50% of the total investment) plus £40m from universities alongside £130m of public funds
- The majority of the public funding (97%) was provided, as intended, by EPSRC and three partnership co-funded by BBSRC (3%)
- The **business investment represents a considerable proportion of the total industrial leverage for EPSRC across its entire portfolio of investments** (10% of the total £1.7b) indicating the scale and importance of the programme for EPSRC
- 48% of the surveyed industry partners are UK-owned, and the remaining 51% overseas-owned or mixed ownership. The significant cash contribution requirement means that the majority of industrial partners are enterprises (82%) and only 18% are small or medium-sized companies
- **Partnerships cover a wide range of research domains and sectors in alignment with EPSRC's research remit**, ranging from digital, AI and quantum technologies to sustainable chemistry and novel materials for applications in sectors from aerospace and energy to telecoms and pharmaceuticals
- **Academic partners include universities across the UK** from Exeter and Bristol to Edinburgh, Swansea and Belfast as well as the 'golden triangle' of London, Cambridge and Oxford
- **Industry partners include global businesses across a wide range of sectors** and include AstraZeneca, BBC, BT, Dyson, Google, GSK, HSBC, Jaguar Land Rover, Microsoft, Microsoft, Nikon, Rolls Royce, Siemens, Unilever and others

Programme achievements

The Partnerships are intended to deliver outputs and short and longer-term outcomes in four impact domains (as identified in the programme theory of change): knowledge and skills; economic and productivity; collaboration and investments; and policy. While no Partnerships have finished, there is evidence of outputs and early outcomes in three of the four impact domains.

Knowledge and skills

Knowledge and skills have been generated in the form of traditional academic outputs - papers and PhDs - but also industry-focused outputs where new knowledge is embodied in patents and technological progression. At the start of the Partnerships, technologies are typically at TRL1, so focused on early-stage research as intended in the programme design, with the expectation that most will reach TRLs 3-5 by the end of the partnerships. However, partners also report an expectation that a small, but not insignificant, portion of the

technologies (26% of all reported) will reach the prototype, demonstration or implementation stage by the end of Partnership (TRLs 6-9).

The Partnerships have supported (and are still supporting) the development of future scientific and engineering talent. Industrial partners have provided secondment opportunities for many of the PhD students supported and often go to on recruit them after graduation, indicating the value and relevance of the skills being developed and evidence that the Partnerships are creating a pipeline of experienced and capable post-doctorate students with the industrial experience and networks to access industry opportunities. Partnerships are active in disseminating new knowledge through non-academic channels to reach wider society and play a role in contributing to long-term STEM skills development by raising awareness and inspiring young people to pursue careers in STEM.

- Nearly **500 papers** have been published and another **~900 are expected**
- Technologies are being developed and progressed. Typically **from TRL1 at the start of Partnerships to TRLs 3-5 at the end**. With a quarter expected to be developed much further to TRLs 6-9
- More than **30 patents have already been granted** with an expectation that **a further 60+** will be granted by the end of the Partnerships, and **another 70+** after the Partnerships
- **101 PhDs have been awarded** and **198 more are expected** at the end of Partnerships and 116 after the end. **Many PhD students also spend time on secondment with the industrial partners** and, in many cases, the **companies go on to recruit the secondees**. There are also instances of industry partner engineers joining university teams

Economic and productivity benefits

The knowledge outputs are creating innovation and commercialisation opportunities for industrial partners. The vast majority have identified opportunities and expect new products and services to be launched on the market and/or new processes to be adopted with an expectation of future improved and sustained business growth (jobs, revenue) and productivity improvements. These benefits are expected to arise after the Partnerships have completed, so from 2023 at the earliest. Industry partners are expecting to continue to progress the technologies via their own internal R&D activities once the Partnership research activities come to an end, with a large proportion expecting to continue this work with their academic partners. Innovations in the form of new products and processes are reported more frequently than service innovations.

There are a handful of examples from the case studies, from Partnerships in the earliest rounds, where products and services have already been launched on the market and a new manufacturing process is being piloted. Furthermore, as might be expected sectors such as electronics, IT and telecoms with fast-moving technological evolution are producing outcomes more quickly. Partnerships involving companies such as BT and M-Squared Lasers have already delivered or will soon deliver commercial outcomes. However, there are also examples of Partnerships with lead industry partners (e.g. Wrightbus) in more traditional manufacturing industries (automotive and consumer goods) that are also demonstrating the start of commercial benefits within the lifetime of the Partnership. Though for many Partnerships the commercial benefits remain several years away.

Just a small proportion of respondents expect to (15% industry and 29% academics) to establish spin-out companies. That this outcome is more commonly considered by academic rather than industry partners reflect the fact that the large industrial partners participate in order to generate opportunities for innovation and commercialisation for their own purposes, while for

academics spin-outs are often the only route to commercialisation (for technologies their industry partners do not wish to commercialise).

The programme design intends that the technologies developed will have use and be replicated, scaled and adopted in other sectors and businesses beyond the partners. While at this point it is too early to determine if this is the case, there is a reasonably high expectation among the partners that this will occur, with academics rather more positive than industry partners.

- **Most partners (85%) report the identification of opportunities for new products, services, manufacturing methods and processes**, while a small proportion of respondents (31.5% academic and 15.2% industry) have not yet been able to identify commercial benefits
- **Outcomes from the Partnerships are expected to occur after the end of the projects** and the first Partnerships will end in 2023. However, a small number of respondents reported that new products or services have already been launched on the market and one processes in currently being piloted. A further 73 products, services and new processes are expected after the end of the Partnerships, with many other opportunities likely to arise from the knowledge generated.
- **73% of industry partners expect to launch new products onto the market and 76% new processes, methods or tools to be implemented, and a smaller proportion (55%) expect to launch new services**
- A small proportion of respondents expect to (15% industry and 29% academics) to establish **spin-out companies**
- Academic partners report expected wider replicability, scalability and adoption of the technologies being developed more frequently (71%) than the industry partners (55%)

Collaboration and investment

There is considerable evidence of strengthened and deepened academic-industry relationships as well as an interest and skills in undertaking such partnering activities. Only one Partnership lost the lead industrial partner part way through. Almost all partners plan to continue the collaboration supported via the programme indicating that sustained partnerships have been created. In addition, all partners have gone also on to establish collaboration with other organisations, and most intend to continue working in the early-stage (low TRL) space via academic-industry collaborations – indicating that the experience has been extremely positive for participants from both the academic and business communities.

There is evidence that the successful relationships established and the innovation opportunities generated are having broader effects on R&D activities and investments within the industry partners. Around a half of industry partners are expecting to make further investments in R&D and participants report £75m already invested (in addition to the original £167m co-funding). The emerging Partnership outputs are being shared within the multinational industry partners and generating wider interest in the technologies, to the extent that just over a third of industry partners report investment in UK R&D activities from non-UK sources within the parent company. Industry partners also report positive effects in terms of influencing increasing in internal company R&D budgets.

- All academic and industry partners have **plans to continue collaboration** and **all have established new collaborations with different organisations**
- Most academic and industry partners report **plans to continue undertaking low TRL research in partnership with academic/industry partners**, influenced by their Prosperity Partnership experience
- 42% of industry partners claimed that the **Partnership had influenced an increase in internal investment in R&D** to a small extent and a further 35% claimed that the Partnership influenced internal investment to a significant extent
- About half of the industry partners reported **having made or having plans to make additional investments** in the research domain of the Prosperity Partnership in the UK from internal UK company sources /budgets
- Prosperity Partnerships **have** facilitated foreign direct investment. Evidence from participant interviews suggested that results emerging from the Partnerships are presented and brought to the attention of the non-UK management teams. 36% of industry respondents report **investments in the technology domain of the Partnership from non-UK company sources/budgets** (i.e. from a parent company).
- **Industry partners report having already made an additional investment in the value of £75m** (UK and non-UK sources together), which means that together with the initial industry investment in the Partnerships, the programme has leveraged industry contribution in the value of £242m
- Additional private funding was invested in new equipment at partner universities and in collaborative research with the academic partner

Policy

While there is no clearly defined objective for impact in the policy domain, it was identified in the theory of change as an area where the programme may play a role, with an expectation that some of the knowledge emerging from the projects might have direct or indirect relevance for policy.

An analysis of case studies indicates that there is a potential for the new knowledge to be relevant to policy making and around 40%-45% of academic and industry partners report that innovations arising from Partnerships will have applications and benefits in public policy design and public service efficiency. In these cases, Partnerships are generating relevant and often unique insights into important matters for policymakers and several Partnerships have made efforts to disseminate new knowledge to policy-makers and engage them in the formulation of research questions. Key examples include addressing the policy requirements and consequences of the switch to electric and/or hydrogen powered vehicles and using digital twins to explore the flow of data on 'digital roads'. However, as yet, there is limited evidence of the adoption of Partnerships' outputs into policy.

Attribution and additionality

Attribution and additionality was assessed qualitatively via theory-based methods, exploring evidence for the assumptions that underpin progression through the theory of change and looking into how and why the outputs and outcomes were generated.

Input additionality / programme design: The programme design provided a unique offering in the UK funding landscape, enabling academia and industry to work together on early-stage research while also requiring industry to contribute 50% of the costs as a cash investment. All other programmes in the EPSRC portfolio (and similarly for other Research Councils) accept in-kind contributions from industry for collaborative R&D projects and programmes. It was not the intention that new relationships would be formed but that existing relationships would be

strengthened and deepened and industry encouraged and enabled to invest in early-stage research. The programme was over-subscribed with many high-quality proposals and 47 businesses willing to invest considerable sums in early-stage research and equally academic groups willing to undertake fundamental research with a strong industry steer. This indicates there was an existing appetite for early-stage research among business rather than an interest stimulated by the programme itself. However the survey and interviews suggest that the programme provided a means to undertake what was perceived as risky research and do so at a larger scale than might have been the case. The scale also enabled a degree of interdisciplinarity, with industry partners able to access more several research groups in one academic institution to address their complex industrial challenges. Requiring such a significant cash investment from industry was a novel and unproven approach for EPSRC, however it proved to be attractive to industry because it enabled them to play a leading role in driving the direction of the research programmes undertaken. Industry was attracted to the prospect to invest in risky business-relevant research ('use-inspired' research) with academic experts at a much larger scale than they would do so otherwise and, importantly, with a much stronger leadership role and clear oversight via the industry lead PI and the requirement for internal governance processes and a Partnership Review Board. The programme requirement to build on existing research relationships was key factor in enabling such partnerships to be developed and secure the intellectual and financial buy-in. Furthermore, universities were also willing to invest their own funds to strengthen and embed strong relationships with existing industrial collaborators. There is not full input additionality as these relationships may have continued via other collaborative programmes and in-kind contributions, but a shift to more effective industrial leadership of research activities, as opposed to a much more academically driven research programme, is evident.

In terms of outputs and future outcomes, there is clear evidence that innovative products, services and processes are emerging and are expected to emerge from the Partnerships and that industry partners are expecting to commercialise or adopt them and gain future business benefits. Academic and industry partners strongly believe that the majority of these benefits are additional, i.e. would not have occurred without the Prosperity Partnerships programme and the evidence above suggests that the programme design facilitated strong industry leadership ensuring the early-stage research was relevance to their interests and needs. Commercial and wider 'prosperity' outcomes are yet to arise as the majority of innovations require further (non-EPSRC) investment to bring them to market. There is clear evidence that the many industrial partners (around half) are investing internal funding in further R&D to achieve this and, in many cases continuing to collaborate with the academic partners to do so, indicating that future benefits will have been influenced by (so partial attribution) to the programme.

There is also clear evidence that the research relationships will continue in all cases, with further early-stage research activities being undertaken and new collaborations developed with a wider group of organisations. While many of the partners were already experienced in research collaboration and the specific academic and industry partners in each Prosperity Partnership had worked together before, the scale and nature of the Prosperity Partnerships has in many cases enabled what were 'looser' relationships to be evolved into stronger and more formal arrangements. This may be less the case for some industry partners that already have quite formal structures for their investments in academic research groups (e.g. pharmaceutical business, Rolls Royce).

There is some evidence that the programme has influenced an increase in industry partners' investment into the research domains and an inward flow of R&D investment from partners' oversea parent companies. While the latter can be considered new investment to the UK, the former may be displacing R&D investment from other areas. A real uplift in R&D investment will

only be evident in future company accounts and, considering the scale of the companies involved, potentially in BERD data. However, any uplifts here will have been influenced by a wide range of factors in addition to any influence of the programme and attribution relatively small.

Programme processes

Participants were generally satisfied with EPSRC process to select and monitor partnerships. In evaluating collaborative R&D programmes, it is common to identify concerns regarding the application burden for industrial partners, as was the case here. However the funding agencies will always have to balance the need for robust accountability for public funds with industry's desire for simplicity and speed. Nevertheless, EPSRC was willing to listen and learn and adapted its application processes to be more business-friendly, a step that was widely welcomed. Unsuccessful applicants will tend to perceive more of an application burden than successful applicants, but with a high number of high-quality proposals and limited funding this is largely unavoidable. Likewise the removal of the requirement for quarterly monitoring reports was also welcomed. The mid-term review was found to be an effective mechanism for steering Partnerships towards the generation of tangible and relevant outputs in the second half of the partnership lifetime.

Participants welcomed the requirements for internal partnerships governance procedures and a Review Board for, in particular, keeping a focus on the success and relevance of the research. Also welcomed was the flexible approach taken by EPSRC regarding the research direction, allowing the partners (via the governance processes) to redirect the research based on research outputs during the Partnerships.

A number of participants were less satisfied with the lack of stability and consistency in the EPSRC project officer assigned to their Partnership. Another group would like to see improved access to post-Partnership funding, reporting dissatisfaction with the lack of coordination between UKRI bodies, between the Research Councils and Innovate UK programmes in particular.

Value for money

Considering the long timescales to generating the full effects of the programme, we made a 'cautious' preliminary analysis of the value for money based on the outcomes generated to date and those projected by participants. We found that:

- Each £1m invested by the EPSRC in the PP generates a return of £7.75m (£1.1m per annum)². On average, it will take five and a half years for companies to start generating their first returns, which will last for more than seven years
- Each £1m invested by the EPSRC in the PP generates 0.4 FTEs³ (as a direct effect of grants). Additionally, each £1m invested generates 8.5 FTEs⁴ in period 2017-2022 and 2023 onwards

² Each £1m invested taking into account total costs (EPSRC investment, business investment and research organisation investment) in the PP would generate a return of £3.0m (£0.4m per annum).

³ Each £1m invested taking into account total costs (EPSRC investment, business investment and research organisation investment) in the PP would generate 0.1 FTEs.

⁴ Each £1m invested taking into account total costs (EPSRC investment, business investment and research organisation investment) generates 3.3 FTEs in period 2017-2022 and 2023 onwards as a result of the additional income generated thanks to the products/services developed under the PPs grants.

as a result of the additional income generated thanks to the products/services developed under the PPs grants

The return-on-investment figure has to be interpreted with caution for two reasons. Firstly, the majority of benefits are projected (with a range of confidence levels reported by survey respondents). The final value of revenue and jobs gained is highly likely to differ and could do so in either direction i.e. be higher or lower. Secondly, the assessment only includes benefits for participants and not benefits generated through wider adoption of the technologies in the same or other sectors or wider knowledge spillovers.

Conclusions and recommendations

The Prosperity Partnership is successfully delivering against its objectives. It was not clear at the outset if the design of the programme would be attractive to the academic and industrial communities (industry in particular), but it proved to be able to attract and support a wide range of Partnerships, and Partnerships are delivering outputs and early outcomes entirely in line with the theory of change and programme objectives. However, the longer-term effects will not be observed for a number of years.

A small number of adjustments to the programme operations are recommended:

- Light-touch on-going monitoring post completion to enable capture of on-going outcomes generation. This could take the form of a short online survey tool or a request for a short report. Several participants were keen to have their on-going benefits captured and reported.
- Evaluation would be improved by capturing data on all Partnership participants – as some Partnerships have more than the two lead partners and/or additional partners join during the Partnership
- Increased resources for EPSRC programme administration. Not only is the application process more resource-intensive than the standard EPSRC process, but Partnerships are keen to have a consistent project officer throughout a Partnership

A wider issue concerns the coordination amongst the UKRI bodies, between the Research Councils and Innovate UK in particular, and the ability to access funding for different stages of the innovation pathway. While innovation is to a large extent 'survival of the fittest' and there is no rationale for guaranteed follow-on funding from Innovate UK, there is scope to improve communication and engagement between EPSRC and Innovate UK. This could raise awareness within Innovate UK of the promising innovations arising and enable EPSRC to confidently and effectively sign-post and alert participants to appropriate Innovate UK funding opportunities. This not to say that there isn't scope for EPSRC and Innovate UK to also explore the potential for some form of competitive follow-on innovation funding. The interdisciplinary requirements of many industrial challenges may benefit from cross-Research Council support for future partnerships. EPSRC has already partnered with BBSRC in the current programme and BBSRC is now implementing its own Prosperity Partnership programme, but it could explore the potential for further collaborations with other Research Councils.

Participants across the board are keen to see the programme continued and ideally expanded. The number of high-quality unfunded applicants suggests the 'market' for the programme is not yet saturated. However these potential partnerships scored less than those that were funded and EPSRC is interested to explore the potential to widen the programme to smaller businesses who may have less experience collaborating with academics. This may increase the potential for failed or less successful partnerships and may require some adjustments to programme processes to mitigate this risk:



- With more resource dedicated to programme administration, EPSRC can provide additional guidance and support to applicants and funded Partnerships ensuring, for example, that participants are clear about the need to maintain wider company buy-in and support for the Partnership and guidance in designing effective Partnership governance processes
- For smaller businesses, there may be barriers to participation (the cash contribution) as well as challenge to successful delivery (less experience in R&D collaboration) and EPSRC support a pilot stage, allowing potential partners to work together to explore research ideas and develop a future research programme for a future application for a Prosperity Partnership.

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