

*March 2023*

# Evaluation of the Prosperity Partnerships programme

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Impact evaluation report



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# 1 Introduction

## 1.1 Background and objectives of the programme

Policy support for business-academic collaboration has been a key feature of UK research and innovation policy for over 20 years; from the EPSRC-led Faraday Partnerships in the late 1990s to the science / innovation strategies of various Governments<sup>1</sup> through to the current 2021 UK Innovation Strategy<sup>2</sup>. The current UKRI strategy and delivery plan<sup>3</sup> emphasises the role of business-academic collaboration in innovation, placing significant focus on engagement and connectivity, convening and catalysing – to create and deepen effective relationships and partnerships between research and innovation activities and to aid the flow of knowledge, people and skills between research and innovation actors.

EPSRC has been at the forefront of business-academic collaboration for many years (prior to UKRI's creation) through its long-standing strategic partnerships with key UK business investors in R&D (such as Arup, BT, GSK, Tata Steel, Jaguar Land Rover, Rolls Royce) and its longstanding focus on collaborative R&D at programme (e.g., Links programme) and project level<sup>4</sup>. As a result, almost 50% of its research grants involve collaboration with a business partner, worth over £1.8bn (cash and in-kind contributions from business). With an extensive experience in facilitating and maintaining productive partnerships with businesses and the wider innovation ecosystem, the EPSRC is well-placed to contribute to the government's vision for the UK as an innovation nation.

The EPSRC Prosperity Partnerships (PPs) build on the above base; with the aim of strengthening and deepening existing strategic relationships between academia and businesses and supporting excellent, world leading fundamental research which has clear benefit to the businesses involved, resulting in accelerated impact arising from the new knowledge, innovations, or technologies. Connecting academic and industrial actors in partnerships is not necessarily a novel conception. What is unique about the PPs is placing businesses in the lead of low technology readiness level (TRL)<sup>1</sup> projects and requiring significant industry cash contribution. Figure 1 summarises programme objectives, key inputs, activities, outcomes and impacts.

Figure 1 Prosperity Partnerships programme objectives



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

The Prosperity Partnerships first launched in 2016/17, are multi-year, multimillion pound research collaborations between leading UK universities and industry, all seeking to meet the demands of complex topics of national and international interest. The partnerships are intended to focus on research between TRL 1-3, supporting both academic research and commercial applications over the lifetime of the partnership period and beyond. The research challenges addressed by a partnership should be relevant to stimulating innovation to tackle major problems faced by the UK and the world as well as to drive capability in key technologies and scientific advancements. Academic and industrial participants are expected to build upon existing strategic relationships, with a clear intention to both deepen the partnership during their PP and to continue the relationship after the partnership.

## 1.2 Evaluation objectives

The study's objective is to demonstrate the impact and success of the Prosperity Partnerships programme since its inception in 2017. Table 1 summarises specific evaluation objectives. Evaluation has two over-arching aims and a number of sub-questions and features to be explored. It seeks to identify and quantify the outcomes and impacts generated to date (**impact evaluation**) and understand how, and the extent to which, the programme design and implementation enables the intended impacts to be generated (**process evaluation**). Finally, it seeks to identify programme improvements (**lessons learned**). Process evaluation questions are addressed in a separate Process Evaluation Report.

Table 1 Evaluation objectives

EVALUATION OBJECTIVES
<b>OBJ1: Identify what <u>quantifiable impacts and benefits</u> these investments have had, or are expected to have, at a local and national level on the UK's economy, productivity, policy and scientific advancement</b>
<p><b>Economic and productivity at local and national level</b></p> <ul style="list-style-type: none"> <li>• In terms of new/improved products &amp; services, jobs, efficiencies</li> <li>• Plus intermediate effects in terms of               <ul style="list-style-type: none"> <li>– Commercialisation of research outputs, technologies, innovations (including IP, licences, spin-outs, etc)</li> <li>– Benefits for participating businesses – reputation, competitiveness, growth</li> <li>– Early adoption of innovations for wider economic, productivity and societal benefits (environment, health, etc)</li> </ul> </li> </ul>
<p><b>Collaboration and investment</b></p> <ul style="list-style-type: none"> <li>• Strengthening of current partnerships – additional investment, collaborative activities</li> <li>• New partnerships / collaborations and related investment</li> <li>• Foreign private investment (FDI) and any local effects of this investment</li> <li>• Strengthening of partnerships with local economic/ civic development activities and policies</li> </ul>
<p><b>Policy</b> - impacts on policy and regulations at UK and local level</p>
<p><b>Knowledge and skills / scientific advancement</b></p> <ul style="list-style-type: none"> <li>• UK leadership in key scientific disciplines and in industrially relevant domains</li> <li>• Attracting, retaining, developing talented people – locally and nationally</li> <li>• Influencing advancement and/or catalysing growth in key disciplines / sectors / clusters</li> </ul>
<b>OBJ 2: Identify the <u>key process areas such as the successful features of the programme</u> and how have they mobilised businesses and the research community to deliver the programmes objectives</b>
<p>The <b>unique and/or innovative features of the programme and its delivery</b> that attracted the partners to participate</p>
<p>The extent to which the <b>partners intend to build on the programme</b>, its investments, and activities</p>
<p><b>Lessons for the evolution of the Prosperity Partnerships</b></p> <ul style="list-style-type: none"> <li>• Administrative and M&amp;E processes</li> <li>• Opportunities to achieve success, increase outcome &amp; impact</li> <li>• Opportunities to extend scope e.g. industry, sector, position in supply-chain</li> </ul>



### 1.3 This report

This report presents impact evaluation of Prosperity Partnerships programme based on data collected during the period from September 2022 to mid-January 2023. The following section presents an overview of the methodology, Theory of Change and evaluation indicators. Section 4 presents the inputs – an overview of EPSRC, academic and industry match funding. Section 5 presents the evidence for the outputs, outcomes and impact of each impact domain:

- Economic and productivity
- Knowledge and skills
- Collaboration and investments
- Policy

Section 6 presents the results of the return of investment analysis and section 7 presents summary and conclusions.



## 2 Methodology

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### 2.1 Prosperity Partnerships programme Theory of Change

The overarching approach to the evaluation of the Prosperity Partnerships programme is a theory-based evaluation. Theory-based evaluation is suitable for evaluating programmes with complex and diverse expected outcomes and impacts and long timescales to impact. A programme Theory of Change (ToC) is essential in theory-based evaluation because the evaluation collects evidence and tests the ToC to demonstrate causality between inputs, outcomes, and impacts. This section describes the ToC, logic behind the pathways to impact, assumptions, risks and external influences.

EPSRC developed a logic model for the Prosperity Partnerships programme as part of the Delivery Plan for Prosperity Partnerships in 2017. We have elaborated the original model and developed a programme ToC. The ToC forms the basis of the evaluation methodology and guided our data collection, analysis and reporting.

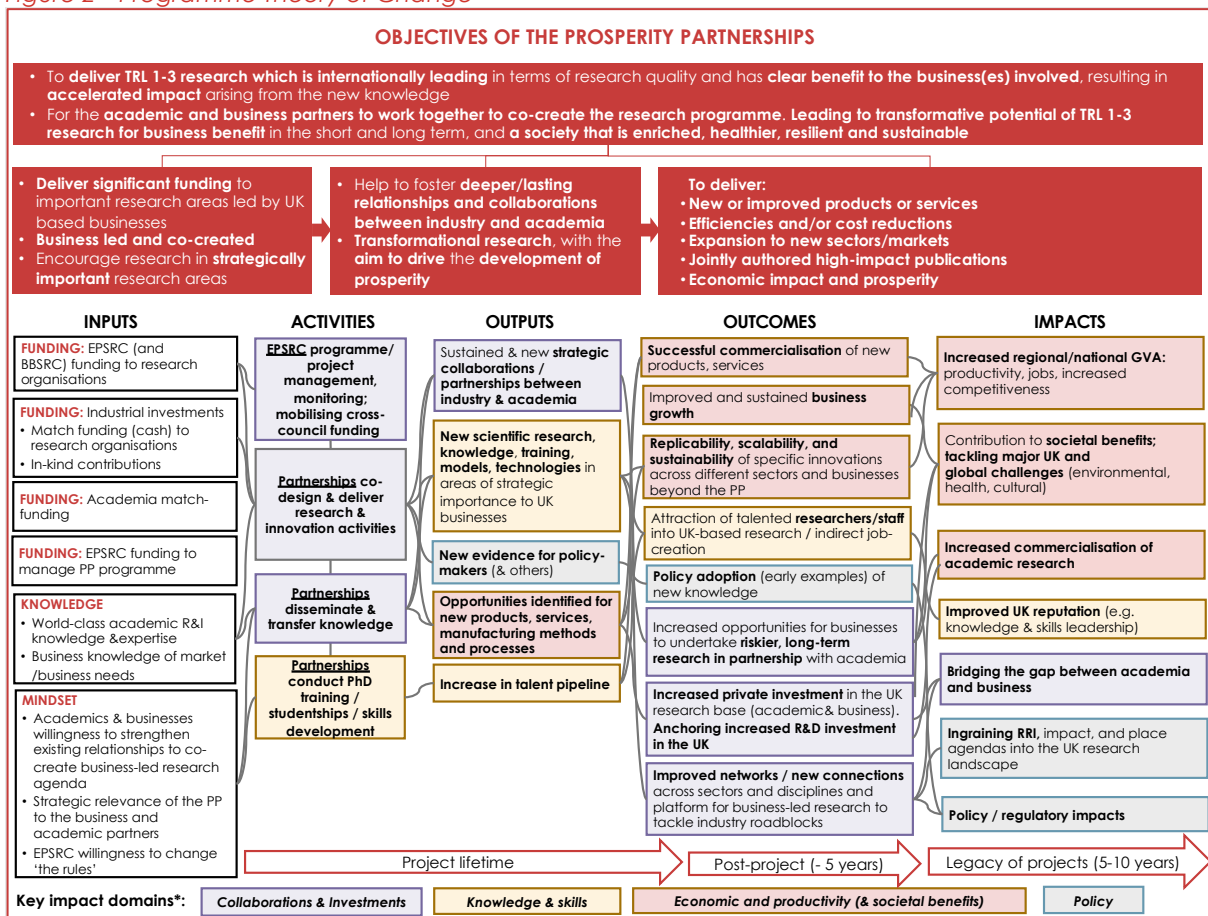
Figure 2 shows the graphical illustration of the ToC. The ToC structure is to be read from left to right, starting with inputs and activities – i.e., the EPSRC and industry funding that supports the co-designed research and innovation activities. The activities directly produce outputs that are largely attributable to the Prosperity Partnerships. Finally, outcomes and impacts arise partly as a result of the Prosperity Partnerships but also depend on external factors, other funding, investments, etc. Prosperity Partnerships thus contribute to the outcomes and impacts, but full attribution is unlikely.

We have colour-coded activities, outputs, outcomes and impacts to trace the pathways across the four types of impact that the evaluation should explore:

- **economic, productivity and societal benefits**
- **collaboration and investment**
- **knowledge and skills**
- **policy**

The ToC has a timeline along the bottom. This indicates that partnerships should deliver outputs within their lifetime. Partnerships might also deliver some outcomes (e.g., the attraction of talent or commercialisation plans) during their lifetime. Timelines will vary with sector, for example, telecommunications can progress faster than aerospace meaning that some companies might benefit from outcomes within the lifetime of the PP. However, because the programme funds low TRL research, most outcomes to the full extent are expected to arrive up to about five years post-partnership so that that impact may be evident 5-10 years after partnership completion. A significant share of partnerships (16) will complete by 2026. Therefore, the evaluation demonstrates the outcomes achieved and capture prospective outcomes and impact expected in the coming years.

Figure 2 Programme Theory of Change



Drawing on the ToC provided above, a list of indicators was developed for the evaluation. The indicators were used to design and systemise data collection. The indicators cover all ToC elements (inputs, outputs, outcomes) and are summarised in each of the sections analysing the outputs and outcomes of each impact domain (sections 5.1.-5.4.).

## 2.2 Methods

The data collection and analysis methods used in this evaluation aim to comprehensively address the two evaluation objectives - identify and quantify outcomes and impacts and understand whether and how the programme design and processes enables impacts to be generated. The evaluation builds on mixed methods and that enables the evaluation to capture the diversity and breadth of outcomes and impact and explore causal links and attribution.



Table 1 presents an overview of methods for data collection and analysis and details on collected data. The data collection methods were an analysis of secondary partnerships monitoring data, surveys of Prosperity Partnership participants and a programme of interviews with academic and business stakeholders to quantify and characterise outcomes and impact achieved to date and assess signals of prospective impact. In-depth impact case studies explore and showcase in detail the diverse impacts achieved so far, progression along the impact pathways (including the role of programme processes) and prospective impact.

Table 1 An overview of data collection and analysis methods and collected data

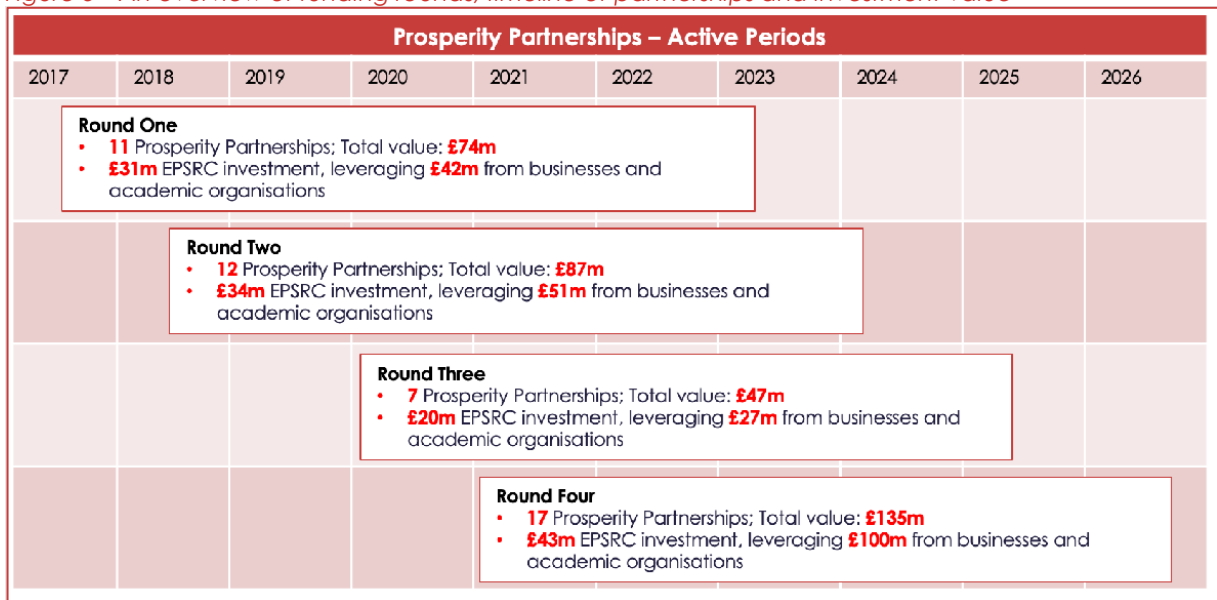
Methods	Description	Details on collected data
<b>Data collection</b>		
<b>Analysis of monitoring data (ResearchFish and monitoring reports)</b>	To populate indicators (inputs, activities, outputs, early outcomes). To benchmark and contextualise the programme outputs, outcomes with outcomes of other EPSRC portfolio programmes (based on RF data). Monitoring data were also used to support the interview process and inform case studies.	<ul style="list-style-type: none"> <li>• ResearchFish data from the most recent upload in May 2022</li> <li>• Annual reports of all Partnerships</li> <li>• Mid-term reviews of rounds 1-3 Partnerships</li> </ul>
<b>Surveys of all industry and academic partners</b>	To obtain structured feedback from a large number of stakeholders and collect additional quantitative data and qualitative details on achieved and prospective outputs, outcomes and impact (to populate indicators) and experience with programme processes.	<ul style="list-style-type: none"> <li>• Survey of industry lead partners (N=47, n=33, response rate: 70.2%)</li> <li>• Survey of academic lead partners (N=47, n=35, response rate: 74.4%)</li> <li>• PPs covered by at least one survey response (N=47, n=42, response rate: 89.3%)</li> </ul> Aggregate survey results are presented in the Annex of this report. Industry survey questionnaire is attached in Appendix A and academic survey questionnaire in Appendix B.
<b>Interviews with stakeholders</b>	To gain more in-depth insights into scale and scope of outputs, outcomes and impact achieved, how they were achieved, what are the barriers; and on the role of programme processes in enabling impact achievement.	<b>Rounds 1 and 2 Partnerships:</b> Interviews with industry lead partners to support case studies: 15 Interviews with academic lead partners to support case studies: 15 <b>Rounds 3 and 4 Partnerships:</b> Interviews with industry lead partners: 15 <ul style="list-style-type: none"> <li>• Additional interviews with the PVCs at HEIs and directors of academic liaisons at industry partners with several Partnerships: 5</li> </ul>
<b>Synthesis and analysis</b>		
<b>Impact case studies</b>	To illustrate examples of outcomes and impact achieved by selected partnerships and the pathways to impact. Impact case studies include quantitative data, where available, and characterise the added value of the programme and any critical success factors.	15 impact case studies of rounds 1-3 Partnerships. The set of 15 draft case studies forms a separate deliverable of this evaluation.
<b>Contribution analysis</b>	Contribution analysis is a theory-based approach which seeks to determine whether the causal mechanisms as set out in an intervention's ToC provide a valid and real explanation for observed outcomes and impacts. It involves synthesising data from all collected evidence and providing an assessment of the extent to which outcomes and impact has been achieved and evidence for the pathways to impact identified in the ToC. This includes a Qualitative Comparative Analysis of the case studies to identify the role of specific factors and combinations of factors in generating outputs, outcomes and impacts.	
<b>Return on investment</b>	Return on investment calculations were completed using quantitative data collected in the survey.	

### 3 Programme inputs

The main inputs to the intervention are public and private financial resources deployed to co-design and conduct collaborative research and innovation activities. The requirement for industry co-funding is an important element of the programme.

Since 2017 EPSRC has supported 47 Partnerships via four rounds, with a total investment of £337m with significant leverage from businesses (£167m, 50% of the total) and academic partners (£40m, 12%). Figure 3 shows an overview of funding rounds, timeline of partnerships supported in each round and investment value. The majority of the UKRI funding has been provided, as intended, by EPSRC (£125.2m), with three partnership co-funded by BBSRC (£3.6m). The partnerships are intended to last for a period of up to five years, with the first partnerships expected to conclude in 2023 and many received extensions (in terms of time) due to the COVID-19 pandemic.

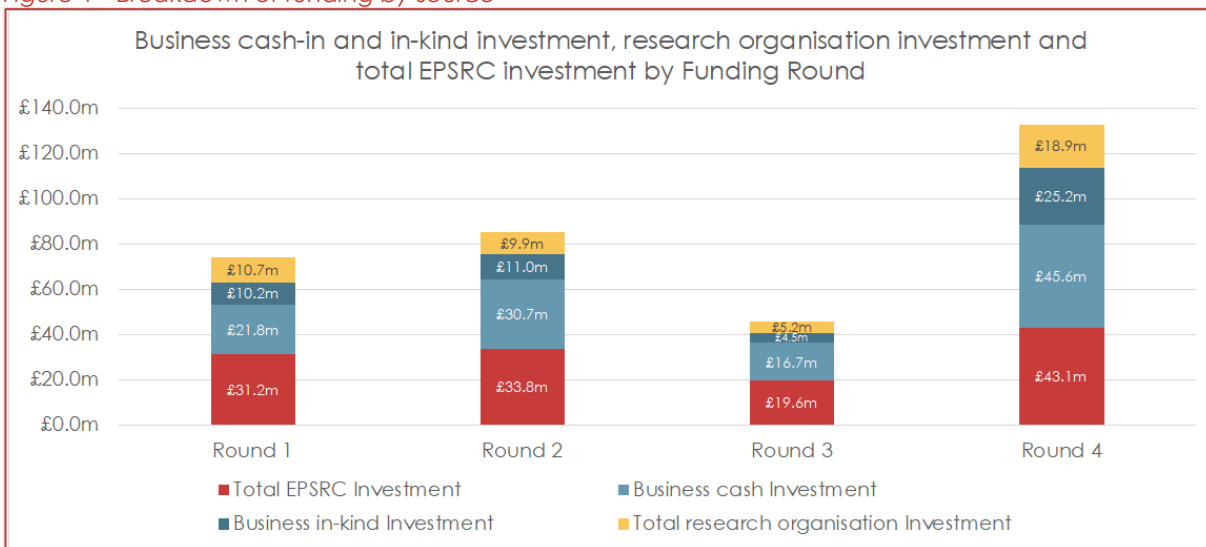
Figure 3 An overview of funding rounds, timeline of partnerships and investment value



Technopolis: based on programme data

As shown in Figure 4 the business investment is significant, because it is (as required by the programme design) an investment in cash rather than in-kind (though there are also additional in-kind investments) and includes financial transfers to the academic partners. Furthermore, it represents a considerable proportion of the total industrial leverage for EPSRC across its portfolio of investments (10% of the total £1.7b) indicating the scale and importance of the programme for EPSRC.

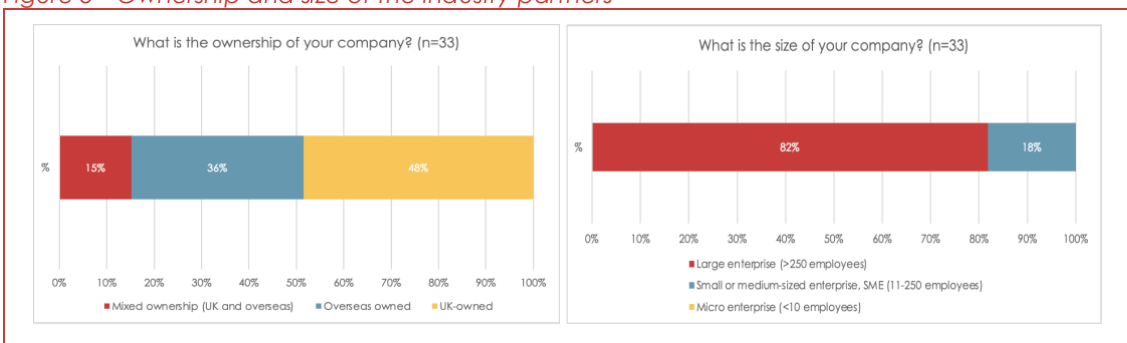
Figure 4 Breakdown of funding by source



Technopolis: based on programme data

Figure 5 shows the ownership and size of the surveyed industry partners. 48% of industry partners are UK-owned, and the remaining 51% are overseas-owned or mixed ownership. The significant cash contribution requirement means that the programme attracts mostly large enterprises (82%) while 18% are small or medium-sized companies.

Figure 5 Ownership and size of the industry partners



Technopolis survey of academic and industry PIs

Table 2 shows that the average total budget of the partnership from all sources is similar across the funding rounds.

Table 2 Average funding per partnership through funding rounds 1-4

Funding round	Mean amount of funding per partnership
1	£6,716,221
2	£7,246,056
3	£6,698,417
4	£7,916,038

Technopolis: based on programme data

Non-financial inputs such as existing academic and industry research and innovation knowledge, expertise, and willingness to strengthen existing relationships are equally relevant.

According to the survey of industry and academic lead partners, the primary motivation for both types of partners for establishing a Prosperity Partnership was to deepen the existing partnership. For industry partners the second most important motivation for applying to the programme was that they were seeking to increase their activities in low TRL research. Interview and case study evidence suggests that many partners had undertaken higher TRL research together before the Prosperity Partnerships project, and the programme allowed them to expand the partnership to lower TRL's and broader disciplinary subjects. The case study box below showcases how the Partnership helped the University of Exeter and QinetiQ broaden and deepen their long-lasting collaboration. Interviews also suggest that partnerships have high strategic relevance and are considered to be, and align with, strategic priorities of the participating academic and industry partners.

#### University of Exeter and QinetiQ Partnership 'The Tailored Electromagnetic and Acoustic Materials Accelerator'

The Partnership is a collaboration between the University of Exeter and QinetiQ, aimed at developing innovative materials that can control the propagation of electromagnetic and acoustic energy. **This Partnership builds upon a long-standing partnership between the two organisations that spans several decades.** In the past, QinetiQ has funded PhD programmes at the university and supported multiple grant applications for EPSRC funding. This relationship was predominantly with the physics department and focused on microwave and radiofrequency radiation. Part of the motivation for applying for this project was to broaden and deepen the relationship between the two partners and reach other academic groups within the university (such as the engineering, maths, and computer science departments). The programme also appealed to the partners due to the opportunity to share expertise in scientific / technology domains and benefit from access to each other's valuable facilities. QinetiQ's main commercial interest in having a Prosperity partnership was to develop new materials with multiple potential commercial applications in sectors as diverse as healthcare, security and defence.

EPSRC's willingness to modify the usual funding processes to better meet business needs is an additional essential input shaping the programme. The business-led research agenda sets Prosperity Partnerships apart from other EPSRC programmes. EPSRC has invested effort to raise awareness about the programme among businesses and make the programme processes business-friendly. Further detail on programme processes is provided in the Process Evaluation Report.

## 4 Outputs and outcomes

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This section presents outputs and outcomes achieved and expected for each of the programme impact domains identified in the Theory of Change:

- **knowledge and skills**
- **economic, productivity and societal benefits**
- **collaboration and investment**
- **policy**

Each section presents quantitative evidence from the surveys of industry and academic lead partners. The survey asked the lead partners to report data on achieved outputs and outcomes and provide estimates for expected outputs and outcomes. Most survey questions were the same for academic and business stakeholders to enable aggregation and comparison of responses. However, some questions (and phraseology) were tailored for the two groups. The academic lead partners survey also included questions about the lead industry partner's outputs and outcomes (e.g., number of opportunities identified for products, number of new products, etc.). This way, we were able to collect data on these outputs and outcomes in case the lead industry partner of the particular partnership did not respond to the survey. If the same partnership's industry and academic lead partners responded to the survey, we used the data reported by the industry partner to report on the commercial outputs and outcomes.

Each section first presents the number and proportion of survey respondents that report each output and outcome. For example, we show the number of industry partners who have identified opportunities for new products. This shows to what extent involved partners have (or will) generate expected outputs and outcomes. After the presentation of the number and proportion of respondents reporting the outputs and outcomes, each section presents the reported count of outputs and outcomes. For example, we show how many opportunities for new products the industry partners report.

The survey response rate was 70.2% for industry partners and 74.4% for academic partners. 89.3% of all funded Partnerships are covered by at least one survey response. Good response rates make the survey results appropriate for drawing conclusions about the programme outputs and outcomes.

Evidence from the interviews and case studies complements the quantitative data and provides in-depth and more nuanced insights into scale and scope of outputs, outcomes and impact achieved and how they were achieved.

### 4.1 Knowledge and skills

#### 4.1.1 Introduction

Within the **knowledge and skills** impact domain, two key outputs are expected according to the ToC. Firstly, new scientific knowledge in areas of strategic importance to UK businesses. Partnerships produce academic publications, intellectual property (IP), research tools and methods, databases, software, etc. Partnership research also progresses technologies along the early TRLs. Secondly, Partnerships result in an increase in the skills available and the talent pipeline in key technical domains. The research programme (lasting 4-5 years) allows for training new PhD students, hiring new staff from the UK and abroad and developing new skills for existing staff. The evaluation also found that the Partnerships are active in disseminating new knowledge through non-academic channels to reach wider society and thus play a role in contributing to long-term STEM skills development by raising awareness and inspiring young people to pursue careers in STEM.



The key outcome of the Partnerships is attracting and retaining talented researchers/staff into UK-based research. Funding for the collaborative research and innovation (R&I) programme and skills development activities accompanying the research programme, as well as sustained partnerships and commercialisation of resulting innovations, has resulted in the retention and attraction of new research personnel to the UK-based industry and academic research organisations. The evidence also shows increased researcher mobility between the academic and industry sectors.

#### 4.1.2 Outputs

Table 3 shows the indicators used to measure the new scientific knowledge and increase in the skills resulting from the Partnerships and the number of academic and industry partners reporting each type of output. Survey respondents include round 4 Partnerships that are likely to have not yet produced some of the outputs and/or might have been more cautious when estimating expected outputs. Overall, all partners report good progress with all types of expected outputs. Most academic and industry respondents report TRL progression and publications. Most academic partners report completion of PhDs, and most industry partners report secondments. More academic partners report achieved or expected patent applications compared to the industry.

*Table 3 Number and proportion of surveyed academic and industry partners reporting achieved and expected new knowledge and skills outputs*

Output	Academic n (% of respondents)	Industry n (% of respondents)
<b>New scientific knowledge in areas of strategic importance to UK businesses</b>		
Publications	30 (85.7%)	29 (87.8%)
TRL progression	32 (91.4%)	31 (93.9%)
Patents granted	31 (88.5%)	22 (66.6%)
<b>Increase in the skills available and the talent pipeline</b>		
PhDs completed	33 (94.2%)	
Secondments		26 (78.7%)

Technopolis survey of academic and industry PIs

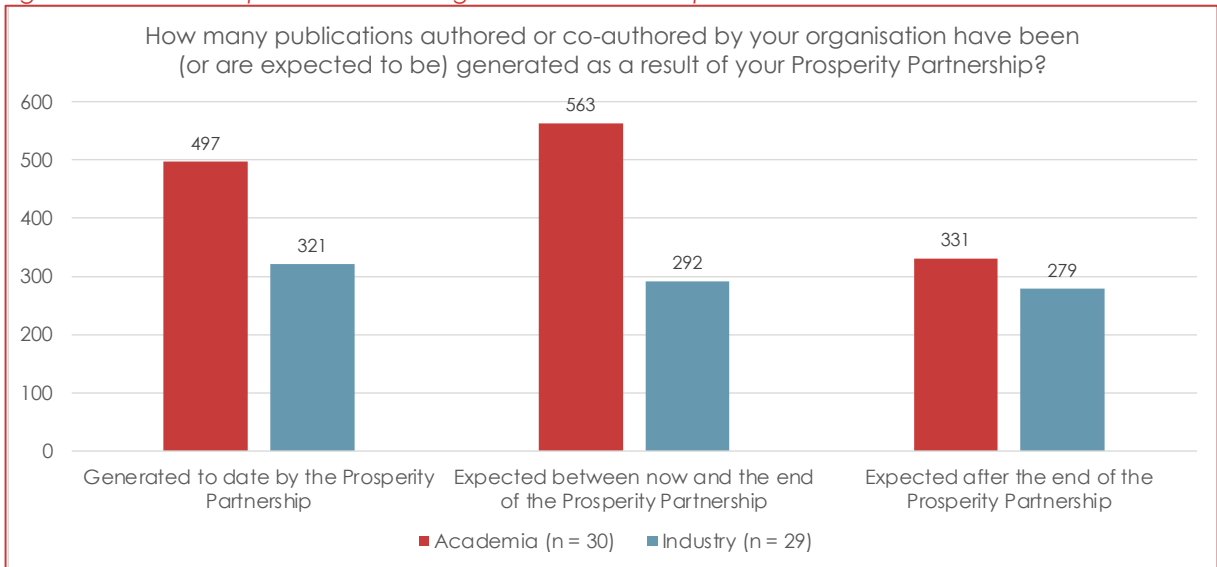
##### 4.1.2.1 New scientific knowledge in areas of strategic importance to UK businesses

The first indicator for new scientific knowledge is the **number of publications produced** (and expected) by the Partnerships. Publications are a direct output of the research work carried out by the Partnerships. Because of the early-stage (low TRL) research, Partnerships can potentially produce significant numbers of publications as the work focuses on concepts and early-stage ideas with many potential applications. Figure 6 shows the number of publications generated or expected to be generated by the academic and industry partners. Partnerships expect to produce over a thousand publications, with academic respondents understandably reporting higher numbers because, in many cases, the concepts studied within the Partnerships are applicable in several contexts and because academic partners are more incentivised to publish. The data on publications generated to date are largely in line with what is reported in ResearchFish, where the Partnerships had reported 717 publications by May 2022.

Interview evidence suggests that the projects have helped raise the scientific profile through publications in prestigious journals and to acquire significant citations. This indicates the scientific ambition of some of the research questions defined by the Partnerships. Several academic interviewees pointed to the unique feature of the Prosperity Partnerships programme that enables them to work with and for the benefit of industry but simultaneously

also achieve significant scientific progress and development of outputs relevant for the academic careers and performance measures.

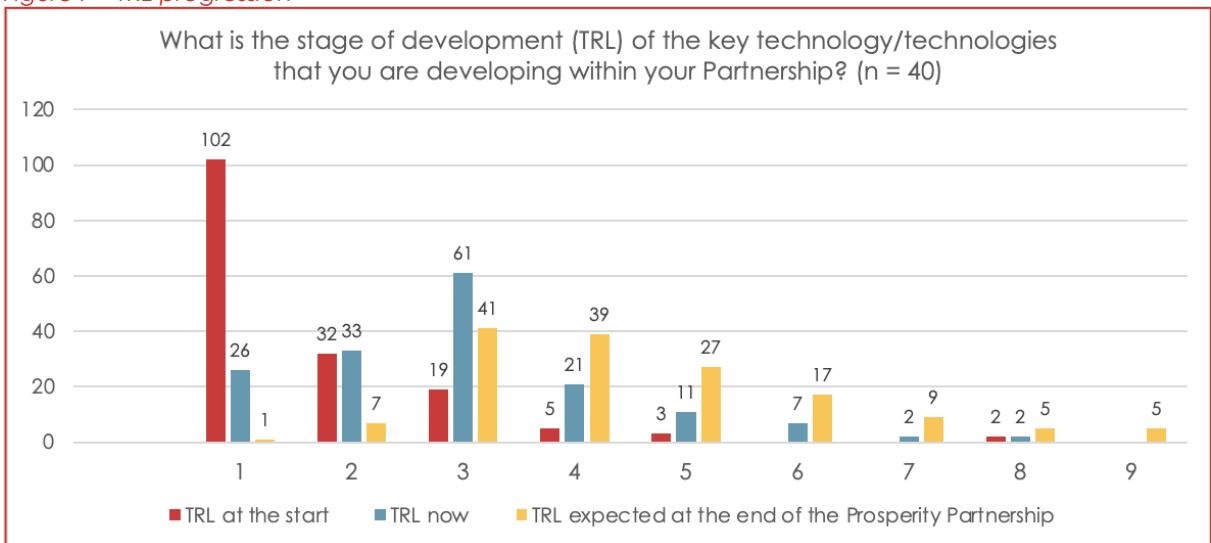
Figure 6 Number of publications arising from the Partnerships



Technopolis survey of academic and industry PIs

**Technological development** is another measure of the *new knowledge* impact domain, considered in terms of progression along the scale of Technology Readiness Levels. Prosperity Partnerships are, by design, low TRL projects. Figure 7 shows the TRL progression for all individual technologies (n=163) under development in PP projects, as reported by survey respondents. Most technologies (102) are at TRL1 at the start of the Partnerships, implying that Partnerships focus on basic science. By the end of the Partnership, most technologies are expected to be at TRLs 3-5, but there is also a share of technologies (26% of all reported) that are expected to progress to prototyping, demonstration or implementation by the end of Partnership (TRLs 6-9).

Figure 7 TRL progression

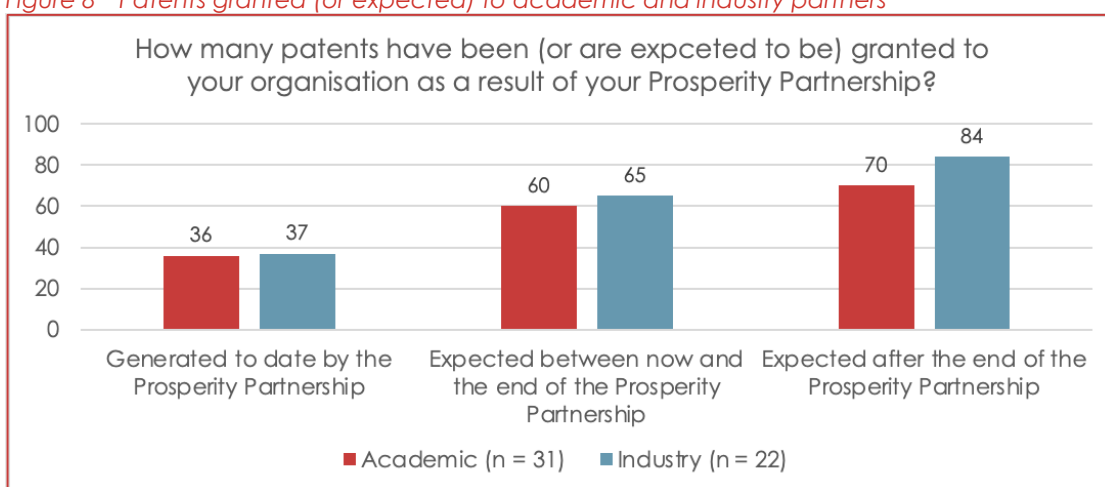


Technopolis survey of academic and industry PIs

Note: Figure shows counts at PP level. Both, industry and academic partners reported the TRL progression. Where both partners of the same Partnership responded, we use industry data.

The new knowledge and technology development may also result in **granted patents**. Although the survey asked to respondents to report patents granted to their own organisation, it is possible that the patent applications may have been made under the names of both lead partners. Thus the values provided by academic and industry partners cannot be summed. Nevertheless, according to the data reported in the surveys, lead partners are active in patenting new technologies. Academic and industry partners report that more than 30 patents have already been granted; over 60 will be granted by the end of the Partnerships, and over 70 are expected after the end of the Partnership. It has to be noted that one Partnership in the energy sector stands out in patenting activity and accounts for 49% of all granted patents reported and 33% of all expected patents reported. The data on granted patents are largely in line with what was reported in ResearchFish May 2022 submission, where Partnerships reported 32 patents achieved to date.

Figure 8 Patents granted (or expected) to academic and industry partners



Technopolis survey of academic and industry PIs

#### 4.1.2.2 Increase in the skills available and the talent pipeline

The research programme (lasting 4-5 years) allows for training new PhD students. The surveyed academic lead partners report that they have produced **101 new PhDs**, 198 more are expected at the end of Partnerships and 116 after the end. Elaborating on survey responses, the respondents pointed out the Partnerships are facilitating the development of future talent and creating a pipeline of experienced and capable post-doctorate students with the potential to move to careers in industry. PhD training within a collaborative research project means that the young researchers see all aspects of research - from the most blue-sky instruments at the academic facilities to industry labs and real prototypes that are meant to be sold. As a result, the PhD students are exposed across the board to the entire pipeline from innovation to translation.

Industry partners (26) report over 100 completed or expected incoming **secondments** from their academic partner. Several industry partners (e.g., QinetiQ, Siemens, GSK) emphasised the role and benefits of secondments, reporting that secondments work as training opportunities, and companies later hire many of the seconded people. Several respondents highlighted that they would maintain the secondment model with the academic partner beyond the partnership to enable specialist training. Secondees are mostly PhD students but also post-doctoral researchers and researchers. Secondment in the industry helps academics to understand how industrial projects look. For example, industry partners train the seconded

people to use specific industry equipment, or academics make measurements needed for the research. Survey respondents reported fewer secondments into the academic partner – 22 organised and 25 expected by the end of the Partnerships. The survey data on secondments to date (incoming and outgoing) align with the number of secondments reported to ResearchFish for the May 2022 submission, where the Partnerships reported 72 secondments.

Finally, the monitoring data analysis and stakeholder consultation revealed that the Partnerships are active in disseminating new knowledge through non-academic channels to reach wider society and thus are contributing to **long-term STEM skills development** by raising awareness and inspiring young people to pursue careers in STEM. Partnerships report 466 engagement activities on ResearchFish (broadcasts, expert panels, newsletters, blogs, social media, public events, etc.). Interview evidence highlights examples of outreach work occurring via the Partnerships. For example, the Imperial-Dyson partnership is producing YouTube videos, Bristol-Rolls-Royce Partnership has been presenting and demonstrating solutions at international exhibitions and summits, and Manchester-Unilever Partnership is running activities for school children and the general public during British Science Week. UCL-Nikon Partnership produced press releases have gained significant media attention (over 150 different media outlets covered the news) and several news media have reported the new X-ray technology developed and discussing many potential applications.

#### 4.1.3 Outcomes

New knowledge and skills generated by the Partnerships have helped the academic and industry partners to **retain and attract talented researchers** to their organisations. Table 4 shows the number and proportion of surveyed Partnerships that report skills outcomes. Partnerships contribute to improved researchers' skills/knowledge of academic and industry organisations participating in the programme. All surveyed academic and industry lead partners report already achieved or expected skills/knowledge improvement. Most academic lead partners report having established new FTE research positions as a direct result of the Partnership.

*Table 4 Number and proportion of surveyed academic and industry partners reporting achieved and expected skills outcomes*

Outcome	Academic n (% of respondents)	Industry n (% of respondents)
<b>Attraction of talented researchers/staff into UK-based research / indirect job-creation</b>		
New or improved employee skills/knowledge resulting from the partnership	35 (100%)	33 (100%)
FTE new researcher positions created as a direct result of PP	27 (77.1%)	

*Technopolis survey of academic and industry PIs*

Answers to the survey's open questions reveal that the Partnerships enabled staff career progression, talent attraction, improvement of skills and employee training for academic and industry partners. Interview evidence highlights ways the industry's talent pipeline has improved. Partnerships offer industrial training and mentorship for PhD students and post-doctoral researchers, giving them the skills and knowledge that the industry looks for, resulting, in some cases, in the industry partners employing the new graduates. PhD graduates that move to the industry remain a contact point for academic institutions and help to sustain collaboration.

As showcased by the University of Sheffield and Siemens Partnership (case study box below), exchange with academic researchers helps to upskill industry engineers. Other partnerships

reported improving research culture at the company and the excitement of industry engineers and researchers for having a chance to work with the best academic scientists in their field and on new research areas.

#### University of Sheffield and Siemens Partnership in Offshore Wind

Access to academic knowledge and exchange with researchers brought significant benefits to Siemens. Company engineers and researchers worked closely with academic researchers. Day-to-day learning from the PhD and post-doctoral researchers was very valuable and improved the understanding of the science behind the technologies. This will result in better design and production of wind turbine components and the management of wind farms.

Academic partners also benefit from a skills perspective. Interviews highlight that Partnerships provide an opportunity to showcase basic academic research and improve the industry's knowledge of new academic research, ideas and concepts. This also works the other way around by helping academic partners improve their understanding of longer-term industry research needs. Furthermore, because of the scale and ambition of projects, several interviewees pointed out the role of Partnerships in bringing together different academic groups in a single university or across the lead academic institution and the additional academic partners. This has allowed for interdisciplinary research, thus improving the overall understanding of the application area.

In the survey of academic partners, principal investigators (PIs) reported that **309 new FTE researcher positions were created** in the academic institution as a result of the Partnership. Further, 119 new positions are expected by the end of Partnerships and 72 after the end. Interviewees reported that the Partnership had enabled an expansion of their research groups, giving them the critical mass needed to work on solutions for the industry effectively. In addition, successful collaboration with industry within the Prosperity Partnership project has helped to build teams, capabilities and reputation and attract the interest of other industry players willing to explore new collaboration opportunities.

One area where the evaluation found less evidence was encouraging talent flows into the UK. Two main reasons for the challenges are the global competition for talent and the pandemic. Several industry interviewees pointed out the very intense global competition for talent and the difficulties of attracting and retaining good international post-doctoral researchers. Partnerships do report examples of international industry and academic hires, and the Prosperity Partnership funding allows them to make better offers to prospective employees compared to what the companies could offer with their resources. However, global companies like Google and Facebook can still make better offers of very high wages for smart PhDs and post-docs.

The pandemic further complicated the attraction of foreign talent because of the travel restrictions and the people's reluctance to move in turbulent times. Several Partnerships that had hired international students before the start of the pandemic, reported significant challenges with mental health issues experienced by foreign students because of the lockdowns, living in isolation and limited ability to access labs and perform the research they were intending to complete.

#### 4.1.4 Attribution and additionality

As noted in the methodology, contribution analysis provides one way of systematically determining an intervention's attribution. It involves critically assessing the ToC, determining the extent to which evidence supports the notion that the ToC has operated as planned, and

therefore how far the intervention itself can explain observed outcomes and impacts. We have done this by firstly establishing a series of casual hypotheses that explain how and why the programme could in theory lead to knowledge and skills outcomes. We have then examined the extent to which the evidence provides us with confidence that the hypothesis is valid, and that the programme is responsible for generating its intending outcomes and impacts. There are two main reasons why a causal hypothesis may not be valid: a) the target outcomes and impacts have not been realised, or b) that targets have been achieved but have occurred owing to factors outside the programme. We have therefore presented evidence that both supports and refutes each casual hypothesis. We then assess the balance of these to determine how far the evidence available supports the respective hypotheses.

As shown in Table 5 below, there is clear evidence of the programme having generated meaningful outputs in relation to knowledge and skills. Knowledge and skills benefits generated have occurred within all participating industry and academic partners. It is clear that the programme can directly be linked to improving the reputation of participating organisations (e.g. helping them engage in world-leading research which feature in prestigious journals), and in retaining some skills within the UK (e.g. creating jobs in the UK for skilled researchers who could conceivably have chosen to work elsewhere given a competitive global labour market). These benefits will contribute towards meeting of target UK-wide outcomes around knowledge and skills retention, albeit at a small scale.

*Table 5 Programme contribution analysis for knowledge and skills outcomes*

Aspect of logic model	Causal hypothesis	Assessment of Prosperity Partnership's contribution
Outputs to outcomes	Knowledge exchange between industry and academia provides both sectors with access to new research, knowledge, training and technologies. This creates improved perceptions of the UK being somewhere where individuals working in STEM can further their careers in research, in turn encouraging more people pursue careers in this country (including those previously based outside the UK).	<p><u>Evidence that strengthens hypothesis</u></p> <p>Our survey of academic PIs involved in the programme shows that 77% of respondents have created new researcher positions in academia as a result of the programme and the programme has led to the creation of 309 new FTE research positions amongst academic partners. All of these positions are at UK-based HEIs meaning that the jobs created will in turn be UK-based. This is evidence that PPs have encourage some individuals to pursue careers in the UK.</p> <p>Interview evidence has also revealed instances where the industry partner has employed early career researchers that they have interacted with through the PP. Again, this suggests that the Partnerships have helped showcase the career opportunities present in the UK, and therefore encouraged talented researchers to take jobs in the UK.</p> <p>Survey and interview evidence also suggest that participation in the programme has helped improve public visibility and exposure of different organisations. It is reasonable to expect that some of the improved visibility might translate into some researchers being more interested in pursuing a UK-based career than might otherwise have been the case.</p> <p><u>Evidence to refute hypothesis</u></p> <p>Interview evidence indicates that the programme has not played a meaningful role in encouraging those based outside the UK to pursue a UK-based career either through the programme itself, or through any enhanced reputation to the UK built by the Partnerships. This is largely due to factors external to the PP programme. There is intense global competition for good international post-doctoral researchers, while travel restrictions in place during the pandemic also prevented the relocation of overseas talent to the UK.</p> <p><u>Overall assessment</u></p>

Aspect of logic model	Causal hypothesis	Assessment of Prosperity Partnership's contribution
	<p>With the Partnerships having helped increase the talent pipeline in the UK (e.g. through PhD training and studentships), the majority of those trained decide to stay in the UK, helping retain talent in the country.</p>	<p><b>Hypothesis partially supported:</b> the evidence clearly suggests that the programme has helped create a positive image of the participating organisations, with a large number of individuals (309) choosing to take up UK-based employment opportunities in research. What is less clear is whether the programme has had any bearing on improving the general perception of the UK as a whole as a place to pursue as STEM career outside the programme.</p> <p>It is also clear that at best, the programme has had a negligible effect in encouraging talented researchers based outside the UK to relocate here.</p> <p><u>Evidence that strengthens hypothesis</u>            Survey evidence suggests that participants will continue to produce studentships and employment opportunities once their programme participation ends.</p> <p>Interview evidence also suggests that industry partners have employed early career researchers that they have worked with through the Partnerships. To that end, involvement in the programme has helped create opportunities that have enabled the retention of skilled talent within the UK. The case studies have also revealed instances where participants have found it easier to attract talent owing to the reputational benefits associated with undertaking cutting-edge research through the programme.</p> <p><u>Evidence to refute hypothesis</u>            Interviewees also spoke of how the students they had been working with through the Partnerships were hired by global tech companies, with bases all across the world. This suggest that the broader sector level labour market may have a greater bearing on the ability to retain skilled researchers in the UK, and indeed the fact that some researchers trained through a Partnership may be leaving for jobs in other countries.</p> <p><u>Overall assessment</u>  <b>Hypothesis somewhat confirmed:</b> evidence suggests that many industrial partners are now employing early career researchers they have worked with through the Partnerships, ensuring that this talent remains in the UK. Nevertheless, evaluation found other instances of industry partners losing out to global competitors for talent. On balance therefore, the causal hypothesis has some validity but may not be especially strong.</p>
Outcomes to impacts	<p>With the UK having a larger and better skilled workforce in STEM disciplines, the country's reputation improves internationally, being seen as a centre for skills and knowledge leadership.</p>	<p><u>Evidence that strengthens hypothesis</u>            Evidence coming from the interviews shows that organisations involved in Partnerships have improved their visibility and reputation. New knowledge and technologies emerging from the Partnerships often is world-leading, as indicated by publications in prestigious journals, citation numbers and interest from other industries.</p> <p><u>Evidence to refute hypothesis</u>            No evidence to refute.</p> <p><u>Overall assessment</u>  <b>Hypothesis confirmed:</b> evidence suggests that Partnerships result in internationally leading research contributing to increased UK reputation in knowledge leadership.</p>

## 4.2 Economic and productivity

### 4.2.1 Introduction

Within the **economic, productivity and societal benefits** impact domain, the business-led and needs-driven research and innovation (R&I) projects are expected to result in opportunities identified for new products and services and manufacturing efficiencies (processes) and cost reductions for the participating businesses. These are considered to be outputs of the programme, that will lead (and have led) to outcomes in the form of:

- Further development and **successful commercialisation of the new knowledge, technologies, methods** generated by the R&I activities. This takes the form of further progression along the TRLs after the Partnership, the launch of new products and services, new companies/spin-outs established, and new manufacturing processes deployed
- **Improved and sustained business growth.** The adoption of new products and services is expected to lead to improved and sustained business growth for companies involved in the partnerships because of the revenue the new products and services generate and /or process efficiencies for partners and wider adopters of the process innovations developed
- Once the new products/ services /processes (innovations) are developed they would be expected to have wider use beyond the partnership participants leading to **replicability, scalability, and adoption in other sectors and businesses beyond the partnership.** This may start with new partners brought into existing partnerships and then extend further to more individual adopters and then sectors

### 4.2.2 Outputs and outcomes

The main output indicator to measure the economic and productivity outputs emerging from the Partnerships is the number of opportunities identified for new products, services, manufacturing methods and processes. The Partnerships can also progress with the realisation of the opportunities during the project's lifetime, but more realistically, the majority of the outcomes (successful commercialisation and business growth) will emerge after the completion of the project. Thus, this section presents the instances of commercialisation opportunities, evidence of successful commercialisation, improved and sustained business growth and replicability of innovations arising from the Partnerships that are already achieved and expected to be achieved after the end of the Partnerships. All numerical values and estimates are self-reported in the survey of academic and industry partners.

Table 6 shows the indicators used to measure the economic and productivity outputs and outcomes emerging from the Partnerships and the number of academic and industry partners reporting each type of output and outcome.

*Table 6 Number and proportion of surveyed academic and industry partners reporting achieved and expected economic and productivity outputs and outcomes*

Output indicator	Academic n (% of respondents)	Industry n (% of respondents)
Opportunities identified for new products, services, manufacturing methods and processes	24 (68.5%)	28 (84.8%)
Outcome indicators	Academic n (% of respondents)	Industry n (% of respondents)
Successful commercialisation of new products, services		
New products launched (or planned) to the market	16 (45.7%)	24 (72.7%)

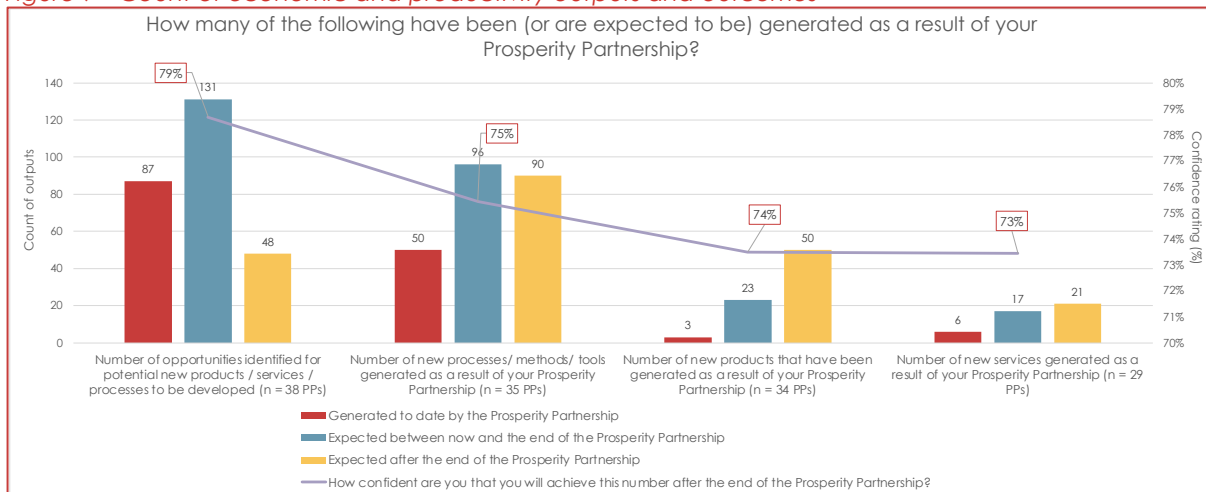


New services launched (or planned) to the market	14 (40%)	18 (54.5%)
New processes/methods/tools implemented	24 (68.5%)	25 (75.7%)
Spin-out companies established (or planned)	10 (28.5%)	5 (15,1%)
<b>Improved and sustained business growth</b>		
New jobs created or planned as a direct result of the Partnership		25 (75.7%)
New jobs created or planned as a result of income generated by the outcomes of the Partnership		18 (54.5%)
License income from patents resulting from the partnership		12 (36.3%)
New sales achieved or expected as a result of commercialisation of products or services		16 (48.4%)
<b>Replicability, scalability, and sustainability of specific innovations across different sectors</b>		
Adoption of innovations resulting from the partnership in other sectors	25 (71%)	18 (55%)

Technopolis survey of academic and industry PIs

Figure 9 shows the count of economic and productivity outputs and outcomes reported by the respondents that were able to provide estimates. The figure shows the count at the Partnership level. Both industry and academic partners reported the data for the indicators shown in the figure although the survey question phrasing was slightly different for each type of respondent. For example, academic partners were asked to report the number of new products launched on the market by the lead industry partner of the Partnership. Where both partners of the same Partnership responded, we have presented the industry data. The figure also shows the confidence rating for each type of output and outcome, a percentage assessment made by survey respondents of how likely they will achieve the reported outputs and outcomes.

Figure 9 Count of economic and productivity outputs and outcomes



Technopolis survey of academic and industry PIs

The programme's overarching objective is to deliver research benefiting the businesses involved. Most surveyed academic (24) and industry (28) partners report having identified **opportunities for new products, services, manufacturing methods and processes**.

However, the survey results show that a small proportion of respondents (31.5% academic and 15.2% industry) were not (yet) able to identify commercial benefits. It is reasonable to expect that new product and service opportunities should be identifiable within the project duration. Therefore, the results are somewhat alarming. It has to be noted that the respondents were asked to provide a count of opportunities identified, and several respondents reported they were uncomfortable with providing estimates. Furthermore, the survey included round 4 Partnerships and these have the highest proportion of respondents not indicating the number of commercial opportunities identified. Finally, interview evidence suggests that many companies see new skills benefits as the main benefit arising from their projects. These benefits are equally important but cannot be easily quantified and attributed to commercial benefits.

In terms of the count, respondents report 87 opportunities already identified (40% of these are from two Partnerships) and almost 200 are expected by the end or after the Partnerships end. Respondents are highly confident (79%) they will identify the opportunities for new products or services. Interview evidence suggests that many identified opportunities still require further research and commercialisation work. However, there is evidence that even rounds 3 and 4 Partnerships have already identified specific opportunities for new products, services and processes. As evidenced by the case study example below, many round 1 and round 2 Partnerships will soon turn the opportunities into actual products, services or processes.

#### Case study on the Prosperity Partnership between the University of Manchester and Unilever 'CAFE4DM'

CAFE4DM, a partnership led by the University of Manchester and Unilever, aimed at developing models and methods to increase the efficiency of manufacturing liquid consumer goods and food products. The project has resulted in developing new datasets on the materials used, new capacity to model Unilever-made fluids, measurement techniques and process analytics to enable **efficient manufacturing. The fluids modelling and process analytics are piloted within two Unilever factories with plans to begin implementing in 2023.**

#### Successful commercialisation of new products, services

As noted, outcomes emerging from the Partnerships are expected to occur after the end of the projects. The first projects will end in 2023. However, a relatively high proportion of respondents, from industry in particular, report that **new products have been or will be launched on the market**. 72.7% of industry respondents report they have or will launch new products as a result of the Partnership. Two survey respondents noted that it was unrealistic to progress from fundamental research to a final product in the five years of the Partnership. Still, they see strong commercial potential in the technologies being developed. Two others commented they believe that research outputs will feature in a product but were unsure what and when and reported they did not wish to provide estimates.

Respondents report three products already launched on the market. These are from the Partnerships STEP Aluminium, Roadmaps to Zero Net Emissions in Urban Public Transport and Scalable Qubit Arrays. The examples show that, in some cases, commercial outcomes can be achieved within the lifetime of the Partnership. Case studies on the two of the Partnerships show that further funding was the key enabler of the commercial progress.

### Case study on the Wrightbus and Queen's University of Belfast Partnership 'Roadmaps to Zero Net Emissions in Urban Public Transport'

The Prosperity Partnership between Queen's University Belfast and Wrightbus has resulted in an extensive knowledge base for zero-emission public transport and a commercially available vehicle. Through the Prosperity Partnership, Wrightbus has developed a portfolio of zero-emission buses. This now forms the core of their business. As a result, the Partnership has led to securing contracts for hundreds of buses to customers in the UK and abroad.

### Case study on the Partnership between the University of Strathclyde and M Squared Lasers 'Scalable Qubit Arrays for Quantum Computing and Optimisation'

The 'Scalable Qubit Arrays for Quantum Computing and Optimisation' Prosperity Partnership aims to develop a new architecture for scalable quantum computing based on arrays of individually trapped neutral atoms. Quantum computing provides an option to solve computational problems faster. Quantum computers could provide a financial benefit to very many sectors. The Prosperity Partnership combined capabilities of M Squared Lasers in advanced laser systems and quantum system integration and the University of Strathclyde's expertise in quantum algorithms and neutral atoms and has **resulted in the development of the UK's first commercial neutral atom quantum computer**. As a result of the project, M Squared Lasers has expanded the portfolio of available laser systems with wider impacts on commercial opportunities.

Fewer respondents report the launch (or expected launch) of **new services**. 54.5% of the industry and 40% of academic respondents report this outcome. The count of introduced services is six, and 28 are estimated to be launched by the end or after the end of the Partnership. Examples below showcase some of the expected and introduced new services.

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*The Prosperity Partnership team across the University of Cambridge and Microsoft Research worked closely together to improve AI object recognition tools for the blind and low-vision community. We are delighted that this research is now on a path for exploitation in Microsoft's Seeing AI app that is available in 70 countries.*

*Interview with Kenji Takeda, Director of Academic Health and AI Partnerships, Microsoft*

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#### Case study on the BT and the University of Lancaster Partnership 'Next Generation Converged Digital Infrastructure'

The Partnership has **demonstrated Intent-Based interfaces, and it has been identified as a potential service that will open a new growth opportunity for BT.** It's already caught the attention of big multinational companies (customers of BT) which are interested in this capability and are pleased to see BT undertaking research in the field. According to the interviewees, some of these customers' contracts are worth billions, and thus this research in the technological frontier will provide further opportunities for new value generation for BT and its customers.

Most surveyed academic (68.5%) and industry (75.7%) partners report having already achieved (50 instances) or expected (166 instances) implementation of **new processes, methods or tools** as a result of the Partnership. Evidence from the case studies shows that the process improvements are around improved efficiency and sustainability of manufacturing processes or service delivery. Some of these are already being implemented by the industry partners and provide cost savings.

#### Case study on the GSK and the University of Strathclyde Partnership 'Research for Accelerated Discovery and Development of New Medicines'

GSK continually seeks to improve the efficiency and sustainability of the processes across the supply chain's discovery, manufacturing, and delivery components. The Partnership aimed to achieve outcomes for better productivity, and ultimately health outcomes, and create resilience in the drug discovery and manufacturing processes. New catalytic processes and effective catalyst ligand classes developed by the Partnership are being investigated and within GSK projects. The commercialisation of the catalyst ligands and their application in GSK manufacturing routes, when appropriate, are the targeted goals moving forward. The catalyst ligands would be employed by GSK for a specific set of transformations, and whether these transformations are required by GSK on a manufacturing scale depends on the specific molecule and synthetic route towards it. However, it could reasonably be expected that an applicable transformation will be required to be carried out on scale in roughly the next five years. This will enable a much more efficient and sustainable synthetic route, with the potential for significant cost savings.

Only a small proportion of respondents (15.1% industry and 28.5%) report having established (or planned) **spin-out companies**. Interviews confirm the survey evidence that academic partners consider spin-out opportunities more frequently mainly because many of the technologies developed by the Partnerships potentially have several other applications beyond that developed for the lead industry partner. For example, the case study on the Partnership between the University of Strathclyde and Weir Group, where the lead industry partner left the Partnership, has still resulted in an exploration of an entirely new application of the seismic monitoring technology developed by the Partnership. Edinburgh University is leading on this opportunity and is considering establishing a spin-out company.

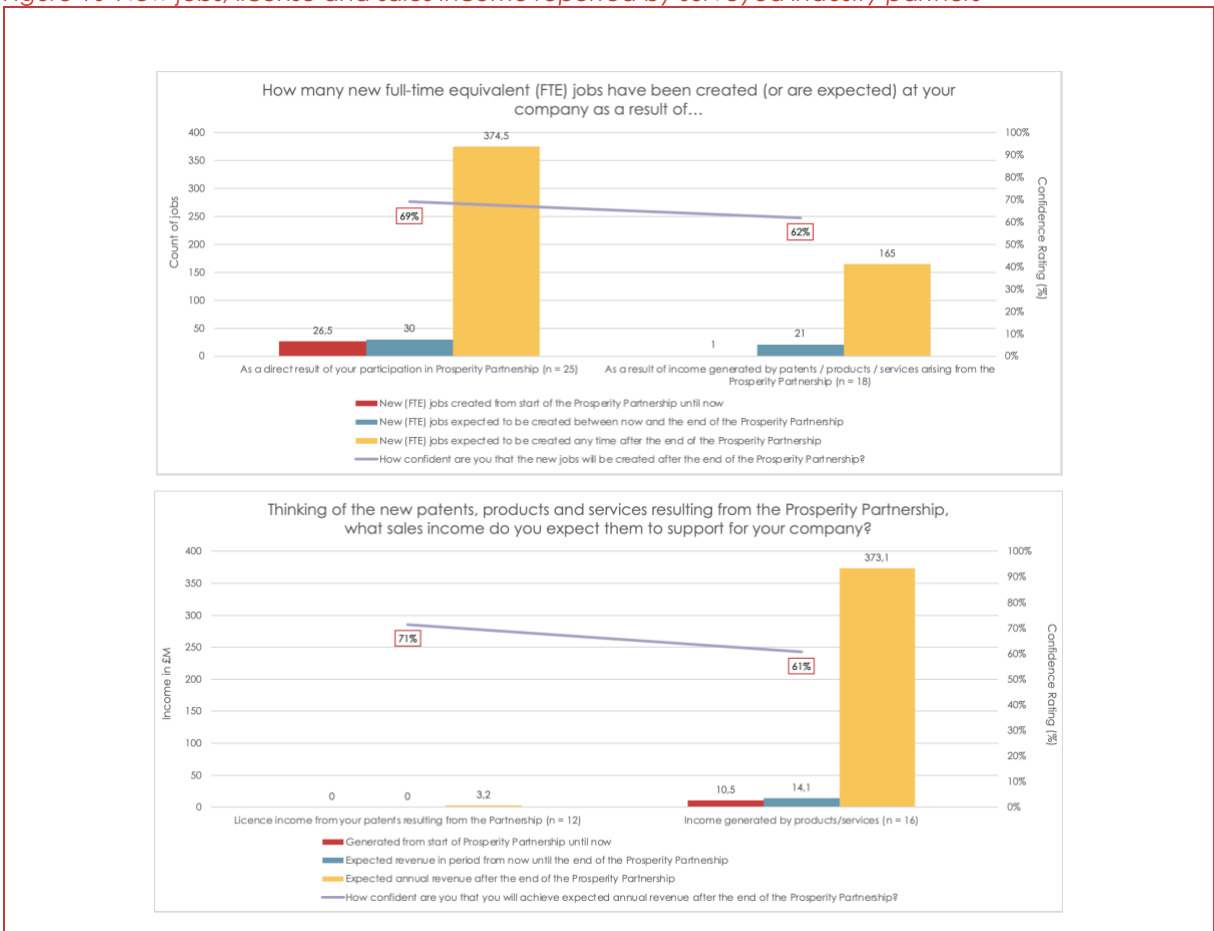
#### Improved and sustained business growth

Adopting new products and services is expected to lead to **improved and sustained business growth** for companies involved in Partnerships. Indicators to measure this are new jobs, sales and licence income from the commercialised products or services. Most (75.7%) surveyed

industry partners report having created or expecting to create new jobs as a direct result of the Partnership.

Figure 10 shows that industry partners report 26 direct jobs created and a further 404 expected by the end or after the end of the Partnership. These include mostly jobs created to engage in the research funded by the partnership and continued research and development after the end of the Partnership. Respondents are fairly confident about this outcome reporting a 69% confidence rating. About half (54.5%) of surveyed industry partners report **new jobs** will be created as a result of income generated by the outcomes of the Partnership (187 jobs expected). Respondents report the expected jobs created with an average confidence rating of 62%.

Figure 10 New jobs, license and sales income reported by surveyed industry partners



Source: Technopolis survey of industry PIs

The case study on Prosperity Partnership between Queen's University Belfast and Wrightbus is an example of a Partnership contributing to job creation resulting from new commercial contracts. The research and innovation work completed by the partners resulted in an extensive knowledge base for zero-emission public transport and a commercially available vehicle. As a result, the Partnership has led to securing contracts for hundreds of buses to customers in the UK and abroad, upskilling the local transport workforce and supporting the creation of hundreds of jobs at the industry partner Wrightbus. Another example is an indirect contribution of a Partnership to securing the future (including employment opportunities) of the Siemens blade factory, the largest offshore wind manufacturing facility in the UK, located in Hull. Siemens Gamesa opened the factory in 2016, and the Partnership has helped to leverage further support through research, innovation and skills training to secure the factory's future.

Siemens will expand the factory in 2023, and 200 new jobs will be added, thus contributing to economic growth in the region.

Fewer respondents report license income from patents resulting from the partnership (36.3%) and, as shown in Figure 10, respondents expect the income to materialize after the end of the Partnership. A higher share of respondents (48.4%) report new sales achieved or expected as a result of the commercialisation of products or services with an expected value of £387m. However, several respondents commented they were uncomfortable providing estimates as the outcomes are too far in the future.

### **Replicability, scalability, and sustainability of specific innovations across different sectors**

Once the new knowledge and innovations are developed they would be expected to have wider use beyond the partnership participants leading to **replicability, scalability, and adoption in other sectors and businesses beyond the partnership**. This may start with new partners brought into existing partnerships and then extend further to other adopters. Surveyed academic and industry partners are optimistic about the potential adoption of innovations resulting from the partnership in other sectors. Academic partners report expected wider adoption more frequently (71%) than the industry partners (55%).

Interviews and case studies evidence suggests that many Partnerships have developed technologies with potential applications beyond the lead industry partner. Partnerships often work on technologies with potentially wide applications and the low TRL focus of the work means that knowledge about fundamental characteristics is acquired and so the research findings have broad applications. For example, the UCL and Nikon work on X-ray technology is of interest to Nikon but X-rays have very many potential applications in hospitals, customs; at synchrotrons researchers study batteries, food security, new materials, magnetism, computer memories and many other. Similarly, the technologies developed within the Microsoft and the University of Cambridge Partnership have other applications in other industries. 'Hawk-Eye Innovations' (sports broadcast enhancement technology provider) and Cambridge University are working together to apply machine learning developed in the Partnership. They are also working with 'Pinpoint Learning' to exploit personalised maths tutoring. These new partnerships were created leveraging research from the Prosperity Partnership. The academic partners are working to build new partnerships based on the Prosperity Partnership project.

#### Case study on the Dyson-Imperial College London Partnership 'Perceiving, Modelling and Interacting with the Object-Based World'

The partnership aims to develop new robot vision technologies that will allow the creation of robot products, especially home robots. These products will be capable of understanding the environment in which they are working and interacting with it, allowing them to perform more complex tasks compared to the current robot products on the market. **The technology under development is expected to find application in several fields behind household support, including assisted living and all those requiring robots that can interact in real-time with complex, dynamic environments.**

#### 4.2.3 Attribution and additionality

Table 7 provides a contribution analysis for the economic and productivity outcome area. Several of the causal hypotheses are supported here, showing that the Theory of Change is a valid explanation for several economic and productivity outcomes. The programme appears to be particularly effective in supporting the development of products and services of long-

term relevance to industry – the research has either helped or is helping develop better manufacturing processes, or products which could capture target commercial markets. While there is not widespread evidence of products having reached market yet, many believe there is clear potential for them to ultimately do so. The programme appears to therefore have supported research which is clearly industry relevant.

*Table 7 Programme contribution analysis for economic and productivity outcomes*

Aspect of logic model	Causal hypothesis	Assessment of Prosperity Partnership's contribution
Outputs to outcomes	<p>Research and innovation activity undertaken through a prosperity partnership contributes to the development of commercially relevant products and services that make it to market.</p>	<p><u>Evidence to support hypothesis</u></p> <p>Evaluation found several instances of the Partnership work having supported the development of the products, services or processes that have clear commercial interest and applicability. These are cited in the survey data and case studies above.</p> <p>While there are understandably a relatively small number of products that have reached market to date, survey evidence shows there is confidence amongst a number of programme partners of being able to launch new products or services to market over the coming years, especially following completion of their Partnership.</p> <p><u>Evidence to refute hypothesis</u></p> <p>A small proportion of respondents (31.5% academic and 15.2% industry) were not (yet) able to identify opportunities for new products, services or processes. Interviewed industry stakeholders have also spoken of how the commercial potential of their activity is currently unclear.</p> <p><u>Overall assessment</u></p> <p><b>Hypothesis somewhat supported:</b> there are several instances where the Partnerships have resulted in commercial outcomes and many opportunities for future commercialisation have been identified. However, with the commercial potential of other research being uncertain, it is not always clear that the causal links will be observed.</p>
	<p>Products and services generated through PP-backed activity leads to sales and/or cost efficiencies which enable continued growth in the industry partners' revenue and/or profitability.</p>	<p><u>Evidence to support hypothesis</u></p> <p>There is some survey evidence of programme participants expecting to be able to generate additional income through their PP-funded work – survey data suggest at least £24 million of additional income will have been generated by the end of the programme. Survey evidence also indicates a potential £373 million of additional revenue will be generated every year following the programme.</p> <p><u>Evidence to refute hypothesis</u></p> <p>While there is some evidence of early sales of new products and services, the majority of innovation outcomes are in the future. Industry partners still have to progress with commercialisation before it can result in growth and revenue. The proportion of survey respondents providing estimates on expected income is small (less than half).</p> <p><u>Overall assessment</u></p> <p><b>Hypothesis neither confirmed nor unconfirmed:</b> while some organisations have generated additional income through their Partnership work, this is yet far from universal. The main business growth that participants have seen is in employment. It is still too early to determine whether this will ultimately contribute to greater revenues and/or profits.</p>

Aspect of logic model	Causal hypothesis	Assessment of Prosperity Partnership's contribution
Outcomes to impacts	The collaboration between academic and industry partners enables increased commercialisation of academic research	<p><u>Evidence that supports hypothesis</u> A high proportion of academic and industry partners self-report that the collaborative low TRL research has resulted in opportunities identified for new products, services and processes. Thus, the programme results in clear commercial opportunities.</p> <p><u>Evidence that refutes hypothesis</u> Several consultees from across industry and academia have highlighted that while Partnerships have contributed to improved and more frequent interactions between the two communities, on its own, it is not enough to sustain them. Wider factors as overall economic environment and the availability of funding to support commercialisation will influence commercialisation of academic research.</p> <p><u>Overall assessment</u> <b>Hypothesis somewhat supported:</b> The programme strengthens academic-industry collaboration and results in new opportunities identified for products, services or processes with some first evidence of successful commercialisation. Thus, the programme showcases the value of collaborative R&amp;D at low TRLs. However, future collaboration and commercialisation of academic research depends on many wider factors beyond the control of the programme.</p>
	Business growth achieved by PP participants leads to net additional increases in regional and national GVA.	<p><u>Evidence that supports hypothesis</u> Survey and interview data reveal that many innovations resulting from the Partnerships will be commercialised and likely lead to business growth. Thus, it can be reasonably expected that in the long- term, Partnerships will contribute to increases in regional and national GVA.</p> <p><u>Evidence that refutes hypothesis</u> In the large majority of Partnerships the industry partners still need to invest time and resources to arrive at commercial results. Commercial success and further business growth depends on many other factors.</p> <p><b>Hypothesis neither confirmed nor unconfirmed:</b> Programme contribution to any wider economic growth at this point cannot be determined and will only be partial. However, the evidence of achieved and expected outcomes is strong, thus in case of successful commercialisation and business growth, in the long term (5-10 years) programme might contribute to economic growth.</p>

#### 4.2.4 Return on investment

Return-on-investment analysis was completed using industry lead partners survey data. Thus, the analysis counts only on the data reported by the companies involved in the Partnerships. Detailed method description and results are presented in the Appendix C.

We retrieved self-reported data from the survey on three main topics:

- **Sales income generated from both patents and products/services generated under the Prosperity Partnership grants in three periods of time:**
  - a) generated from start of Prosperity Partnership until now
  - b) expected revenue in period from now until the end of the Prosperity Partnership



- c) expected annual revenue after the end of the Prosperity Partnership.
- **Full-time equivalent (FTE) jobs** that have been created (or are expected) at the company as:
    - a) a direct result of participation in Prosperity Partnership
    - b) a result of income generated by patents / products / services arising from the Prosperity Partnership.
  - **Estimated time frame for which companies expect the income to be generated** from the new patents / products / services arising from the Prosperity Partnership. This allowed the calculation of the time needed for effects to materialise, as well as their average duration.
  - **The overall contribution of the programme** for the generated and expected revenues, based on what would have occurred without the prosperity partnership (counterfactual scenario). Also, attribution to the programme is already embedded in the approach since participants were asked to report on sales and employment emerging directly from their projects.

We find that:

- Each £1m invested by the EPSRC in the PP would generate a return of £7.7m (£1.1m per annum)<sup>2</sup>, taking into account current and expected sales and after accounting for the counterfactual scenario. 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 would generate 0.4 FTEs<sup>3</sup> (as a direct effect of grants), after accounting for the counterfactual scenario. Additionally, each £1m invested by the EPSRC in the PP generates 8.5 FTEs<sup>4</sup> 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. This value also takes into account current and expected FTEs and the counterfactual scenario.

The return-on-investment figure has to be interpreted with caution. Higher TRLs are a critical requirement to start commercialising the products and generate sales and income. Although, according to survey data, at the end of the Prosperity Partnership, the average TRL is expected to increase to almost 4.5, there is also some uncertainty in terms of the overall gains, with companies reporting an average confidence interval of 63% - 87% on their expected sales. It can be it is too soon to make estimates of future sales.

As the qualitative data shows, technological developments and innovations emerging from the Partnerships might not always lead to new products/services and sales. Partnerships also generate other applications and wider benefits, for example, improved manufacturing effectiveness or other commercial impacts, which are harder to count and monetise. For example, the case study of BAE Systems and Southampton University Partnership show that the technological innovations developed in this project will be adapted to BAE System's maritime products to improve their performance and functionality. As such, the commercial potential

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<sup>2</sup> 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).

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

<sup>4</sup> 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.

from innovations will only materialise indirectly, through improving the functionality and performance of existing products, and will likely become visible in the next 10+ years. Similarly, the outcomes of the Partnership between Siemens Gamesa and the University of Sheffield have resulted in improved maintenance of the offshore wind turbines leading to more efficient operations but not necessarily new sales. These examples show that Partnerships contribute to not only the generation of new products but also the improvement of existing and it takes time for the benefits to materialise. Commercial benefits like the above are not reported as direct sales income, which is the main input in our return-on-investment calculation.

### 4.3 Collaborations and investments

#### 4.3.1 Introduction

Within the **collaborations and investments** impact domain, the key outputs are **sustained, and new strategic collaborations/partnerships between industry and academia**. Programme funding to established partnerships provides an opportunity to develop and strengthen existing collaborations between industry and academia with the expectation that they will be sustained over a longer time frame. The joint R&I programme offers the opportunity for deepening and strengthening collaboration and provides a framework for continued partnering. The partnership can also potentially bring in new partners if, for example, the new knowledge being created has applications in other industries.

Within the **collaborations and investments** impact domain, the key outcomes are:

1. **Increased opportunities for businesses to undertake riskier, long-term research in partnership with academia.** Prosperity Partnerships resulting in sustained and new collaborations/partnerships between industry and academia contribute to building long-term collaboration between industry and academia partners. That also enables conducting more riskier, fundamental research where industry benefits might not be immediately visible but are likely to be achieved because of the well-established and long-term relationships with academic partners.
2. The above outcome also means **increased private investment in the UK research base (academic & business)** because of the positive experience conducting use-inspired collaborative fundamental research within the Prosperity Partnerships programme. Strengthened partnerships also help to **anchor increased R&D investment in the UK**. Prosperity Partnerships include several foreign businesses (36% of surveyed industry lead partners) that invest in Prosperity Partnerships at the partnership outset and through later collaborations arising from the partnership.
3. Besides strengthening direct partnerships, the programme results in overall **improved networks / new connections across sectors and disciplines and a platform for business-led research to tackle industry roadblocks**. Several Prosperity Partnerships involve additional partners besides the lead industry and academic partners. Thus, the collaborative activity helps to broaden networks and seek new technology applications. Funding modalities that combine resources across funding councils and allow for cross-disciplinary collaborations results in new knowledge that helps to seek wider technology applications in various industries.

#### 4.3.2 Outputs

The main indicators to measure the outputs of the collaboration emerging from the Partnerships are the number and proportion of partnerships that report plans of a continuing collaboration between industry and academic partners following the end of the partnership and the number

and proportion of partnerships reporting new collaborations with industry and academic partners as a result of the partnership. Table 6 shows the number and proportion of surveyed academic and industry partners that reported these outputs. As evident, almost all surveyed partners report plans to continue collaboration, and all have established new collaborations.

*Table 8 Number and proportion of surveyed academic and industry partners reporting achieved and expected collaborations and investments outputs*

Output indicators	Academic n (% of respondents)	Industry n (% of respondents)
<b>Sustained &amp; new strategic collaborations / partnerships between industry &amp; academia</b>		
Number and proportion of partnerships that report plans of continuing collaboration between industry and academic partners following the end of the partnership	33 (94.2%)*	32 (96.9%)*
Number and proportion of partnerships reporting new collaborations with industry and academic partners as a result of the partnership	35 (100%)	33 (100%)

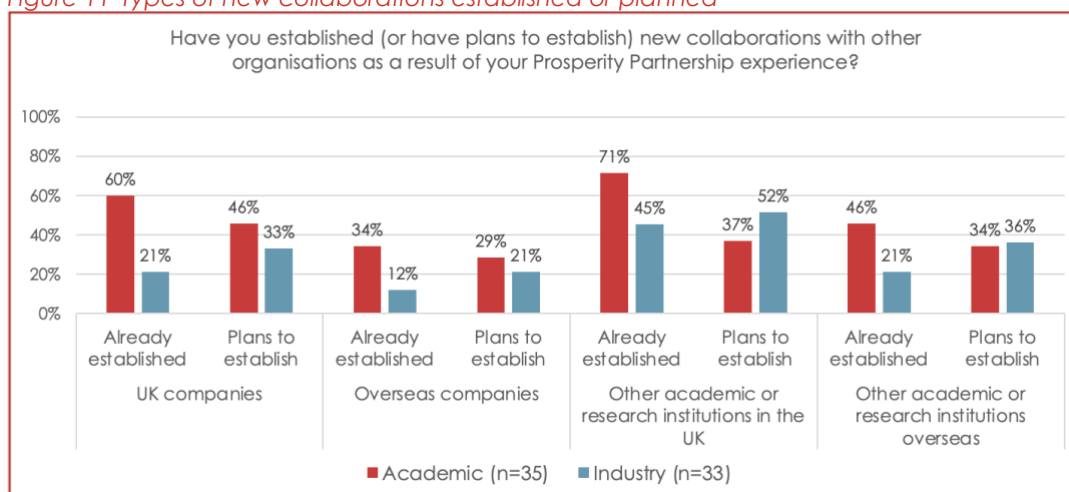
Source: Technopolis survey of academic and industry PIs

Note: \*All respondents who responded to the question reported plans of continuing collaboration. Two academic respondents and one industry respondent skipped the question, therefore the percentage of respondents in the table is not 100%.

Many respondents provided positive feedback about the benefits of the Partnerships regarding the improvement, extension, or creation of networks and partnerships with universities and industry partners. Access to new departments, staff, research facilities and equipment was mentioned as a benefit of the Partnerships.

Figure 11 shows that industry partners have established (45%) or plan to establish (52%) new partnerships, mostly with other academic or research institutions in the UK. Also, academic institutions have mostly established new collaborations with other academic institutions (71%), and plans are mostly about establishing new partnerships with other UK companies (46%). As showcased by the case study example below, Partnerships help to sustain and expand existing collaborations and establish new.

*Figure 11 Types of new collaborations established or planned*



Source: Technopolis survey of academic and industry PIs

### BAE Systems and Southampton University Partnership 'Intelligent Structures for Low Noise Environments (ISLNE)'

This Prosperity Partnership project builds upon a long-standing relationship between the lead industry and academic partners that has been maintained over multiple decades. The company dedicates a share of their annual R&D funding to support activities at the University of Southampton's Institute of Sound and Vibration Research, including supporting fundamental research with industrial applications and providing access to equipment and manpower for experimental campaigns. While previous collaborations involved innovations at various technology readiness levels (TRLs), the Prosperity Partnership has provided resources to early-stage innovations (i.e. TRL1 to TRL3). The project activities represent a strategically important part of the maritime businesses and the wider portfolio of investments within the company.

The Prosperity Partnership project has allowed team members to expand their relationship in existing and new scientific and technology domains. The partnership has allowed the University of Southampton to build a better understanding of industry needs and challenges, whilst it has also provided a platform for BAE Systems to demonstrate the benefits of long-term investments in collaborative R&D activities. Once the ISLNE project finishes in 2023, the partners intend to apply for future funding from EPSRC and other sources to continue their research efforts in noise and vibration control.

The partnership has also helped to establish University of Nottingham as a new strategic partner for BAE Systems. Without the EPSRC's funding, the partners would not have been able to build a strong collaborative relationship with the Nottingham University, nor would they have been able to focus on blue sky thinking where early-stage research is needed to explore the potential of ideas.

#### 4.3.3 Outcomes

Strengthened existing and new collaborations established as a result of the Partnerships have increased opportunities for businesses and academics to undertake riskier, long-term collaborative research. Partnerships have also resulted in increased private investment in the UK research base. Table 9 shows the number and proportion of surveyed Partnerships that report collaborations and investment outcomes.

*Table 9 Number and proportion of surveyed academic and industry partners reporting achieved and expected collaborations and investments outcomes*

Outcome indicators	Academic n (% of respondents)	Industry n (% of respondents)
<b>Increased opportunities for businesses and academics to undertake riskier, long-term collaborative research</b>		
Number and proportion of industry and academic partners reporting plans to continue undertaking early-stage research in partnership with academic/industry partners influenced by partnership*	29 (82.8%)	26 (78.7%)
<b>Increased private investment in the UK research base</b>		
Additional investment in the research domain of the Prosperity Partnership in the UK from UK private sector sources	14 (42.4%)	18 (51.4%)
Additional investment in the research domain of the Prosperity Partnership in the UK from non-UK private sector sources	12 (36.3%)	11 (41.4%)
Additional investment in the research domain of the Prosperity Partnership in the UK from internal UK company sources /budgets		16 (48.4%)

Additional investment in the research domain of the Prosperity Partnership in the UK from non-UK company sources/budgets (i.e., from a parent company)		12 (36.3%)
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Source: Technopolis survey of academic and industry PIs

Note: \* Industry partners were asked about plans to continue undertaking early-stage research in partnership with academic partners and academic partners were asked about plans to continue undertaking early-stage research in partnership with industry partners.

### Increased opportunities for businesses and academics to undertake riskier, long-term collaborative research

Partnerships have increased opportunities for businesses and academics to undertake riskier, long-term collaborative research. Most surveyed academic (82.8%) and industry (78.7%) partners report plans to continue undertaking early-stage research in partnership with academic/industry partners influenced by the partnership. It has to be noted that most industry (81%) and academic partners (73%) already had positive views about investing in/undertaking early-stage research, and the programme has not changed their views. Thus, the programme attracted participants with positive views about this kind of collaboration. There is also a share of academic partners (27%) and industry partners (19%) that report they are more inclined to invest in/undertake early-stage collaborative research.

#### Nikon and UCL Partnership 'Prosperity Partnership on Next-Generation X-Ray Imaging'

The collaboration will continue beyond the Partnership. Both organisations have benefited from working with each other. **Future collaborations will still be based on early-stage research on the same topic as the Partnership because the research fields will not have been fully exploited by the end of the project.** Moreover, the partners will focus on continuing to co-develop the products and services, building on the results of the Partnership, but also to have joint PhD and postdoctoral training, as well as secondments and staff exchange.

Nikon will continue funding collaborative research on X-Ray imaging, but partners will also continue to look for additional government funding.

### Increased private investment in the UK research base

About half of the surveyed industry partners and a slightly fewer academic partners report having secured or expecting additional investment in the research domain of the Prosperity Partnership in the UK from UK private sector sources. Instances of additional investment from non-UK private sector sources are fewer.

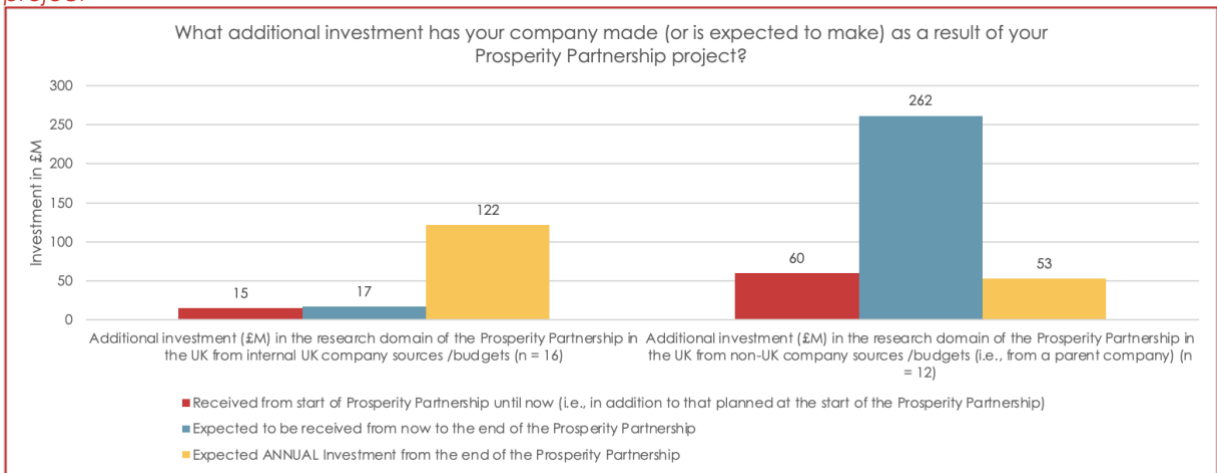
About half of the surveyed industry partners report having made or plan to make additional investments in the research domain of the Prosperity Partnership in the UK from internal UK company sources /budgets, and 36% of industry respondents report investments from non-UK company sources/budgets (i.e., from a parent company) signalling that Prosperity Partnerships facilitate foreign direct investment. Figure 12 shows the value of additional investments made (and expected) from internal and non-UK company sources. Industry partners report having already made an additional investment in the value of £75m<sup>5</sup> (UK and non-UK sources together), which means that together with the initial industry investment in the Partnerships, the

<sup>5</sup> One respondent reports about 80% of the overall value.

programme has leveraged industry contribution in the value of £242m. The value of already made follow-on private investment reported in the survey is higher than that reported in ResearchFish (£5.4m). ResearchFish submission was made about five months before the evaluation survey and might have missed some recent developments. For example, ResearchFish data does not capture Siemens additional investment demonstrated in the case study box below.

As evident in the figure, industry partners expect to make further significant investments by the end and after completing the Partnerships. Two survey respondents commented on the additional investments made and explained that additional funding was invested in new equipment at partner universities. Interview evidence confirms this and also points to instances of further investment in collaborative research with the academic partner. Companies like Siemens and Wrightbus continue to invest amounts of around £1m a year to support research work. The case study box below provides example of additional private investment already made by the industry lead partner to support further research building on the work started within the Partnership.

*Figure 12 Additional investments industry lead partners have made as a result of the Prosperity Partnership project*



Source: Technopolis survey of industry Pls

### Siemens and University of Sheffield Partnership in Offshore Wind Technologies

The Partnership has increased private investment in R&D. Siemens Gamesa will financially support further collaboration with the University of Sheffield and further develop the work started within the Partnership. Siemens Gamesa has already invested a further £1m (in addition to the initial investment in the Partnership), and the research will focus on developing high-power density direct drive permanent magnet generators building on the work started in the Prosperity Partnership. Partners did consider securing other public funding, but none of the available funding opportunities fit their needs, so they decided to proceed with private investment.

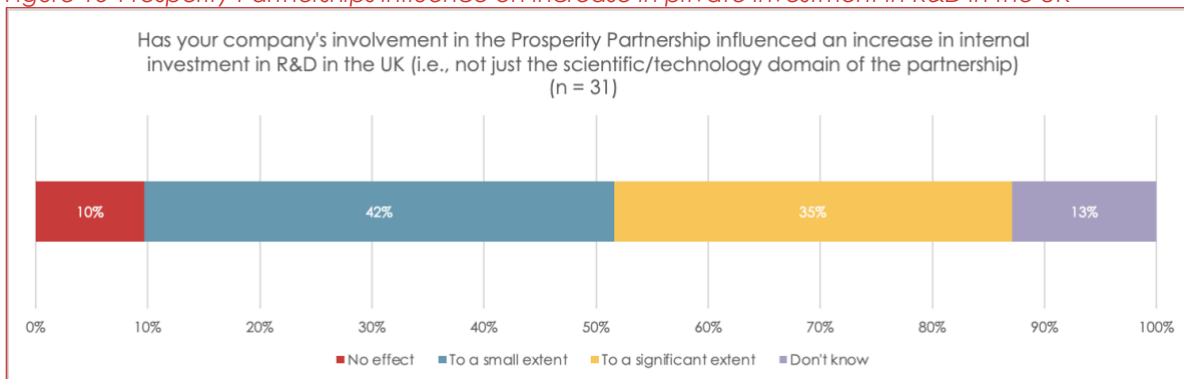
Other partners have also secured further funding – the University of Sheffield has received new grants from EPSRC, and the University of Hull has won several grants from EPSRC and NERC building on the research on blade construction started within the Partnership.

Working with Siemens has positively contributed to the reputation of the University of Sheffield as trusted academic research partner and several companies have approached the academic PI professor Zhu with inquiries about establishing new partnerships. The University of Hull was admitted to the European Academy of Wind Energy as a result of improved reputation by working with Siemens and University of Sheffield, both established players in the OSW research.

Although the number of respondents reporting additional investment from non-UK company sources is smaller, interviews' evidence suggests that results emerging from the Partnerships are presented and brought to the attention of the non-UK management teams (where industry partner ownership is mixed or non-UK). Non-UK company decision makers are familiar with the research outcomes produced in partnership with UK-based academics and consider this in their R&D spending decisions.

Industry survey respondents were asked not only to indicate the amount of investment but also to provide an overall assessment of whether the company's involvement in the Prosperity Partnership influenced an increase in internal investment in R&D in the UK. Figure 13 shows that most respondents (42%) claimed that the Partnership had influenced an increase in investment to a small extent, and a further 35% claimed that the Partnership influenced internal investment in R&D to a significant extent. Thus, according to the self-reported evidence, the programme has positively affected the increased private investment in R&D.

Figure 13 Prosperity Partnerships influence on increase in private investment in R&D in the UK



Source: Technopolis survey of industry PIs

Finally, surveyed academic and industry partners report securing follow-on funding from public sources. Industry partners report receiving or expected follow-on grants in the UK from UK sources in the value of £157m. Surveyed academic lead partners mostly report instances of already secured

and expected follow-on grants in the UK from UK sources with an overall value of £149m. Four Partnerships studied as part of the in-depth impact case studies report having secured HORIZON 2020 funding building on the work conducted within the Partnership. The case study example below shows an example of a Partnership securing follow-on funding from public and private sources.

Case study on the BT and Lancaster Partnership 'Next Generation Converged Digital Infrastructure'

The partnership's research agenda has fostered additional research represented in follow-on and new bids that will bring more than £11m of additional funding from public and private sources in the UK. Some of them involve existing partners, for example, Surrey and Lancaster, with a grant from the DCMS. In other cases, it has enabled new partnerships with private companies, with a £1.7m investment for work around the future of networks – Network 2030 – and pathways to exploitation of new network features.

Evidence from the in-depth impact case studies of 15 partnerships shows that partners use follow-on funding for various activities, but most often, a mixture of private or public research funds are invested to:

- enable the technological advancement and commercialisation of innovations initiated under the Partnerships (higher TRLs research)
- continue deepening and broadening collaborative research agendas beyond the theme of the Partnership both in fundamental research higher TRLs research
- support studentships to enable the fundamental technology transfer of tools developed within the Partnership to the company

4.3.4 Attribution and additionality

Most collaboration and investment outcomes and impact are highly attributable to the programme. The survey reveals that academic and industry partners involved in the partnerships already had very positive views of investing in collaborative low TRL research, therefore the programme has not added to change in the overall perceptions on the value of this activity. However, the evidence suggests that the programme's financial scope and duration has enabled a number of participants to propose collaborations that involve several academic institutions, combining diverse disciplinary backgrounds to support wholistic solutions for the industry. The programme has therefore enabled participants to strengthen existing commitments to collaborative research, as well as facilitating the emergence of new collaborations. The programme's financial scope and duration has also encouraged greater UK-based activity amongst organisations based outside the country.

Table 10 Programme contribution analysis for collaboration and investment outcomes

Aspect of logic model	Causal hypothesis	Assessment of Prosperity Partnership's contribution
Outputs to outcomes	The experiences in working with academia on low TRL research through the PP, gives industry the willingness and experience to continue doing similar work more long-term with academia.	<p><u>Evidence to support hypothesis</u></p> <p>Survey evidence shows that a large proportion of industry PIs and academic PIs plan to continue engaging in early-stage research as part of an academic/industry partnership.</p> <p>Case study evidence shows that some partnerships believe the research they have been working on has not yet been fully exploited. Hence, there is a desire to continue working with the others on low TRL research.</p> <p><u>Evidence to refute hypothesis</u></p> <p>The majority of respondents to a question in the industry PI survey stated that participation in the programme had not changed their view or willingness to engage in</p>



Aspect of logic model	Causal hypothesis	Assessment of Prosperity Partnership's contribution
		<p>low TRL research. In large part, this was because the company already had a positive view of low TRL research and were already engaging with it. Therefore, the programme provided limited additionality in terms of perceptions on the value of low TRL research.</p> <p><u>Overall assessment</u></p> <p><b>Hypothesis somewhat confirmed:</b> The available evidence suggests that PP participants are keen to continue working on low-TRL work with each other. Successful experience with the programme and tangible (future) commercial benefits increase the confidence in investing in low TRL research. However, it has to be noted that both industry and academic partners already had positive views on engaging in low TRL research before the programme. Thus, the programme has helped to further strengthen and exemplify the benefits of investing in low TRL research but not necessarily significantly change attitudes or encourage increase this type of research.</p>
	<p>Senior leaders within the industry participant organisations believe the collaborations and partnerships with academia have been so successful, that they decide to invest more in their UK operations to help further exploit these opportunities.</p>	<p><u>Evidence to support hypothesis</u></p> <p>Survey evidence indicates that a sizeable proportion of respondent industry participants have secured additional investment for research in the same domain as their Prosperity Partnership research. Over half (51%) indicated investment from the UK private sector, with 41% securing investment from non-UK private sector sources. The programme has therefore supported foreign direct investment (FDI).</p> <p>Survey evidence reveals that there is a planned investment worth £53 million from non-UK parent companies of participants.</p> <p>Interview and case study evidence also show that PP-backed research has helped facilitate the case for safeguarding internal investment in the UK relative to other sites the company may have internationally.</p> <p><u>Evidence to refute hypothesis</u></p> <p>Some of the most substantial follow-on investment made in PP-based research has been by British-businesses. Survey evidence shows that much of the planned investment in the UK for after the programme will come from UK-based firms.</p> <p><u>Overall assessment</u></p> <p><b>Hypothesis confirmed:</b> it is clear that PPs have been the conduit for FDI both during and after a company's participation in the programme. The programme has shown itself able to recruit UK-owned and foreign-owned businesses. To that end, the Theory of Change holds in that the programme does create additional FDI into the UK.</p>
	<p>The relationships developed through PP participation have included new inter sector or interdisciplinary ones, with participants maintaining these post-programme.</p>	<p><u>Evidence to support hypothesis</u></p> <p>Survey evidence shows an intent amongst many survey respondents to work with different research domains. This includes working to develop new products and services in a different domain to them, and conducting early-stage research in a different topic. Qualitative evidence points to many cases of partners being able to conduct interdisciplinary research because of the scale and duration of the programme.</p> <p><u>Evidence to refute hypothesis</u></p> <p>Most interviewees pointed that the PP programme is a good mechanism for interdisciplinary research but a few interviewees pointed that they had to narrow the scope</p>

Aspect of logic model	Causal hypothesis	Assessment of Prosperity Partnership's contribution
		<p>or apply to other councils to support research that is not in the remit of EPSRC.</p> <p>Survey evidence suggests that more individuals were not interested in pursuing research outside their domain than those that were.</p> <p><u>Overall assessment</u></p> <p><b>Hypothesis somewhat confirmed:</b> Many Partnerships involve interdisciplinary collaborations and participants would like to engage in inter-sector or interdisciplinary work going forward. Programme financial scope and duration has enabled participants to propose collaborations that involve several academic institutions combining diverse disciplinary backgrounds to support wholistic solutions for the industry. Nevertheless, while the causal hypothesis has some validity, it appears that the preference amongst many remains to prioritise working in their own research domain rather than engaging in inter sector or interdisciplinary work.</p>
Outcomes to impacts	Increased levels of sustained co-operation and joint working between academia and industry leads to a culture where both communities interact with each other more than they did before.	<p><u>Evidence to support hypothesis</u></p> <p>The programme has facilitated a deepening and expanding of previous collaboration between the partners. There is evidence of several partnerships that have expanded from collaboration on higher TRLs to starting joint low TRL research within the Prosperity Partnership. The programme allowed many existing partnerships to bring in additional expertise from other academic partners. There is a nearly universal agreement that the collaboration will continue and expand to new partners.</p> <p><u>Evidence to refute hypothesis</u></p> <p>The majority of survey respondents, 73% of academic survey respondents stated that the programme had had no bearing on their desire to undertake early-stage research with industry partners because of already positive views before the programme.</p> <p><u>Overall assessment</u></p> <p><b>Hypothesis confirmed:</b> The programme has funded partnerships between organisations already actively engaged with each other. But the programme has played a significant role in helping deepen relationships either more quickly, or to a larger extent than might have been possible otherwise.</p>

## 4.4 Policy and wider benefits

### 4.4.1 Introduction

Policy impact is not the key area where the Prosperity Partnerships programme was designed to have a significant impact. There are no specific programme objectives that aim towards policy impact and programme design does not involve any activities to facilitate that. However, because of the internationally leading and industry driven research funded by the programme, it is reasonable to expect that some of the knowledge emerging from the projects might have direct or indirect relevance for the policy.

Within the **policy** impact domain, the partnerships may produce new evidence relevant for policy-makers. The new knowledge produced by the fundamental R&I in diverse disciplinary and inter-disciplinary settings can potentially be relevant for policy-makers. Prosperity

Partnerships cover many themes where new knowledge is relevant for businesses and valuable in policy-making. For example, partnerships conducting R&I on solar energy, electrification of vehicles, and responsible use of AI yield relevant insights for policy-makers.

Within the **policy** impact domain, the outcomes would be the adoption of new knowledge in policy. If new evidence for policy-makers (output) is well disseminated and taken up by policy-makers, it has the potential to adopt a policy or inform policy decisions. However, the evaluation finds little evidence (yet) of policy adoption of the new knowledge.

#### 4.4.2 Outputs and outcomes

The main indicator to measure the policy outputs are qualitative details on how the new knowledge might have relevance for policy. An analysis of case studies shows that in many cases there is a potential for the new knowledge to be relevant in policy making. Partnerships hold relevant and often unique insights into matters of important relevance to the policymakers. Several Partnerships have made an effort to engage policy makers in the formulation of research questions and disseminate new knowledge. For example, the Partnership between Wrightbus and Queen's University Belfast looks at new generation of EVs and one of the work streams considers potential policy impacts and wider consequences would be in moving away from diesel dominated transport architecture and towards hydrogen and batteries. The Partnership has held a series of workshops engaging directly with many stakeholders, local government authorities, bus manufacturers, climate pressure groups and activists to understand the various perspectives.

Another example is the Partnership between Costain and University of Cambridge on digital roads which investigates how digital twins, smart materials, data science and robotic monitoring can work together to create a connected physical and digital product and associated processes with a strong focus on the flow of data. The Partnership collaborates with National Highway and as evidenced from the quote below has gained significant interest from public authorities.

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*“We have been communicating with the scientific advisor to the government, so policy influence of the Partnership is important. PP allowed us to work closely with policy makers. The Partnership will have an impact on decarbonisation of heavy roads network and electrification of heavy vehicles. National Highways (additional partner) for us is a client-supplier relationship, they are one of our biggest clients. If you drive a road in Britain, it is very likely it was built by Costain or is serviced by Costain. So National Highways challenges are our challenges as well. If we improve our digital capabilities, it enhances National Highways.”*

*Interview with Tim Embley, Costain*

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In some cases, the Partnerships have helped the partners to develop reputation of expertise in a specific niche area and they are invited by policymakers to provide insights and consultations. For example, the University of Strathclyde work in neutral atom computing has resulted in an expertise unique in the UK. This has enabled academics to feed input into BEIS and National Quantum Computing Centre in their development of quantum computing research roadmaps and providing practical advice (helping with technical specifications) on the lab requirements for neutral atom technologies.

The main outcome indicator is actual influence on policy, standards or regulation, again measured mainly by qualitative evidence. Only a small proportion of surveyed academic and industry partners (40% and 45% respectively) report that innovations arising from the Partnership will have applications and benefits in public policy design and public service efficiency. More academic partners (49%) think that the innovations will have applications and benefits in regulation and/or standards. Industry partners are less inclined to think so (27%). Survey and interview evidence shows that many academic and industry survey respondents believe that the innovation arising from the PPs will lead to applications in environmental protection. In addition, approximately 40% of academic and 35% of industry survey respondents believed their research could have applications in health and welfare. Qualitative evidence supports these claims and many potential wider benefits are expected from the innovations emerging from the Partnerships. The evaluation found little evidence of new knowledge and innovations arising from the Partnerships resulting in policy or other adoption.

Several survey respondents and interviewees pointed that it is too early for the new knowledge and innovations to have influence on policy. Two interviewees of Partnerships with planned policy outreach activities reported that the COVID-19 pandemic negatively affected the progress in this area. Engagement exercises were halted and some tasks involving paperwork were slowed down.

#### 4.4.3 Attribution and additionality

Table 11 summarises programme contribution analysis for policy outcomes. Prosperity Partnerships have resulted in new evidence for policymakers but there is no evidence on policy adoption, thus programme contribution in this impact domain is limited.

*Table 11 Programme contribution analysis for policy outcomes*

Aspect of logic model	Causal hypothesis	Assessment of Prosperity Partnership's contribution
Outputs to outcomes	Policy makers deem the new knowledge developed by Partnerships to be applicable to tackling policy challenges and adopt them in response.	<p><u>Evidence to support hypothesis</u></p> <p>Many Partnerships report the production of knowledge of potential relevance to policymakers (as showcased by interest from policymakers) and dissemination activities. This includes knowledge of technologies associated with societal challenges (e.g. healthcare and decarbonisation)</p> <p><u>Evidence to refute hypothesis</u></p> <p>Evaluation finds no evidence to date of actual adoption of new knowledge in policy.</p> <p><u>Overall assessment</u></p> <p><b>Hypothesis unconfirmed:</b> although many Partnerships report having produced insights potentially relevant for policymakers and there are instances of dissemination and even close collaboration, this has not yet resulted in any adoption in new policy. That said, it may be too early for these outcomes to be realised and confirming evidence may be available in the future.</p>
Outcomes to impacts	Policy adoption of new knowledge emerging from the Partnerships leads to policy and regulatory impacts (e.g. more efficient and effective running of government, improved citizen outcomes).	<p><u>Evidence to support hypothesis</u></p> <p>There is early evidence that some of the research developed by the Partnerships may enable more effective policy delivery and citizen outcomes (e.g. improved strategies to deliver healthcare, and decarbonisation of public transport)</p> <p><u>Evidence to refute hypothesis</u></p> <p>No evidence yet of policy adoption, therefore no evidence of policy or regulatory impacts. In large part because it too early for them to be seen.</p> <p><u>Overall assessment:</u></p>

		<p><b>Hypothesis neither confirmed nor unconfirmed:</b> Although many Prosperity Partnerships result in new knowledge relevant for policymakers, it is too early to observe any policy impact.</p>
	<p>Products, services, or new manufacturing techniques developed through PP-based research are sufficiently effective that they make tangible differences to cultural, health, or environmental challenges.</p>	<p><u>Evidence to support hypothesis</u></p> <p>Survey and interview evidence shows that many academic and industry survey respondents believe that the innovation arising from the PPs will lead to applications in environmental protection. In addition, approximately 40% of academic and 35% of industry survey respondents believed their research could have applications in health and welfare. Qualitative evidence supports these claims and many potential wider benefits are expected from the innovations emerging from the Partnerships.</p> <p><u>Evidence that refutes hypothesis</u></p> <p>There is little evidence of actual impacts having been generated to date in this area. Rather our interview and case study analysis show that there is the future potential for new knowledge gained through PP activity to be applied to the tackling of societal problems.</p> <p><u>Overall assessment</u></p> <p><b>Hypothesis neither confirmed nor unconfirmed:</b> There is insufficient evidence to determine the validity of the causal hypothesis. While many participants believe there will be links between their PP-backed research and the tackling of societal challenges, much of the work is at too early a stage to determine this for sure.</p>
	<p>The exposure to a greater variety of research (including that with a focus on place-based effects and/or sustainability) through the PP programme leads to responsible research and innovation becoming more embedded amongst participants, and the UK landscape more generally.</p>	<p><u>Evidence to support hypothesis</u></p> <p>Insufficient evidence to support hypothesis.</p> <p><u>Evidence that refutes hypothesis</u></p> <p>Insufficient evidence to refute hypothesis</p> <p><u>Overall assessment</u></p> <p><b>Hypothesis neither confirmed nor unconfirmed:</b> There is insufficient evidence to determine the validity of the causal hypothesis. Not enough time has elapsed yet to be able to judge the long-term changes to the research habits of participants.</p>

## 5 Summary and conclusions

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The evaluation collected quantitative and qualitative evidence on a number of indicators to assess the diverse impact of the Prosperity Partnerships programme. Following a theory-based approach, the evaluation explored and tested the pathways from inputs to impacts.

The evaluation shows that the Prosperity Partnerships programme funds use-inspired basic research as described by Donald Stokes and his concept of Pasteur's Quadrant<sup>6</sup>. Prosperity

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<sup>6</sup> Stokes D. (1997). Pasteur's Quadrant: Basic science and technological innovation. Washington DC: Brookings Institution Press.

Partnerships start at low TRLs with a research programme co-created between industry and academia and progress to higher TRLs and opportunities identified for new products, services, manufacturing methods and processes.

### 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 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 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.

### 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 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 or 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 reflects 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 is currently being piloted. A further 73 products, services and new processes are expected after the 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 an 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

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-EP SRC) 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.

### 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<sup>7</sup>. 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 FTEs<sup>8</sup> (as a direct effect of grants). Additionally, each £1m invested generates 8.5 FTEs<sup>9</sup> 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

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.

In summary, 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

<sup>7</sup> 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).

<sup>8</sup> Each £1m invested taking into account total costs (EPSRC investment, business investment and research organisation investment) in the PP would generate 0.1 FTEs.

<sup>9</sup> 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.



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.

Process Evaluation Report provides further insights on the programme additionality and how the programme design and processes were relevant in delivering the positive outcomes. The Process evaluation also lists recommendations to improve the programme design and processes to enable further success against the programme objectives.

## Appendix A Survey questionnaire: INDUSTRY lead partners

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### Please select the Prosperity Partnership you are involved in

(drop-down list of the titles of all PPs)

#### Your company

1. **What is the ownership of your company?**

- UK-owned
- Mixed ownership (UK and overseas)
- Overseas owned

2. **What is the size of your company?**

- Micro enterprise (<10 employees)
- Small or Medium-sized enterprise, SME (11-250 employees)
- Large enterprise (>250 employees)

#### The Prosperity Partnership you are involved in

3. **Does your partnership involve additional industry or academia partners (besides the lead industry and academia partners)?**

Yes

No

4. **If YES. What is the role of additional academia and industry partners involved in your partnership?**

	Select all that apply
Additional academic partners provide missing knowledge or infrastructure	
Additional industry partners are involved in co-delivering research and innovation work	
Additional academic partners are involved in co-delivering research and innovation work	
Additional industry partners provide new exploitation or testing route for technologies / innovations developed by the Prosperity Partnership project	
Other, please specify	

#### Motivations for establishing a Prosperity Partnership

5. **What were your company's motivations for establishing a Prosperity Partnership?**

	Select all that apply
We were seeking to deepen our existing partnership with the university in this scientific / technology domain	
We were seeking to deepen our existing partnership with the university in a <b>new</b> scientific / technology domain	
We were seeking to increase our activities in <b>early-stage (low TRL) research</b> in a specific scientific / technology domain	

We had not undertaken or participated in <b>early-stage (low TRL) research</b> before and were seeking to explore it in a scientific / technology domain of interest to us	
Other, please specify	

### Outputs and outcomes of your Prosperity Partnership

6. **What is the stage of development (TRL\*) of the key technology/technologies that you are developing within your Partnership (please fill-in as many rows as necessary in the table below providing technology name, the TRL at the start of the Partnership, TRL now and TRL expected at the end of Prosperity Partnership)?**

\*Technology Readiness Levels estimate the maturity of technologies on a scale 1 to 9. More information available here: <https://www.ukri.org/wp-content/uploads/2022/01/EPsrc-11012022-Technologyreadinesslevelsfrombasicresearchtoadoptionanddiffusion.pdf>

Technology / innovation name	TRL at the start of the Prosperity Partnership	TRL now	TRL expected at the end of the Prosperity Partnership

7. **How many of the following have been (or are expected to be) generated as a result of your Prosperity Partnership? Please populate all that apply.**

	Generated to date by the Prosperity Partnership	Expected now and between the end of the Prosperity Partnership	Expected after the end of the Prosperity Partnership	How confident are you that you will achieve this number after the end of the Prosperity Partnership?  Please provide confidence rating as a percentage where 100% is fully confident
<b>Number</b> of publications authored or co-authored by your company				

<b>Number of secondments into your company</b> from the academic partner(s)				
<b>Number of secondments from your company</b> (i.e. your company's staff) into the academic partner organisation(s)				
<b>Number of opportunities</b> identified for potential new products, services or processes to be developed			N/A	
<b>Number of patents</b> granted to your company				
<b>Number of new products</b> (arising from the project) launched on the market by your company				
<b>Number of new services</b> (arising from the project) launched on the market by your company				
<b>Number of new processes/ methods/ tools</b> (arising from the project) implemented by your company				

**8. Has your Prosperity Partnership led to (or is expected to lead to) new or improved employee skills/knowledge? (tick all that apply)**

	Select all that apply
Partnership has already led to new or improved employee skills/knowledge	
Partnership will lead to new or improved employee skills/knowledge	

**9. Thinking of the new patents, products and services resulting from the Prosperity Partnership, what sales income do you expect them to support for your company? Please populate all that apply.**

	<b>Generated from start of Prosperity Partnership until now</b>	<b>Expected revenue in period from now until the end of the Prosperity Partnership</b>	<b>Expected ANNUAL REVENUE after the end of the Prosperity Partnership</b>	<b>How confident are you that you will achieve expected annual revenue after the end of the Prosperity Partnership?</b>

				Please provide confidence rating as a percentage where 100% is fully confident
Licence income from your patents resulting from the Partnership (£M)				
Income generated by products/services (£M)				
Proportion of income above from non-UK markets (%)				

10. **What are the timescales for any expected income from the new patents / products / services arising from your Prosperity Partnership?**

- **Start date of income** (the year is sufficient):
- **End date of income** (the year is sufficient):

11. **Please provide any additional details on the type of new patents, products /services and markets expected.**

12. **Will the technologies / innovations arising from the Partnership lead to any process efficiencies for your company?**

- Yes
- No

**If YES,**

What will be the <b>annual value</b> (£M) of savings to be made	
<b>When</b> would you expect these efficiencies to start (date: the year is sufficient)	
<b>When</b> would you expect these efficiencies to end (date: the year is sufficient)	

13. **Have any spin-out companies been created (or are expected) as a result of your Prosperity Partnership? Please populate all that apply.**

	Created from start of the Prosperity Partnership until now	Expected to be created in period from now until the end of the Prosperity Partnership	Expected after the end of the Prosperity Partnership
<b>Number</b> of spin-outs formed			

Number of employees working at these spin-outs (estimates are acceptable)			
Investment raised by spin-outs (£M) (estimates are acceptable)			
Annual turnover of these spin-outs (£M) (estimates are acceptable)			

**14. How many new full-time equivalent (FTE) jobs have been created (or are expected) at your company as a result of...**

Please populate all that apply.

	New (FTE) jobs created from start of the Prosperity Partnership until now	New (FTE) jobs expected to be created between now and the end of the Prosperity Partnership	New (FTE) jobs expected to be created any time after the end of the Prosperity Partnership	How confident are you that the new jobs will be created after the end of the Prosperity Partnership?  Please provide confidence rating as a percentage where 100% is fully confident
As a direct result of your participation in Prosperity Partnership				
As a result of income generated by patents / products / services arising from the Prosperity Partnership				

**15. What additional investment has your company made (or is expected to make) as a result of your Prosperity Partnership project?**

	Received from start of Prosperity Partnership until now (i.e., in addition to that planned at the start of the Prosperity Partnership)	Expected to be received from now to the end of the Prosperity Partnership	Expected ANNUAL Investment from the end of the Prosperity Partnership
Additional investment (£M) in the research domain of the Prosperity Partnership in the UK from internal UK company sources /budgets			
Additional investment (£M) in the research domain of the Prosperity			



Partnership in the UK from non-UK company sources /budgets (i.e., from a parent company)			
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16. What are the timescales for any additional investment after the end of the partnership?

- Start date of additional investment (the year is sufficient):
- End date of additional investment (the year is sufficient):

17. Has your company received (or expects to receive) investment (or grants) from external sources as a result of your Prosperity Partnership?

	Received from start of Prosperity Partnership until now (i.e. in addition to that planned at the start of the Prosperity Partnership)	Expected to be received from now to the end of the Prosperity Partnership	Expected ANNUAL Investment from the end of the Prosperity Partnership
Additional investment (£M) in the research domain of the Prosperity Partnership in the UK from UK private sector sources (£M)			
Additional investment (£M) in the research domain of the Prosperity Partnership in the UK from non-UK private sector sources			
Follow-on grants (£M) in the research domain of the Prosperity Partnership in the UK from UK sources			
Follow-on grants (£M) in the research domain of the Prosperity Partnership in the UK from non-UK sources			

18. Has your company's **involvement** in the Prosperity Partnership influenced....

Please select only one response per row

	To a significant extent	To a small extent	No effect	Negative effect	Don't know
An increase in internal investment in R&D in the UK (i.e. not just in the scientific/technology domain of the Partnership)					



**19. Has your company experienced (or is expecting to experience) any other benefits, not covered by your responses so far, as a result of your Prosperity Partnership?**

Please provide brief additional details of these benefits:

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**20. Which of the following statements most accurately describes the extent to which the business benefits reported above (achieved or expected) are linked to your Prosperity Partnership?**

Please select only one response \*

	Select one
The benefits could not have occurred without the Prosperity Partnership	
Only a small portion of the benefits could have occurred without the Prosperity Partnership	
A notable proportion of these benefits could have occurred without the Prosperity Partnership	
Most of the benefits could have occurred without the Prosperity Partnership	
All of the benefits could have occurred without the Prosperity Partnership	
Not applicable – no changes seen through the Prosperity Partnership	

**21. Do you expect to continue your collaboration with the lead academic institution once your EPSRC supported Prosperity Partnership has ended?**

- Yes
- No
- Don't know

**If YES, in what way will you collaborate?**

	Select all that apply
<b>Using a similar co-funded partnership model in the same research domain to:</b>	
Conduct collaborative early-stage research in the same topic as your Prosperity Partnership	
Continuing to co-develop and commercialise the products / services / processes developed in the Prosperity Partnership	
Joint PhD and postdoctoral training	
Secondments and staff exchange	

<b>Using a similar co-funded partnership model in a different research domain to:</b>	
Conduct collaborative early-stage research in a different research domain than your Prosperity Partnership	
Co-develop new products / services / processes in a different research / technology domain than the Prosperity Partnership	
Joint PhD and postdoctoral training	
Secondments and staff exchange	
<b>A more loosely defined collaboration in the same research domain</b>	
Project-by-project agreement to collaborate in research	
Informal knowledge exchange	
Other; please specify	

**If NO, why will you not continue your collaboration with the lead academic institution once your EPSRC supported Prosperity Partnership has ended?**

**22. Has working within a Prosperity Partnership changed your company's views on investing in /undertaking early-stage (low TRL) research?**

<b>We are...</b>	<b>Select one</b>
<b>More inclined</b> to invest in / undertake / participate in early-stage (low TRL) research than before	
No change in our views – <b>we already had a positive view</b> of investing in / undertaking early-stage (low TRL) research	
No change in our views – <b>we were sceptical</b> of the value of investing in / undertaking early-stage (low TRL) research and remain so	
<b>Less inclined</b> to invest in / undertake / participate in early-stage research than before	
Other; please specify	

**Please elaborate on your answer.**

**23. Has your company established (or has plans to establish) new collaborations with other organisations as a result of your Prosperity Partnership experience (select all that apply):**

	<b>Already established collaboration</b>	<b>new</b>	<b>Plans to establish new collaboration</b>
Academic or other research institutions in the UK			



Academic or other research institutions overseas		
Other UK companies		
Other overseas companies		

Please provide brief additional details of these collaborations:

**24. If your company has not yet experienced any benefits as a result of your Prosperity Partnership project, what are the reasons for that?**

**25. Thinking about the innovations (new or improved products/ services/ processes) arising from your Prosperity Partnership, do you expect them to lead to any of the following wider benefits:**

	Select all that apply
Adoption of these innovations in industrial sectors other than your own	
Applications and benefits in environment protection	
Applications and benefits to support net-zero	
Applications and benefits in health and welfare	
Applications and benefits in public policy design and public service efficiency	
Applications and benefits in regulation and/or standards	
Benefits for regional development / levelling up	

**Prosperity Partnerships programme processes**

**26. How did you become aware of the Prosperity Partnerships programme?**

	Select all that apply
I saw an announcement on EPSRC website	
I found it through UKRI Funding Finder	
I learned about it from EPSRC Business Engagement Forum	
I received information from colleagues within my company	
I received information from another company	
I received an invitation to collaborate from our academic partner	
Other; please specify.....	

27. Thinking about the EPSRC application process (expression of interest/outline proposal, Interview Panel, full proposal, contract negotiation), how satisfied or dissatisfied were you with:

	Not applicable	Very dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied
Clarity of the objectives of the programme						
Clarity of criteria for assessing applications						
The information and support provided during the application process						
The amount of time given to applicants to submit an outline proposal						
The amount of time given to applicants to submit full proposal						
Overall time taken from submission of outline proposal to EPSRC funding decision						
The clarity of the feedback on decisions made about your application						
The effectiveness of the process to sign the grant agreement and get the Partnership started						

28. Thinking about how the EPSRC application process for the Prosperity Partnerships programme might be improved, what would you change and why?

29. Thinking about the implementation of your Prosperity Partnership, how satisfied you are with the following EPSRC processes:

	Not applicable	Very dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied
Administrative support provided by EPSRC						
EPSRC responsiveness to requests and queries for information, advice, support						
Frequency of EPSRC monitoring reports						

Content required for the EPSRC monitoring reports						
EPSRC feedback on monitoring reports						
The EPSRC process for the mid-term report						
EPSRC feedback on the mid-term report						

**30. Thinking about how the EPSRC project monitoring processes for the Prosperity Partnerships programme might be improved, what would you change and why?**

**31. How did the COVID-19 pandemic affect the delivery of your Prosperity Partnership?**

	Select all that apply
Delayed planned activities	
Collaboration made more difficult/challenging	
We requested extension of project deadline	
Change in partners	
Other, please specify	
None of the above	

**32. What one element of the application and support processes would you change, and why?**

4.

**33. What one element of the application and support processes would you NOT change, and why?**

5.

**34. Do you have any comments or reflections on your Prosperity Partnership or the design of the Prosperity Partnerships programme as a whole?**

6.

7.



Thank you for your participation in this survey. Your feedback is very valuable.

## Appendix B Survey questionnaire: ACADEMIC lead partners

**Please select the Prosperity Partnership you are involved in**

*(drop-down list of the titles of all PPs)*

**The Prosperity Partnership you are involved in**

- 1. Does your partnership involve additional industry or academia partners (besides the lead industry and academia partners)?**

Yes

No

- 2. If YES. What is the role of additional academia and industry partners involved in your partnership?**

	Select all that apply
Additional academic partners provide missing knowledge or access to infrastructure	
Additional industry partners are involved in co-delivering research and innovation work	
Additional academic partners are involved in co-delivering research and innovation work	
Additional industry partners provide new exploitation or testing route for technologies developed by the Prosperity Partnership project	
Other, please specify	

**Motivations for establishing a Prosperity Partnership**

- 3. What were your / your research group's motivations for establishing a Prosperity Partnership?**

	Select all that apply
We were seeking to deepen our existing partnership with the industry partner in this scientific / technology domain	
We were seeking to encourage an existing industry partner to work with us in earlier-stage research (low TRL) in this scientific / technology domain	
We were seeking to deepen our existing partnership with the industry partner in a <b>new / different</b> scientific / technology domain	
We were seeking to increase our activities in <b>use-oriented early-stage (low TRL) research</b> in a specific scientific / technology domain (i.e. with a greater focus on end-users)	
We had not undertaken <b>use-oriented early-stage (low TRL) research</b> directly with an industry partner before and were seeking to explore doing so	
Other, please specify	

**Outputs and outcomes of your Prosperity Partnership project**

- 4. What is the stage of development (TRL\*) of the key technology/technologies that you are developing within your partnership (please fill-in as many rows as necessary in the table below providing technology name, the TRL at the start of the partnership, TRL now and TRL expected at the end of Prosperity Partnership)?**



\*Technology Readiness Levels estimate the maturity of technologies on a scale 1 to 9. More information available here: <https://www.ukri.org/wp-content/uploads/2022/01/EPsrc-11012022-Technologyreadinesslevelsfrombasicresearchtoadoptionanddiffusion.pdf>

Technology / innovation name	TRL at the start of the Prosperity Partnership	TRL now	TRL expected at the end of the Prosperity Partnership

5. How many of the following have been (or are expected to be) generated as a result of your Prosperity Partnership? Please include outputs for your research group and also those for your lead industry partner that you are aware of. Please populate all that apply.

	Generated to date by the Prosperity Partnership	Expected between now and the end of the Prosperity Partnership	Expected after the end of the Prosperity Partnership	How confident are you that you will achieve this number after the end of the Prosperity Partnership? Please provide confidence rating as a percentage where 100% is fully confident
<b>Number</b> of publications authored or co-authored by your organisation				
<b>Number</b> of PhDs completed in your organisation				
<b>Number</b> of patents granted to your organisation				
<b>Number of</b> opportunities identified for potential new products, services or processes to be developed and			N/A	

commercialised by lead industry partner				
<b>Number</b> of new products (arising from the project) launched on the market by lead industry partner				
<b>Number</b> of new services (arising from the project) launched on the market by lead industry partner				
<b>Number</b> of new processes/ methods/ tools (arising from the project) implemented by lead industry partner				

**6. How many of the following have been (or are expected to be) generated as a result of your Prosperity Partnership by industry partners that are not the lead industry partner? Please populate all that apply**

	Generated to date by the Prosperity Partnership	Expected between now and the end of the Prosperity Partnership	Expected after the end of the Prosperity Partnership
<b>Number</b> of opportunities identified for potential new products, services or processes to be developed and commercialised			
<b>Number</b> of new products (arising from the project) launched on the market			
<b>Number</b> of new services (arising from the project) launched on the market			
<b>Number</b> of new processes/ methods/ tools (arising from the project) implemented			

**7. Please provide any additional details on the type of new patents, products /services and markets expected.**

**8. Has your Prosperity Partnership led to (or is expected to lead to) new or improved researcher skills/knowledge?**

	Select all that apply
Partnership has already led to new or improved researcher skills/knowledge	
Partnership will lead to new or improved researcher skills/knowledge	

9. Have any spin-out companies been created (or are expected) as a result of your Prosperity Partnership project? Please populate only for spin-outs from your research group /university (and not any from the industry partners). Populate all that apply.

	Created from start of the Prosperity Partnership until now	Expected to be created in period from now until the end of the Prosperity Partnership	Expected after the end of the Prosperity Partnership
Number of spin-outs formed			
Number of employees working at these spin-outs <i>(estimates are acceptable)</i>			
Investment raised by spin-outs (£M) <i>(estimates are acceptable)</i>			
Annual turnover of these spin-outs (£M) <i>(estimates are acceptable)</i>			

10. How many full-time equivalent new researcher positions (including PhDs) were created (or are expected) in your organisation as a result of...

Please populate all that apply.

	New researchers hired from start of the Prosperity Partnership until now	New researchers expected between now and the end of the Prosperity Partnership	New researchers expected after the end of the Prosperity Partnership
As a direct result of your participation in Prosperity Partnership			
As a result of follow-on grants / further income generated by patents / products / services arising from the Prosperity Partnership			

11. Have you received (or expect to receive) any follow-on funding for your research group in this research domain as a result of your Prosperity Partnership?

	Received from start of Prosperity Partnership until now (i.e., in addition to that planned at the start of the Prosperity Partnership)	Expected to be received from now to the end of the Prosperity Partnership	Expected ANNUAL Investment from the end of the Prosperity Partnership
Follow-on grants (£M) in the research domain of the Prosperity Partnership in the UK from UK sources			
Follow-on grants (£M) in the research domain of the			

Prosperity Partnership in the UK <b>from non-UK sources</b>			
Follow-on investment/income ( <b>£M</b> ) in the research domain of the Prosperity Partnership in the UK <b>from UK private sector sources</b> ( <b>£M</b> )			
Follow-on investment/income ( <b>£M</b> ) in the research domain of the Prosperity Partnership in the UK <b>from non-UK private sector sources</b>			

**12. Have you / your research group experienced (or is expecting to experience) any other benefits, not covered by your responses so far, as a result of your Prosperity Partnership?**

Please provide brief additional details of these benefits:

**13. Which of the following statements most accurately describes the extent to which the benefits reported above (achieved or expected) are linked to your Prosperity Partnership?**

Please select only one response \*

	Select one
The benefits could not have occurred without the Prosperity Partnership	
Only a small portion of the benefits could have occurred without the Prosperity Partnership	
A notable proportion of these benefits could have occurred without the Prosperity Partnership	
Most of the benefits could have occurred without the Prosperity Partnership	
All of the benefits could have occurred without the Prosperity Partnership	
Not applicable – no changes seen through the Prosperity Partnership	

**14. Do you expect to continue your collaboration with the lead academic institution once your EPSRC supported Prosperity Partnership has ended?**

- Yes
- No
- Don't know

**If YES, in what way will you collaborate?**

	Select all that apply
<b>Using a similar co-funded partnership model in the same research domain to:</b>	
Conduct collaborative early-stage research in the same topic as your Prosperity Partnership	
Continuing to co-develop the products / services / processes developed in the Prosperity Partnership	
Joint PhD and postdoctoral training	
Secondments and staff exchange	
<b>Using a similar co-funded partnership model in a different research domain to:</b>	
Conduct collaborative early-stage research in a different research domain than your Prosperity Partnership	
Co-develop new products / services / processes in a different research / technology domain than the Prosperity Partnership	
Joint PhD and postdoctoral training	
Secondments and staff exchange	
<b>A more loosely defined collaboration in the same research domain</b>	
Project-by-project agreement to collaborate in research	
Informal knowledge exchange	
Other; please specify	

**If NO, why will you not continue your collaboration with the lead industry partner once your EPSRC supported Prosperity Partnership has ended?**

**15. Has working within a Prosperity Partnership changed your views on undertaking (and investing university funds in) use-oriented early-stage (low TRL) research with industry partners?**

We are...	Select one
<b>More inclined</b> to invest in / undertake / participate in early-stage (low TRL) research with industry partners than before	
No change in our views – <b>we already had a positive view</b> of investing in / undertaking early-stage (low TRL) research with industry partners	
No change in our views – <b>we were sceptical</b> of the value of investing in / undertaking early-stage (low TRL) research with industry partners and remain so	
<b>Less inclined</b> to invest in / undertake / participate in early-stage research with industry partners than before	
Other; please specify	

**Please elaborate on your answer.**

**16. Have you / your research group established (or have plans to establish) new collaborations with other organisations as a result of your Prosperity Partnership experience (select all that apply):**

	Already established new	Plans to establish new collaboration
UK companies		
Overseas companies		
Other academic or other research institutions in the UK		
Other academic or other research institutions overseas		

Please provide brief additional details of these collaborations:

**17. If you / your research group have not yet experienced any benefits as a result of your Prosperity Partnership project, what are the reasons for that?**

**18. Thinking about the innovations (new or improved products/ services/ processes) arising from your Prosperity Partnership, do you expect them to lead to any of the following wider benefits:**

	Select all that apply
Adoption of these innovations in industrial sectors other than your own	
Applications and benefits in environment protection	
Applications and benefits to support net-zero	
Applications and benefits in health and welfare	
Applications and benefits in public policy design and public service efficiency	
Applications and benefits in regulation and/or standards	
Benefits for regional development / levelling up	

### Prosperity Partnerships programme processes

**19. How did you become aware of the Prosperity Partnerships programme?**

	Select all that apply
I saw an announcement on EPSRC website	
I found it through UKRI Funding Finder	

I learned about it from EPSRC Business Engagement Forum	
I received information from colleagues within my organisation	
I received information from another academic or research organisation	
I received an invitation to collaborate from our industry partner	
Other; please specify.....	

**20. Thinking about the EPSRC application process (expression of interest/outline proposal, Interview Panel, full proposal, contract negotiation), how satisfied or dissatisfied were you with:**

	Not applicable	Very dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied
Clarity of the objectives of the programme						
Clarity of criteria for assessing applications						
The information and support provided during the application process						
The amount of time given to applicants to submit an outline proposal						
The amount of time given to applicants to submit full proposal						
Overall time taken from submission of outline proposal to EPSRC funding decision						
The clarity of the feedback on decisions made about your application						
The effectiveness of the process to sign the grant agreement and get the Partnership started						

**21. Thinking about how the EPSRC application process for the Prosperity Partnerships programme might be improved, what would you change and why?**

**22. Thinking about the implementation of your Prosperity Partnership, how satisfied you are with the following EPSRC processes:**

	Not applicable	Very dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied
Administrative support provided by EPSRC						
EPSRC responsiveness to requests and queries for information, advice, support						
Frequency of EPSRC monitoring reports						
Content required for the EPSRC monitoring reports						
EPSRC feedback on monitoring reports						
The EPSRC process for the mid-term reporting						
EPSRC feedback on the mid-term report						

**23. Thinking about how the EPSRC project monitoring processes for the Prosperity Partnerships programme might be improved, what would you change and why?**

**24. How did the COVID-19 pandemic affect the delivery of your Prosperity Partnership?**

	Select all that apply
Delayed planned activities	
Collaboration made more difficult/challenging	
We requested extension of project deadline	
Change in partners	
Other, please specify	
None of the above	

**25. What one element of the application and support processes would you change, and why?**

**26. What one element of the processes would you NOT change, and why?**





**27. Do you have any comments or reflections on your Prosperity Partnership or the design of the Prosperity Partnerships programme as a whole?**

Thank you for your participation in this survey. Your feedback is very valuable.

## Appendix C Return on investment calculations

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### C.1 Method

Return-on-investment analysis was completed using industry lead partners survey data.

To conduct the analysis, several assumptions were made about the survey data. First, we have excluded all companies that have not provided any data on current or expected sales (or on FTE jobs created). This led to a reduction in the number of observations by approximately half. Note that companies that have reported a value of zero (0) were included in the analysis, as we considered them to have answered the question. From 33 companies that replied to the survey, we could use data reported by 11-28 companies, depending on the question.

Secondly, companies receiving funding in a particular year, regardless of the month, have been allocated to that respective year.

Thirdly, we calculated the average duration (in years) of expected returns across all companies that have provided data. Then, we multiplied the average (7 years) to all expected returns and calculated their present value using a discount rate of 3.5%.

Finally, we also considered the overall contribution of the programme for the generated and expected revenues, based on what would have occurred without the Partnership. For this, we looked at the survey question "Which of the following statements most accurately describes the extent to which the business benefits reported above (achieved or expected) are linked to your Prosperity Partnership?" and attributed the following percentages to the different answers:

- The benefits could not have occurred without the Prosperity Partnership – 100%. This means that 100% of sales and expected returns are attributed to the programme.
- Only a small portion of the benefits could have occurred without the Prosperity Partnership – 50%. We assume that 50% of returns can be attributed to the programme.
- A notable proportion of these benefits could have occurred without the Prosperity Partnership – 10%. We assume that only a small percentage of returns can be attributed to the programme.

On average, the attribution factor for current and expected revenues is 43% and for employment is 64%. The higher attribution factor for employment is explained by the fact that companies typically direct the received funding to expand their staff.

We have also identified one survey respondent that reported an extremely high value of expected annual revenue after the end of the Prosperity Partnership. A closer analysis of other data reported by the respondent and the expected outcomes of the respective Partnership, reveal that the optimistic estimate is feasible. However, from a statistical viewpoint, the survey response is considered an outlier (i.e. reports value higher than 1 standard deviation + mean) and therefore was excluded in the final calculation.

Please note that the analysis is based on a small number of observations (14-19 companies in the case of figures based on sales data and 11-28 companies in the case of figures based on employment data). This means that results need to be taken with caution and that any grossed-up estimates (i.e. conclusions for the PPs overall) should be considered as indicative.

### C.2 Results

Based on the estimates explained above we find that:

- Each £1m invested by the EPSRC in the PP would generate a return of £7.7m (£1.1m per annum)<sup>10</sup>, taking into account current and expected sales and after accounting for the counterfactual scenario. 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 (Table 12).
- Each £1m invested by the EPSRC in the PP would generate 0.4 FTEs<sup>11</sup> (as a direct effect of grants), after accounting for the counterfactual scenario. Additionally, each £1m invested generates 8.5 FTEs<sup>12</sup> 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. This value also takes into account current and expected FTEs and the counterfactual scenario (Table 13).

*Table 12 EPSRC Prosperity Partnerships Economic Modelling - Income*

	Values	Calculations	Number of observations	Notes
<b>Total Value of EPSRC Investment (£m)</b>				
[1] In period 2017 - 2022 (6 years)	44.37		19	
<b>Total Income generated by these capabilities /products / services (£m)</b>				
[2] In period 2017 - 2022 (6 years)	10.5		14	
[3] Expected from 2023 onwards (no outliers)	787.8		16	excludes 1 outlier (with value higher than 1 standard deviation + mean)
<b>Total Income per value of EPSRC Investment from 2017 onwards (excl. outliers)</b>				
[4] Gross Figure	18	[2+3]/[1]		
<b>[5] Attribution factor</b>	<b>43%</b>		16	% associated with the PP
<b>[6] Net figure</b>	<b>7.7</b>	<b>[4*5]</b>	16	
[7] (Mean) Time for effects to materialise (in years)	5.6		14	
[8] (Mean) Duration of effects (in years)	7.3		10	

*Table 13 EPSRC Prosperity Partnerships Economic Modelling – Employment*

	Values	Calculations	Number of observations	Notes
<b>Full-time equivalent employees (FTE) were created and/or retained by your company...</b>				

<sup>10</sup> 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).

<sup>11</sup> Each £1m invested taking into account total costs (EPSRC investment, business investment and research organisation investment) in the PP would generate 0.1 FTEs.

<sup>12</sup> 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.

<b>As a direct result of your participation in Prosperity Partnership</b>				
[9] In period 2017 - 2022 (6 years)	26.5		14	Additional FTEs from 2022 onwards vs 2017-2022
[10] From 2023 onwards	404.5		24	
[11] Increment	378.0	[10-9]		
<b>As a result of income generated by patents / products / services arising from the Prosperity Partnership</b>				
[12] In period 2017 - 2022 (6 years)	1.0		16	
[13] From 2023 onwards	186.0		18	
[14] Increment	185.0	[13-12]		
<b>Total employment per EPSRC Investment</b>				
[15] In period 2017 - 2022 (6 years)	0.6	[9]/[1]	0.3	FTEs from EPSRC Investment only (immediate effects)
[16] In period 2017 - 2022 (6 years) and 2023 onwards	13.3	[9+11+12+14]/[1]		FTEs from EPSRC Investment + additional income generated
<b>[17] Attribution factor</b>	<b>64%</b>			% associated with the PP
<b>[18] Net effect in period 2017-2022 (6 years)</b>	<b>0.4</b>	[17* 15]		
<b>[19] Net effect in period 2017-2022 (6 years) and 2023 onwards</b>	<b>8.5</b>	[17*16]		





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