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Evaluation of the BBSRC Collaborative Research & Development portfolio

Appendices to the Final Report

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Appendix A BBSRC Collaborative Research & Development portfolio

This section provides data on the BBSRC CR&D portfolio. Table 1 sets out BBSRC funded investments per initiative. Table 2 shows the value of BBSRC investments and value of industry contributions per initiative. Table 3 provides a more detailed breakdown of the number and value of awards and projects, by both initiative and the funding scheme within each initiative. All three tables include breakdowns for the five investment categories in the portfolio.

*Table 1 BBSRC funded investments per initiative, 2011–2021**

	Number of awards	Number of projects	% of projects in each category	Average project duration (years)
Responsive Mode grant awards with industry partners	**93**	**88**	**100%**	**3.2**
IPA and LINK awards	**379**	**268**	**100%**	**3.3**
IPA	265	181	68%	3.1
LINK	114	87	32%	3.8
Community and Capacity Building	**531**	**501**	**100%**	**2.5**
International with non-academic partners	255	250	50%	2.5
Pump-priming	109	109	22%	0.3
Sustainable Aquaculture: Health, Disease and the Environment (SAHDE)	21	21	4%	2.3
BBSRC Networks in Industrial Biotechnology and Bioenergy (NIBB) main award	19	19	4%	5.2
Advanced Life Sciences Research Technology Initiative (ALERT)	17	17	3%	0.9
Business Interaction Vouchers	8	8	2%	0.3
Food System Resilience (FSRD)	18	8	2%	3.6
Rapid Response	6	6	1%	1.0
Longer and Larger Grants (LoLas)	5	5	1%	5.1
Community Research Networks (CRN)	2	2	0.4%	5.5
Other	71	56	11.2%	2.7

BBSRC-led Strategic CR&D investments	**280**	**170**	**100%**	**2.5**
Research and Innovation Clubs	258	157	92%	3.0
BBSRC-NERC Joint Call in Aquaculture	21	12	8%	3.3
National Biofilms Innovation Centre (NBIC)	1	1	0%	4.9
Strategic Co-Funding (across UKRI)	**522**	**295**	**100%**	**3.0**
Joint BBSRC / IUK-led funding	467	241	81%	1.7
Knowledge Transfer Partnerships (KTP)	46	46	16%	2.9
Joint BBSRC / EPSRC-led co-funding	5	5	2%	4.1
Joint BBSRC / MRC-led co-funding	1	1	0.3%	4.9
Joint investment between BBSRC, EPSRC, NC3Rs, and Innovate UK	2	1	0.3%	1.2
Gene Therapy Innovation Hub	1	1	0.3%	3.2

Source: Technopolis data analysis of BBSRC Grant database Note: *Includes the DRINC research club starting in 2006

*Table 2 BBSRC investments and value of industry contributions per funding scheme, 2011–2021**

	Value of BBSRC funding	% of BBSRC funding in each category	Total value of cash contributions	Total value of in-kind contributions
Responsive Mode grant awards with industry partners	**£44.8m**	**100%**	**£0.797m**	**£10.8m**
IPA and LINK awards	**£142.5m**	**100%**	**£24.6m**	**£54.0m**
IPA	£104.5m	73%	£13.6m	£8m
LINK	£38.0m	27%	£11m	£46m
Community and Capacity Building	**£171m**	**100%**	**£4.1m**	**£24.5m**
International with non-academic partners	£35.4m	21%	£0.974m	£9.7m
Pump-priming	£2.1m	1.2%	£0.02m	£0.353m
Sustainable Aquaculture: Health, Disease and the Environment (SAHDE)	£4.9m	3%	£0.235m	£0.577m
BBSRC Networks in Industrial Biotechnology and Bioenergy (NIBB) main award	£14.9m**	9%	£0.250m***	£6.9m***
Advanced Life Sciences Research Technology Initiative (ALERT)	£8.1m	5%	£0.470m	£0.650m
Business Interaction Vouchers	£0.05m	0.03%	£0.01m	£0.08m
Food System Resilience (FSRD)	£9.2m	5%	-	£0.279m
Rapid response	£0.6m	0.3%	-	£0.133m
Large and Longer grants (LoLas)	£15.6m	9%	£1.5m	£3.0m
Community research Networks (CRN)	£0.6m	0.4%	-	-
Other	£79.4m	45%	£0.627m	£2.9m
BBSRC-led Strategic CR&D investments	**£100.5m**	**100%**	**£2.6m**	**£5.2m**
Research and Innovation Clubs	£82.6m	82%	£1.1m	£3.9m
BBSRC-NERC Joint Call in Aquaculture	£5.1m	5%	£0.5m	£1.3m
National Biofilms Innovation Centre (NBIC)	£12.8m	13%	£0.980m	-
Strategic Co-Funding (across UKRI)	**£152.5m**	**100%**	**£0.738m**	**£26.1m**

Joint BBSRC / IUK-led funding	£124.4m	82%	£0.738m	£9.3m
Knowledge Transfer Partnerships (KTP)	£5.5m	4%	-	-
EPSRC-led co-funding	£14.4m	9%	-	£16.6m
MRC-led co-funding	£6.1m	4%	-	£0.120m
Gene Therapy Innovation Hub	£2.0m	1%	-	£0.120m
Joint funding call investment between BBSRC, EPSRC, NC3Rs and Innovate UK	£0.1m	0.1%	-	-
Total	**£611m**	**100%**	**£32.8m**	**£120.6m**

Source: Technopolis data analysis of BBSRC Grant database. Notes: *Includes the DRINC research club starting in 2006. **Presents the award value of the main NIBB award. ***Sum of the value of cash and in-kind contributions from all NIBB awards.

NB: There are two large outliers, one GCRF Interdisciplinary Research Hubs (GCRF IRH) award in the Community and Capacity Building category worth £18 million and another award in the Strategic CR&D category for the National Biofilms Innovation Centre (NBIC), worth £12.8 million. The GCRF IRH award is included in the 'Other' funding scheme category. This single award represents 23% of the total £79.4 million funding in that category. When this outlier is removed, the average funding per projects drops to £1.1 million. The NBIC is recorded on its own.

*Table 3 Number and value of awards and projects, by funding scheme and initiative, 2011–2022**

	Number of awards	Number of projects	Value of BBSRC funding, £m	Value of cash contributions, £m	Value of in-kind contributions, £m
Responsive Mode with Industry	**93**	**88**	**44.8**	**0.8**	**10.8**
NSF-BIO	**1**	**1**	**0.7**	**-**	**0.0**
Other	**5**	**5**	**2.1**	**-**	**0.7**
RM with Industry	**78**	**73**	**38.0**	**0.7**	**9.4**
Standard: Responsive Mode	73	68	35.5	0.7	5.9
Standard: Responsive Mode – New Investigator	5	5	2.5	-	3.4
Science Foundation Ireland	**1**	**1**	**0.6**	**0.1**	**0.1**
Standard	**8**	**8**	**3.5**	**-**	**0.6**
Standard: Responsive Mode	8	8	3.5	-	0.6
Strategic IPA & LINK	**379**	**268**	**142.5**	**24.6**	**54.0**
IPA	**265**	**181**	**104.5**	**13.6**	**8.0**
LINK	**114**	**87**	**38.0**	**11.0**	**46.0**
Community and Capacity Building Investments	**531**	**501**	**171.0**	**4.1**	**24.5**
Advanced Life Sciences Research Technology Initiative (ALERT)	**17**	**17**	**8.1**	**0.5**	**0.7**
BBSRC NIBB – Main Award	**19**	**19**	**14.9****	**0.250m*****	**6.9m*****
Business Interaction Vouchers	**8**	**8**	**0.0**	**0.0**	**0.1**
Community Research Networks (CRN) [2014–2015]	**2**	**2**	**0.6**	**-**	**-**
Food System Resilience (FSRD)	**18**	**8**	**9.2**	**-**	**0.3**
International with non-academic partners	**255**	**250**	**35.4**	**0.974**	**9.67**
FAPESP Pump-Priming Awards (FAPPA)	8	8	0.2	0.0	0.2
GCRF Foundation Awards for Global Agricultural and Food Systems Research (GCRF FA GAFSR)	17	16	8.2	-	1.3

GCRF National Institutes of Bioscience Data and Resources (GCRF NIBDR)	13	13	0.7	-	-
GCRF Sustainably Enhancing Agricultural Production	1	1	1.1	0.0	0.0
GCRF: Growing Research Capability	1	1	5.3	-	-
Global Challenges Research Fund Translation Awards (GCRFTA)	12	12	2.2	0.0	0.3
Newton Fund – BBSRC-FAPESP Joint Pump-Priming Awards for AMR in Agriculture (NFBRAZILAMR)	1	1	0.1	-	-
Newton Fund – Brazil (NFB)	17	17	0.7	0.1	0.6
Newton Fund – Global Research Partnership Aquaculture (GRPA)	4	4	4.9	-	1.8
Newton Fund – Initial Awards (NFIA)	1	1	0.3	-	-
Newton Fund – Mexican Crop Resilience (NFIMCRAS)	2	1	0.5	-	0.2
Newton Fund – Rice Research (RICENF)	9	9	4.4	0.2	2.5
Newton Fund – UK-China-Philippines-Thailand Swine and Poultry Research Initiative	1	1	0.5	-	0.0
Newton Fund Impact Scheme	2	2	0.1	-	-
Newton Fund Open Call (NF)	2	2	0.4	-	0.1
Newton Fund UK-Brazil AMR in Agriculture	1	1	0.5	-	0.0
Newton-Bhabha Fund Joint Call on Pulses and Oilseeds (PULSESOILSEEDSNF)	1	1	1.8	-	0.0
International Partnering Awards	98	96	2.95	0.23	2.32
International Partnering Awards – China (IntPAC)	2	2	0.06	0.00	0.06
International Partnering Awards – India (IntPAI)	1	1	0.003	0.001	-

International Partnering Awards – Japan (IntPAJ)	1	1	0.05	0.002	0.00
International Partnering Awards – USA (IntPAU)	5	5	0.20	0.001	0.12
International Scientific Interchange Scheme (ISIS)	28	28	0.15	0.28	0.07
International Travel Award Scheme (ITAS)	6	6	0.002	0.001	0.02
International Workshop Scheme (IWS)	21	20	0.22	0.08	0.06
LoLas	**5**	**5**	**15.6**	**1.5**	**3.0**
Rapid Response / Engineering Biology Breakthrough Awards	**6**	**6**	**0.6**	**-**	**0.1**
International Workshop Scheme (IWS)	**1**	**1**	**0.002**	**-**	**-**
Sustainable Aquaculture: Health, Disease and the Environment (SAHDE)	**21**	**21**	**4.9**	**0.2**	**0.6**
Pump-Priming	**109**	**109**	**2.1**	**0.0**	**0.4**
Animal Welfare Seeding Award	7	7	0.2	0.0	0.0
Diet and Health Seeding Award	27	27	0.5	-	0.0
ISCF Wave 2 Transforming Food Production Seeding Awards	75	75	1.4	0.0	0.3
Other	**70**	**55**	**79.4**	**0.6**	**2.9**
Engineering Biology Transition Awards	16	14	14.5	0.2	0.9
Food System Resilience (FSRD)	9	6	5.2	-	0.0
GCRF BBR Highlight	2	2	0.9	-	0.1
GCRF Interdisciplinary Research Hubs (GCRF IRH)	1	1	18.2	-	0.0
GCRF Malnutrition	2	2	1.5	-	0.0
IB Higher Value Chemicals	9	9	2.2	-	0.5
Longer and Larger Grants (LoLas)	12	10	33.4	0.3	1.2
Priming Food Partnerships (PFP)	9	3	0.9	0.0	0.1

Research and development on Campylobacter (Campy1)	10	8	2.8	0.1	0.1
BBSRC-led strategic CR&D investments	**280**	**170**	**100.5**	**2.6**	**5.2**
BBSRC-NERC Joint Call in Aquaculture: Collaborative Research and Innovation	**21**	**12**	**5.1**	**0.5**	**1.3**
Club	**258**	**157**	**82.6**	**1.1**	**3.9**
Animal Health Research Club (ARC)	25	16	9.3	0.2	0.2
Bioprocessing Research Industry Club (BRIC)	61	49	23.5	0.1	0.3
Crop Improvement Research Club (CIRC)	27	15	7.3	-	0.5
Diet and Health Research Industry Club (DRINC)	73	43	22.1	0.0	0.1
Horticulture and Potato Initiative (HAPI)	28	10	7.0	0.8	0.6
Integrated Biorefining Research and Technology Club (IBTI)	24	12	6.2	-	0.0
Sustainable Agriculture Research and Innovation Club (SARIC)	20	12	7.1	-	2.2
National Biofilms Innovation Centre (NBIC	**1**	**1**	**12.8**	**1.0**	**-**
Strategic Co-Funding (across UKRI)	**522**	**295**	**152.5**	**0.7**	**26.1**
EPSRC-led co-funding	**5**	**5**	**14.4**	**0.0**	**16.6**
Gene Therapy Innovation Hub (GTIH)	**1**	**1**	**-**	**-**	**0.1**
Joint BBSRC / IUK-led funding	**467**	**241**	**124.4**	**0.7**	**9.3**
The Exploitation and Management of Biofilms	24	15	0.8	-	-
Tools and services for synthetic biology	10	10	1.2	-	-
Data exploration – Creating new insight and value	2	1	0.2	-	-
Agri-Tech Catalyst (ATC)	150	75	41.2	0.7	1.9

Improving food supply chain efficiency	5	4	1.1	-	-
Industrial Biotechnology Catalyst (IBCAT)	123	52	48.6	0.0	7.3
Innovate UK (TSB)	139	75	29.6	-	-
ISCF Wave 1 Agri-Tech Catalyst	12	8	1.6	-	-
ISCF Wave 1 IB	2	1	0.1	-	-
Joint funding call investment between BBSRC, EPSRC, NC3Rs and Innovate UK	**2**	**1**	**0.1**	**-**	**-**
Knowledge Transfer Partnerships (KTP)	**46**	**46**	**5.5**	**-**	**-**
Joint BBSRC / MRC-led co-funding	**1**	**1**	**6.1**	**-**	**0.1**
Gene Therapy Hubs	1	1	6.1	-	0.1
Grand Total	**1,805**	**1,322**	**611**	**32.8**	**120.6**

Source: BBSRC programme data. Notes: *Includes the DRINC research club starting in 2006. **Presents the award value of the main NIBB award only; ***Sum of the value of cash and in-kind contributions from all NIBB awards.

NB: Due to rounding, the sum of individual values may not always match the reported totals. Zeros indicate small values, while the lines indicate the absence of cash or in-kind contributions for the category.

Appendix B Project outcomes reported to Researchfish

B.1 Descriptive analysis of project outcomes data

This section presents a summary of project outputs and outcomes achieved by funded projects. The data was extracted from Researchfish in 2023, a useful source of information detailing the impacts from research grants funded by the seven UKRI Research Councils. Researchers who have received a grant, fellowship, or studentship are required to report their research outcomes through Researchfish to help demonstrate the impact of public spending, improve accountability, and demonstrate the case for further funding. The online platform collects data on standardised outcome types, for example publications, new products and methods, spinouts, as well as narrative impacts outlining demonstratable contributions to society. Across the entire investment portfolio, 85% of projects are included in the Researchfish system (Table 4).

Table 4 Number and percentage of projects that have reported outcomes in Researchfish

Category	Number of projects in Researchfish	Percentage of projects in Researchfish
Responsive Mode grant awards with industry partners	88	100%
IPA and LINK awards	264	99%
Community & Capacity Building Investments	380	89%
BBSRC-led Strategic CR&D Investments	168	66%
Strategic Co-Funding (across UKRI)	220	77%
Overall	**1,120**	**85%**

Source: Researchfish data extracted in 2023

Researchfish outcomes data is self-reported by individual PIs and co-PIs every year around March. It is usually collected for the period of the award and five years after where outcomes can be attributed to more than one project. This means that some records are duplicated. As a result, for each outcome type, we conducted one de-duplication for the entire dataset and five separate de-duplications for each BBSRC investment category. The totals of the individual investment categories are higher than the grant total because of the de-duplication of records within the entire dataset.

Our findings present a count of all projects that have achieved a specific outcome and are accompanied by a separate count of distinct outcomes. Outcomes without dates have been included in the analysis but those with reported dates prior to the start date of the award have been removed. Whilst every effort was made to reduce duplicates outcomes, it is possible that the findings include some duplicated records which refer to the same outcomes.

It is worth noting that the dataset does not capture an exhaustive account of all long-term impacts expected to materialise in the future. However, it provides a good starting point which allows us to understand the evolving nature of achievements supported by the funding. It includes information on new engagements and their policy influence, publications and

dissemination of knowledge, innovations, and economic activity. Each outcome type is covered in more detail below.

B.1.1 Collaborations

Information regarding planned project collaborations are initially submitted to BBSRC during the application phase and are subsequently recorded on the grant system. This information signifies the intentions of potential project partners to cooperate with the PI as well as allocate cash and in-kind contributions to the project if the application is successful. PIs are subsequently requested to submit the outcomes data into Researchfish, confirming the partnership as well as recording any new collaborations established after the project's initiation. As a result, Researchfish records information on collaborations that have resulted from or are directly linked to the award. This includes partnerships with industry, participation by the PI or a member of their research team in networks, consortia, or other initiatives with other departments within their institution or non-profit organisations. As Researchfish data is separate from the BBSRC grant system, determining the number of additional collaborations over and above existing commitments made at the application stage is a challenge. This section focuses on analysing the data that appears in Researchfish, recognising the difficulty in disaggregating how many collaborations surpass the ones promised at the application stage.

The findings suggest that 673 BBSRC funded projects have reported at least one collaboration outcome, representing 60% of all projects with outcomes data recorded on Researchfish (see Table 5). The analysis suggests that 368 projects have at least one collaboration with an industry partner (see Table 6).

Collaborative projects have resulted in 2,092 unique collaborations or partnerships with different project partners.[1] 875 of these collaborations were with an industry partner, representing 42% of all unique collaboration outcomes recorded in Researchfish (see Table 7).

The majority of collaborations (781) are associated with projects in the Community and Capacity Building category, representing 37% of the total number of unique collaborations in the portfolio. It was identified, and is important to note, that a single collaboration outcome was in some cases associated with projects in two distinct BBSRC categories. This results in a percentage grant total that exceeds 100%.

Researchfish also provides estimates of the direct financial and/or in-kind contributions made by the partner organisation to the collaboration. It was identified that 26% of partner organisations in the dataset have provided contributions worth £109 million to the collaboration. The majority of this funding originated from the private sector (£68 million, 62%), followed by academia (£27 million, 25%), the public sector (£12 million, 11%), the charity sector

[1] Note that a fraction of collaboration outcomes recorded in Researchfish had started before the BBSRC award start date. When pre-award outcomes are included in the analysis, we find that 759 projects have resulted in 2,422 collaborations. Of these, around 876 collaborations are with an industry partner, representing 36% of all collaborations.

(£1.9 million, 2%), and hospitals or learned societies (£0.72 million, 1%). Furthermore, 61% of this funding came from the UK with the remaining 39% coming from countries outside of the UK. It was also identified that over half (61%) of these collaborations have formal agreements such as material transfer agreements or confidentiality agreements.

Table 5 Number of collaborations emerging from BBSRC funded projects

Category	No. of projects with collaborations	% of projects with collaborations*	No. of collaborations	% of collaborations	Value of contributions	% value of contributions
Responsive Mode grant awards with industry partners	49	56%	117	6%	£5.1m	5%
IPA and LINK awards	171	65%	450	22%	£20.8m	19%
Community & Capacity Building Investments	226	59%	781	37%	£12.9m	12%
BBSRC-led Strategic CR&D Investments	110	65%	572	27%	£55.6m	51%
Strategic Co-Funding (across UKRI)	117	53%	246	12%	£33.8m	31%
Overall **	**673**	**60%**	**2,092**	*******	**£109m**	*******

Source: Researchfish data extracted in 2023. Notes: *The denominator is the number of projects with outcomes recorded in Researchfish. **The total figures represent a count of unique outcomes achieved from all projects in the portfolio. Hence, the figure is lower than the sum of all five individual categories. ***This figure is calculated as a percentage of total collaborations after removing duplicates, therefore the distribution across categories do not add to 100%

Table 6 Number of collaborations with industry partners emerging from BBSRC funded projects

Category	No. of projects with industry partner collaborations	% of projects with industry partner collaborations	No. industry partner collaborations	% of industry partner collaborations	Value of contributions	% value of contributions
Responsive Mode grant awards with industry partners	26	30%	37	4%	£1.2m	2%
IPA and LINK awards	107	41%	174	20%	£10.2m	15%
Community & Capacity Building Investments	79	21%	220	25%	£4.3m	6%
BBSRC-led Strategic CR&D investments	66	39%	327	37%	£36.7m	54%
Strategic Co-Funding (across UKRI)	90	41%	152	17%	£29.5m	43%
Overall *	**368**	**33%**	**875**	**	**£68m**	**

Source: Researchfish data extracted in 2023. Notes: *The total figures represent a count of unique outcomes achieved from all projects in the portfolio. Hence, the figure is lower than the sum of all five individual categories. **This figure is calculated as a percentage of the total collaborations after removing duplicates, therefore the distribution across categories do not add to 100%

Table 7 Industry partner collaborations as a percentage of all collaborations

Category	No. collaborations	No. of industry partner collaborations	% of industry partner collaborations
Responsive Mode grant awards with industry partners	117	37	32%
IPA and LINK awards	450	174	39%
Community & Capacity Building Investments	781	220	28%
BBSRC-led Strategic CR&D Investments	572	327	57%
Strategic Co-Funding (across UKRI)	246	152	62%
Overall *	**2,092**	**875**	**42%**

Source: Researchfish data extracted in 2023. *The total figures represent a count of unique outcomes achieved from all projects in the portfolio. Hence, the figure is lower than the sum of all five individual categories

B.1.2 *Further funding*

Researchfish collects data on the value of further funding obtained throughout as well as once the award has completed for a set period of time. This funding takes different forms and includes but is not limited to new research grants (including intramural programmes), fellowships, studentships, capital, infrastructure, and equipment, as well as travel and small personal awards. This information helps with capturing the amount of additional research investment raised from other sources, which expands or extends the research supported by the initial BBSRC investment.

Researchers reported instances of further funding in 655 projects shown in Table 8, representing 60% of the 1,120 projects with outcomes reported in Researchfish. The total value of awards in the BBSRC portfolio is approximately £611 million and the total value of further funding secured is 1.9 times as much, at £1.15 billion. Thus, for every £1 invested by BBSRC, £1.90 was generated in further funding from all sources that allow researchers to continue their project work, extend their research ideas into new areas, or help exploit the findings of their work.

This funding was primarily from the public sector (£936 million, 82%), whilst other sources of funding include the private sector (£86 million, 8%), charities (£93 million, 8%), and academic sources (£22 million, 2%). 78% of the total value of funding came from the UK and 22% came from outside of the UK, predominantly from the European Union, Germany, Belgium, and the United States.

Table 8 Instances of further funding emerging from BBSRC funded projects

Category	**No. of projects with further funding**	**% of projects with further funding**
Responsive Mode grant awards with industry partners	48	55%
IPA and LINK awards	162	61%
Community & Capacity Building Investments	193	51%
BBSRC-led Strategic CR&D Investments	119	71%
Strategic Co-Funding (across UKRI)	133	60%
Overall *	**655**	**58%**

Source: Researchfish data extracted in 2023. Note: *The overall percentage represents the share of projects with further funding across the portfolio, hence does not correspondent to the sum of percentages for each funding category

Value of further funding[2]	**£1.15bn**
Share of further funding from industry	**8%**

B.1.3 Publications

The funding provided by BBSRC through the CR&D portfolio has played a key role in advancing scientific research and generating new knowledge for UK bioscience. This has benefited participants and the wider academic and business communities. Publications are the most common outcome type submitted in Researchfish in terms of count where 8,821 scientific publications have emerged from 952 funded projects. These include journal articles, conference proceedings, book chapters, and reports. Activities supported through the Community and Capacity Building category accounted for the largest share of all publications (32%), followed by IPA and LINK (31%), and BBSRC-led Strategic CR&D investments (23%) (see Table 9).

Table 9 Number of publications emerging from BBSRC funded projects

Category	No. of projects with publications	% of projects with publications	No. of publications	% of publications
Responsive Mode grant awards with industry partners	79	90%	863	10%
IPA and LINK awards	249	94%	2,815	32%
Community and Capacity Building	299	79%	2,751	31%
BBSRC-led Strategic CR&D investments	163	97%	2,011	23%
Strategic Co-Funding (across UKRI)	162	74%	1,081	12%
Overall *	**952**	**85%**	**8,821**	**100%**

Source: Researchfish data extracted in 2023. Note: *The total figures represent a count of unique outcomes achieved from all projects in the portfolio, hence the figure is lower than the sum of all five individual categories

[2] In cases where further funding is award to a consortium, the estimated figure presented includes only the value allocated to individual researchers.

B.1.4 Engagements

BBSRC investments through the CR&D portfolio have fostered engagements which have helped to identify future research opportunities and promote the exchange of knowledge between UK bioscience researchers, the private sector, and policy makers. 786 BBSRC funded projects have disseminated new learning through more than 10,000 engagements, most of which took the form of talks and presentations (41%) as well as through participating in workshops (27%). Other popular dissemination activities that have provided a platform to showcase project findings more widely include formal working groups, expert panels, press conferences, and media releases, as well as participation in open days. Projects in the Community and Capacity Building and the IPA and LINK categories accounted for the largest share of all engagements (33% each) followed by BBSRC-led Strategic CR&D (23%) (see Table 10).

Table 10 Number of engagements emerging from BBSRC funded projects

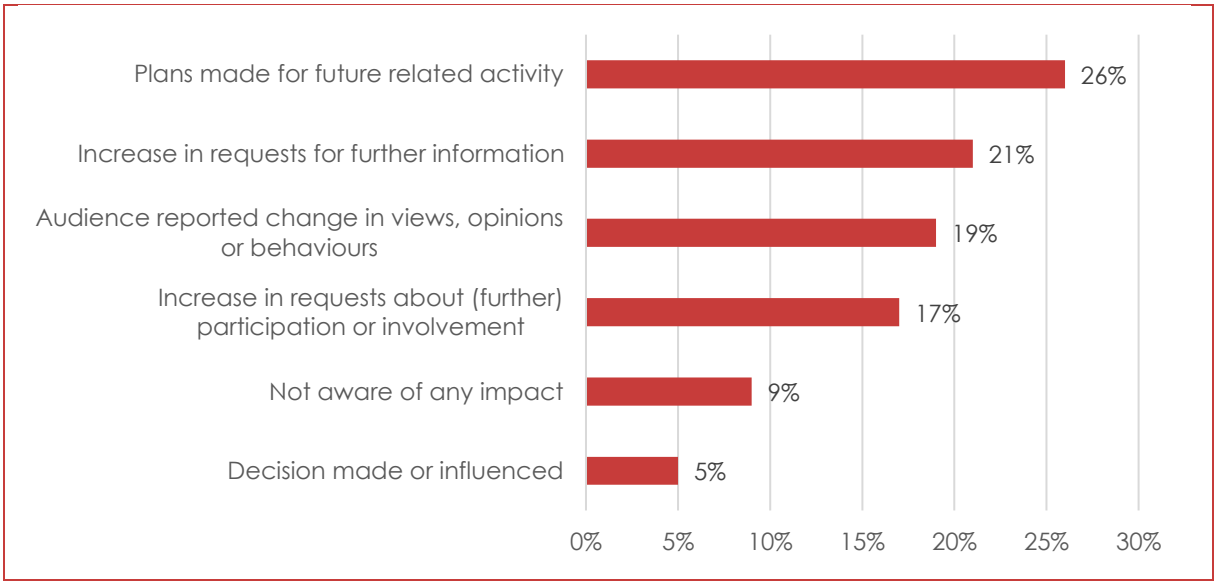
Category	No. of projects with engagements	% of projects with engagements	No. of engagements	% of engagements
Responsive Mode grant awards with industry partners	63	72%	501	5%
IPA and LINK awards	208	79%	3,291	33%
Community & Capacity Building Investments	236	62%	3,309	33%
BBSRC-led Strategic CR&D Investments	125	74%	2,342	23%
Strategic Co-Funding (across UKRI)	154	70%	1,363	14%
Overall *	**786**	**70%**	**10,053**	**100%**

Source: Researchfish data extracted in 2023. Note: *The total figures represent a count of unique outcomes achieved from all projects in the portfolio, hence the figure is lower than the sum of all five individual categories

Furthermore, it was found that the impact of these activities had extended beyond the UK, as almost half of all engagements had an international reach. The remainder reported a national (30%), regional (12%), or local (9%) reach. It was also identified that these engagements had a wide reach in terms of audience size as 42% of all engagements had more than 100 attendees and a further 23% had between 51 and 100 attendees. Across these activities, the most popular types of audience included professional practitioners (35%), followed by industry (21%), the public (13%), academia/students (14%), and policy makers (4%).

When asked to outline the impacts of these engagements, respondents reported a variety of benefits including plans being developed for future related activities and an increased request for further participation, involvement, and influencing of views/opinions (see Figure 1).

Figure 1 Reported impacts of engagement activities



Source: Researchfish extracted in 2023

BBSRC investments through the CR&D portfolio have also catalysed notable impacts on policy, where Researchfish data suggests that 192 projects have resulted in 449 policy relevant engagements. Training practitioners or researchers accounted for the largest share of these engagements (32%), followed by participating in advisory or guideline committees (21%), membership of a guideline committee (18%), and engaging with national consultations or government reviews (16%).

In terms of the geographical reach of these policy engagements, 56% had a national influence in the UK and 44% had an international or continent-focused influence. Approximately half of these policy engagements reported an impact, including improving workforce skills, regulatory environments, environmental sustainability, as well as economic or social wellbeing.

B.1.5 Use of facilities

Access to advanced technology, facilities, and equipment are critical for the bioscience community to perform research. Examples include genome sequencing and seed collection facilities but also extend to more specialist facilities and equipment such as accessing synchrotron beamtime, high-performance computing, mathematical modelling services, as well as other biological resources. BBSRC funding through the CR&D portfolio aims to support academic researchers and businesses to use a wide range of research and innovation infrastructure across the UK and abroad. To date, 137 projects (12% of projects with Researchfish outcomes data) have accessed specialist facilities as part of their project (see Table 11). Researchers reported 205 unique instances of using a portion of BBSRC funding to access research facilities to support their work, however, it is worth noting that this outcome type tends to be underreported.

Access to facilities is critical because it provides an opportunity for partnerships to pursue specific research questions and produce important scientific or technological advances that may not be possible without access to such facilities. From the narrative information analysed in Researchfish, there are reported examples of benefits attributed to the use of facilities, which include the publication of scientific papers, development of new algorithms and techniques

for analysis, and the advancement of research to the point where negotiations for further funding with large multinational companies is made possible.

Table 11 Use of facilities

Category	No. of projects that have used facilities	% of projects that have used facilities	No. of times facilities were used	% of times facilities were used
Responsive Mode grant awards with industry partners	13	15%	24	12%
IPA and LINK awards	41	16%	59	29%
Community & Capacity Building Investments	43	11%	66	32%
BBSRC-led Strategic CR&D Investments	17	10%	43	21%
Strategic Co-Funding (across UKRI)	23	10%	26	13%
Overall *	**137**	**12%**	**205**	**100%**

Source: Researchfish extracted in 2023. *The total figures represent a count of unique outcomes achieved from all projects in the portfolio, hence the figure is lower than the sum of all five individual categories

B.1.6 Innovations and economic activity

BBSRC investment through the CR&D portfolio has contributed to the development of new Intellectual Property (IP) rights and innovations which span across a variety of different fields including food security, health, and nutrition. These technological advances and innovations have enabled participants to attract further funding, as well as reap commercial benefits from new and improved product lines which have ultimately benefitted society through supporting the development of novel solutions to long-standing challenges.

To date, the portfolio has supported the development of **164 new IP rights**, where over a third are already licensed on a commercial or non-commercial basis. 54% of these IP rights are patent applications, 18% are granted patents, and 5% are copyrights or trademarks. Approximately 18% of recorded IP rights did not require protection.

39% of these IP rights are associated with projects in the IPA and LINK category and a further 36% emerged from projects in the Strategic Co-funding category (see Table 12). The application of these innovations have provided solutions to various BBSRC strategic priority areas, for example through the breeding of agricultural products with improved disease resistance or improving UK sources of vital pharmaceuticals for the future treatment of human disease.

Table 12 Number of new IP rights emerging from BBSRC funded projects

Category	No. of projects with IP rights	% of projects with IP rights	No. of new IP rights	% of IP rights
Responsive Mode grant awards with industry partners	3	3%	4	2%
IPA and LINK awards	39	15%	63	38%
Community & Capacity Building Investments	17	4%	18	11%
BBSRC-led Strategic CR&D Investments	25	15%	35	21%
Strategic Co-Funding (across UKRI)	40	18%	60	37%
Overall *	**124**	**11%**	**164**	**100%**

Source: Researchfish extracted in 2023. Note: *The total figures represent a count of unique outcomes achieved from all projects in the portfolio, hence the figure is lower than the sum of all five individual categories

BBSRC funded projects have also supported the development of a significant number of new outputs, including tools and methods, database and models, medical products, artistic products, software products, and spinouts. Table 13 shows the number of projects that have achieved a given outcome and Table 14 shows the number of unique counts of outcomes reported.

301 projects have resulted in 504 new tools and methods (seen in Table 14) where more than half of these are published or have been made available to the wider community. 42% of these new tools have resulted in technology assay or reagents, while others have resulted in improvements to research infrastructure (18%), biological samples (17%), or models of mechanisms or symptoms (11%). Examples of new tools and methods supported by BBSRC funding include:

- A new optical detection system capable of detecting the presence of multiple protein species within a single sample, including the analysis of chromatographic peaks in real time
- Development and refinement of novel infection models to study infection, co-infection, and transmission by food borne bacterial pathogens

237 projects have resulted in 458 databases and models, 64% of which were published or have been made available. Of these, 76% were databases, 14% algorithm or computer models, 9% were data analytic techniques, and 1% were for data handling and controls. Examples of databases and models supported by BBSRC funding include:

- A Python framework that can be used to systematically record known information about host-pathogen interactions
- A database which provides estimates for several key conditions that affect the health and reproduction of British dairy herds. The dataset includes extensive analysis and a detailed description of the spatial distribution of different reproductive pathogens and their risk

factors in Great Britain. It has been used to inform studies aimed at designing strategies to monitor the occurrence of major diseases and conditions affecting dairy farms

19 of these projects have resulted in 26 medical products. These include diagnostic tools, preventative interventions, and therapeutic interventions for example vaccines, drugs, and medical devices. In terms of development, approximately two-thirds are under active development and distribution, a quarter are actively seeking support, and 5% of medical products have been closed. Examples supported by BBSRC funding include:

- A new technology for the modification of filters which capture and kill viruses and bacteria from air flow were used in face masks and tested on coronavirus. The face masks have been prototyped and commercialised
- An edible vaccine has been tested in an animal trial with salmon to understand if the oral vaccine can confer immunity

44 projects have resulted in 114 artistic products, including film, podcasts, images, and artwork for example cover designs for publications, creative exhibitions, creative writing, and performing. Examples supported by BBSRC funding include:

- A set of microbiology YouTube films about funded research and what it's like working in a laboratory
- A video abstract created for educational purposes which shows an aphid changing plant hosts, where the narrator explains what happens to the aphid upon the host change

103 projects have resulted in 171 software products which have been used for genotyping arrays, and genetic mapping. Further examples include using machine learning to predict zoonotic risk as well as simulate the outcome of breeding programmes. Specific examples include:

- An alpha version of a pipeline which enables a rapid and automated approach to predict bTB and pregnancy status of individual cows using mid infrared spectral data generated via routine milk recording
- An online early warning system that provides users with information on harmful algal blooms and shellfish biotoxins

53 new spinouts have been launched. The creation and success of spinouts often hinges on public funding, and it is unlikely they would exist without BBSRC support. The full list of spinouts reported to Researchfish and supported by the BBSRC CR&D portfolio is available in Table 15.

Table 13 Number of projects with new methods, databases, products, or spinouts

Category	Projects with new tools and methods	Projects with Data-bases and models	Projects with medical products	Projects with artistic products	Projects with software products	Projects with spinouts
Responsive Mode grant awards with industry partners	22	23	1	1	5	4
IPA and LINK awards	88	68	5	12	32	9
Community & Capacity Building Investments	80	79	1	23	36	15
BBSRC-led Strategic CR&D Investments	51	26	8	4	6	12
Strategic Co-Funding (across UKRI)	60	41	4	4	24	13
Overall *	**301**	**237**	**19**	**44**	**103**	**53**

Source: Researchfish extracted in 2023. Note: *The total figures represent a count of unique outcomes achieved from all projects in the portfolio, hence the figure is lower than the sum of all five individual categories

Table 14 Number of new methods, databases, products, or spinouts

Category	New tools and methods	Databases and models	Medical products	Artistic products	Software products	Spinouts
Responsive Mode grant awards with industry partners	51	52	1	1	7	5
IPA and LINK awards	158	136	5	20	72	9
Community & Capacity Building Investments	141	161	1	51	57	14
BBSRC-led Strategic CR&D Investments	95	57	15	35	8	18
Strategic Co-Funding (across UKRI)	87	65	4	9	34	13
Overall *	**504**	**458**	**26**	**114**	**171**	**53**

Source: Researchfish extracted in 2023. Note: *The total figures represent a count of unique outcomes achieved from all projects in the portfolio, hence the figure is lower than the sum of all five individual categories

B.2 Spinouts

Table 15 List of reported spinouts supported by BBSRC funding

Name of spinout	Date incorporated
3D Bio-Tissues Limited	2018
Aelius Biotech Limited	2018
Agroceutical	2012
Alphacells Biotechnologies Limited	2019
Alternox Scientific Limited	2020
Amprologix Limited	2018
Antimicrobial Discovery Solutions Limited	2015
Arkvax Limited	2020
Atelerix Limited	2017
Bio-Shape Limited	2015
C3 Biotechnologies Limited	2015
Caldan Therapeutics	2015
Cddmtec Limited	2012
Cell Mogrify	2016
Cromerix Limited	2021
Curtis Analytics	2017
Decima Biomed	2015
Deep Branch Biotechnology Limited	2018
Disyn Biotec Limited	2021
Enfold Health Limited	2022
Erebagen Limited	2020
Estuar Pharmaceuticals	2020
Fotenix Limited	2018
Glocentrica	2014
Green Bioactives Limited	2019
Humane Technologies Limited	2018
Hydrolyze Limited	2019

Innovative Solutions For Decision Agriculture	2018
Keltic Pharma Therapeutics Limited	2020
Marrabio Limited	2022
Miatech Biosolutions Limited	2013
Mycosciences	2015
Nano Clinical Limited	2020
Nuspec Bioscience Limited	2019
Nuspec Oil Limited	2019
Oxford Mestar Limited	2013
Penrhos Bio	2019
Phenotypeca Limited	2018
Plasma4 Limited	2021
Polypharmakos	2016
Reepel Limited	2020
Roslin Technologies Limited	2016
Roxijen Limited	2020
Satisfed	2021
Sebomix Limited	2021
Sloan Water Technology Limited	2018
Soil For Life Limited	2017
Sooba Medical	2020
Suprex Limited	2016
Twig Bio Limited	2022
Virocell Biologics Limited	2020
Wellfish Diagnostics Limited	2021
Zentraxa Limited	2017

Appendix C Overview of REF2021 impact case studies

This section summarises the contribution of projects funded through the BBSRC CR&D portfolio to REF2021 impact case studies, a summary of which is shown in Table 16. Based on data provided to the evaluation team by the BBSRC, 62 projects from the CR&D portfolio were cited a total of 67 times in 55 separate REF2021 impact case studies. These case studies cover impact generated between 2014–2021 and as such cover much of the period of interest in this evaluation (Table 17, Table 18, and Table 19).

Projects from the IPA and LINK and Strategic Co-Funding categories were most frequently cited, whereas only one project from the Responsive mode with Industry category was cited. The majority of Impact case studies citing BBSRC CR&D projects were about "Technological impact", according to the Summary Impact type assigned to them in the REF2021 database.

Table 16 Impact case studies submitted to REF2021 which cite BBSRC CR&D awards, by REF2021 panel.

Panel/Unit of Assessment	Case studies (#)	Case studies (%)
Main Panel A	**35**	**64%**
Agriculture, Food and Veterinary Sciences	16	29%
Biological Sciences	14	25%
Allied Health Professions, Dentistry, Nursing and Pharmacy	3	5%
Clinical Medicine	1	2%
Psychology, Psychiatry and Neuroscience	1	2%
Main Panel B	**18**	**33%**
Engineering	6	11%
Chemistry	4	7%
Earth Systems and Environmental Sciences	4	7%
Physics	3	5%
Computer Science and Informatics	1	2%
Main Panel C	**1**	**2%**
Geography and Environmental Studies	1	2%
Main Panel D	**1**	**2%**
Art and Design: History, Practice and Theory	1	2%
Grand total	**55**	**100%**

Source: Technopolis adapted from REF2021 impact case study database. Note: due to rounding, the sum of individual values may not always match the reported totals

Table 17 Number of references to BBSRC CR&D projects in REF2021 impact case studies, by investment category and summary impact type

Investment category	Summary impact type (REF2021)				Total	
	Technological	Environmental	Health	Societal	#	%
Responsive Mode grant awards with industry partners	1	-	-	-	**1**	**1%**
IPA and LINK awards	16	3	2	-	**21**	**31%**
Community & Capacity Building Investments	8	3	-	1	**12**	**18%**
BBSRC-led Strategic CR&D Investments	7	2	2	1	**12**	**18%**
Strategic Co-Funding (across UKRI)	20	1	-	-	**21**	**31%**
Total	**52**	**9**	**4**	**2**	**67**	**100%**

Source: BBSRC and REF2021. Note: due to rounding, the sum of individual values may not always match the reported totals

Table 18 Number of BBSRC CR&D projects cited in REF2021 impact case studies, by investment category and summary impact type (deduplicated)

Investment category	Summary impact type (REF2021)				Total	
	Technological	Environmental	Health	Societal	#	%
Responsive Mode grant awards with industry partners	1	-	-	-	**1**	**2%**
IPA and LINK awards	16	3	2	-	**21**	**30%**
Community & Capacity Building Investments	7	3	-	1	**11**	**22%**
BBSRC-led Strategic CR&D Investments	7	2	2	1	**12**	**19%**
Strategic Co-Funding (across UKRI)	16	1	-	-	**17**	**28%**
Total	**47**	**9**	**4**	**2**	**62**	**100%**

Source: BBSRC and REF2021. Note: deduplicated to account for instances where the same project is cited in multiple case studies. Due to rounding, the sum of individual values may not always match the reported totals

Table 19 Number of REF2021 Impact case studies citing BBSRC CR&D grants, by investment category and summary impact type (counted fractionally)

Investment category	Summary impact type (REF2021)				
	Technological	**Environmental**	**Health**	**Societal**	**Total**
Responsive Mode grant awards with industry partners	1.0	-	-	-	**1.0**
IPA and LINK awards	11.3	3.0	2.0	-	**16.3**
Community & Capacity Building Investments	8.0	3.0	-	1.0	**12.0**
BBSRC large-scale	5.3	2.0	2.0	1.0	**10.3**
Strategic co-funding	14.3	1.0	-	-	**15.3**
Total	**40.0**	**9.0**	**4.0**	**2.0**	**55.0**

Source: BBSRC and REF2021. Note: weighted to account instances where the same impact case study cites multiple BBSRC CR&D projects. Due to rounding, the sum of individual values may not always match the reported totals

Appendix D Econometric analysis

D.1 Methodology

D.1.1 Data sources

The study team used two key secondary data sources to perform the econometric analysis, including the:

BBSRC monitoring dataset which contains comprehensive information on projects funded through the CR&D portfolio. This offered detailed insight into the academic recipients of funding, their project partners, and the nature of the funding. The dataset outlines the investment size allocated to individual projects, indicating the amount of BBSRC funding received by academic organisations and the additional match-funding from project partners. This provided a comprehensive financial overview of the programmes and projects. Firm-level monitoring data on industry partners that were connected to the BBSRC CR&D portfolio were matched with records in the Business Structure Database (BSD) described below.

Business Structure Database (BSD) provided longitudinal records of employment and turnover for all firms registered for VAT or PAYE and offers an annual snapshot of the Inter-Departmental Business Register (IDBR). It is estimated that businesses on the register account for 99% of UK economic activity. The "snapshot" of IDBR is taken around April of each year and made available to researchers in September. The data has a lag of one year i.e., the 2021 BSD file reflects the financial year of April 2020 to March 2021. The way the IDBR is constructed means that the period to which observations correspond may suffer from a significant lag, although the Office for National Statistics (ONS) may complement the IDBR data with data from its own business survey to offset the effects of this issue. When linking the BSD data files to the BBSRC monitoring data, we incorporated a lag of one year, meaning that the most up-to-date data on turnover and employment is for 2020, and this is aligned with monitoring data for the same year.

Gross Value Added (GVA) conversion factors. The dataset includes GVA and turnover estimates per region and industry for the years between 2008 and 2021[3]. The data is based on findings from the Annual Business Survey and published by the ONS. We have used information from this dataset to convert the BSD turnover estimates to GVA by multiplying these turnover figures by the corresponding GVA per £1 of turnover conversion factors for each industry, region, and year.

D.1.2 Econometric model

Our analytical approach aims to explore to what extent the support from BBSRC's funding has contributed to improved economic performance. The methodological approach shows whether those industry partners who engaged with the programme achieved higher growth,

[3] GVA conversion factors represent the ratio of GVA to turnover for a specific industry. Estimated GVA = Turnover x GVA Conversion Factor. The data was sourced from the ONS, Annual Business Survey, 2021 https://www.ons.gov.uk/businessindustryandtrade/business/businessservices/datasets/uknonfinancialbusinesseconomyannualbusinesssurveyregionalresultssectionsas

in terms of employment and turnover, compared to a similar group of businesses who did not receive support. The latter groups act as a "counterfactual", showing what would have happened to businesses in the absence of the funding. To make this a credible comparison, however, we needed to control for systematic difference in business characteristics prior to the first year of treatment. This step was necessary because the allocation of funding is non-random, and self-selection bias means that companies who chose to engage with the programme probably differ from those who did not.

To identify a suitable control group, and account for differences in business characteristics prior to involvement in BBSRC-funded projects, we implemented a **Propensity Score Matching (PSM)** approach with nearest neighbour matching. This is a statistical method which identifies a control group with similar probabilities of receiving support based on a set of observable characteristics. The characteristics we control for in our analysis include age, industry,[4] and location as well as baseline turnover and employment levels. As project partners engaged with the programme at different points in time, the baseline is defined as the two-year average prior to the individual project start year. The PSM was conducted once for the whole portfolio and then separately for the five investment categories using the same modelling specifications i.e., the same matching criteria. This approach provides flexibility to identify the most suitable match before the first year of treatment for the specific category and thereby removes the confounding impact of prior awards which may have been funded from other investment categories. As such, the results for the overall portfolio reflect the aggregate impacts from multiple awards, while the results for each individual category are tailored to the context of that specific investment category.

By matching each beneficiary business with a similar type of non-beneficiary business it was possible to examine the differences in key performance indicators between the two groups and measure the extent to which the observed differences can be attributable to the funding. This method helps to disentangle the real impacts of BBSRC's funding from other potential confounding factors, although it doesn't control for unobservable characteristics such as the quality of leadership and the propensity to innovate.

To estimate the effect of the CR&D portfolio interventions, the study team implemented a **Difference-in-Difference** model using the reduced sample of matched businesses identified via PSM. This model compares the outcomes of the beneficiary and non-beneficiary groups (first difference), before and after an intervention (second difference). The model estimates whether the intervention has helped businesses improve their performance, and whether this change has been greater for beneficiaries than for the non-beneficiary group. As the timing of the first intervention varies across project partners, the treatment effects are staggered over several periods to allow for a more flexible and nuanced analysis. The baseline is defined as the two-year average in outcome variables before the first year of treatment (marked as 'B' in all charts). We denoted the project start year as t_0, and we traced the change in business performance from the baseline up to ten years after the first interaction with the programme

[4] The analysis is based on the current ONS Standard Industrial Classification (SIC) 2007 used in classifying business establishments and other statistical units by the type of economic activity in which they are engaged. The analysis is based on 21 different SIC code groupings (from Section A to Section U).

(from t_1 to t_{10}). The impact of the programme at t_0 is assumed to be negligible due to time needed to set up the project.

Businesses which become inactive i.e., were dissolved or liquidated were kept in the analysis and their employment and turnover figures are recorded as zero. As such, differences in the rates of business survival between the beneficiary and non-beneficiary group are reflected in the final median estimates of impact. For active companies, the turnover figures are adjusted for inflation using the Consumer Price Index (CPI) and presented in 2020 prices.

The research team conducted separate analysis to assess the impact on beneficiary businesses who benefited from awards associated with each of the five BBSRC investment categories. Industry partners who participated in projects across multiple categories are included in the CR&D portfolio analysis and the corresponding category-specific analysis i.e., businesses with multiple projects are included in the results for each category they are associated with. This is available below.

Single vs multiple projects

The study team tested the impact on beneficiary businesses with a single project compared to those who benefited from multiple projects from the same or different investment categories. This analysis is only available for the BBSRC CR&D portfolio and not for the separate investment categories. The results show whether businesses who benefited from multiple projects experienced better business performance than those business who benefited from a single project. Our analysis indicates that most project partners (77%) have benefited from funding associated with only one investment category.

The analysis relies on the original matching between beneficiaries and non-beneficiaries, without any additional matching between different beneficiary groups. For each business in the analysis, we used the earliest project start date to establish the baseline. Appendix D3 includes descriptive statistics on the characteristics of companies involved in a single project versus multiple projects.

The evaluation aimed to test the extent to which beneficiaries with multiple projects spanning different investment categories experienced greater impact than those with a single project or multiple projects from the same investment category. However, this analysis was not possible due to the small sample size of beneficiaries with multiple projects spanning different categories. As such, the group of beneficiaries with multiple projects includes those with multiple projects from the same or different investment categories.

Return on Investment

Our approach to estimating the **Gross Value Added (GVA)** associated with BBSRC funding involved a series of steps. First, we employed ONS conversion tables to translate the turnover figures in BSD into GVA, providing a measure of economic impact. The GVA conversion factors provide a more direct way to account for the portion of turnover that represents value added, acknowledging that not all the turnover contributes to the final value of the product or service.

To estimate the cumulative GVA, we estimated the annual GVA increase in every post treatment period from the baseline and summed across all periods. Subsequently, we assessed

the cumulative rise in turnover for the beneficiary group over and above that for the non-beneficiary group, thus determining the net effect attributed to the funding. In other words, the cumulative GVA benefits since the first year of funding are estimated and adjusted for additionality by subtracting the changes observed for the 'counterfactual' group of non-beneficiaries.

We calculated the **Return on Investment (ROI)** by comparing the net increase in GVA attributed to the funding to the gross BBSRC investment. We also present additional ROI estimates which compare the net cumulative GVA to the total cost of investment, including both BBSRC's funding and private co-investment from industry partners.

Although the econometric modelling was extended to gauge effects on employment and labour productivity, in addition to turnover and GVA, these effects were not aggregated into the ROI calculations because they represent overlapping facets of impacts. However, presenting these results separately allowed us to provide a comprehensive understanding of the economic implications of BBSRC funding across multiple dimensions.

As noted previously, some companies in the analysis have had only a limited amount of time since their first year of treatment. Therefore, we expect that the CR&D portfolio will continue to generate impacts in the future. However, the ROI results presented here are based on data of realised GVA growth to date, without incorporating projected increases in future years. The findings present the direct impacts for beneficiaries and exclude any indirect impacts resulting from a change in the supply chain. As such, Type I and Type II multipliers were not used.

D.1.3 Caveats and assumptions

The successful implementation of the model relies on several **assumptions**, including:

- **Conditional independence assumption** (CIA) also known as "selection on observables" which implies that the variables used to perform the PSM are sufficient to ensure that businesses in the non-beneficiary group are a suitable counterfactual. While PSM offers a way of controlling for several differences in business characteristics prior to the intervention, it omits important aspects that cannot be observed in the secondary dataset such as the quality of leadership or propensity to innovate. Furthermore, the propensity score estimate is a rough approximation based on a basket of different variables and it is therefore unlikely to provide an exact match on every characteristic.
- **Common support** which implies that there is overlap between the propensity scores of beneficiary and non-beneficiary businesses. Our analysis indicates that most businesses in our sample fall within the common support (see Table 21).
- **Common trends** which implies that, in the years before the first intervention, the trends in outcome indicators observed for the beneficiary and non-beneficiary businesses remain similar.

D.2 Matching treatment and control groups

To examine the different characteristics of industry project partners involved in the programme, the study team linked firm-level monitoring data to administrative data from the BSD. From the 1,025 industry partners based in the UK, 55% were successfully identified in BSD, leaving us with

a sample of 560 businesses.[5] Of them, 474 businesses were active in 2020 and 86 had liquidated or dissolved (see Table 20).

Table 20 Percentage of project partners successfully identified in BSD, by category (2006 – 2020)

Category	Number of project partners*	Number of project partners identified in BSD	Percent of project partners identified in BSD	Value of funding	Value of funding for matched project partner	Value of funding match rate (%)
Responsive Mode grant awards with industry partners	57	30	53%	£44.8m	£13.9.0m	31%
IPA & LINK awards	207	103	50%	£142.5m	£44.3m	31%
Community & Capacity Building Investments	503	246	49%	£170.1m	£30.0m	18%
BBSRC-led strategic CR&D investments	167	81	49%	£100.5m	£10.8m	10%
Strategic co-funding	317	227	72%	£152.5m	£45.3m	30%
BBSRC portfolio*	**1,025**	**560**	**55%**	**£611m**	**£152m**	**25%**

Source: BBSRC monitoring data and Business Structure Database. Note: the count excludes academic and non-profit organisations, as well as businesses identified to be based outside of the UK. *The figures for the entire portfolio are de-duplicated. The sums of investment categories are higher than the total shown because one project partner many appear in multiple investment categories. Due to rounding, the sum of individual values may not always match the reported totals

The control group in this study was identified using PSM, a method which matches each beneficiary business with another business who did not receive support from the programme but was otherwise similar in terms of their business characteristics. The study team implemented nearest neighbour matching without replacement i.e., one treated unit can only be matched with one other control unit. As shown in Table 21, 434 project partners have a matched control unit after PSM is implemented, resulting in a match rate of 78%.

In addition to performing an exact match based on year, main district, and industry of operation, the study team also matched businesses based on baseline characteristics such as age, employment, turnover, and turnover per employee. Table 22 shows the reduction in bias after performing PSM. We see a considerable improvement across all three variables, including

[5] The data linking excludes international businesses without offices in the UK. The BBSRC Grant database suggests that there are 1,025 UK-based industry partners. This count excludes academic and non-profit project partners, as well as industry partners based outside of the UK.

a reduction in bias for turnover (-86%), employment (-79%), age (-47%), and turnover per employee (-30%),

Table 21 Percentage of active treated beneficiaries matched with non-beneficiary control units using PSM

Category	Number of project partners identified in BSD	Number of project partners with a matched control unit after PSM	Match rate (%)
Responsive Mode grant awards with industry partners	30	27	90%
IPA and LINK awards	103	86	83%
Community & Capacity Building Investments	246	176	72%
BBSRC-led strategic CR&D investments	81	63	78%
Strategic co-funding	227	188	83%
BBSRC portfolio *	**560**	**434**	**78%**

Source: BBSRC monitoring data and Business Structure Database. Note: *the totals for the portfolio are deduplicated. The sums of investment categories are higher than the total shown because one project partner many appear in multiple investment categories.

Table 22 Reduction in bias after Propensity Score Matching

		Beneficiaries	Non-beneficiaries	% Bias	% Reduction in bias
Baseline average age	Unmatched	24.6	13.0	47%	
	Matched	28.5	28.5	0%	-47%
Baseline average employment	Unmatched	1,558	11	99%	
	Matched	808	650	20%	-79%
Baseline average turnover	Unmatched	£282m	£2.7m	99%	
	Matched	£150m	£130m	13%	-86%
Baseline average turnover per employee	Unmatched	£278k	£186k	33%	
	Matched	£306k	£298k	0.2%	-30%

Source: Business Structure Database and programme data. Sample size: 474 beneficiaries and 2.2 million non-beneficiaries

D.3 Descriptive statistics of beneficiaries and non-beneficiaries

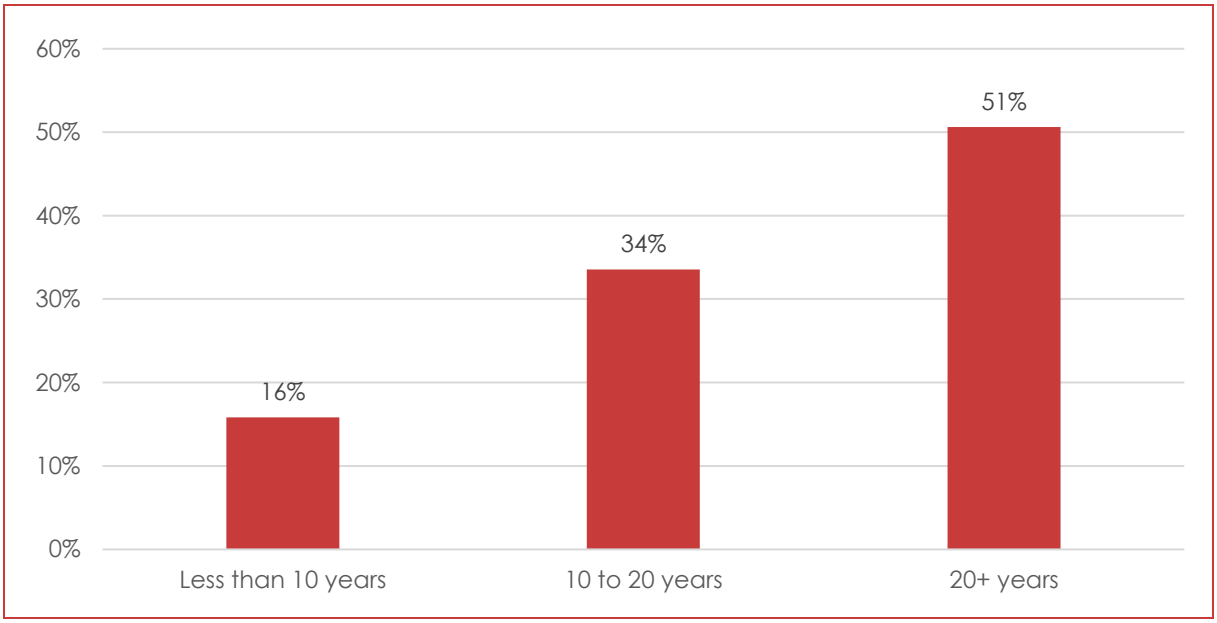
The figures below provide descriptive statistics for all beneficiaries to demonstrate the breadth and diversity of businesses supported across the BBSRC CR&D portfolio. The analysis presented in section D4 consists of a slightly smaller sub-sample of 434 beneficiaries with a matched control unit drawn from the wider business population using PSM. Looking at the descriptive statistics of beneficiaries, we find that:

- The median **age** of beneficiaries is 21 years (seen in Figure 2), indicating that the portfolio has leveraged insights and experience from more established businesses. The age distribution for beneficiary businesses is skewed to the right, with around half of all beneficiaries being older than 20 years of age. 34% of businesses are between 10 and 20 years old and 16% are younger than 10 years old.
- In terms of the **regional distribution** (seen in Figure 3), we note that most businesses identified in BSD are located in the South East (18%), followed by East of England (16%), and Scotland (11%).
- Examining the distribution of support by **sector of operation**[6] (seen in Figure 4) indicates that the majority of beneficiary businesses operate within the professional, scientific, and technical sector (36%), followed by manufacturing (24%), wholesale and retail (14%), and agriculture, forestry and fishing (14%).
- In terms of **size** (seen in Figure 5), most beneficiaries are micro businesses with 10 employees or less (43%), followed by small-to-medium size businesses with 11 to 250 employees (42%) and large businesses with more than 250 employees (15%). The median number of employees for beneficiary businesses is 15 employees.
- In terms of **turnover** (seen in Figure 6), close to half of beneficiaries earned more than £2 million of turnover in 2020 (47%). Around a third of beneficiaries earned between £101,000 and £2 million, while 22% earned £100,000 or less in turnover. The median value of turnover for beneficiary businesses is £1.7 million.
- In terms of **turnover per employee** (seen in Figure 7), nearly half of beneficiaries earned £50,000 or less per employee in 2020 (49%). Around 41% of beneficiaries earned between £101,000 and £500,000, while 10% earned more than £500,000 in turnover per employee. The median value of turnover per employee for beneficiary businesses is £105,000.

Table 23 to Table 29 below provide descriptive statistics for beneficiaries and all non-beneficiaries in the wider business population i.e., before PSM is implemented. The data is available for each investment category, except for "Responsive Mode with Industry" which has a small sample size. Instances where breakdowns are presented differently in each investment category are due to the small sample size and the ONS rules on confidentiality.

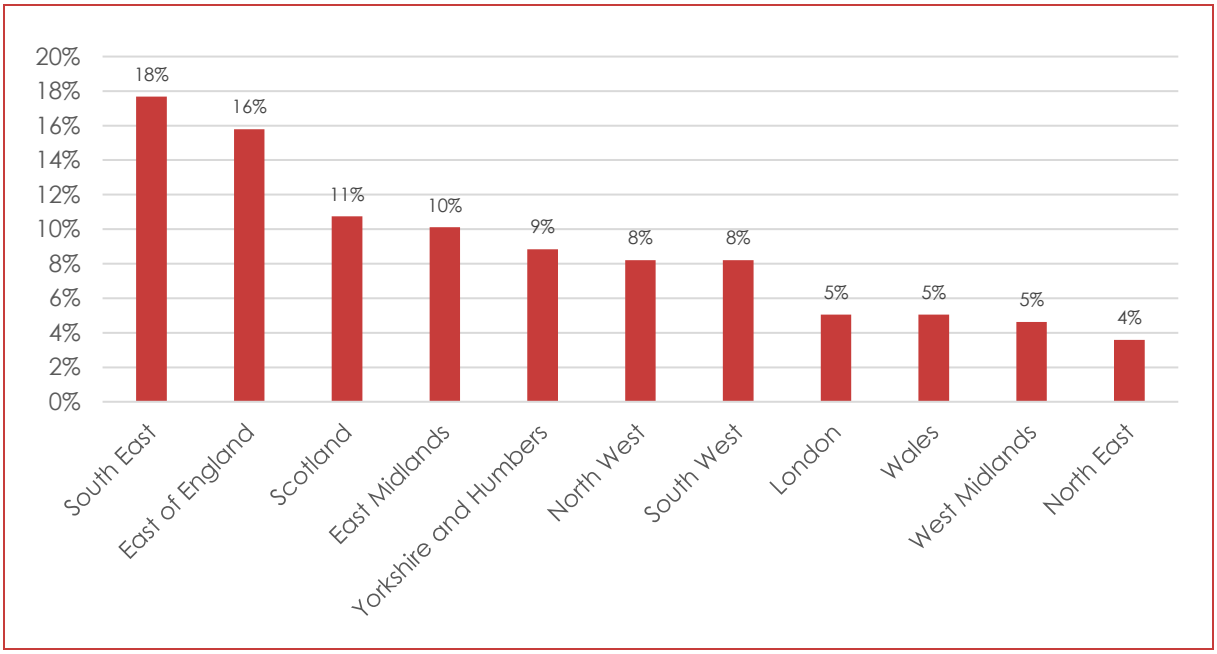
[6] The analysis is based on the current ONS Standard Industrial Classification (SIC) 2007 used in classifying business establishments and other statistical units by the type of economic activity in which they are engaged. The category "Other" contains all other industries not presented in the chart.

Figure 2 Age distribution of active BBSRC beneficiaries, 2020



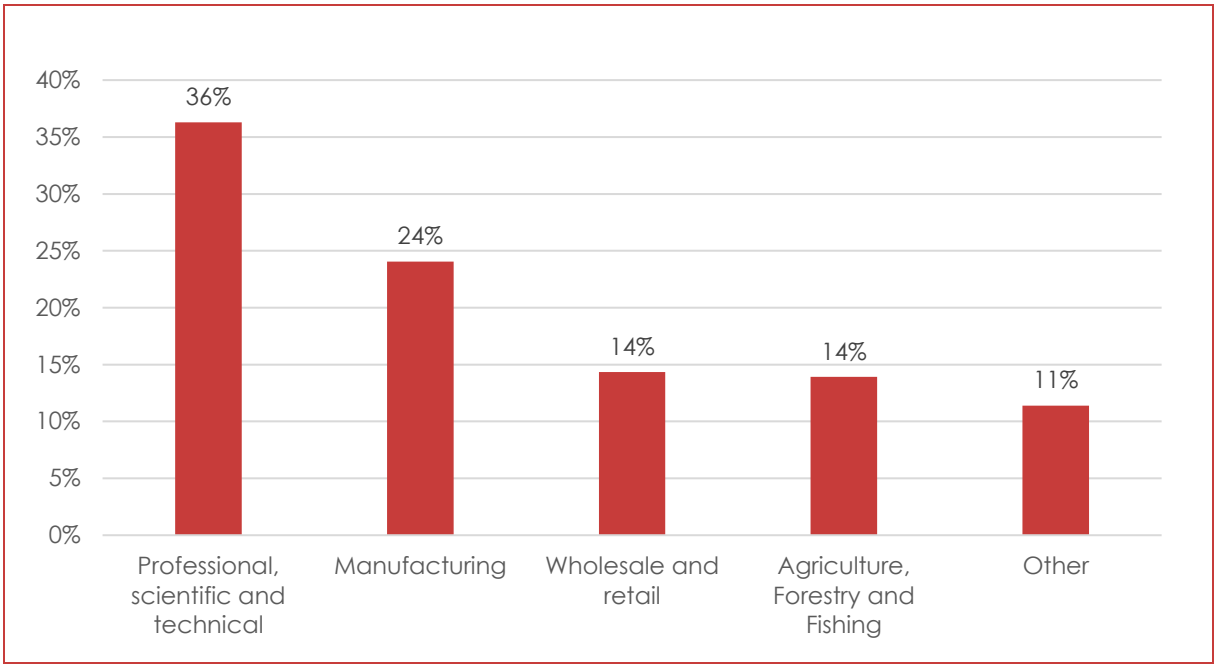
Source: Business Structure Database. Sample size: 474 beneficiaries. Note: due to rounding, the sum of individual percentages may not equal 100%

Figure 3 Regional distribution of active BBSRC beneficiaries, 2020



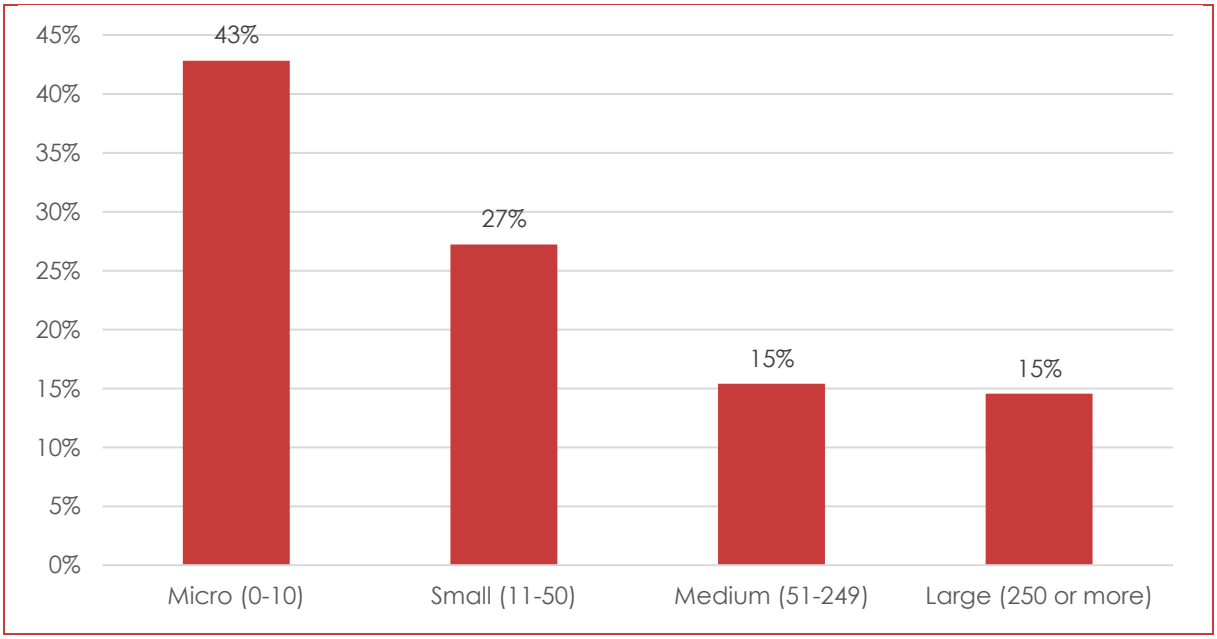
Source: Business Structure Database. Sample size: 474 beneficiaries. Note: due to rounding, the sum of individual percentages may not equal 100%

Figure 4 Sector of operation for active BBSRC beneficiaries, 2020



Source: Business Structure Database. Sample size: 474 beneficiaries. Notes: the category "Other" contains all other industries not presented in the chart. This data cannot be disaggregated further due to the small sample size. Due to rounding, the sum of individual percentages may not equal 100%

Figure 5 Size distribution (by number of employees) of active BBSRC beneficiaries, 2020



Source: Business Structure Database. Sample size: 474 beneficiaries. Note: due to rounding, the sum of individual percentages may not equal 100%

Figure 6 Turnover distribution of active BBSRC beneficiaries, 2020

Source: Business Structure Database. Sample size: 474 beneficiaries. Note: due to rounding, the sum of individual percentages may not equal 100%

Figure 7 Turnover per employee distribution of active BBSRC beneficiaries, 2020

Source: Business Structure Database. Sample size: 474 beneficiaries. Note: due to rounding, the sum of individual percentages may not equal 100%

Table 23 Descriptive statistics for active beneficiaries and non-beneficiaries, 2020

		Age (years)	Employees (n)	Turnover	Turnover per employee
Responsive Mode grant awards with industry partners beneficiaries	Mean	31	1,022	£484m	£288k
	Median	32	138	£21m	£160k
	St. deviation	16	2,331	£1.4bn	£386k
	n	**24**	**24**	**24**	**24**
IPA and LINK awards beneficiaries	Mean	32	726	£256m	£767k
	Median	30	81	£22m	£267k
	St. deviation	14	2,251	£790m	£2.3m
	n	**89**	**89**	**89**	**88**
Community & Capacity Building Investments beneficiaries	Mean	20	1,168	£226m	£242k
	Median	15	8	£272k	£61k
	St. deviation	14	8,633	£1.5m	£1.3m
	n	**204**	**204**	**204**	**204**
BBSRC-led strategic CR&D investments beneficiaries	Mean	29	496	£162k	£837k
	Median	28	21	£4.1k	£132k
	St. deviation	16	2,103	£473k	£2.9m
	n	**68**	**68**	**68**	**68**
Strategic co-funding beneficiaries	Mean	27	2,757	£495m	£382k
	Median	24	27	£3.5m	£132k
	St. deviation	13	22,633	£3.7bn	£1.4m
	n	**205**	**205**	**205**	**203**
BBSRC CR&D portfolio beneficiaries	Mean	25	1,524	£288m	£339k
	Median	21	15	£1.7m	£105k
	St. deviation	15	15,241	2.5m	£1.3m
	n	**474**	**474**	**474**	**474**
Non-beneficiaries	Mean	13	10	£2.5m	£178k
	Median	9	2	£127k	£78k
	St. deviation	10	254	£170k	£11.9m
	n	**2.2m**	**2.2m**	**2.2m**	**2.2m**

Source: Business Structure Database

Table 24 BBSRC CR&D portfolio: distribution of descriptive statistics for active beneficiaries and non-beneficiaries, 2020

	Non-beneficiaries (n)	Beneficiaries (n)	Non-beneficiaries (%)	Beneficiaries (%)
Age				
Less than 10 years	1,143,335	75	52%	16%
10–20 years	662,889	159	30%	34%
20+ years	400,415	240	18%	51%
All	2,206,639	474	100%	100%
Employment size				
Micro (0–9)	1,988,531	203	90%	43%
Small (10–50)	173,699	129	8%	27%
Medium (51–249)	36,627	73	2%	15%
Large (250 or more)	7,782	69	0.4%	15%
All	2,206,639	474	100%	100%
Turnover				
£100k or less	919,360	106	42%	22%
£101k–£500k	895,101	73	41%	15%
£501k–£2m	255,095	72	12%	15%
More than £2m	137,083	223	6%	47%
All	2,206,639	474	100%	100%
Turnover per employee				
50k or less	607,179	146	28%	31%
£51k–£100k	768,864	84	35%	18%
£101k–£500k	669,224	195	30%	41%
More than £500k	161,372	49	7%	10%
All	2,206,639	474	100%	100%
Region *				
North East	51,520	17	2%	4%
North West	220,708	39	10%	8%
Yorkshire and Humber	141,024	42	6%	9%

East Midlands	140,904	48	6%	10%
West Midlands	171,754	22	8%	5%
East of England	213,805	75	10%	16%
London	496,514	24	23%	5%
South East	347,145	84	16%	18%
South West	161,052	39	7%	8%
Wales, Scotland, and Northern Ireland	259,107	84	12%	18%
All **	2,203,533	474	100%	100%
Industry				
Professional, scientific and technical	397,174	172	18%	36%
Manufacturing	123,475	114	6%	24%
Wholesale and retail	391,224	68	18%	14%
Agriculture, Hunting and Forestry	23,435	66	1%	14%
Other	1,271,331	54	58%	11%
All	2,206,639	474	100%	100%

Source: Business Structure Database (BSD). Note: *regions are grouped due to small sample sizes. **Not all non-beneficiaries in the BSD dataset are assigned to a location and the total is therefore lower than elsewhere in the table. Due to rounding, the sum of individual values may not always match the reported totals

Table 25 IPA and LINK: distribution of descriptive statistics for active beneficiaries and non-beneficiaries, 2020

	Non-beneficiaries (n)	Beneficiaries (n)	Non-beneficiaries (%)	Beneficiaries (%)
Age				
Less than 20 years	1,806,377	19	82%	22%
20 years or more	400,531	66	18%	78%
All	2,206,908	85	100%	100%
Employment size				
Micro (0–9)	1,988,676	22	90%	25%
Small (10–50)	173,755	18	8%	20%
Medium (51–249)	36,660	18	2%	20%
Large (250 or more)	7,817	30	0%	34%
All	2,206,908	88	100%	100%
Turnover				
100k or less	919,443	12	42%	14%
£101k–£2m	1,150,278	10	52%	11%
More than £2m	137,187	66	6%	75%
All	2,206,908	88	100%	100%
Turnover per employee				
50k or less	919,443	14	42%	16%
£51k–£100k	895,147	11	41%	13%
£101k–£500k	255,131	44	12%	50%
More than £500k	137,187	19	6%	22%
All	2,206,908	88	100%	100%
Region *				
East Midlands	140,931	12	6%	14%
East of England	213,845	16	10%	18%
South East	347,192	20	16%	23%
Rest of England	1,242,677	25	56%	28%

Wales, Scotland, and Northern Ireland	259,156	15	12%	17%
All	2,203,801	88	100%	100%
Industry				
Professional, scientific, and technical	397,281	23	18%	26%
Manufacturing	123,541	24	6%	27%
Wholesale and retail	391,255	16	18%	18%
Agriculture, Hunting and Forestry	23,473	25	1%	28%
Other	1,271,358	0	58%	0%
All **	2,206,908	88	100%	100%

Source: Business Structure Database. Note: *regions are grouped due to small sample sizes. *Due to rounding, the sum of individual values may not always match the reported totals

Table 26 Community and capacity building: distribution of descriptive statistics for active beneficiaries and non-beneficiaries, 2020

	Non-beneficiaries (n)	Beneficiaries (n)	Non-beneficiaries (%)	Beneficiaries (%)
Age				
Less than 10 years	1,143,357	53	52%	26%
10–20 years	662,970	78	30%	38%
More than 20 years	400,582	73	18%	36%
All	2,206,909	204	100%	100%
Employment size				
Micro (0–9)	1,988,622	112	90%	55%
Small (10–50)	173,783	45	8%	22%
Medium (51–249)	36,679	21	2%	10%
Large (250 or more)	7,825	26	0%	13%
All	2,206,909	204	100%	100%
Turnover				
100k or less	919,398	68	42%	33%
£101k–£500k	895,130	44	41%	22%
£501k–£2m	255,137	30	12%	15%
More than £2m	137,244	62	6%	30%
All	2,206,909	204	100%	100%
Turnover per employee				
50k or less	607,237	88	28%	43%
£51k–£100k	768,907	41	35%	20%
£101k–£500k	669,360	59	30%	29%
More than £500k	161,405	16	7%	8%
All	2,206,909	204	100%	100%
Region *				
North East	51,526	11	2%	5%
North West	220,727	20	10%	10%
Yorkshire and Humber	141,047	19	6%	9%

East Midlands	140,936	16	6%	8%
West Midlands	171,764	12	8%	6%
East of England	213,855	25	10%	12%
London	496,523	15	23%	7%
South East	347,194	35	16%	17%
South West	161,076	15	7%	7%
Wales and Northern Ireland	115,821	15	5%	7%
Scotland	143,334	21	7%	10%
All	2,203,803	204	100%	100%
Industry				
Professional, scientific, and technical	397,245	101	18%	50%
Manufacturing	123,539	50	6%	25%
Wholesale and retail	391,273	19	18%	9%
Agriculture, Hunting and Forestry	23,489	12	1%	6%
Other	1,271,363	22	58%	11%
All	2,206,909	204	100%	100%

Source: Business Structure Database. Note: due to rounding, the sum of individual values may not always match the reported totals

Table 27 BBSRC-led strategic CR&D investment: distribution of descriptive statistics for active beneficiaries and non-beneficiaries, 2020

	Non-beneficiaries (n)	Beneficiaries (n)	Non-beneficiaries (%)	Beneficiaries (%)
Age				
Less than 10 years	1,143,357	10	52%	14%
10–20 years	662,970	18	30%	26%
20+ years	400,582	41	18%	59%
All	2,206,909	69	100%	100%
Employment size				
Micro (0–9)	1,988,710	24	90%	35%
Small (10–50)	173,807	21	8%	30%
Medium (51–249)	36,690	10	2%	14%
Large (250 or more)	7,837	14	0%	20%
All	2,207,044	69	100%	100%
Turnover				
100k or less	919,452	14	42%	20%
£101k–£2m	1,150,328	13	52%	19%
More than £2m	137,264	42	6%	61%
All	2,207,044	69	100%	100%
Turnover per employee				
50k or less	607,306	19	28%	28%
£51k–£100k	768,937	11	35%	16%
£101k–£500k	669,392	27	30%	39%
More than £500k	161,409	12	7%	17%
All	2,207,044	69	100%	100%
Region *				
East of England	213,867	13	10%	19%
South East	347,216	13	16%	19%
East Midlands	140,942	10	6%	14%
The rest of England	1,242,736	19	56%	28%

Wales, Scotland, and Northern Ireland	259,176	14	12%	20%
All	2,203,937	69	100%	100%
Industry				
Professional, scientific and technical	397,326	20	18%	29%
Manufacturing	123,575	14	6%	20%
Wholesale and retail	391,279	16	18%	23%
Agriculture, Hunting and Forestry	23,482	19	1%	28%
Other	1,271,382	0	58%	0%
All	2,207,044	69	100%	100%

Source: Business Structure Database. Note: due to rounding, the sum of individual values may not always match the reported totals. *Regions are grouped due to small sample sizes

Table 28 Strategic Co-Funding (across UKRI): distribution of descriptive statistics for active beneficiaries and non-beneficiaries, 2020

	Non-beneficiaries (n)	Beneficiaries (n)	Non-beneficiaries (%)	Beneficiaries (%)
Age				
Less than 10 years	1,143,398	12	52%	6%
10–20 years	662,979	69	30%	34%
More than 20 years	400,531	124	18%	60%
All	2,206,908	205	100%	100%
Employment size				
Micro (0–9)	1,988,676	58	90%	28%
Small (10–50)	173,755	73	8%	36%
Medium (51–249)	36,660	40	2%	20%
Large (250 or more)	7,817	34	0%	17%
All	2,206,908	205	100%	100%
Turnover				
100k or less	919,443	23	42%	11%
£101k–£500k	895,147	27	41%	13%
£501k–£2m	255,131	36	12%	18%
More than £2m	137,187	119	6%	58%
All	2,206,908	205	100%	100%
Turnover per employee				
50k or less	607,281	44	28%	21%
£51k–£100k	768,913	35	35%	17%
£101k–£500k	669,319	100	30%	49%
More than £500k	161,395	26	7%	13%
All	2,206,908	205	100%	100%
Region*				
South East	347,192	37	16%	18%
East of England	213,845	35	10%	17%
Yorkshire and Humber	141,041	25	6%	12%

East Midlands	140,931	21	6%	10%
South West	161,076	15	7%	7%
North West	220,733	14	10%	7%
Rest of England	719,827	24	33%	12%
Wales and Northern Ireland	115,820	15	5%	7%
Scotland	143,336	19	7%	9%
All	2,203,801	205	100%	100%
Industry				
Professional, scientific, and technical	397,281	65	18%	32%
Manufacturing	123,541	48	6%	23%
Wholesale and retail	391,255	37	18%	18%
Agriculture, Hunting and Forestry	23,473	28	1%	14%
Other	1,271,358	27	58%	13%
All	2,206,908	205	100%	100%

Source: Business Structure Database. Note: due to rounding, the sum of individual values may not always match the reported totals. *Regions are grouped due to small sample sizes

Table 29 Descriptive statistics for BBSRC beneficiaries who have benefited from a single project versus multiple projects

	Beneficiaries with a single project (n)	Beneficiaries with multiple projects (n)	Beneficiaries with a single project (%)	Beneficiaries with multiple projects (%)
Age				
Less than 10 years	54	21	17%	14%
10 - 20 years	107	52	33%	35%
More than 20 years	164	76	50%	51%
All	325	149	100%	100%
Employment size				
Micro (0–9)	142	61	44%	41%
Small (10–50)	94	35	29%	23%
Medium (51–249)	59	14	18%	9%
Large (250 or more)	30	39	9%	26%
All	325	149	100%	100%
Turnover				
100k or less	71	35	22%	23%
£101k–£500k	55	18	17%	12%
£501k–£2m	50	22	15%	15%
More than £2m	149	74	46%	50%
All	325	149	100%	100%
Turnover per employee				
50k or less	100	46	31%	31%
£51k–£100k	52	32	16%	21%
£101k–£500k	143	52	44%	35%
More than £500k	30	19	9%	13%
All	325	149	100%	100%
Region *				
North East and North West	31	25	10%	17%
Yorkshire and Humber	30	12	9%	8%

East Midlands	33	15	10%	10%
West Midlands	12	10	4%	7%
East of England	58	17	18%	11%
South East	55	29	17%	19%
London and South West	48	15	15%	10%
Wales, Scotland, and Northern Ireland	58	26	18%	17%
All	325	149	100%	100%
Industry				
Professional, scientific, and technical	108	64	33%	43%
Manufacturing	82	32	25%	21%
Wholesale and retail	49	19	15%	13%
Agriculture, Hunting and Forestry	49	17	15%	11%
Other	37	17	11%	11%
All**	325	149	100%	100%

Source: Business Structure Database. Note: *regions are grouped due to small sample sizes. Due to rounding, the sum of individual values may not always match the reported totals. **The table includes the list of industries that include BBSRC beneficiaries, rather than representing the full economy. As such, the figures for 'All' category are higher than the sum of individual sectors

D.4 Cateogory-specific results from the econometric exercise

This section presents the results from the difference-in-difference modelling with PSM for each one of the five investment categories. The methodology adopted here is the same as for the overall portfolio analysis presented in Section D1. The PSM modelling was performed separately for each investment category to enable the identification of the most suitable match for each business. Consistent matching criteria were applied across all categories to maintain uniformity in the analysis. This approach allows to control for differences in business characteristics prior to the first treatment date observed in a specific category, thereby removing the confounding impacts of any prior awards funded from other categories. The analysis presented below is based on the sample of beneficiaries in each investment category and a small sub-sample of non-beneficiary companies identified from the wider business population of two million businesses via PSM. Hence, the analysis controls for differences in business characteristics between the two groups prior to the intervention. The modelling has identified one non-beneficiary for each beneficiary business in the sample.

The sample sizes in each period are influenced by the number of years that have passed since the first year of treatment. Only the group of beneficiaries who have benefited from the IPA and LINK investment category is reflected in all periods, from t+1 to t+10. The analyses for all other categories include forecasts based on the trend observed in prior periods. These forecasts are marked with dotted lines in the figures or with the letter "f" in the tables. However, due to uncertainty associated with forecasts, the median values presented at the end of the table are based on observed values only i.e., without incorporating the forecast.

For each outcome indicator, we present the median increase from the baseline in absolute terms (in panel a) and the percentage terms (in panel b). To showcase the impacts attributable to the portfolio, the analysis also includes tables that illustrate the median difference-in-difference estimates between beneficiaries and non-beneficiaries in each period and the median annual changes across the entire treatment period. The tables include absolute differences and parentage points differences i.e., the absolute differences between two percentages, marked as ppt.

Each section follows the same structure, staring with a description of the impact on employment, turnover, and labour productivity, before presenting the results from the ROI analysis. To remove the impact of large outliers in the dataset, the ROI figures are based on a sample of companies that fall within the interquartile range i.e., companies that have cumulative GVA that falls within the upper and lower medians in the sample. While this approach reduces the overall sample size of businesses represented in the analysis, the results are more representative and less biased by the large skews in the data.

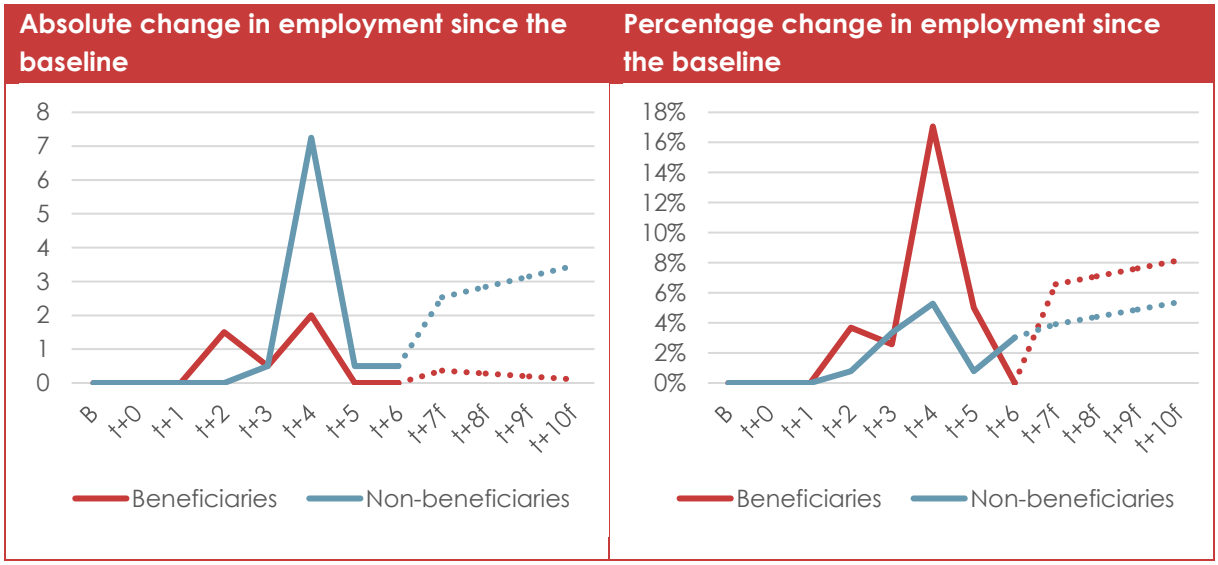
D.4.1 *Responsive Mode grant awards with industry partners*

The analysis for the Responsive Mode grant awards with industry partners category is less robust due to the small sample size, which limits the statistical power and reliability of the findings. Small changes in the sample composition across each treatment period contribute to greater volatility in the results, making them harder to interpret accurately. Moreover, the beneficiaries in this group have more recent project start dates, further complicating the assessment of long-term impacts as there is insufficient time to observe and measure the full extent of the category's effects.

While we observe modest increases in employment and turnover, these improvements are not greater than those observed in the counterfactual group (see Figure 8 to Figure 10 and Table 30 to Table 32). The forecasted values for each outcome indicator are presented with dotted lines in the figures or marked with the letter 'f' in the tables. These forecasts assume that past trends will continue into the future.

D.4.1.1 Employment impacts

Figure 8 Median change in employment since the baseline for beneficiaries and non-beneficiaries: Responsive Mode grant awards with industry partners



Source: Business Structure Database. Note: forecasts are marked with dotted lines in the figures or with the letter 'f' in the tables

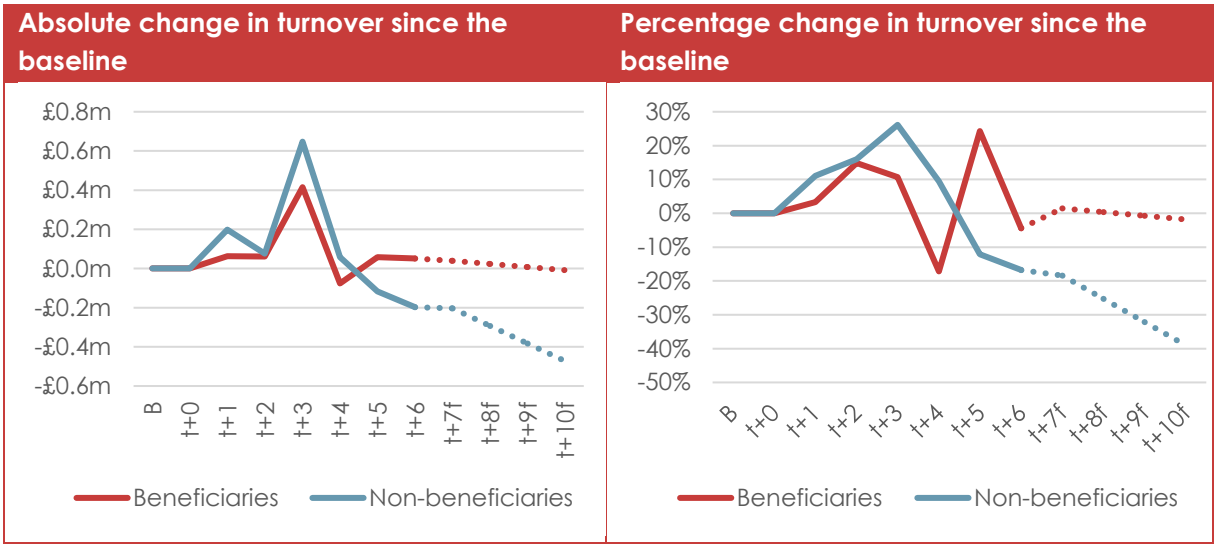
Table 30 Employment: difference-in-difference estimates between beneficiaries and non-beneficiaries: Responsive Mode grant awards with industry partners

	t+1	t+2	t+3	t+4	t+5	t+6	t+7f	t+8f	t+9f	t+10f	Median
Absolute	-	2	-	-5	-1	-1	-2	-3	-3	-3	1
Percentage points (ppt)	0	3	-1	12	4	-3	3	3	3	3	7
Sample size	45	43	35	27	23	20	-	-	-	-	45

Source: Business Structure Database. Note: the sample size is split roughly evenly between beneficiaries and non-beneficiaries. The sample excludes outliers defined as three standard deviations above or below the mean

D.4.1.2 Turnover impacts

Figure 9 Median change in turnover since the baseline for beneficiaries and non-beneficiaries: Responsive Mode grant awards with industry partners



Source: Business Structure Database. Note: the sample size is split roughly evenly between beneficiaries and non-beneficiaries. Forecasts are marked with dotted lines in the figures or with the letter 'f' in the tables

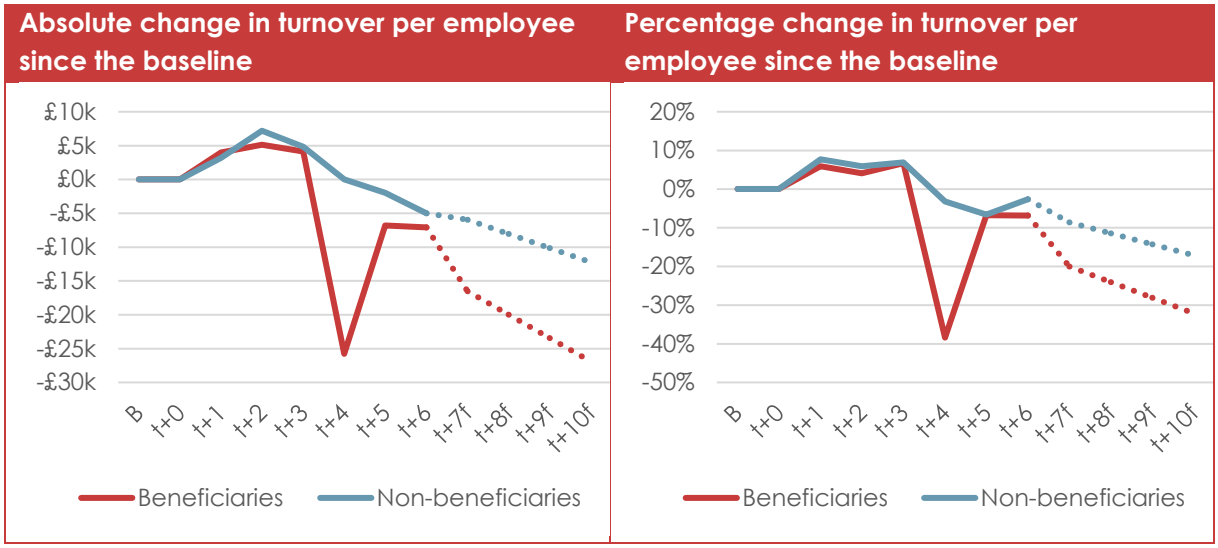
Table 31 Turnover: difference-in-difference estimates between beneficiaries and non-beneficiaries: Responsive Mode grant awards with industry partners

	t+1	t+2	t+3	t+4	t+5	t+6	t+7f	t+8f	t+9f	t+10f	Median
Absolute (£k)	-136	-14	-232	-135	174	248	243	316	390	464	-419
Percentage points (ppt)	-8	-1	-15	-27	36	12	20	26	31	37	-13
Sample size	46	43	36	28	24	20	-	-	-	-	46

Source: Business Structure Database. Note: the sample size is split roughly evenly between beneficiaries and non-beneficiaries. The sample excludes outliers defined as three standard deviations above or below the mean

D.4.1.3 Turnover per employee impacts

Figure 10 Turnover per employee: median absolute and percentage change from the baseline for beneficiaries and non-beneficiaries: Responsive Mode grant awards with industry partners



Source: Business Structure Database. Note: the sample size is split roughly evenly between beneficiaries and non-beneficiaries. Forecasts are marked with dotted lines in the figures or with the letter 'f' in the tables

Table 32 Turnover per employee: difference-in-difference estimates between beneficiaries and non-beneficiaries: Responsive Mode grant awards with industry partners

	t+1	t+2	t+3	t+4	t+5	t+6	t+7f	t+8f	t+9f	t+10f	Median
Absolute (£k)	1	-2	-1	-26	-5	-2	-11	-12	-13	-15	-2.5
Percentage points (ppt)	-2	-2	0	-35	0	-4	-11	-13	-14	-15	-11
Sample size	47	44	35	27	24	20	-	-	-	-	47

Source: Business Structure Database. Note: the sample size is split roughly evenly between beneficiaries and non-beneficiaries. The sample excludes outliers defined as three standard deviations above or below the mean

D.4.1.4 Return on investment (ROI)

The ROI figures for the Responsive Mode grant awards with industry partners category are shown in Table 33. The cumulative figures represent the growth in GVA from the baseline. Due to the small sample size in this investment category, the analysis is based on all companies, excluding large outliers defined as three standard deviations above or below the mean. This is unlike the analysis presented for all other investment categories which is based on the group of companies that fall within the interquartile range. The net increase in GVA accumulated over the entire treatment period with observed data, i.e., excluding the forecast, was compared to the cost of funding for matched companies included in the analysis to present a ROI figure.

The net cumulative value of GVA gained since the baseline is worth £122 million, compared to the initial BBSRC investment funding cost of £14 million and private sector co-investment of £0.392 million (£0.094 million in cash and £0.298 million in-kind contributions) from industry partners. The analysis for the Responsive Mode grant awards with industry partners category indicates that:

- For every £1 invested by BBSRC, the funding has generated £3 in economic benefits
- For every £1 invested by BBSRC and industry partners, the funding has generated £2.50 in economic benefits

Table 33 Return on Investment for the Responsive Mode grant awards with industry partners category

	Responsive Mode grant awards with industry partners
Cumulative change in GVA for beneficiaries *	£122m
Net cumulative GVA *	£36m
Net cumulative GVA per company *	£1.4m
Value of BBSRC investment *	£14m
Value of cash contributions *	£0.094m
Value of in-kind contributions *	£0.298m
Return on investment ratio for BBSRC	1:3
Return on investment ratio for BBSRC and private sector co-investment in terms of cash and in-kind contributions	1:2.5
Sample size of beneficiaries	25

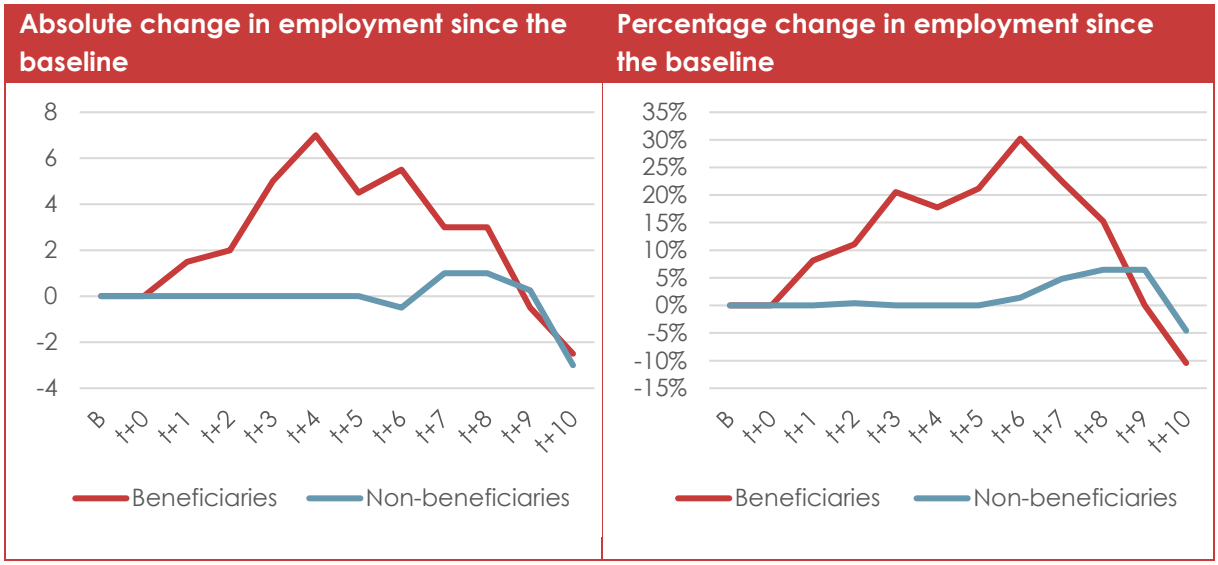
Source: Business Structure Database. Note: *the figure includes businesses who were successfully identified in IDBR. The values exclude outliers defined as three standard deviations above and below the mean

D.4.2 IPA and LINK awards

D.4.2.1 Employment impacts

The econometric analysis shows a strong median increase in employment for industry partners who have participated in IPA and LINK awards. Over the ten-year period, beneficiaries outperformed non-beneficiaries with a median annual employment increase of approximately four employees (see Figure 11 and Table 34).

Figure 11 Median change in employment since the baseline for beneficiaries and non-beneficiaries: IPA and LINK awards



Source: Business Structure Database

Table 34 Employment: difference-in-difference estimates between beneficiaries and non-beneficiaries: IPA and LINK awards

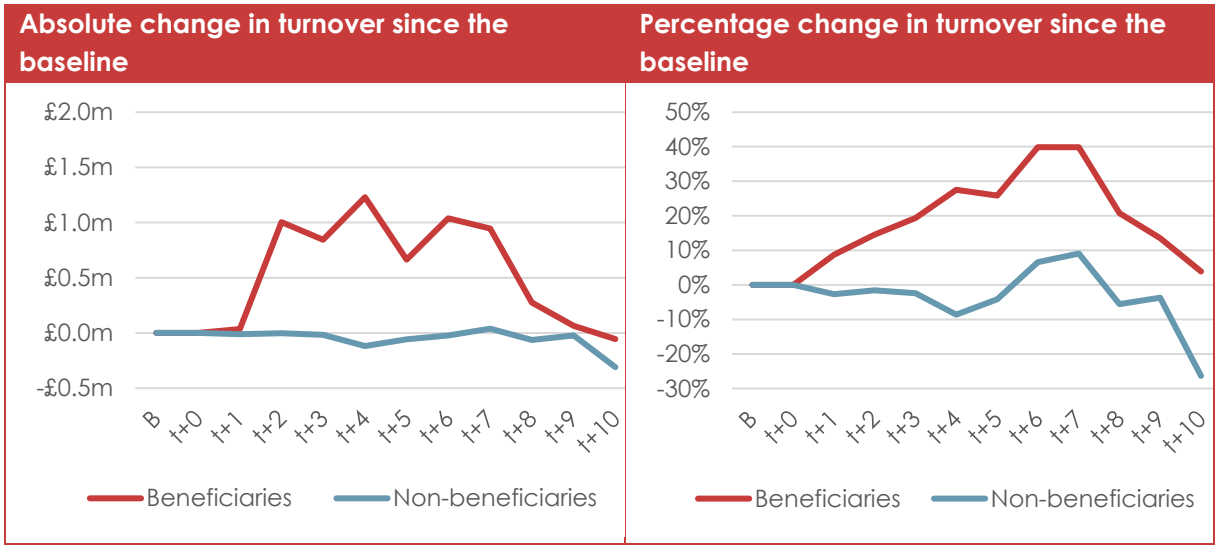
	t+1	t+2	t+3	t+4	t+5	t+6	t+7	t+8	t+9	t+10	Median
Absolute	1.5	2	5	7	4.5	6	2	2	-0.75	0.5	4
Percentage terms (ppt)	8	11	21	18	21	29	18	9	-6	-6	16
Sample size	182	182	170	161	147	104	81	75	60	40	182

Source: Business Structure Database. Note: the sample size is split roughly evenly between beneficiaries and non-beneficiaries. The sample excludes outliers defined as three standard deviations above or below the mean

D.4.2.2 Turnover impacts

The results from the econometric analysis indicates strong turnover growth (see Figure 12 and Table 35. The gap between beneficiaries and matched non-beneficiaries peaked four years after the first project start date, at £1.3 million in four of the beneficiaries. Over a ten-year period, the median turnover increase among beneficiaries was £956,000 per year in comparison with non-beneficiaries.

Figure 12 Median change in turnover since the baseline for beneficiaries and non-beneficiaries: IPA and LINK awards



Source: Business Structure Database. Note: the sample size is split roughly evenly between beneficiaries and non-beneficiaries

Table 35 Turnover: difference-in-difference estimates between beneficiaries and non-beneficiaries: IPA and LINK awards

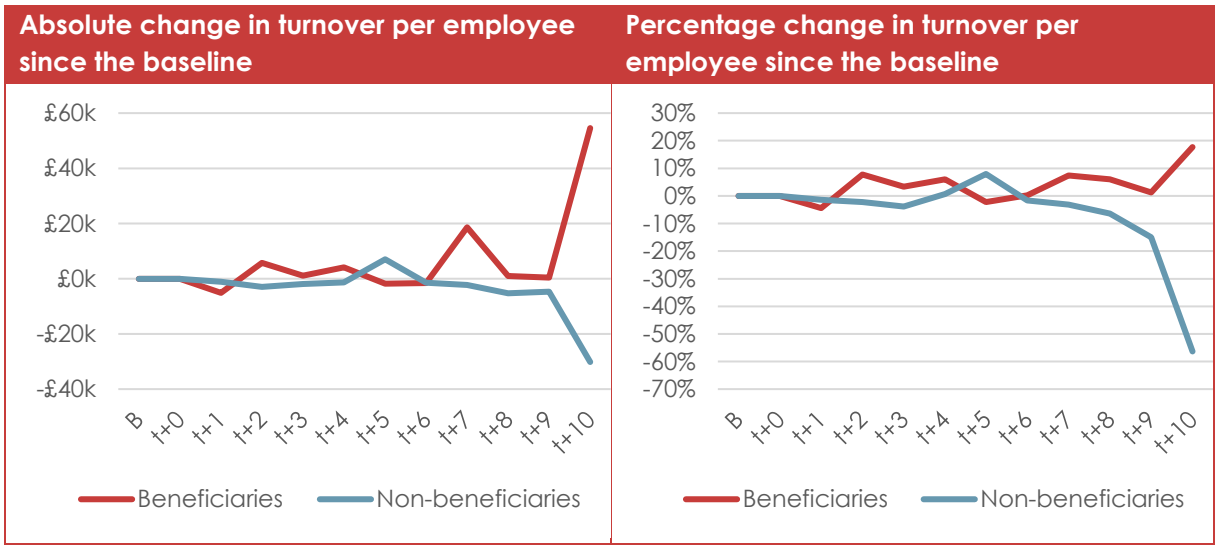
	t+1	t+2	t+3	t+4	t+5	t+6	t+7	t+8	t+9	t+10	Median
Absolute (£k)	44	1,007	862	1,347	721	1,062	907	339	87	255	956
Percentage points (ppt)	11	16	22	36	30	33	31	26	17	30	21
Sample	184	171	164	147	104	81	75	59	40	32	184

Source: Business Structure Database. Note: the sample size is split roughly evenly between beneficiaries and non-beneficiaries. The sample excludes outliers defined as three standard deviations above or below the mean

D.4.2.3 Turnover per employee impacts

Over a ten-year period, beneficiaries had approximately a £2,000 higher median annual change in labour productivity compared to non-beneficiaries (see Figure 13 and Table 36).

Figure 13 Turnover per employee: median absolute and percentage change from the baseline for beneficiaries and non-beneficiaries: IPA and LINK awards



Source: Business Structure Database. Note: the sample size is split roughly evenly between beneficiaries and non-beneficiaries

Table 36 Turnover per employee: difference-in-difference estimates between beneficiaries and non-beneficiaries

	t+1	t+2	t+3	t+4	t+5	t+6	t+7	t+8	t+9	t+10	Median
Absolute (£k)	- 4	9	3	5	-9	0	21	6	5	85	2
Percentage points (ppt)	-3	10	7	5	-10	2	11	12	16	74	3
Sample size	182	171	160	147	104	80	74	59	40	31	182

Source: Business Structure Database. Note: the sample size is split roughly evenly between beneficiaries and non-beneficiaries. The sample excludes outliers defined as three standard deviations above or below the mean

D.4.2.4 Return on investment (ROI)

The ROI figures for the IPA and LINK awards category are shown in Table 37. The cumulative figures represent the growth in GVA from the baseline, based on the group of companies that fall within the interquartile range i.e., companies with cumulative GVA figures that are within the upper and lower median values. The net increase in cumulative GVA represents the value of GVA for beneficiaries over and above that for matched non-beneficiaries. The net increase in GVA accumulated over the entire treatment period with observed data was compared to the cost of funding for matched companies included in the analysis to present a ROI figure.

The net cumulative value of GVA gained since the baseline is worth £244 million, compared to the initial BBSRC investment of £9 million and private sector co-investment of £8.7 million (£2.6 million in cash and £6.1 million in-kind contributions) from industry partners. The analysis for the IPA and LINK investment category indicates that:

- For every £1 invested by BBSRC, the funding has generated £25 in economic benefits
- For every £1 invested by BBSRC and industry partners, the funding has generated £13 in economic benefits

Table 37 Return on Investment for the IPA & LINK investment category

	IPA and LINK awards
Cumulative change in GVA for beneficiaries *	£271m
Net cumulative GVA *	£244m
Net cumulative GVA per company *	£5.8m
Value of BBSRC investment *	£9m
Value of cash contributions *	£2.6m
Value of in-kind contributions *	£6.1m
Return on investment ratio for BBSRC	1:25
Return on investment ratio for BBSRC and private sector co-investment in terms of cash and in-kind contributions	1:13
Sample size of beneficiaries	42

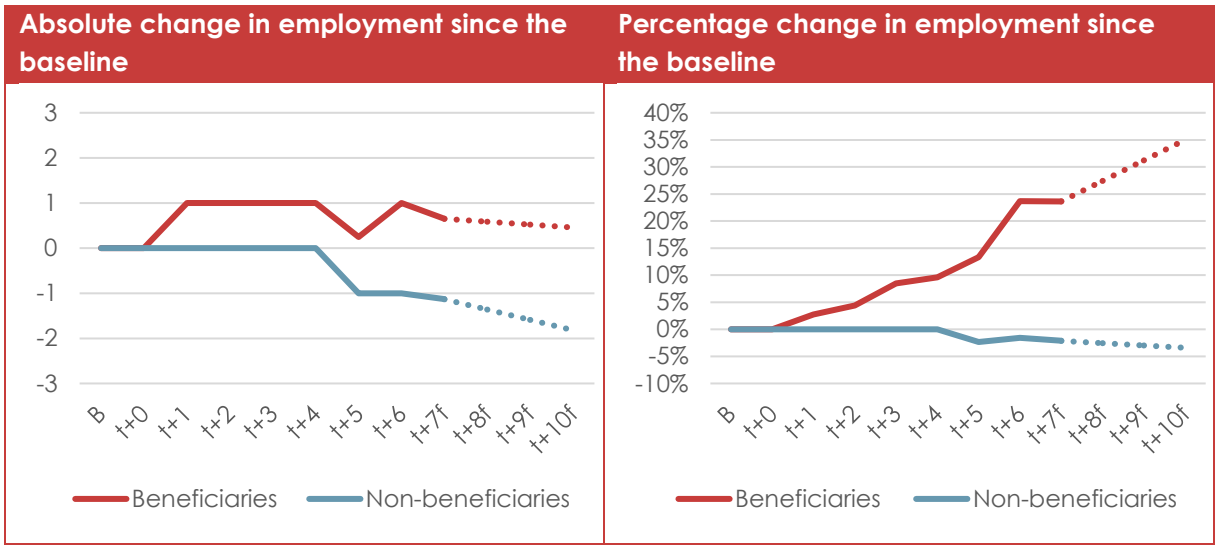
Source: Business Structure Database. Note: *the figure includes businesses who were successfully identified in IDBR and fall within the interquartile range

D.4.3 *Community & Capacity Building Investments*

D.4.3.1 Employment impacts

The analysis tracked the changes in the median employment levels over time and found that beneficiaries have added one new employee six years after the project start date compared to the baseline. In contrast, non-beneficiaries have experienced a decline in median employment levels from the baseline. The gap between the two groups is forecasted to increase to three employees in period t+10f in favour of beneficiaries. The median increase per year for the beneficiary group is one employee, over and above the median increase for matched non-beneficiaries, based on observed data up to six years after the first project start date (see Figure 14 and Table 38).

Figure 14 Median change in employment since the baseline for beneficiaries and non-beneficiaries: Community and Capacity Building investments



Source: Business Structure Database. Forecasts are marked with dotted lines in the figures or with the letter 'f' in the tables

Table 38 Employment: difference-in-difference estimates between beneficiaries and non-beneficiaries: Community and Capacity Building investments

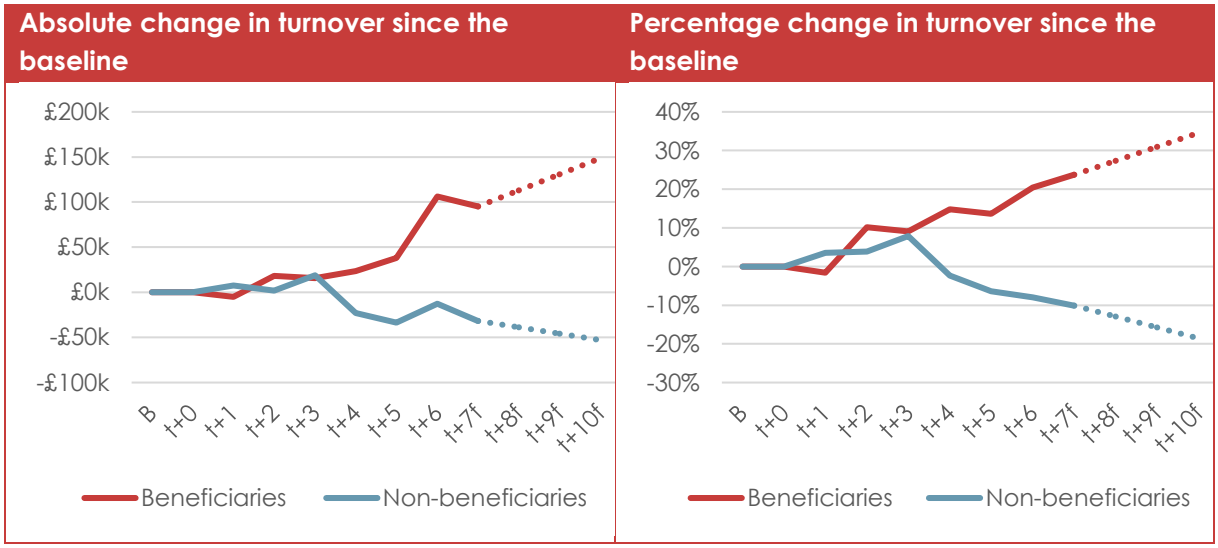
	t+1	t+2	t+3	t+4	t+5	t+6	t+7f	t+8f	t+9f	t+10f	Median
Absolute terms	1.0	1.0	1.0	1.0	2.0	2.0	2.1	2.4	2.6	2.8	1.3
Percentage points (ppt)	3	4	8	10	16	25	26	30	34	38	10
Sample size	329	300	264	231	175	122	-	-	-	-	329

Source: Business Structure Database. Note: the sample size is split roughly evenly between beneficiaries and non-beneficiaries. The sample excludes outliers defined as three standard deviations above or below the mean

D.4.3.2 Turnover impacts

The median increase in turnover is higher for beneficiaries compared to non-beneficiaries (see Figure 15 and Table 39). Six years after the project start date, the median turnover for beneficiaries was £106,000 higher compared to the baseline, whereas that for non-beneficiaries was £13,000 lower compared to the baseline. Defining the turnover growth benefit as the median increase by which beneficiaries outperformed non-beneficiaries, it was found that the median benefit is about £24,000 per year over a six-year assessment period with observed data. The forecast analysis indicates that the gap between the two groups is expected to grow over time, peaking at £201,000 in t+10f in favour of beneficiaries.

Figure 15 Median change in turnover since the baseline for beneficiaries and non-beneficiaries: Community and Capacity Building investments



Source: Business Structure Database. Note: the sample size is split roughly evenly between beneficiaries and non-beneficiaries. Forecasts are marked with dotted lines in the figures or with the letter 'f' in the tables

Table 39 Turnover: difference-in-difference estimates between beneficiaries and non-beneficiaries: Community and Capacity Building investments

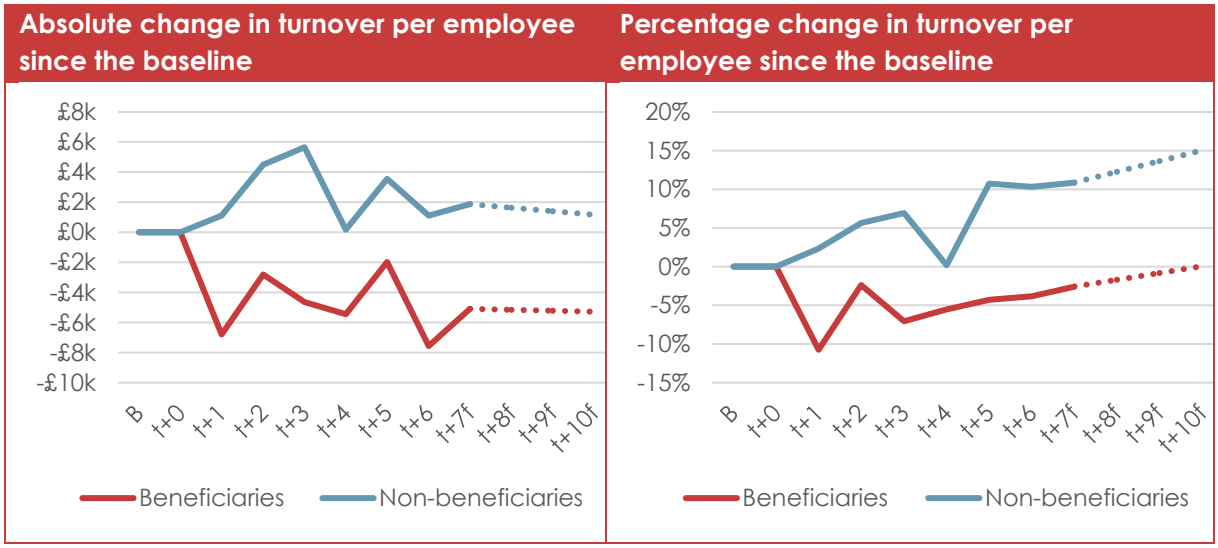
	t+1	t+2	t+3	t+4	t+5	t+6	t+7f	t+8f	t+9f	t+10f	Median
Absolute terms (£k)	-12	17	-3	47	72	119	127	152	177	201	24
Percentage points (ppt)	-5	6	1	17	20	28	34	40	47	53	8
Sample size	327	302	267	234	177	122	-	-	-	-	327

Source: Business Structure Database. Note: the sample size is split roughly evenly between beneficiaries and non-beneficiaries. The sample excludes outliers defined as three standard deviations above or below the mean

D.4.3.3 Turnover per employee impacts

There was no positive effect on labour productivity levels, measured as the turnover per employee (see Figure 16 and Table 40). Relative to the baseline, beneficiaries report a median decrease of £8,000 six years after the project start date, compared to a £1,000 increase for non-beneficiaries (-4ppt vs 10ppt median increase, respectively). Over a six-year period with observed data, the median annual increase in turnover per employee was £12,000 lower for beneficiaries, compared to non-beneficiaries, with this trend forecasted to continue up to t+10f.

Figure 16 Turnover per employee: median absolute and percentage change from the baseline for beneficiaries and non-beneficiaries: Community and Capacity Building investments



Source: Business Structure Database. Note: the sample size is split roughly evenly between beneficiaries and non-beneficiaries. Forecasts are marked with dotted lines in the figures or with the letter 'f' in the tables

Table 40 Turnover per employee: difference-in-difference estimates between beneficiaries and non-beneficiaries: Community and Capacity Building investments

	t+1	t+2	t+3	t+4	t+5	t+6	t+7f	t+8f	t+9f	t+10f	Median
Absolute terms (£k)	-8	-7	-10	-6	-6	-9	-7	-7	-7	-6	-12
Percentage points (ppt)	-13	-8	-14	-6	-15	-14	-13	-14	-14	-15	-18
Sample size	328	300	264	231	170	119					328

Source: Business Structure Database. Note: the sample size is split roughly evenly between beneficiaries and non-beneficiaries. The sample excludes outliers defined as three standard deviations above or below the mean

D.4.3.4 Return on investment (ROI)

The ROI figures for the Community & Capacity Building investments category are shown in Table 41. The cumulative figures represent the growth in GVA from the baseline, based on the group of companies that fall within the interquartile range i.e., companies with cumulative GVA figures that are within the upper and lower median values. The net increase in cumulative GVA represents the value of GVA for beneficiaries over and above that for matched non-beneficiaries. The net increase in GVA accumulated over the entire treatment period with observed data i.e., excluding the forecast, was compared to the cost of funding for matched companies included in the analysis to present a ROI figure.

The net cumulative value of GVA gained since the baseline is worth £10 million, compared to a BBSRC investment funding cost of £1.4 million and private sector co-investment of £0.304 million (£0.033 million in cash and £0.271 million in-kind contributions) from industry partners. The analysis for the Community and Capacity Building investment category indicates that:

- For every £1 invested by BBSRC, the funding has generated £8 in economic benefits
- For every £1 invested by BBSRC and industry partners, the funding has generated £6 in economic benefits

Table 41 Return on Investment for the Community and Capacity Building investment category

	Community & Capacity Building Investments
Cumulative change in GVA for beneficiaries *	£12m
Net cumulative GVA *	£10m
Net cumulative GVA per company *	£0.120m
Value of BBSRC investment *	£1.4m
Value of cash contributions *	£0.033m
Value of in-kind contributions *	£0.271m
Return on investment ratio	1:8
Return on investment ratio for BBSRC and private sector co-investment in terms of cash and in-kind contributions	1:6
Sample size of beneficiaries	86

Source: Business Structure Database. Note: *the figure includes businesses who were successfully identified in IDBR and fall within the interquartile range

D.4.4 BBSRC-led Strategic CR&D investments

D.4.4.1 Employment impacts

The analysis shows no significant change compared to the baseline. It suggests that the median change in the number of employees has remained constant for both beneficiaries and non-beneficiaries seven years after the project start date. This is the reason why we have not shown graphs and tables in this section.

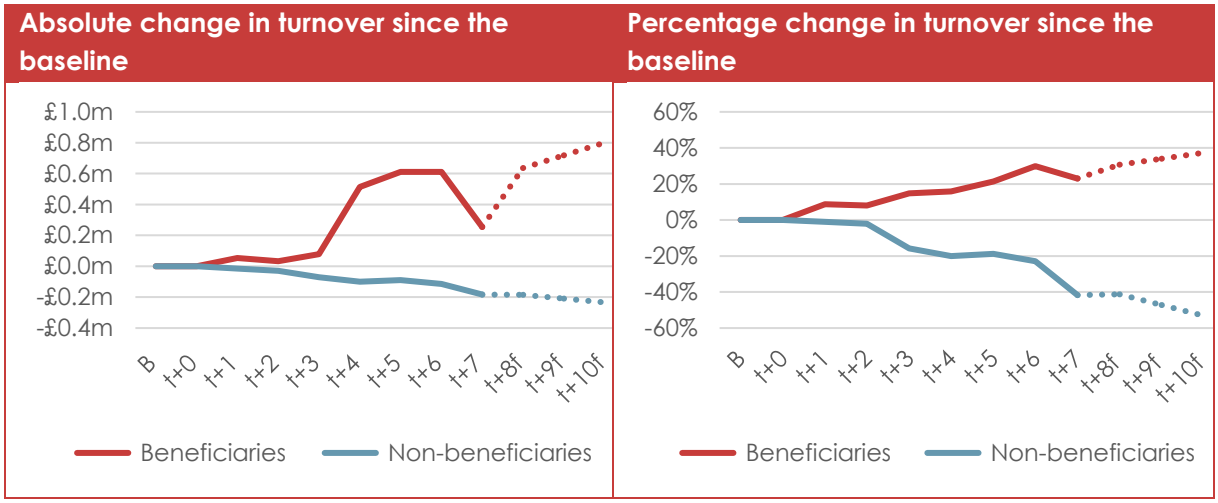
Despite this, there is a large discrepancy between the median and mean impacts, implying that the effects of the treatment are not uniformly distributed across businesses, where large outliers in the sample are responsible for the large differences in our findings. The average difference-in-difference coefficient is 28 employees (Table 50), indicating that the treatment has had a substantial impact on certain businesses within the sample. This disparity between the median and the mean indicates the presence of heterogeneity in treatment effects among businesses. The main analysis is based on the median values as these tend to be relatively more representative of the performance experienced by the majority of businesses in the sample while the mean coefficients are only included as a comparison.

D.4.4.2 Turnover impacts

The econometric analysis shows a strong median increase in turnover for industry partners who have benefited from funding in the BBSRC-led strategic CR&D investments category. Beneficiaries experienced a modest median increase in turnover in the first three periods after the project start date, followed by rapid growth thereafter, while non-beneficiaries saw a decline in turnover over the same period. Relative to the baseline, beneficiaries experienced a median increase of £612,000 five years after the project start date, compared to -£90,000 for non-beneficiaries (see Figure 17 and Table 42). Assuming that the current trends continue into the future, it was identified that the gap between the two groups is forecasted to grow to over £1 million in period t+10f in favour of beneficiaries.

When defining the benefit of the category as the median increase by which beneficiaries outperform non-beneficiaries over the seven-year treatment period with observed data, it was found that the median turnover growth is £265,000 per year per beneficiary (see Table 42).

Figure 17 Median change in turnover since the baseline for beneficiaries and non-beneficiaries: BBSRC-led strategic CR&D investments



Source: Business Structure Database. Note: the sample size is split roughly evenly between beneficiaries and non-beneficiaries. Forecasts are marked with dotted lines in the figures or with the letter 'f' in the tables

Table 42 Turnover: difference-in-difference estimates between beneficiaries and non-beneficiaries: BBSRC-led strategic CR&D investments

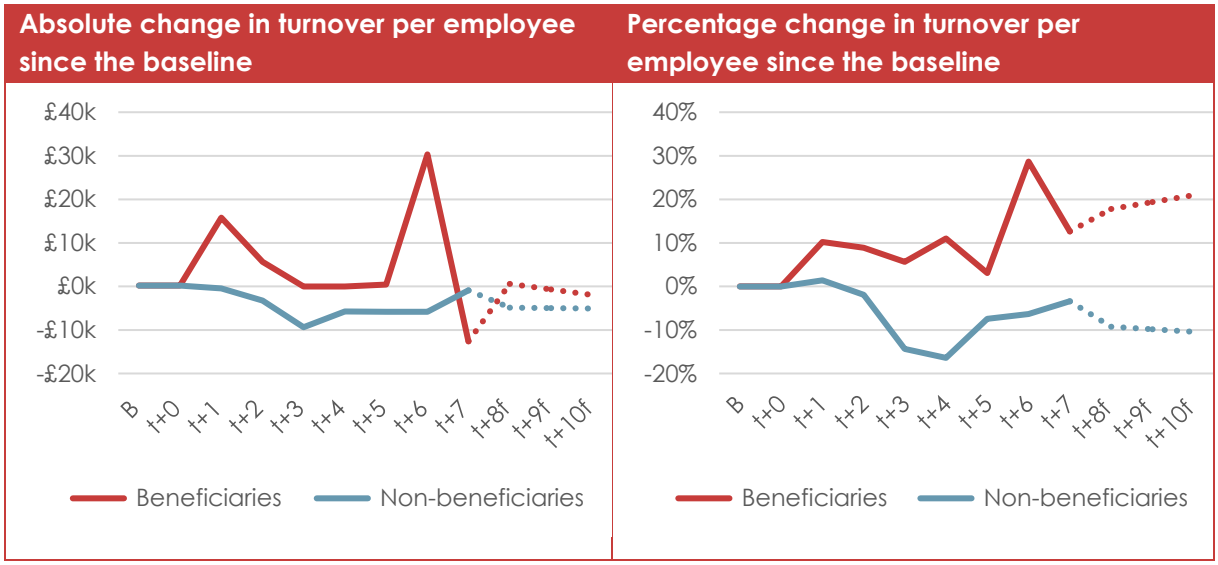
	t+1	t+2	t+3	t+4	t+5	t+6	t+7	t+8f	t+9f	t+10f	Median
Absolute terms (£k)	69	61	149	614	702	725	438	821	927	1,034	265
Percentage points (ppt)	10	10	31	36	40	53	65	72	81	90	26
Sample size	129	128	111	56	51	41	27	-	-	-	129

Source: Business Structure Database. Note: the sample size is split roughly evenly between beneficiaries and non-beneficiaries. The sample excludes outliers defined as three standard deviations above or below the mean

D.4.4.3 Turnover per employee impacts

Since the baseline, beneficiaries have experienced a slightly higher median increase in turnover per employee compared to non-beneficiaries (see Figure 18 and Table 43). Looking at the entire post-treatment period (from t+1 to t+7), it was found that beneficiaries have a median increase of £5,000 per year higher turnover per employee compared to matched non-beneficiaries (see Table 6).

Figure 18 Turnover per employee: median absolute and percentage change from the baseline for beneficiaries and non-beneficiaries: BBSRC-led strategic CR&D investments



Source: Business Structure Database. Note: the sample size is split roughly evenly between beneficiaries and non-beneficiaries. Forecasts are marked with dotted lines in the figures or with the letter 'f' in the tables

Table 43 Turnover per employee: difference-in-difference estimates between beneficiaries and non-beneficiaries: BBSRC-led strategic CR&D investments

	t+1	t+2	t+3	t+4	t+5	t+6	t+7	t+8f	t+9f	t+10f	Median
Absolute terms (£k)	16	9	9	6	6	36	-12	5	4	3	5
Percentage points (ppt)	9	11	20	27	10	35	16	27	29	31	16
Sample	128	128	112	57	51	42	28	-	-	-	128

Source: Business Structure Database. Note: the sample size is split roughly evenly between beneficiaries and non-beneficiaries. The sample excludes outliers defined as three standard deviations above or below the mean

D.4.4.4 Return on investment (ROI)

The ROI figures for the BBSRC-led strategic CR&D investment category are displayed in Table 44. The cumulative figures represent the growth in GVA from the baseline, based on the group of companies that fall within the interquartile range i.e., companies with cumulative GVA figures that are within the upper and lower median values. The net increase in cumulative GVA represents the value of GVA for beneficiaries over and above that for matched non-beneficiaries. The net increase in GVA accumulated over the entire treatment period with observed data i.e., excluding the forecast is compared to the cost of funding for matched companies included in the analysis to present a ROI figure.

The net cumulative value of GVA gained since the baseline is worth £28 million, compared to a BBSRC investment funding cost of £3 million and private sector co-investment of £0.638 million (£0.242 million in cash and £0.396 million in-kind contributions) from industry partners. The analysis for the BBSRC-led strategic CR&D investment category indicates that:

- For every £1 invested by BBSRC, the funding has generated £9 in economic benefits
- For every £1 invested by BBSRC and industry partners, the funding has generated £7 in economic benefits

Table 44 Return on Investment for the BBSRC-led strategic CR&D investment category

	BBSRC-led strategic CR&D investment
Cumulative change in GVA for beneficiaries *	£20m
Net cumulative GVA *	£28m
Net cumulative GVA per company *	£0.892m
Value of BBSRC investment *	£3m
Value of cash contributions *	£0.242m
Value of in-kind contributions *	£0.396m
Return on investment ratio	1:9
Return on investment ratio for BBSRC and private sector co-investment in terms of cash and in-kind contributions	1:7
Sample size of beneficiaries	31

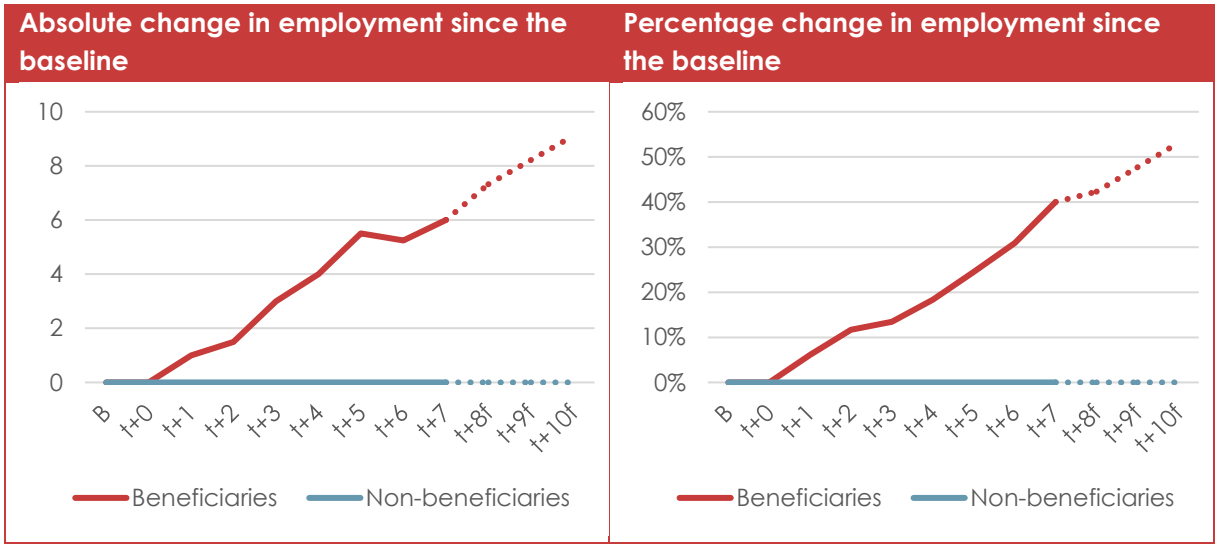
Source: Business Structure Database. Note: *the figure includes businesses who were successfully identified in IDBR and fall within the interquartile range

D.4.5 Strategic co-funding (across UKRI)

D.4.5.1 Employment impacts

The results indicate that industry partners who have collaborated with recipients of strategically co-funded awards have experienced a steady increase in employment compared to the baseline (see Figure 19 and Table 45). Seven years after the first project start date, beneficiaries saw a median increase of six additional employees, while non-beneficiaries experienced no significant changes in employment (40ppt vs 0ppt median growth respectively). The trend is forecasted to peak in period t+10f, with nine additional employees in favour of beneficiaries. Over the entire period with observed data, the median annual employment growth for beneficiaries is four employees more than the median increase for non-beneficiaries.

Figure 19 Median change in employment since the baseline for beneficiaries and non-beneficiaries: Strategic co-funding across (UKRI)



Source: Business Structure Database. Forecasts are marked with dotted lines in the figures or with the letter 'f' in the tables

Table 45 Employment: difference-in-difference estimates between beneficiaries and non-beneficiaries: Strategic co-funding across (UKRI)

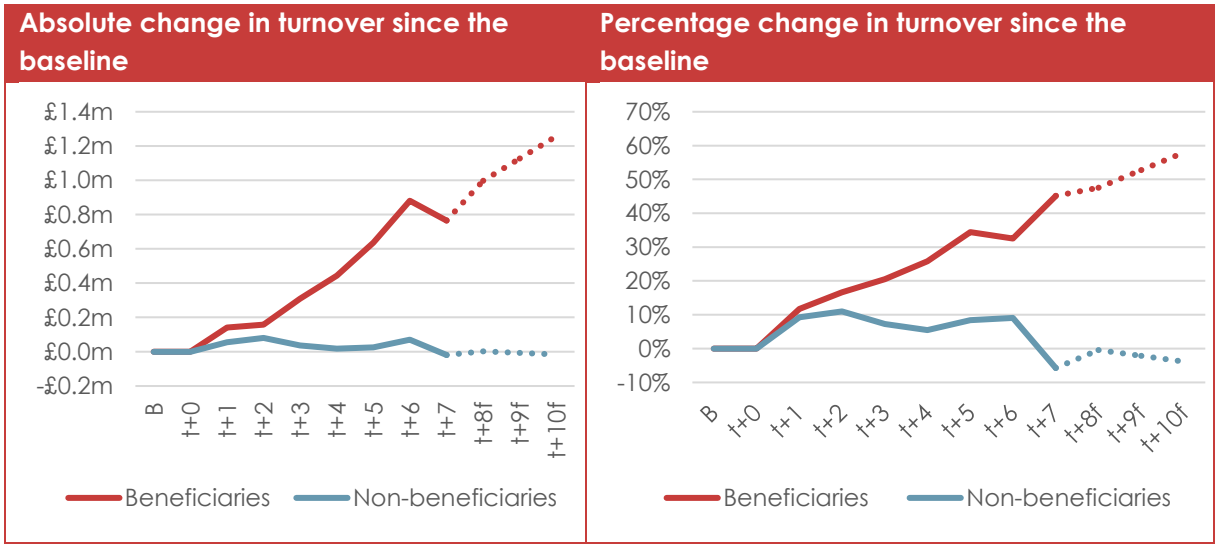
	t+1	t+2	t+3	t+4	t+5	t+6	t+7	t+8f	t+9f	t+10f	Median
Absolute	1	2	3	4	6	5	6	7	8	9	4
Percentage points (ppt)	6	12	13	18	25	31	40	42	48	53	18
Sample size	399	399	389	371	357	232	126	-	-	-	399

Source: Business Structure Database. Note: the sample size is split roughly evenly between beneficiaries and non-beneficiaries. The sample excludes outliers defined as three standard deviations above or below the mean

D.4.5.2 Turnover impacts

When changes in performance over time are observed, the results indicate that turnover for beneficiaries grew by £141,000 in the year after the project start date, rising to £765,000 seven years after the project start date (see Figure 20 and Table 46). In contrast, for non-beneficiaries, the median increase in turnover was close to zero over the entire period from t1 to t7. Defining the turnover growth benefit as the median increase by which beneficiaries outperform non-beneficiaries, it was found that the median benefit per year is £411,000 over a seven-year period with observed data. If we assume that the current trends continue into the future, the forecast indicates that the gap between the two groups is expected to peak at £1.2 million in favour of beneficiaries in period t+10f.

Figure 20 Median change in turnover since the baseline for beneficiaries and non-beneficiaries: Strategic co-funding (across UKRI)



Source: Business Structure Database. Note: the sample size is split roughly evenly between beneficiaries and non-beneficiaries. Forecasts are marked with dotted lines in the figures or with the letter 'f' in the tables

Table 46 Turnover: difference-in-difference estimates between beneficiaries and non-beneficiaries: Strategic co-funding across (UKRI)

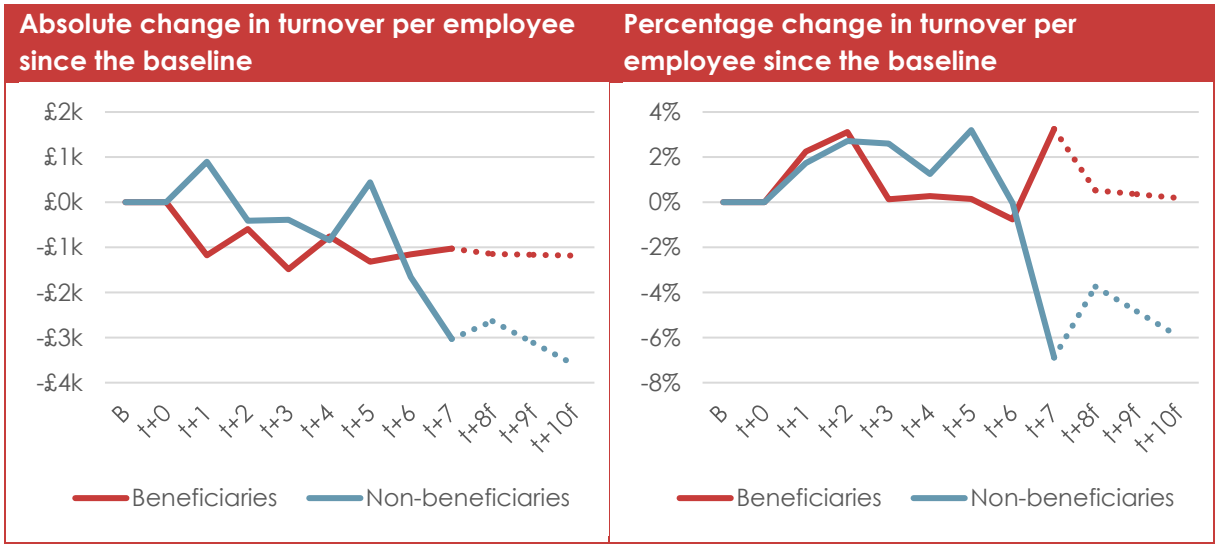
	t+1	t+2	t+3	t+4	t+5	t+6	t+7	t+8f	t+9f	t+10f	Median
Absolute (£k)	86	78	272	426	610	810	785	995	1,134	1,273	411
Percentage points (ppt)	2	6	13	20	26	23	51	48	55	62	12
Sample	396	399	392	379	369	253	144	-	-	-	396

Source: Business Structure Database. Note: the sample size is split roughly evenly between beneficiaries and non-beneficiaries. The sample excludes outliers defined as three standard deviations above or below the mean

D.4.5.3 Turnover per employee impacts

Figure 21 represents the effects on labour productivity i.e., turnover per employee, associated with the programme up to seven years after the project start date relative to the two-year average prior to initiating the project. Both beneficiaries and non-beneficiaries have experienced a decline in the absolute median value of turnover per employee, with the decline being more pronounced for beneficiaries up to t+5. After this point, the trends reverse, with beneficiaries slightly outperforming non-beneficiaries. However, the data points for both groups remain below zero.

Figure 21 Turnover per employee: median absolute and percentage change from the baseline for beneficiaries and non-beneficiaries: Strategic co-funding across (UKRI)



Source: Business Structure Database. Note: the sample size is split roughly evenly between beneficiaries and non-beneficiaries. Forecasts are marked with dotted lines in the figures or with the letter 'f' in the tables

As shown in Table 47, over the seven-year treatment period with observed data, we find that the annual change in the median turnover per employee is £2,000 lower for beneficiaries compared to matched non-beneficiaries.

Table 47 Turnover per employee: difference-in-difference estimates between beneficiaries and non-beneficiaries: Strategic co-funding across (UKRI)

	t+1	t+2	t+3	t+4	t+5	t+6	t+7	t+8f	t+9f	t+10f	Median
Absolute (£k)	-2	0	-1	0	-2	1	2	1	2	2	-2
Percentage points (ppt)	1	0	-2	-1	-3	-1	10	4	5	6	-3
Sample size	393	394	390	379	368	254	142	-	-	-	393

Source: Business Structure Database. Note: the sample size is split roughly evenly between beneficiaries and non-beneficiaries. The sample excludes outliers defined as three standard deviations above or below the mean

D.4.5.4 Return on investment (ROI)

The ROI figures for the non-BBSRC led strategic co-funding investment category are shown in Table 48. The cumulative figures represent the growth in GVA from the baseline, based on the group of companies that fall within the interquartile range i.e., companies with cumulative GVA figures that are within the upper and lower median values. The net increase in cumulative GVA represents the value of GVA for beneficiaries over and above that for matched non-beneficiaries. The net increase in GVA accumulated over the entire treatment period with observed data i.e., excluding the forecast, was compared to the cost of funding for matched companies included in the analysis to present a ROI figure.

The net cumulative value of GVA gained since the baseline is worth £112 million, compared to an investment cost of £13 million and private sector co-investment of £2.7 million (£0.585 million in cash and £2.1 million in-kind contributions) from industry partners. The analysis for the non-BBSRC led strategic co-funding investment category indicates that:

- For every £1 invested by BBSRC, the funding has generated £9 in economic benefits
- For every £1 invested by BBSRC and industry partners, the funding has generated £7 in economic benefits

Table 48 Return on investment for the Strategic Co-funding Investment category

	Strategic co-funding (across UKRI)
Cumulative change in GVA for beneficiaries *	£172m
Net cumulative GVA *	£112m
Net cumulative GVA per company *	£1.2m
Value of BBSRC investment *	£13m
Value of cash contributions *	£0.585m
Value of in-kind contributions *	£2.1m
Return on investment ratio	1:9
Return on investment ratio for BBSRC and private sector co-investment in terms of cash and in-kind contributions	1:7
Sample size of beneficiaries	95

Source: Business Structure Database. Note: *the figure includes businesses who were successfully identified in IDBR and fall within the interquartile range

D.4.6 *Average difference-in-difference modelling results*

This section includes the regression analysis results based on the average estimates, instead of the medians. The analysis excludes outliers defined as values three standard deviations above or below the mean. However, the average figures may be significantly higher or lower than the median if the outcome variable is skewed and there is a cluster of values on one side of the distribution and a long "tail" on the other. Even when outliers are removed, the average absolute values from the regression model tend to be influenced by the presence of larger companies in the sample. As we do not expect immediate impacts to materialise close to the project start date, the model uses one period lag of the treatment variable.

The average difference-in-difference coefficients of the lagged treatment variable is shown in Table 49.

Table 49 Average difference-in-difference coefficients of the lagged treatment variable, per investment category

		Absolute values			**Percentage terms**		
		Employment	**Turnover (£k)**	**Turnover per employee (£k)**	**Employment**	**Turnover**	**Turnover per employee**
Responsive Mode grant awards with industry partners	Coefficient	4.8	4,805	45.4	-9%	6%	13%
	Standard error	22.3	10,328	43.5	15%	17%	12%
	P-value	83%	64%	30%	54%	73%	29%
	R2	0%	0%	0%	0%	0%	0%
	No. groups	307	308	308	308	308	308
IPA and LINK Awards	Coefficient	-2	21,122	92	9%	47%	19%
	Standard error	28	20,900	83	14%	15%	9%
	P-value	94%	31%	27%	52%	0%	4%
	R2	0	0	0.001	0%	0%	0%
	No. groups	938	938	939	939	939	936
Community and Capacity building	Coefficient	60.2	29,427	-6.0	20%	-5%	-10%
	Standard error	49.4	18,630	23.74896	7%	14%	8%
	P-value	22%	11%	80%	0%	71%	20%

	R2	0%	0%	0%	1%	1%	1%
	No. groups	1,936	1,935.0	1,939.0	1,933.0	1,932.0	1,932.0
BBSRC-led strategic CR&D investment	Coefficient	28.0	-4,949	12.1	19%	22%	-2%
	Standard error	17.9	11,518	54.1	9%	20%	12%
	P-value	12%	67%	82%	4%	27%	90%
	R2	0%	0%	0%	0%	0%	0%
	No. groups	674	676	677	677	677	677
Strategic co-funding (across UKRI)	Coefficient	27.1	2,776	23.0	26%	38%	7%
	Standard error	25.1	5,362	39.0	7%	8%	6%
	P-value	28%	61%	56%	0%	0%	21%
	R2	0%	0%	0%	0%	0%	0%
	No. groups	2,250	2,249	2,254	2,248	2,247	2,240
BBSRC CR&D portfolio	Coefficient	4.14	3,873	64	25%	29%	3%
	Standard error	20.05	6,361	37	4%	5%	3%
	P-value	84%	54%	8%	0%	0%	39%
	R2	0.1%	0.1%	0.0%	0.2%	1%	0%
	No. groups	5,126	5,121	5,131	5,117	5,113	5,094

D.4.7 *Summary of results*

The average and median difference-in-difference coefficients and return on investment analysis is shown in Table 50 and Table 51 respectively.

Table 50 Average and median difference-in-difference coefficients, per investment category

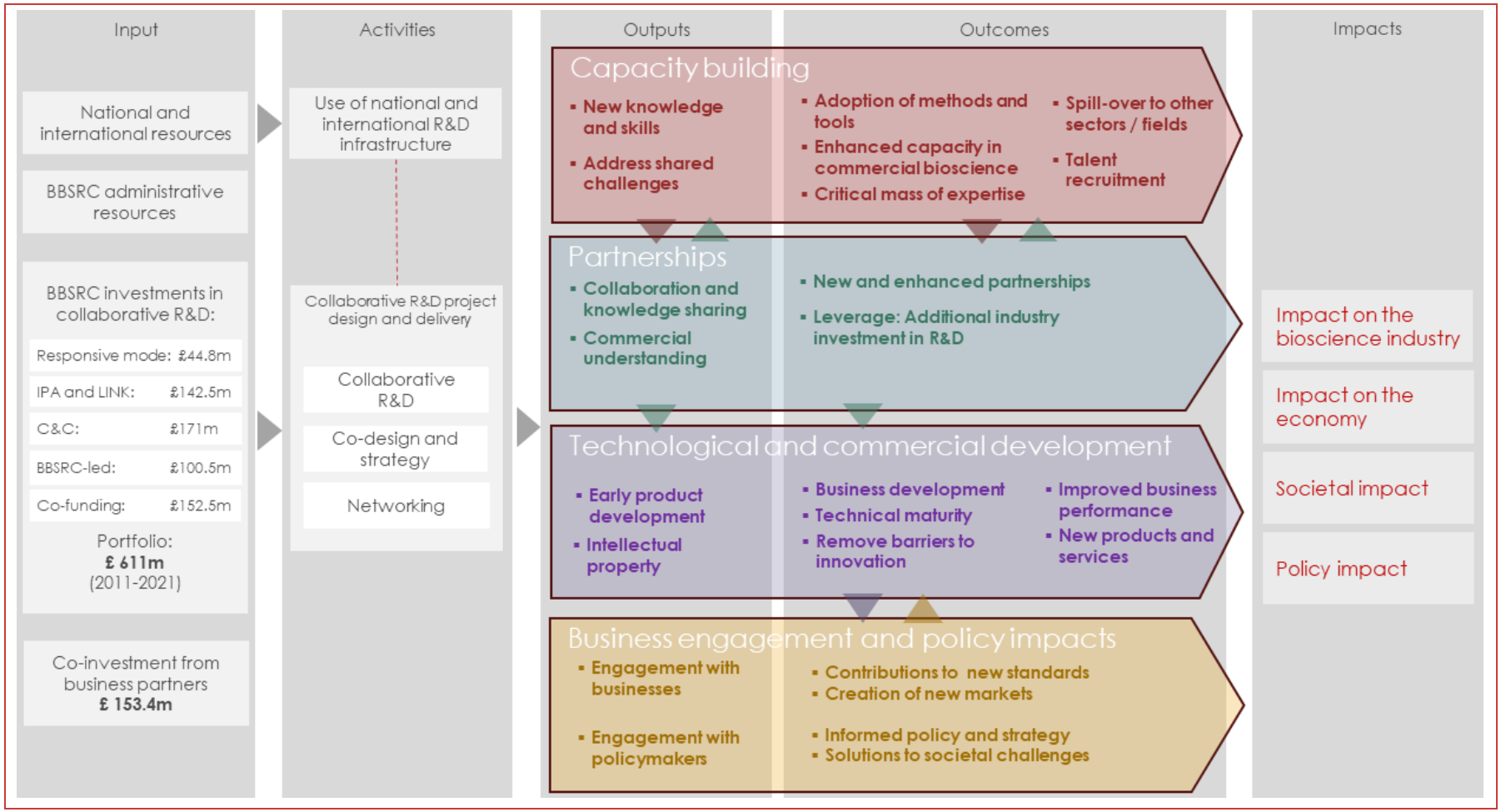
		Absolute values			**Percentage points terms (ppt)**		
		Employment	**Turnover (£k)**	**Turnover per employee (£k)**	**Employment**	**Turnover**	**Turnover per employee**
Responsive Mode grant awards with industry partners	Median	1.5	-419	-0.5	7	-13	-11
	Average	4.8	4,805	45.4	-9	6	13
	Sample	48	48	48	48	48	48
IPA and LINK awards	Median	4.4	956	2.2	16	21	3
	Average	-2	21,122	92	9	47	19
	Sample	188	188	187	187	186	186
Community & Capacity Building Investments	Median	1.3	24	-11.5	10	8	-18
	Average	60.2	29,427	-6.1	20	-5	-10
	Sample	334	334	334	334	330	330
BBSRC-led strategic CR&D investment	Median	-	265	4.5	0	26	16
	Average	28.0	-4,949	12.1	19	22	-2
	Sample	132.0	132	131.0	131.0	129.0	129.0
Strategic co-funding (across UKRI)	Median	4.0	411	-1.5	18	12	-3
	Average	27.1	2,776	23.0	26	38	7
	Sample	403	403	402	402	399	399
BBSRC CR&D portfolio	Median	2.0	145	-2.4	14	13	-4
	Average	4	3,873	64	25	29	3
	Sample	901	901	900	900	894	894

Table 51 Return on investment analysis, per investment category

	Responsive Mode grant awards with industry partners	IPA and LINK awards	Community and Capacity building	BBSRC-led strategic CR&D investment	Strategic co-funding (across UKRI)	BBSRC CR&D portfolio
Cumulative change in GVA for beneficiaries *	£122m	£271m	£12m	£20m	£172m	£184m
Net cumulative GVA *	£36m	£244m	£10m	£28m	£112m	£140m
Net cumulative GVA per company *	£1.4m	£5.8m	£0.120m	£0.892m	£1.2m	£0.646m
Value of programme investment *	£14m	£9m	£1.4m	£3m	£13m	£20m
Value of cash contributions *	£0.094m	£2.6m	£0.033m	£0.242m	£0.585m	£1.4m
Value of in-kind contributions *	£0.298m	£6.2m	£0.271m	£0.396m	£2.1m	£6.6m
Return on investment ratio for BBSRC	1:3	1:25	1:8	1:9	1:9	1:7
Return on investment ratio for BBSRC and private co-investment	1:2.5	1:13	1:6	1:7	1:7	1:5
Sample size of beneficiaries	25	42	86	31	95	217

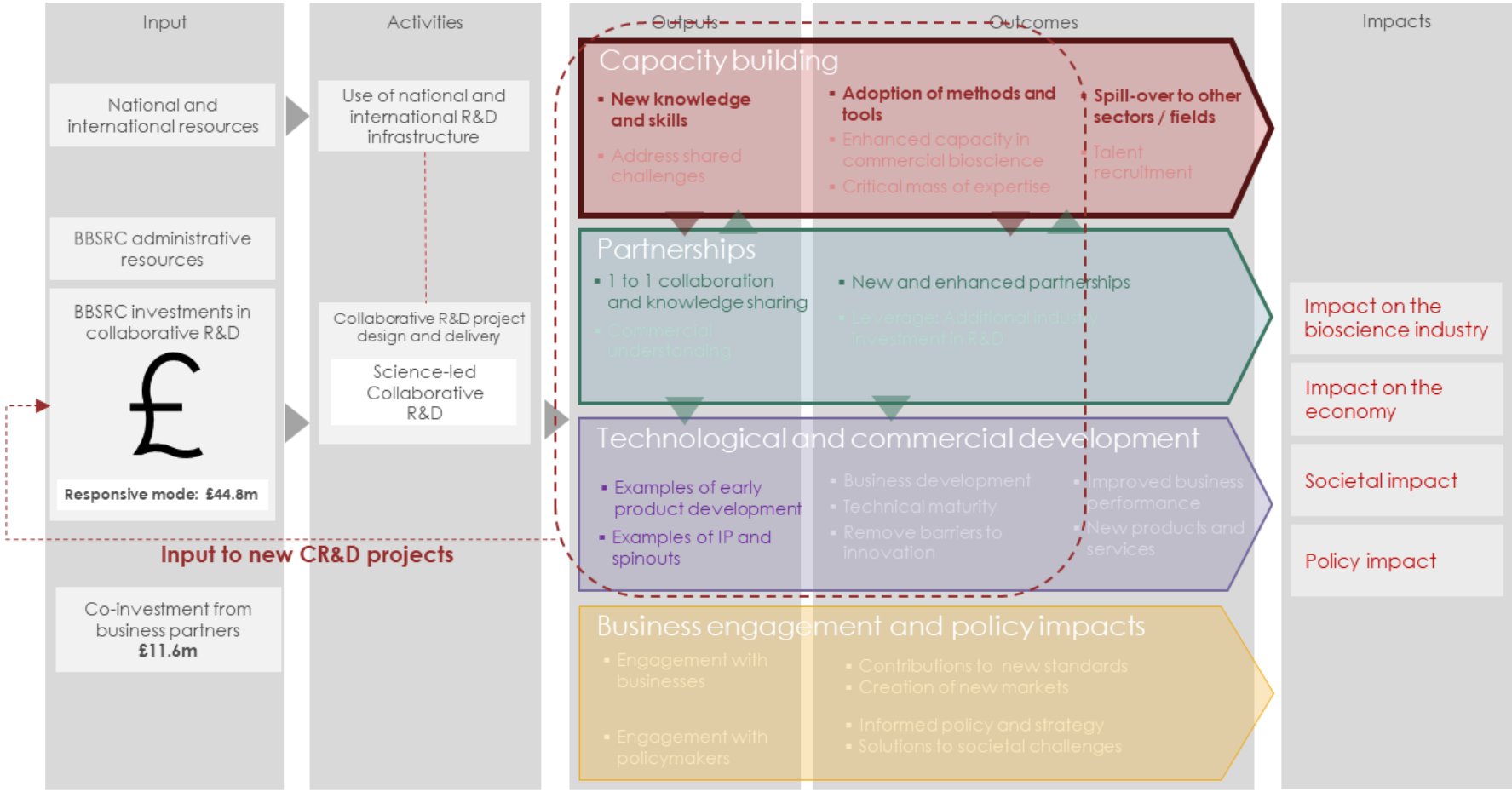
Appendix E Theories of Change

Figure 22 Portfolio-level Theory of Change



Source: Technopolis

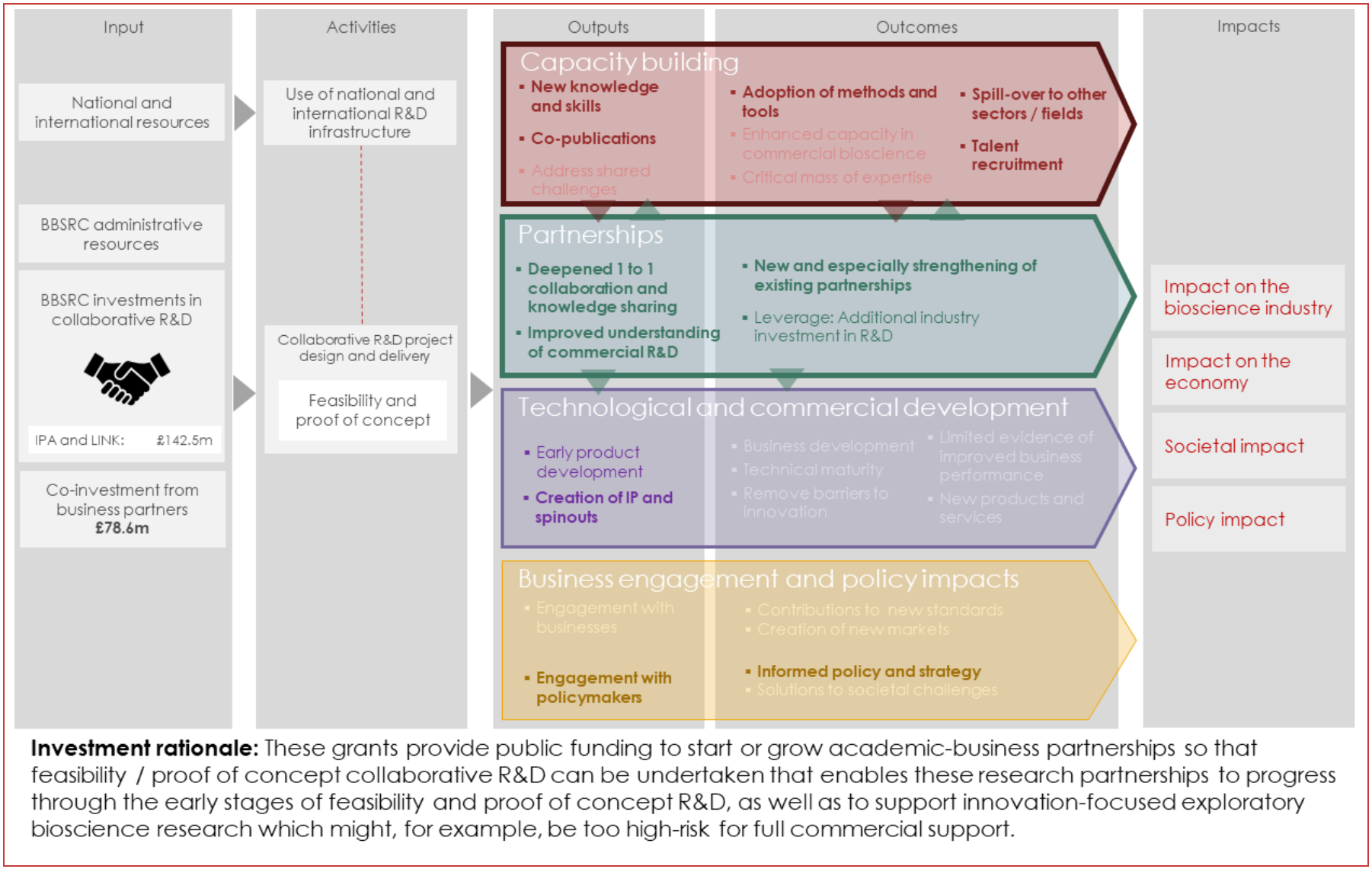
Figure 23 ToC for investment category: Responsive mode with industry



Investment rationale: These competitions are run frequently throughout any given year and the investment rationale is to fund the highest quality, academic-led discovery science. Supporting innovation and collaborative R&D are not priorities for this investment category, but as noted above, occasionally businesses do partner with academic researchers that win these research grants and that is of interest through giving us insight into where there might possibly be early signs of innovation / commercial interest in discovery research areas.

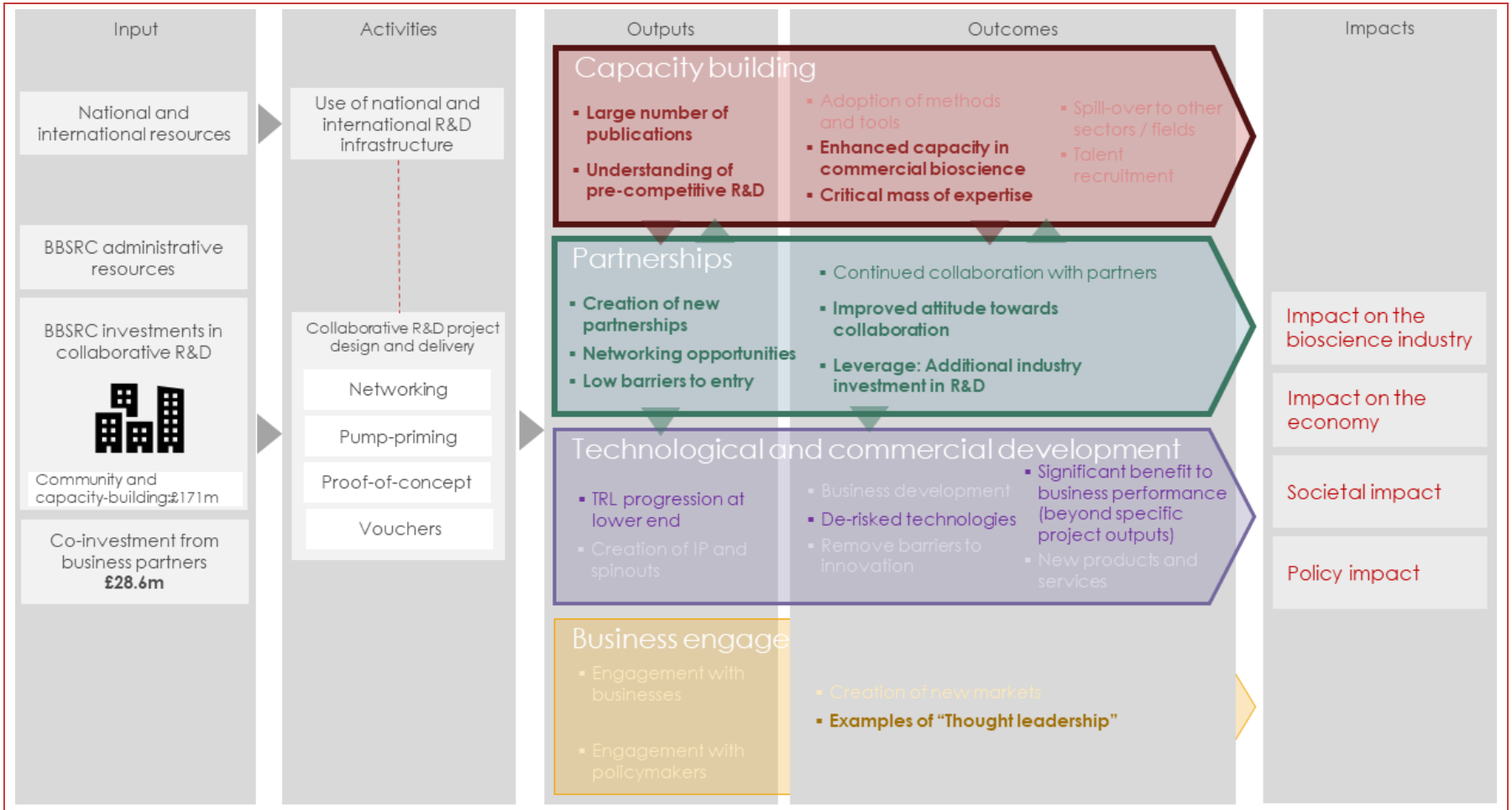
Source: Technopolis

Figure 24 ToC for investment category: IPA and LINK



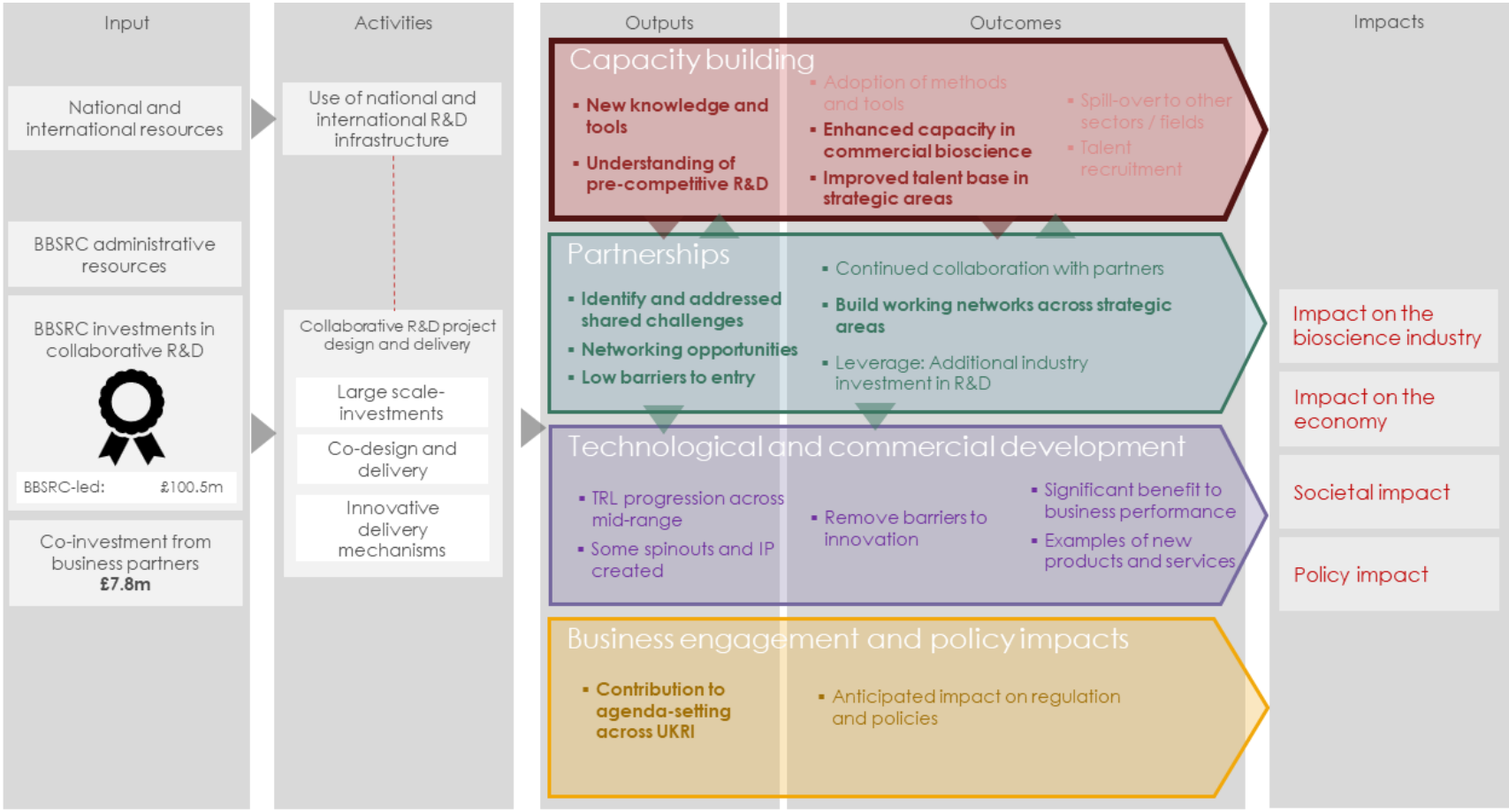
Source: Technopolis

Figure 25 ToC for investment category: Community and Capacity building



Source: Technopolis

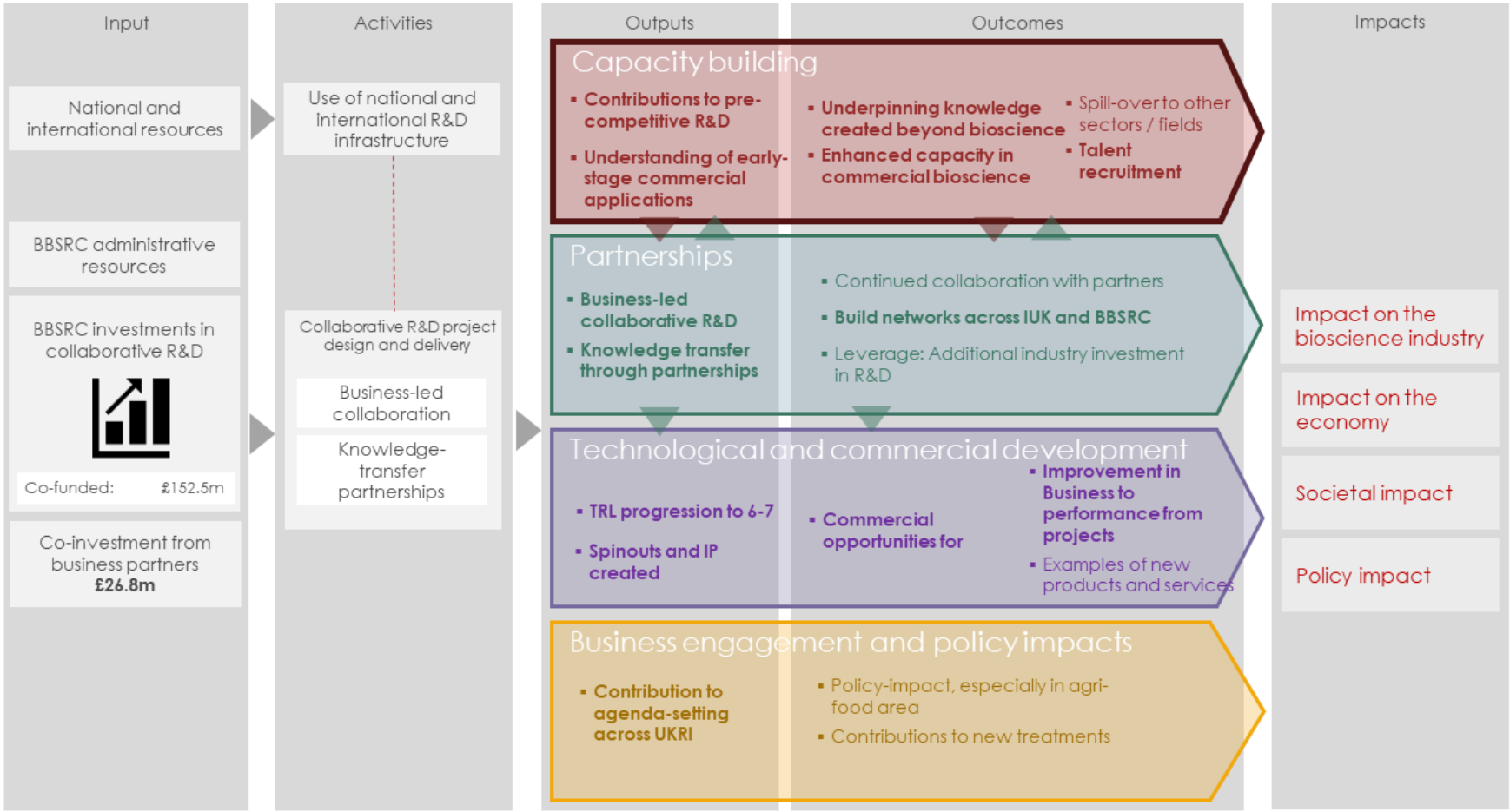
Figure 26 ToC for investment category: BBSRC-led Strategic CR&D investments



Investment rationale: The rationale for these investments is to help address critical national strategy and policy objectives, and/or market failures where public funding can make a difference through supporting pre-competitive research and innovation collaboration. By definition this means that these areas typically support businesses and academic researchers across a sector, industry or particular niche within these at pre-competitive levels, and therefore these schemes will usually involve business competitors. These programmes also focus on what investment model is right for the particular strategic need / innovation barrier(s), and so the types of investment models will vary across programmes.

Source: Technopolis

Figure 27 ToC for investment category: Strategic co-funding



Investment rationale: The investment rationale is focused on strategically supporting bioscience in programmes that have a wider, multidisciplinary scope (and are therefore led elsewhere in UKRI). This typically means that bioscience innovation has a critical underpinning role in the area, such as our support for bioprocessing, which is a critical element of producing gene therapies but outside of the BBSRC's core remit.

Source: Technopolis

Appendix F List of consultees

The following individuals were interviewed for the evaluation:

- Richard Hebdon, Innovate UK
- David Telford, Innovate UK - Biotechnology KTN
- Belinda Clarke, Agri-Tech E
- Paul Mines, Biome Technologies – Industrial Biotechnology Leadership Forum (IBLF)
- Mandy Nevell, Agriculture and Horticulture Development Board (AHDB)
- Malcolm Skingle, GSK
- Kris Wadrop, CPI
- Craig Leadley, Campden BRI
- Simon Berry, Limagrain UK Limited
- David House, GSK
- Reuben Carr, Ingenza Ltd
- Rob Field, Iceni Glycoscience
- Michael Bedford, AB Vista – a unit of AB AGRI
- Tim Hampton, Arlafoods UK
- Tim Bugg, University of Warwick
- John Hardy, Lancaster University
- Mark Reed, Scotland's Rural College (SRUC)
- Robert Edwards, Newcastle University
- Chris Bass, University of Exeter
- Bruce Whitelaw, Roslin Institute - University of Edinburgh
- Ed Louis, University of Leicester
- Zoltan Kevei, Cranfield University
- Susan Rosser, University of Edinburgh
- Jonathan Aylott, University of Nottingham
- Jeremy Webb, University of Southampton
- Lee Beniston, BBSRC

Appendix G Survey of academic leads and project partners

G.1 Overview of survey response

This section summarises the response to the surveys of academic PIs and to the separate survey of project partners.

The survey of academic PIs and Co-Is was launched in September 2023 and follow-up invitations were issued in October and December 2023. The survey was initially distributed only to project PIs, but selected Co-Is were contacted in December 2023 as replacements for project PIs who were unavailable. An overview of respondents is shown in Table 52.

Table 52 Overview of survey response: Academic PIs and Co-Is

Investment category	**Respondents with at least one grant in each category (incl. double counting)**		**Respondents with grants exclusively in each category**	
Responsive Mode grant awards with industry partners	25	29.3%	9	17.7%
IPA and LINK awards	98	35.8%	52	33.8%
Community & Capacity Building Investments	260	34.1%	185	32.0%
BBSRC-led strategic CR&D investments	79	29.6%	37	23.0%
Strategic co-funding (across UKRI)	69	31.5%	27	25.5%
Two or more categories	-	-	97	39.4%
Total	**-**	**-**	**409**	**31.3%**

In the absence of the ability to contact non-academic project partners directly, the partner survey was distributed indirectly. Academic PIs and Co-Is responding to the survey were asked to forward a survey link to their non-academic partners. An overview of these respondents in shown in Table 53.

Table 53 Overview of survey response: Project partners

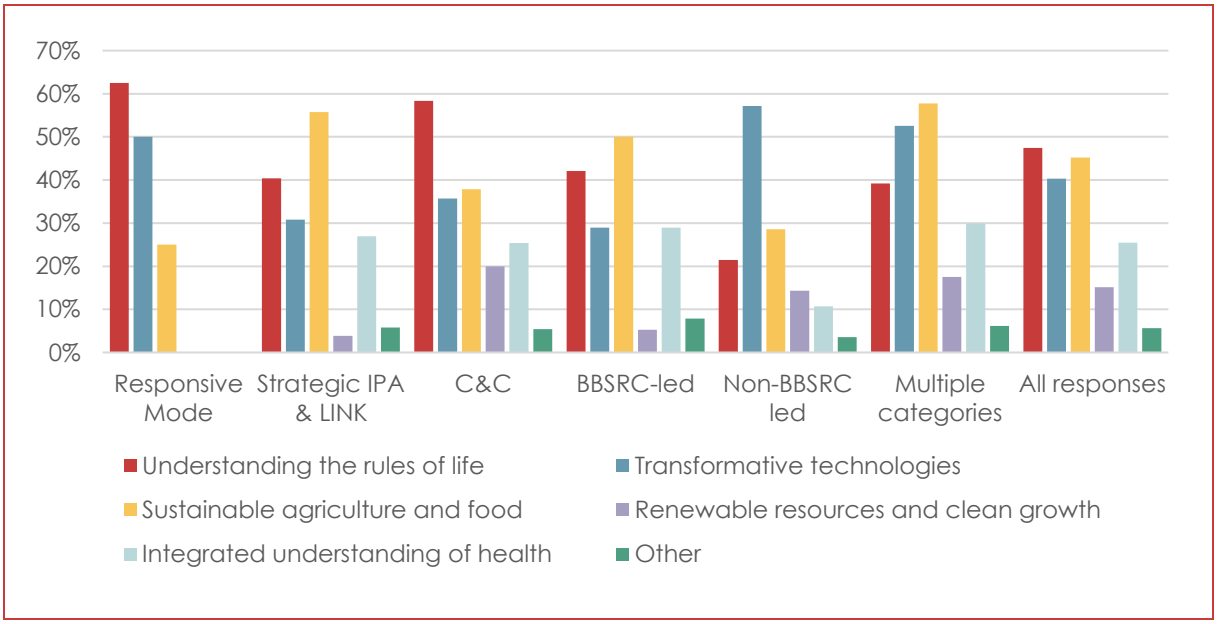
Respondent type	**Responses**
A for-profit company	23
Other non-academic partner	13
Total	**36**

G.2 Descriptive analysis of responses to the survey of academic PIs & Co-Is

G.2.1 *Knowledge and skills*

Q3. Which of the following areas best capture your area of bioscience research in general?

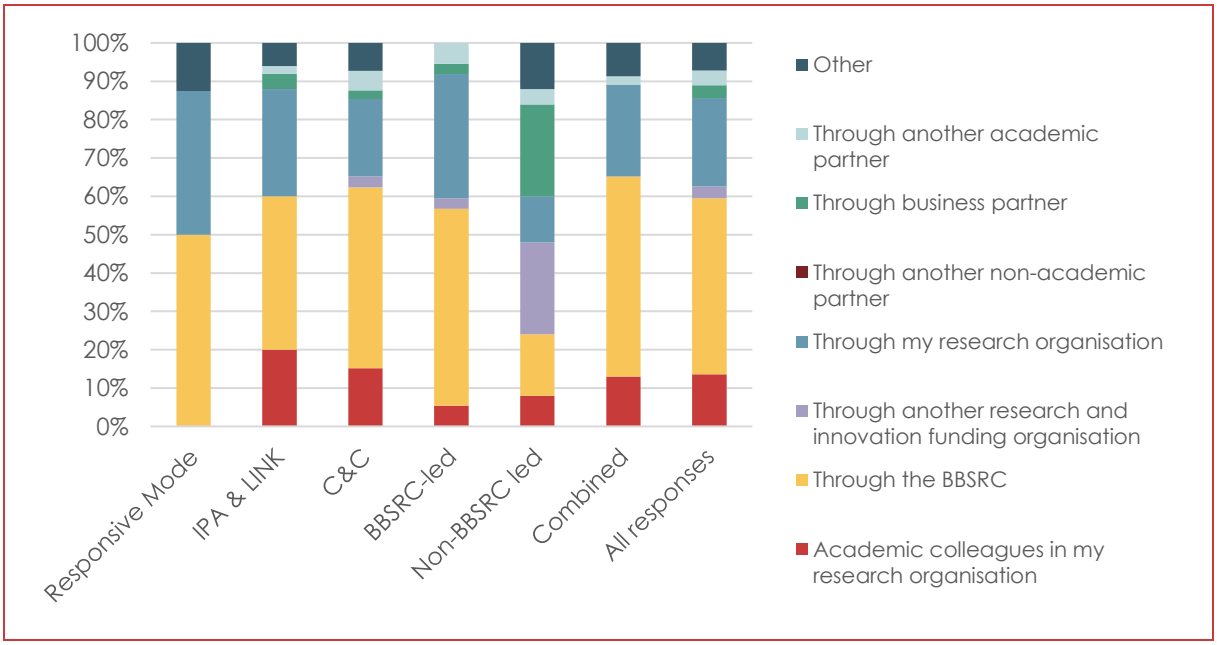
Figure 28 PI research profile, by BBSRC priority area



Source: Survey of BBSRC PIs, n = 407

Q4. How did you first become aware of the opportunity to take part in BBSRC-supported collaborative R&D?

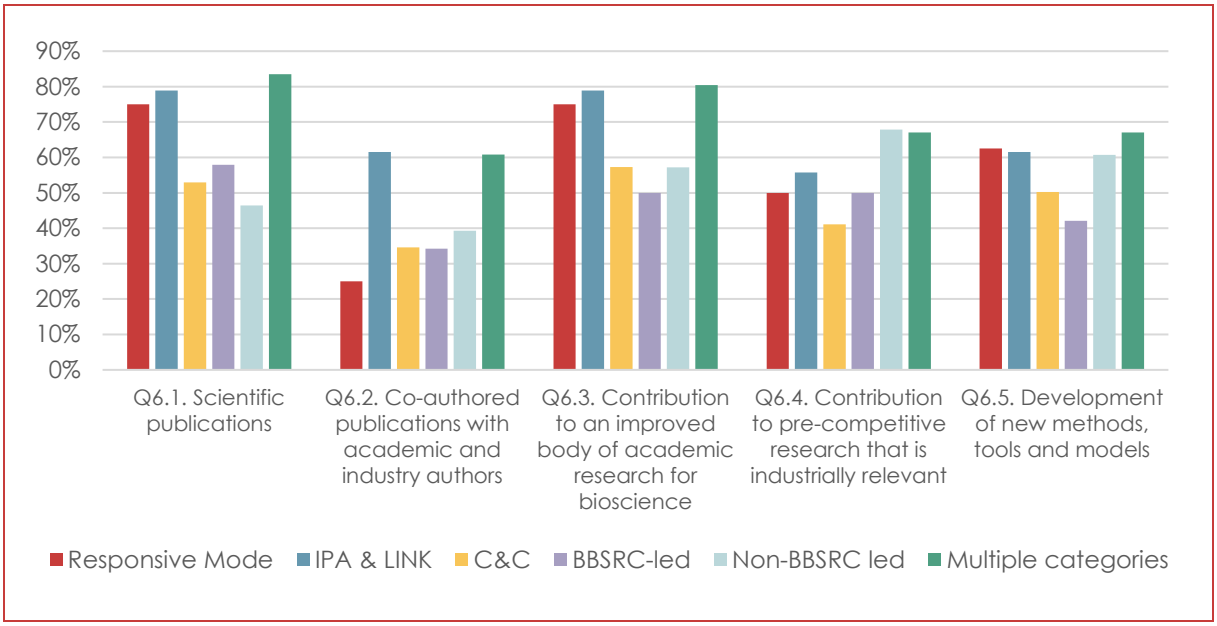
Figure 29 Source of information on BBSRC CR&D opportunities



Source: Survey of BBSRC PIs, n = 390

Q6. To what extent has your BBSRC-funded CR&D project(s) contributed to the development of the following?

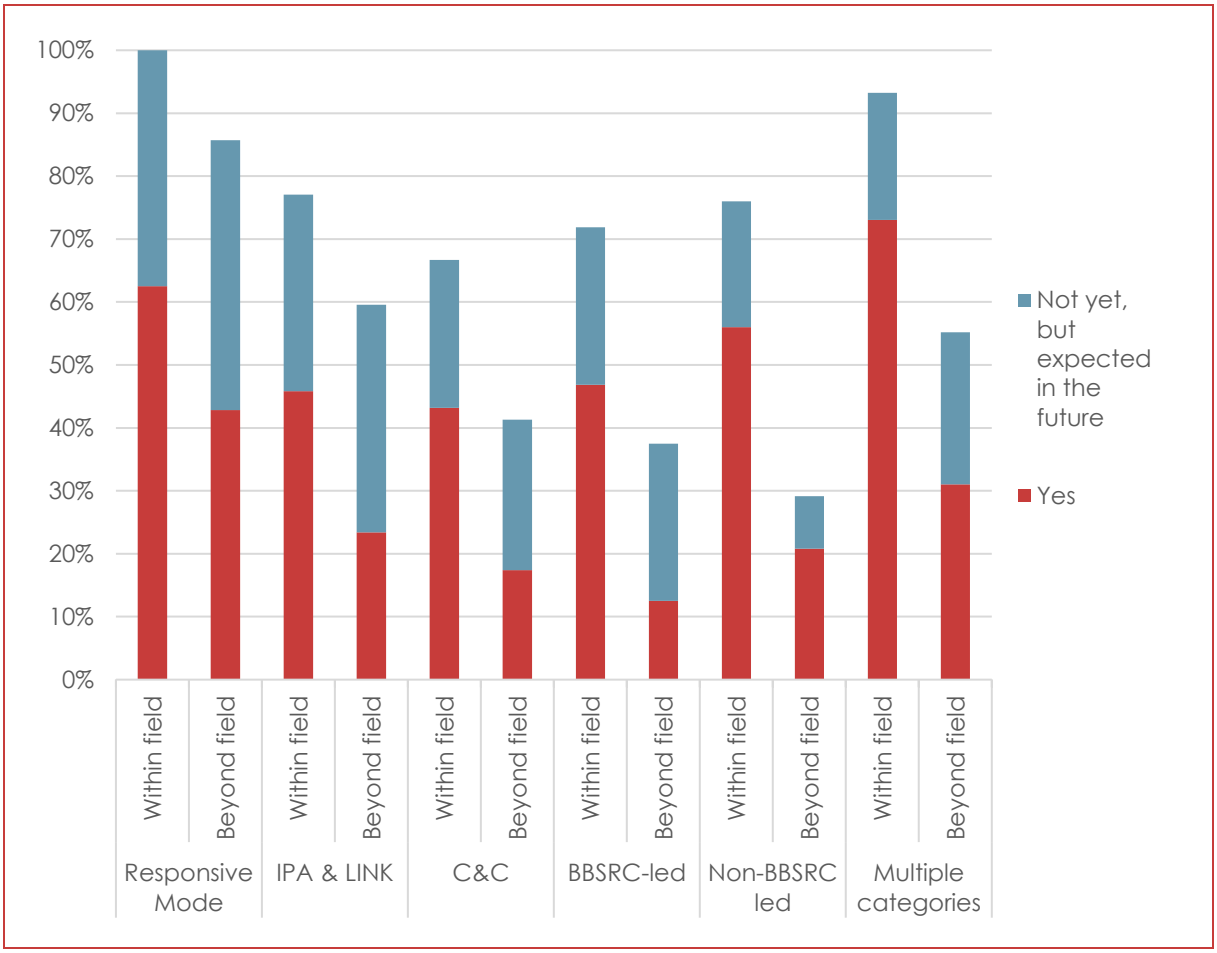
Figure 30 Scientific outputs



Source: Survey of BBSRC PIs, n = 373

Q7. Are you aware if other researchers or companies have taken up project findings or are using new tools, databases, or methodologies developed as part of your BBSRC-funded CR&D project(s)?

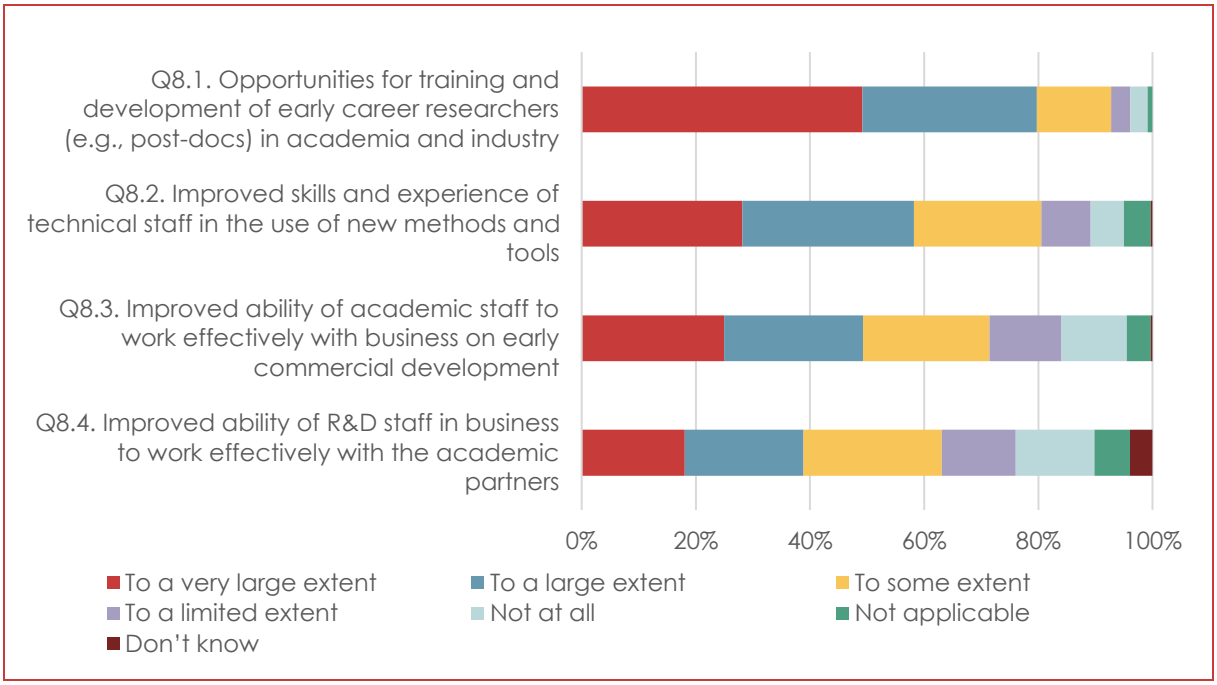
Figure 31 Take-up of tools, databases and methods developed through BBSRC CR&D projects



Source: Survey of BBSRC PIs, n = 364

Q8. To what extent has your BBSRC-funded CR&D project(s) enabled the following skills-related benefits, for yourself and other academic and non-academic members of the team involved in the project(s)?

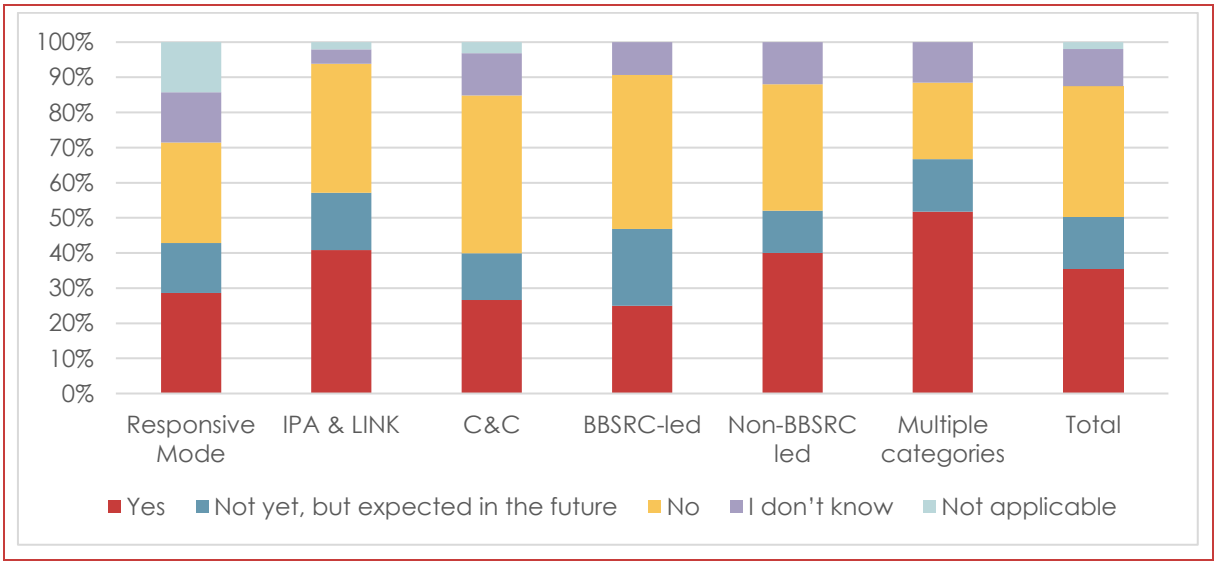
Figure 32 Skills-related benefits enabled by BBSRC CR&D projects



Source: Survey of BBSRC PIs, n = 360

Q9. Are you aware of examples of research and innovation talent being recruited by industry as a result of the collaborative partnership developed as part of your BBSRC-funded CR&D project(s)?

Figure 33 Recruitment of R&I talent by industry



Source: Survey of BBSRC PIs, n = 358

G.2.2 *Technological development*

Q10. Please indicate the technology readiness level (TRL) for technologies that you have developed/are developing within your BBSRC-funded CR&D project(s)

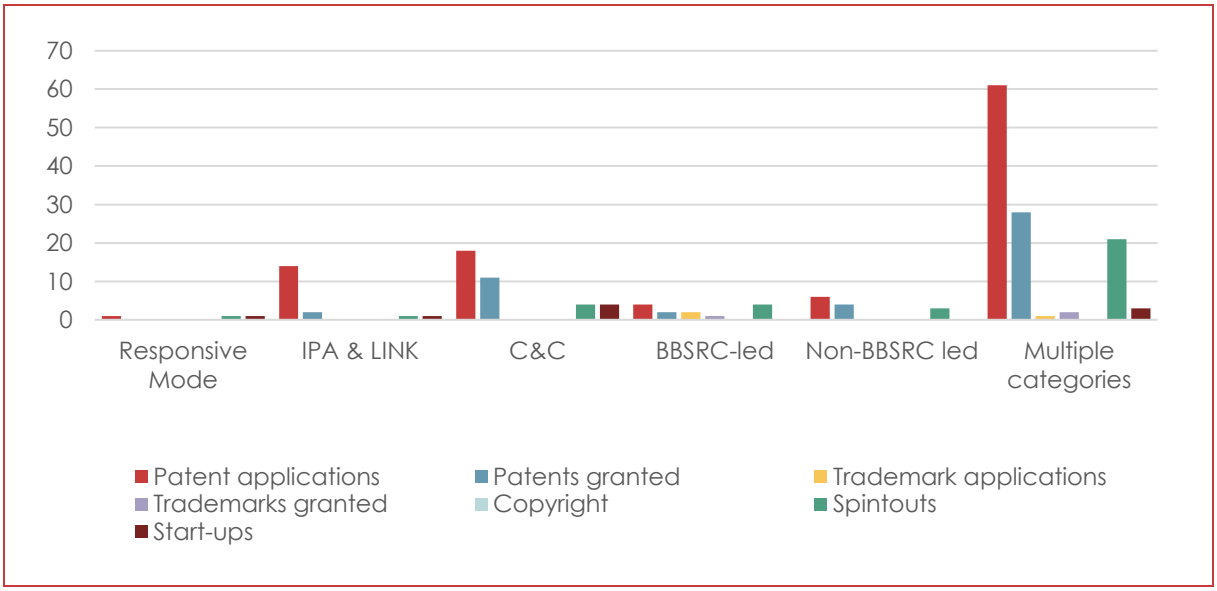
Table 54 Average self-reported TRL progression during and after BBSRC CR&D projects

	TRL at start of project	TRL at end of project	TRL after the end of project
Responsive Mode grant awards with industry partners*	2.36	5.91	7.05
IPA and LINK awards	1.68	4.61	5.30
Community & Capacity Building Investments	2.19	4.42	4.98
BBSRC-led Strategic CR&D investments	2.25	4.80	5.47
Strategic co-funding (across UKRI)	3.07	6.00	6.72
Multiple investment categories	1.87	4.88	5.63

Source: Survey of BBSRC PIs, n = 358 reporting on 688 technologies. Note: *The figures for the 'Responsive mode' category are based on a small number of responses

Q11. Has your BBSRC-funded CR&D project(s) led to any of the following?

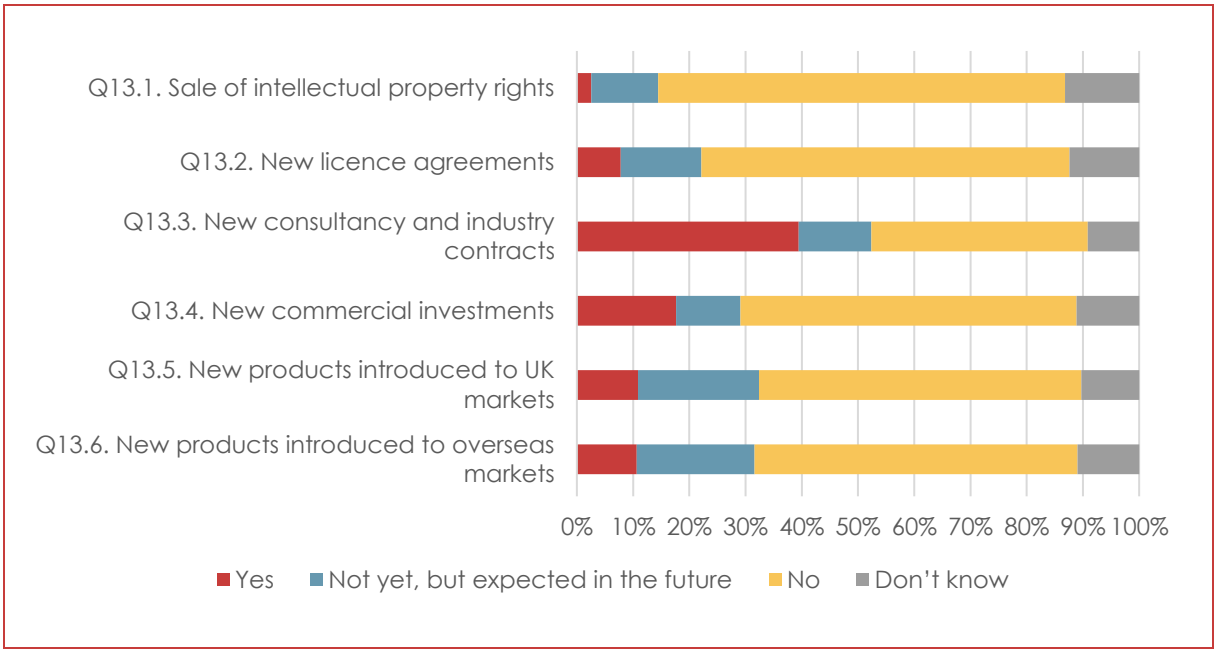
Figure 34 Innovation outputs, by investment category



Source: Survey of BBSRC PIs, n = 358 reporting on 688 technologies

Q13. As far as you know, has your BBSRC-funded CR&D project(s) led to new commercial opportunities for your research organisation or the project business partner following on from initial project results?

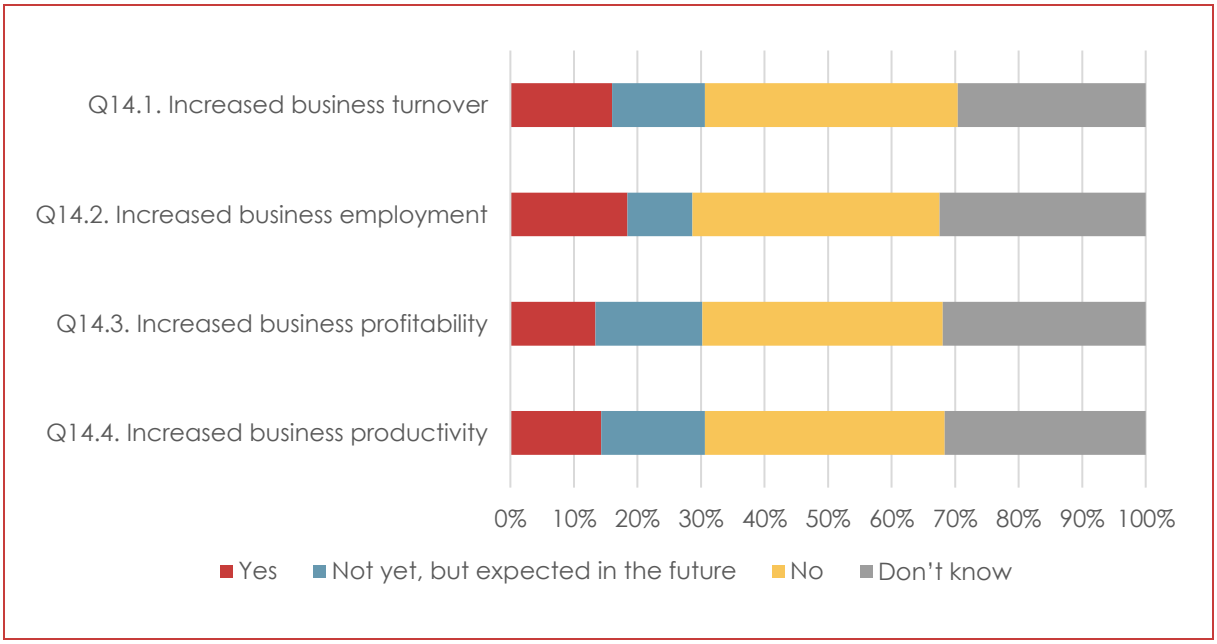
Figure 35 Commercial opportunities resulting from CR&D projects



Source: Survey of BBSRC PIs, n = 317

Q14. As far as you are aware, has your BBSRC-funded CR&D project(s) and follow-on activities helped to deliver any of the following economic benefits for your industry partners?

Figure 36 Economic benefits for industry parts resulting from BBSRC-funded CR&D projects

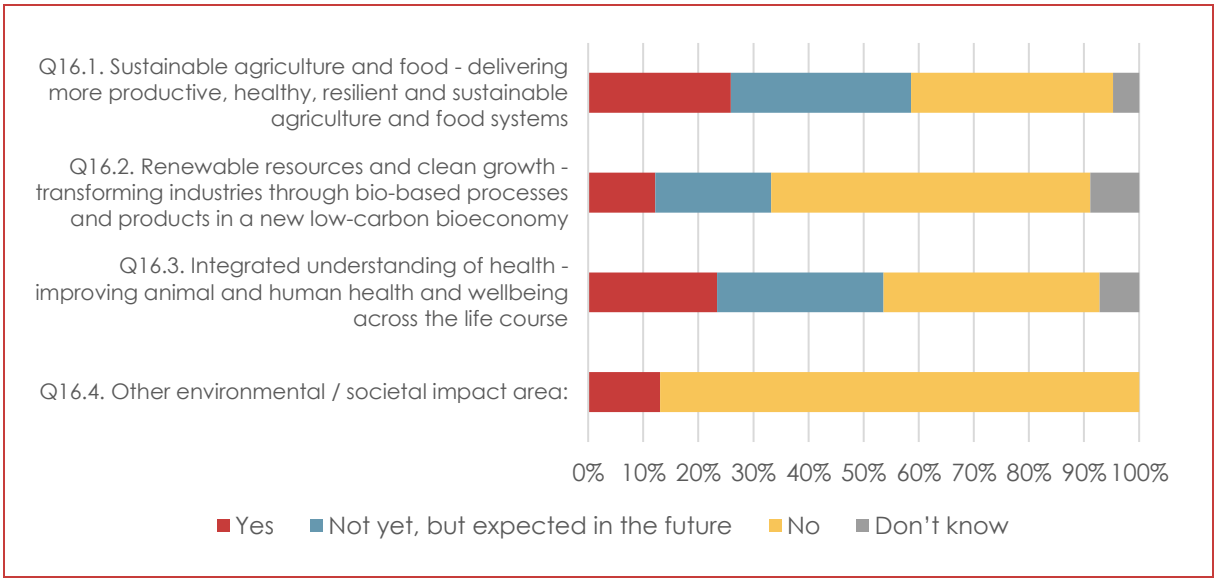


Source: Survey of BBSRC PIs, n = 294

G.2.3 *Policy impact*

Q16. Please indicate whether you believe your BBSRC-funded CR&D project has helped to deliver environmental and societal impacts in any of the following areas?

Figure 37 Environmental and societal impacts of BBSRC CR&D projects

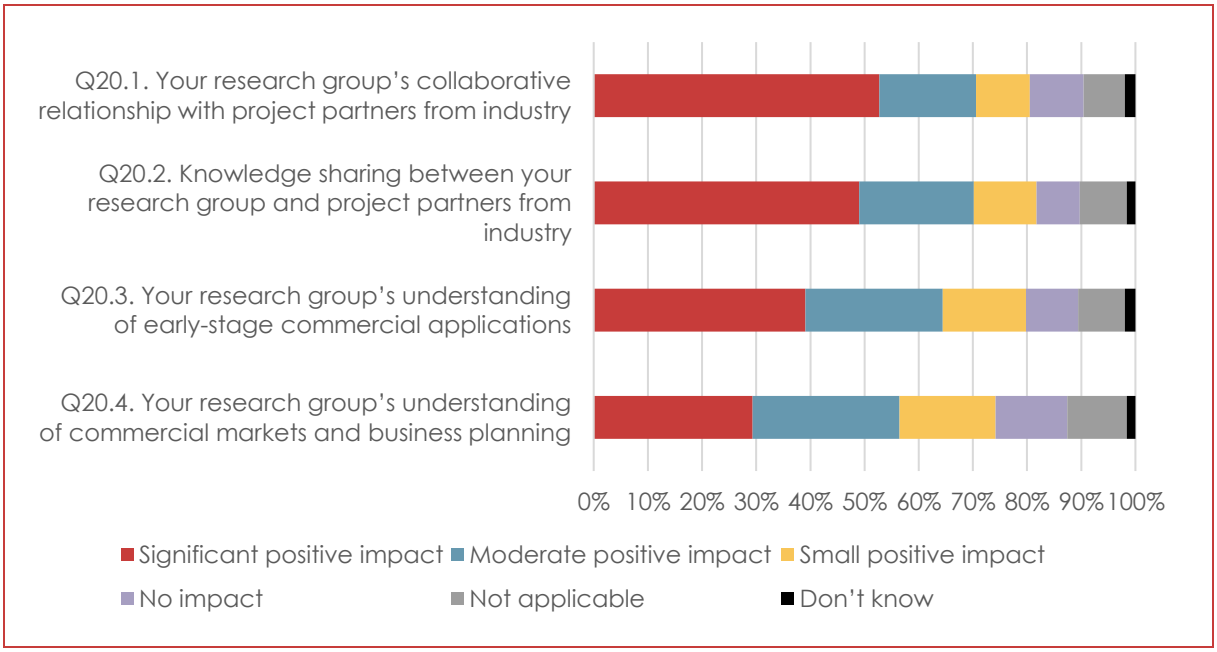


Source: Survey of BBSRC PIs, n = 294

G.2.4 *Partnerships*

Q20. To what extent has your involvement in the BBSRC-funded CR&D project(s) had a positive impact on you / your research group's collaboration with project partners from industry?

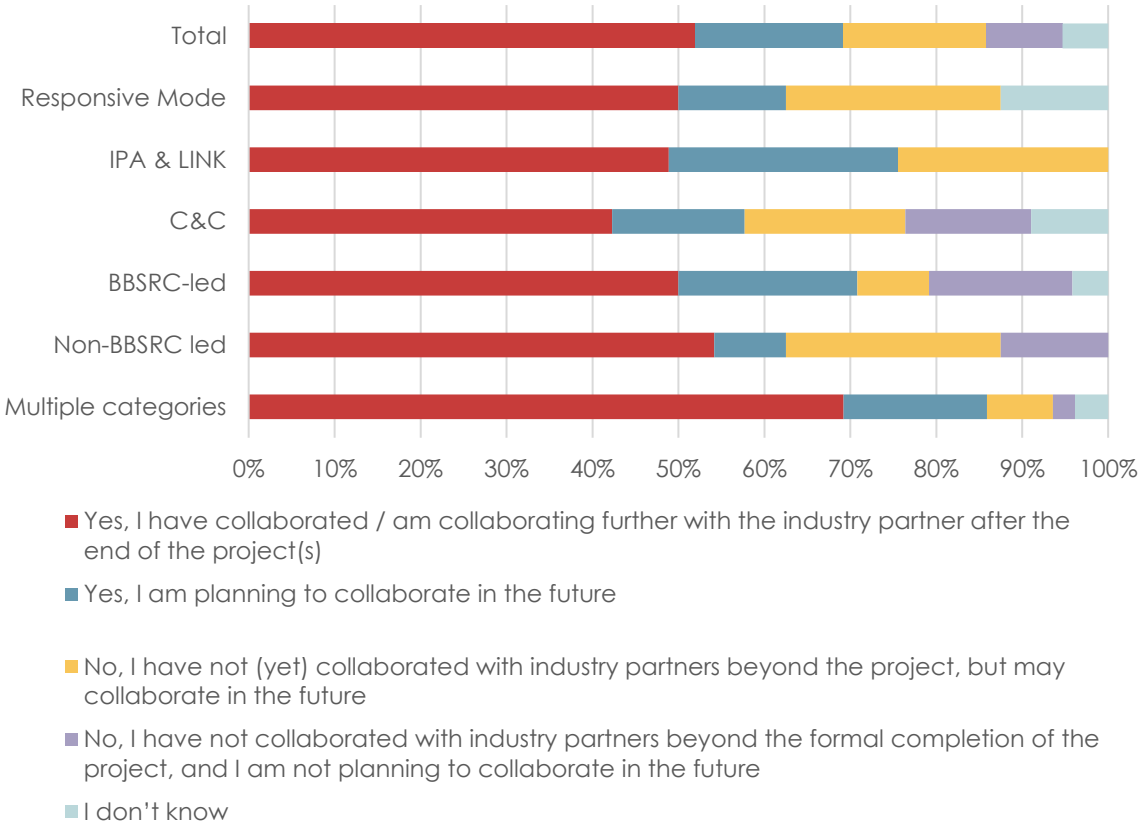
Figure 38 Impact of CR&D projects on collaboration with industry



Source: Survey of BBSRC PIs, n = 313

Q21. Will you continue/have you continued your collaborative relationship with your industry partners after your BBSRC-funded CR&D project(s)?

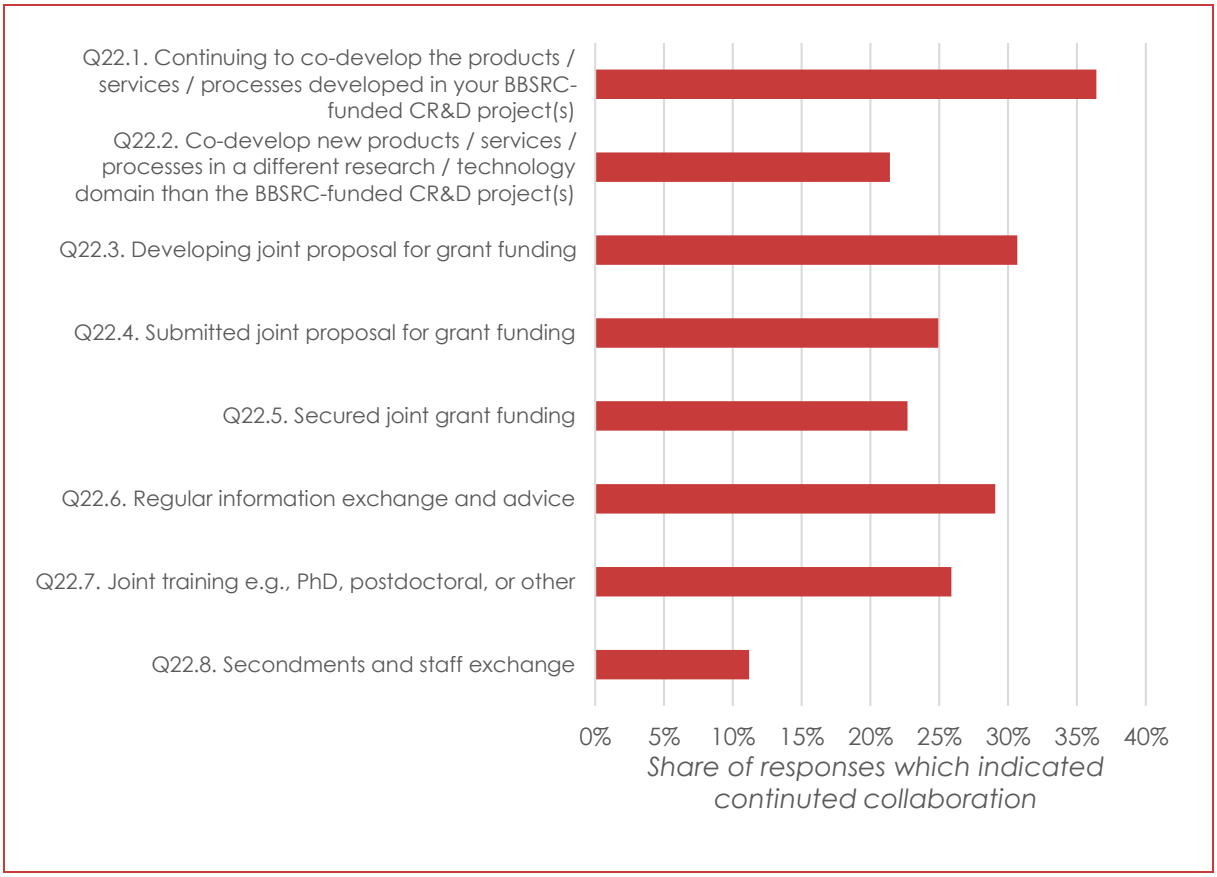
Figure 39 Extent of continued collaboration after BBSRC CR&D projects



Source: Survey of BBSRC PIs, n = 302

Q22. If you have collaborated with industry partners beyond the formal completion of your BBSRC-funded CR&D project(s), please select the options which describe your ongoing collaboration.

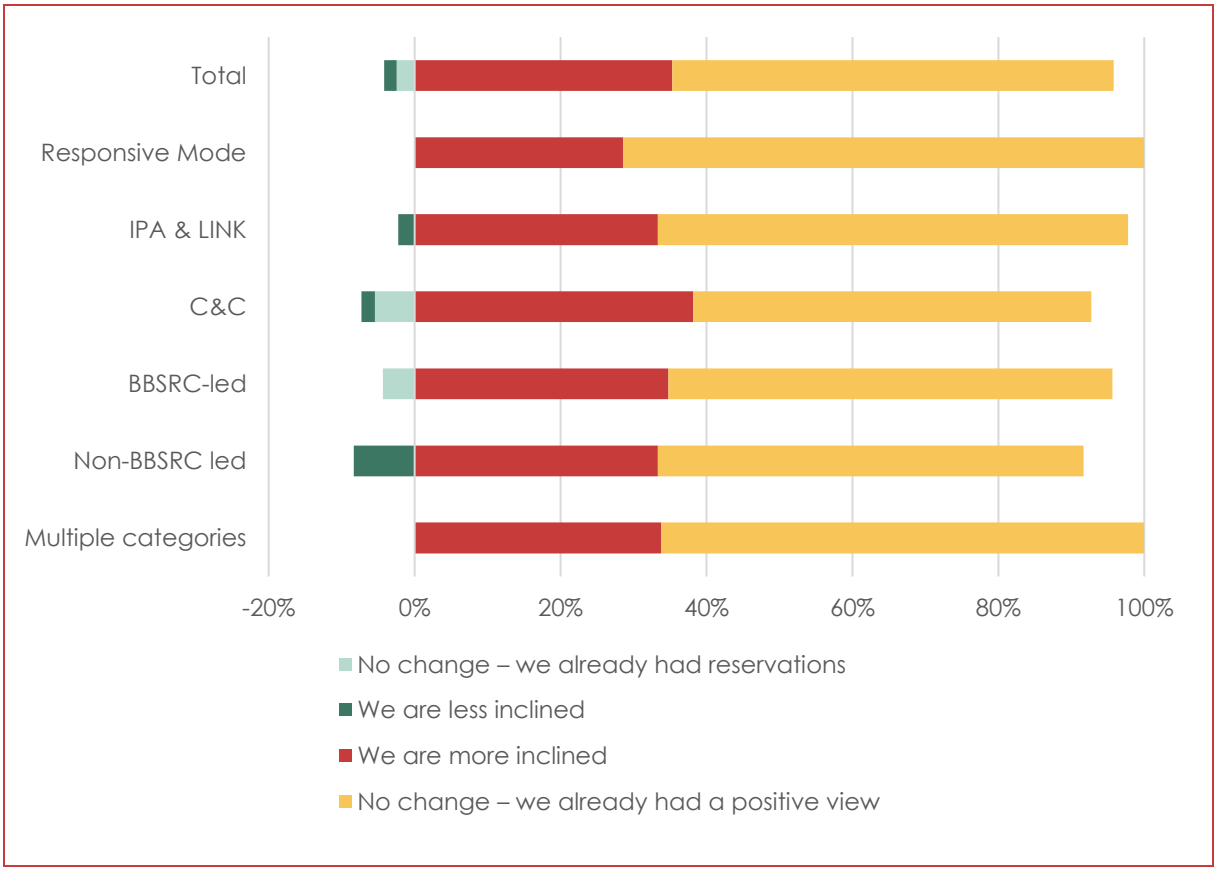
Figure 40 Type of continued collaboration after BBSRC CR&D projects



Source: Survey of BBSRC PIs, n = 114

Q23. Has working within your CR&D-funded project(s) changed your views on undertaking end-user oriented / applied research with industry partners?

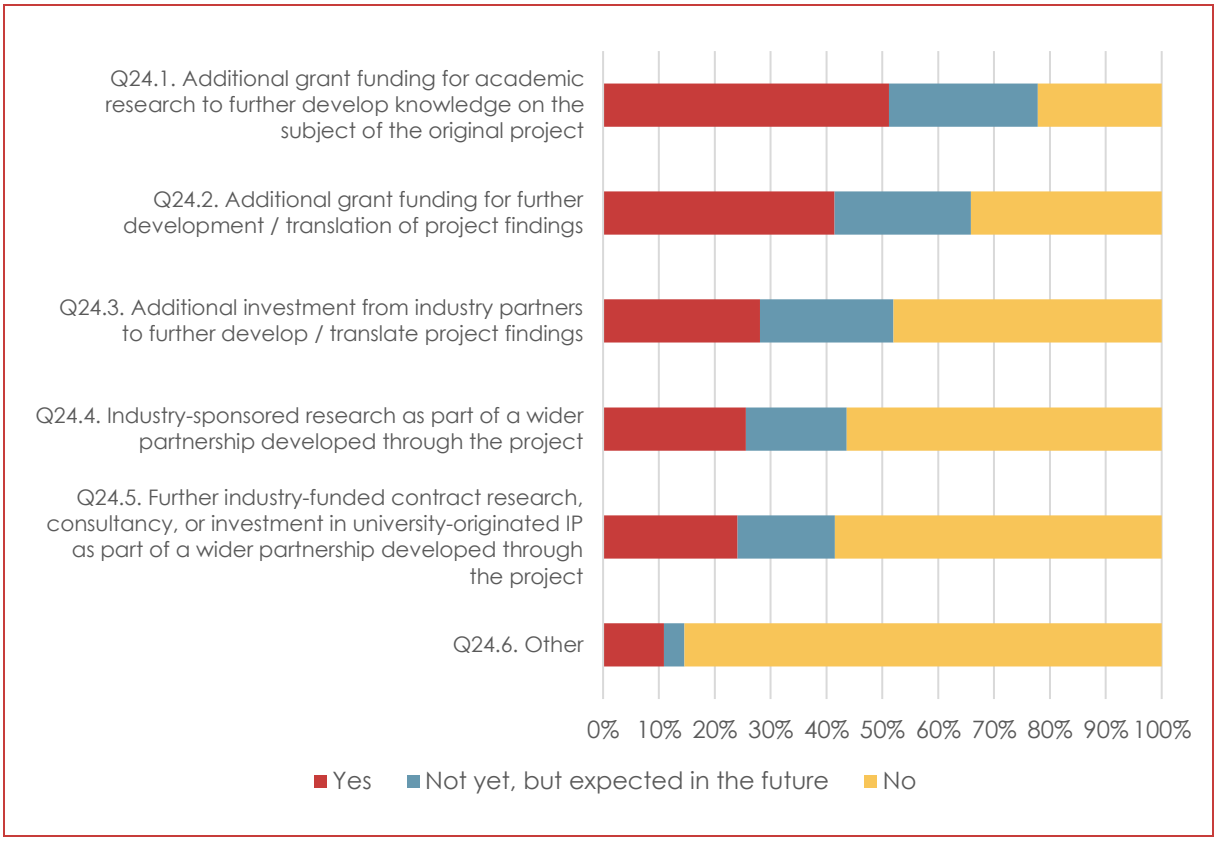
Figure 41 Impact of CR&D projects on attitudes towards collaboration



Source: Survey of BBSRC PIs, n = 286

Q24. Has your BBSRC-funded CR&D project(s) led to additional funding or investment for further research or collaborative R&D?

Figure 42 Additional funding and investment resulting from BBSRC CR&D projects

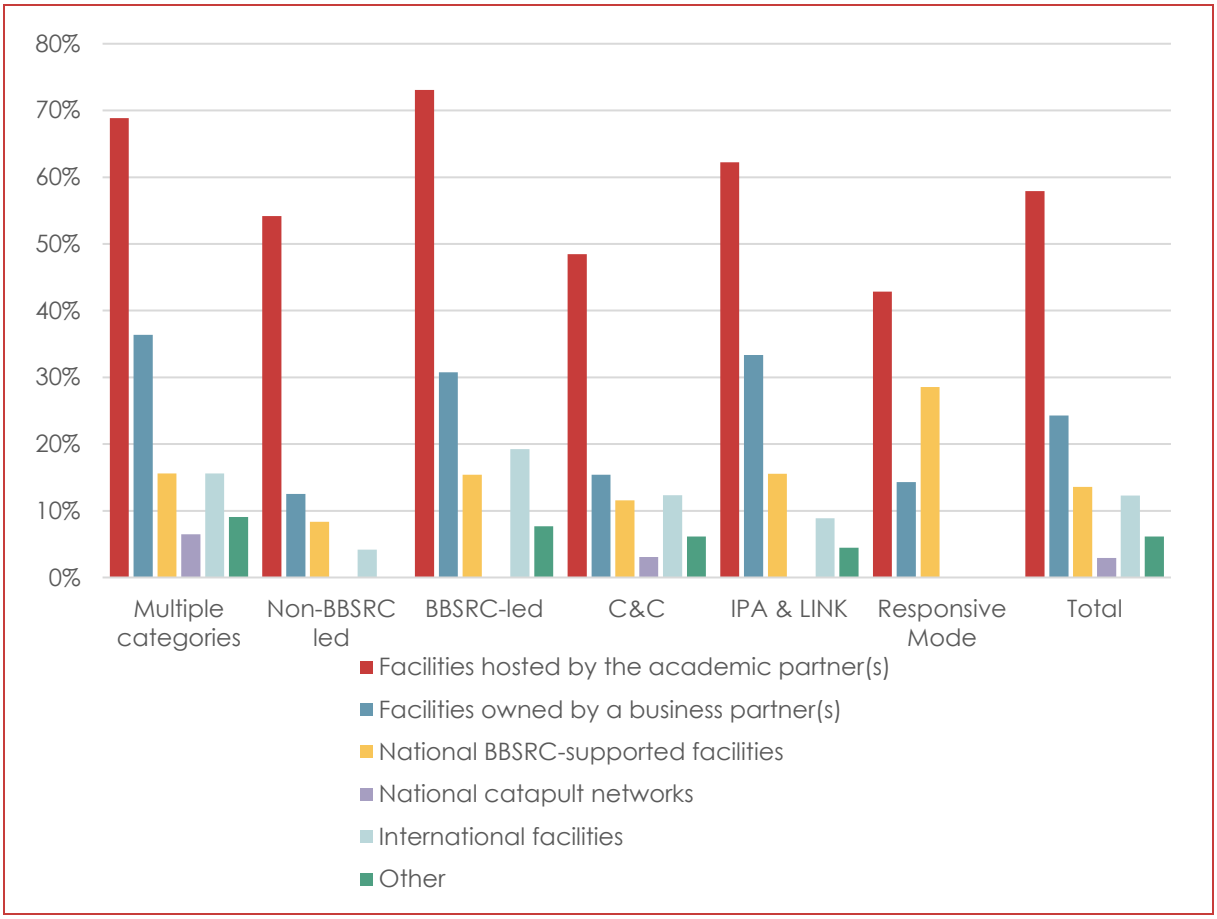


Source: Survey of BBSRC PIs, n = 293

G.2.5 *The use of R&I facilities in CR&D*

Q26. Has your BBSRC-funded CR&D project(s) involved the use of R&I facilities?

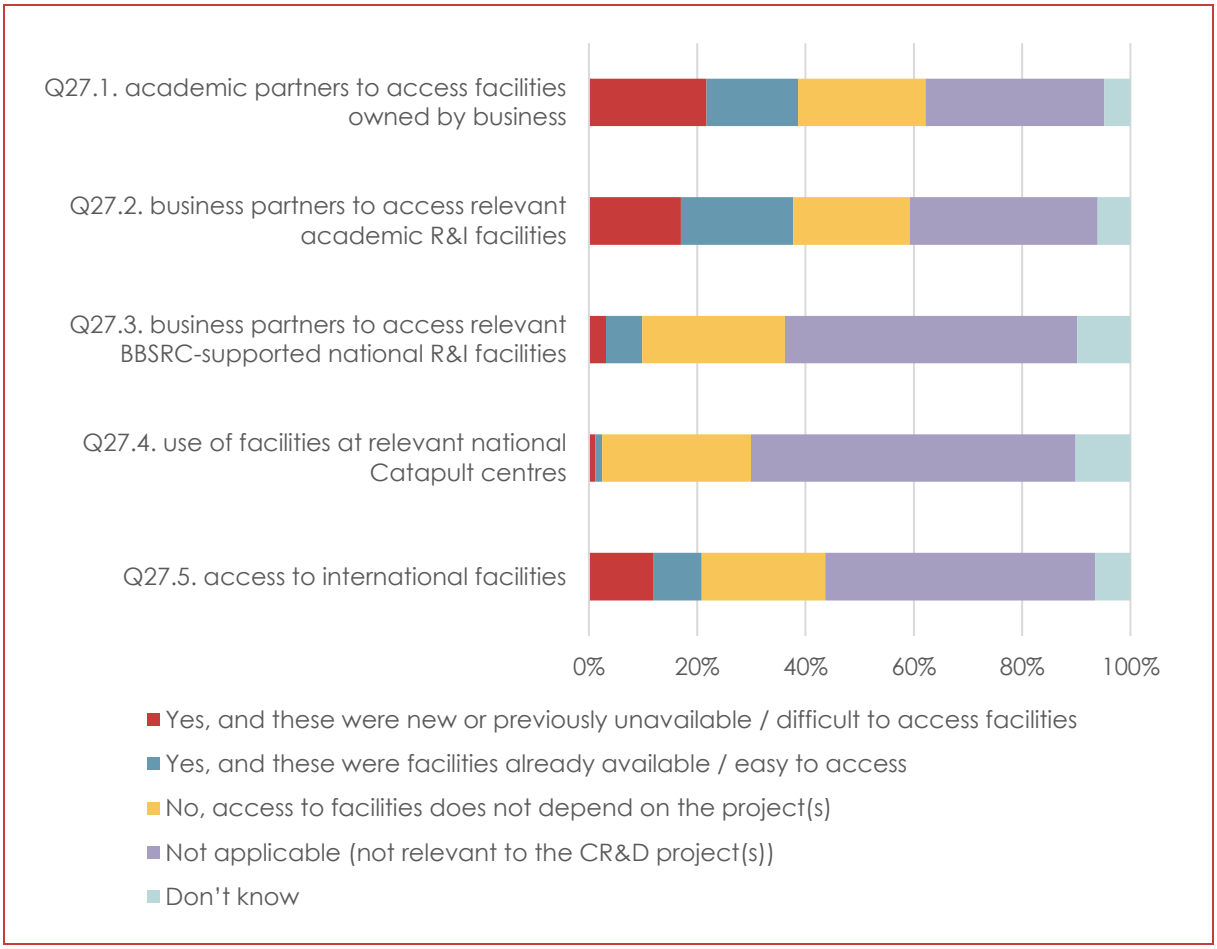
Figure 43 Use of R&I infrastructure in BBSRC CR&D projects, by category



Source: Survey of BBSRC PIs, n = 309

Q27. To what extent has your BBSRC-funded CR&D project(s) enabled you to access R&I facilities?

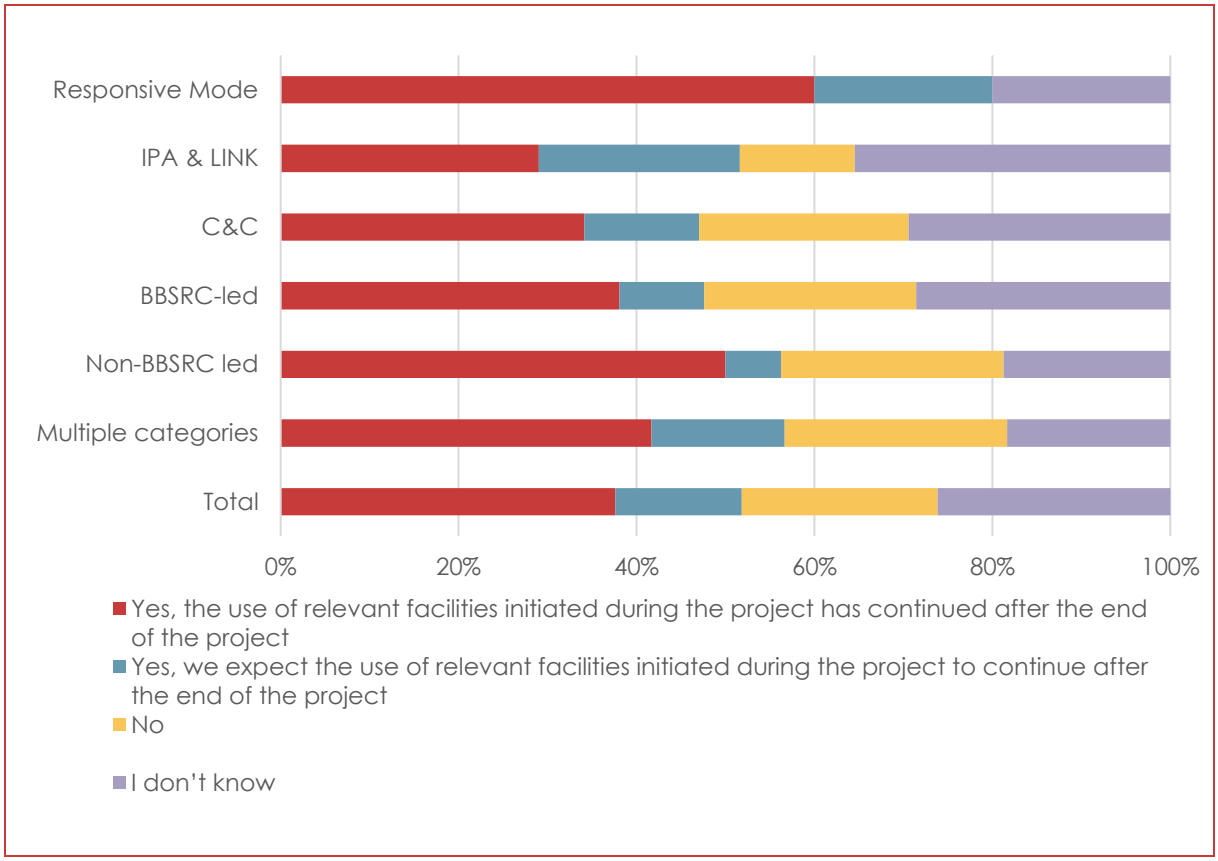
Figure 44 Access to R&I facilities enabled by BBSRC CR&D projects



Source: Survey of BBSRC PIs, n = 272

Q29. If you have used R&I facilities, will the use of these facilities continue after the end of the BBSRC-funded CR&D project(s)?

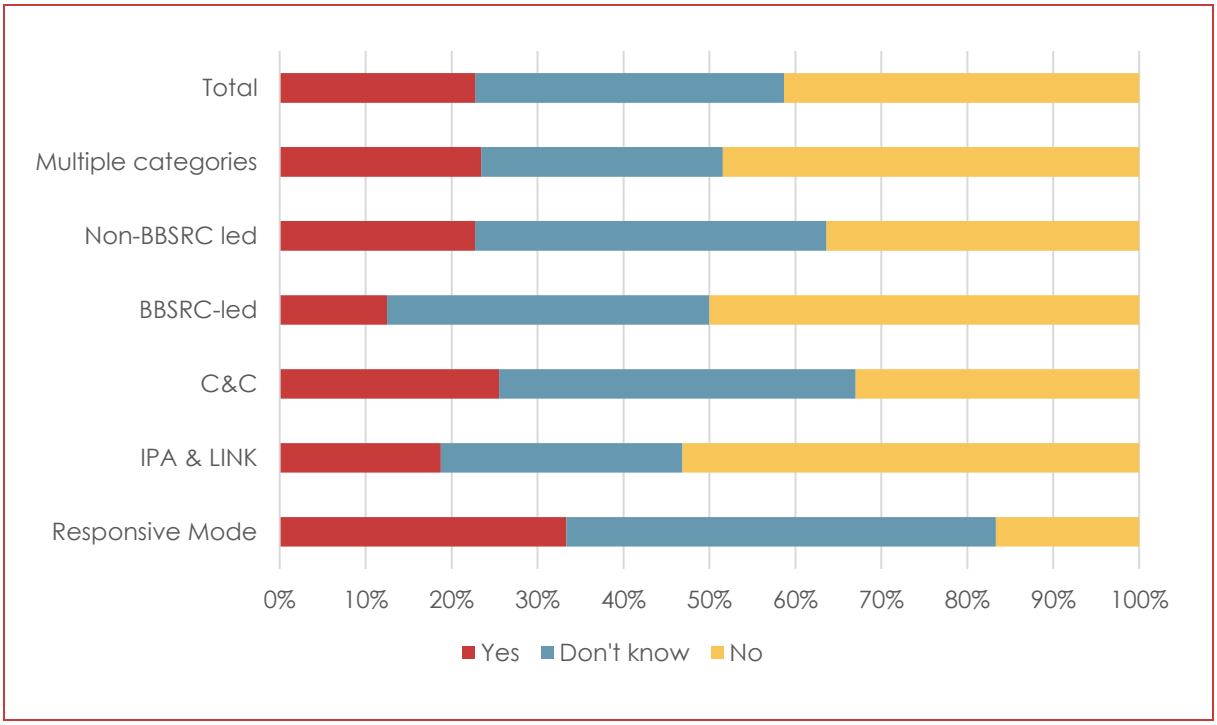
Figure 45 Continued use of R&D facilities after CR&D projects



Source: Survey of BBSRC PIs, n = 272

Q30. Are there any significant barriers to accessing or using relevant R&I facilities - in the context of collaborative R&D with academia in BBSRC-funded projects or more broadly?

Figure 46 Barriers to access and use of R&I facilities for collaborative R&I



Source: Survey of BBSRC PIs, n = 242

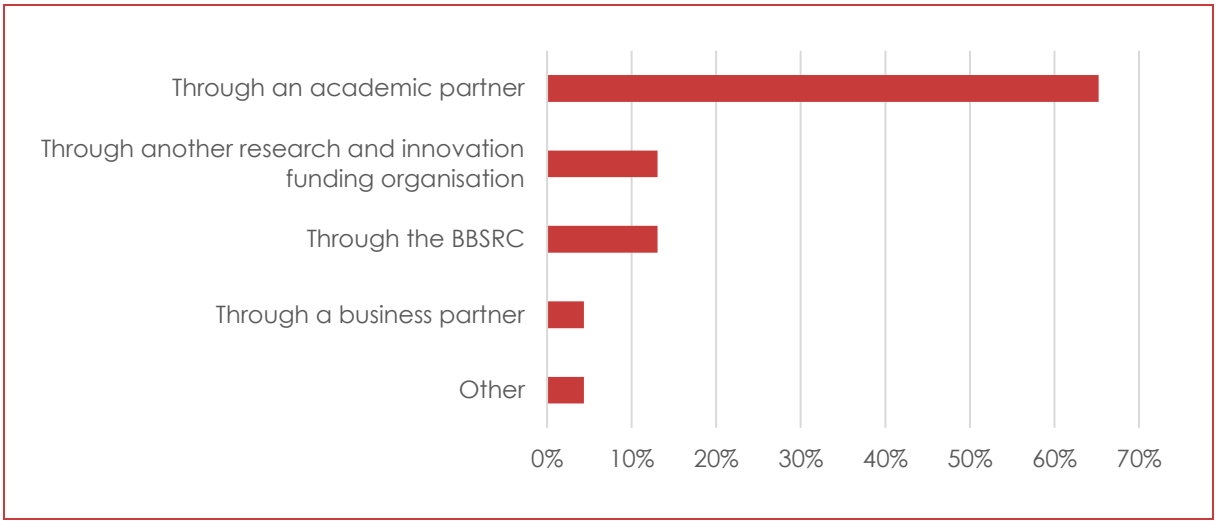
G.3 Responses to survey of non-academic partners

This section contains a summary of responses to selected questions from industry partners. As described above, the number of responses obtained from non-academic partners does not allow for a break-down of responses by company size or grant type. The number of responses from other non-academic partners was not great enough to summarise here but have been analysed qualitatively as part of the analysis.

G.3.1 Your company's participation in BBSRC CR&D project(s)

Q8: How did you first become aware of the opportunity to take part in BBSRC-supported collaborative R&D with academic partners?

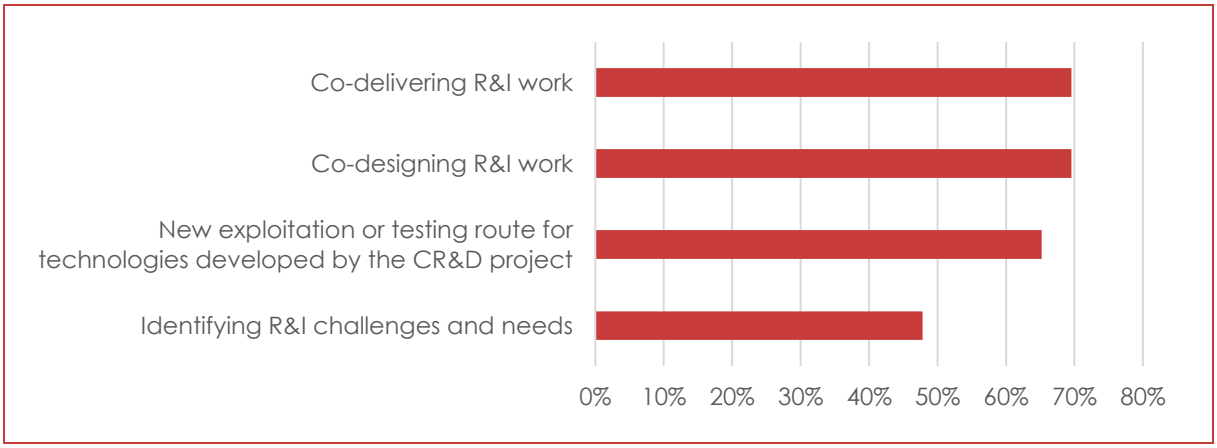
Figure 47 Source of awareness of opportunity to take part in BBSRC CR&D projects



Source: Survey of industry partners, n = 23

Q13: What is/was your organisation's role in the collaboration with the BBSRC-funded CR&D project(s)? Please select all that apply.

Figure 48 Role of industry partners in BBSRC CR&D projects

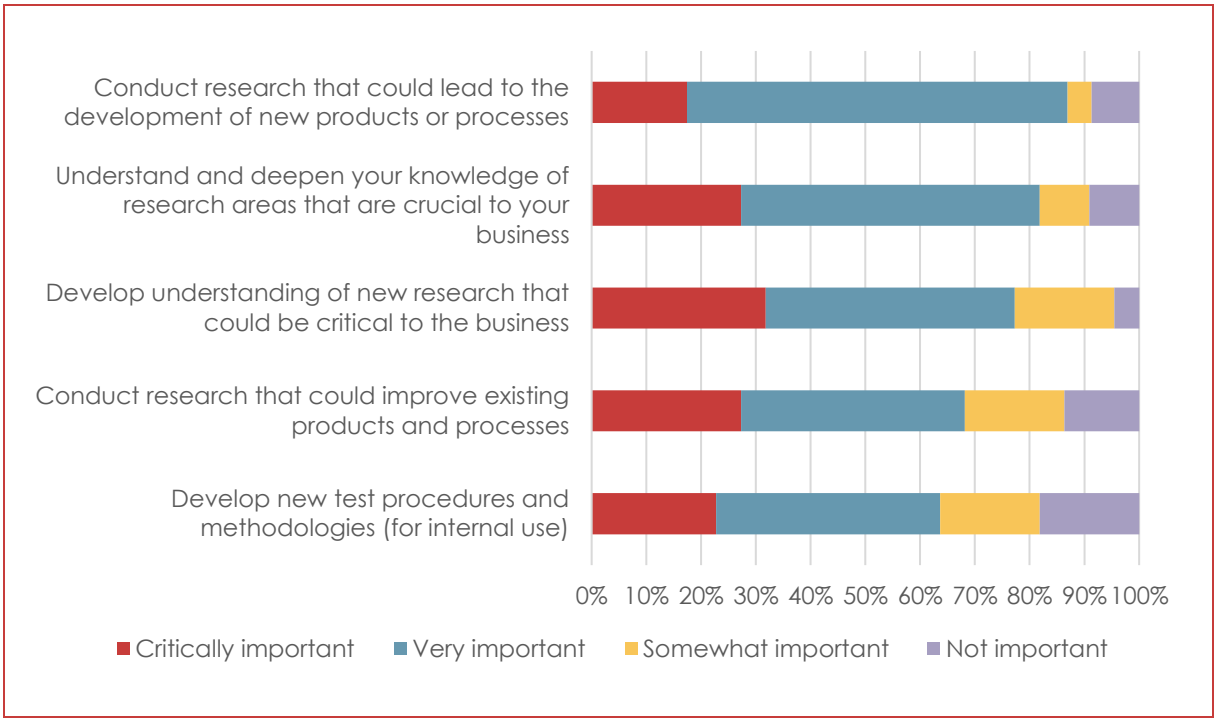


Source: Survey of industry partners, n = 23

G.3.2 *Project activities*

Q15: How important has the BBSRC-funded CR&D project(s) been in enabling your company to undertake the following types of activities

Figure 49 Business R&I activities enabled by BBSRC CR&D projects

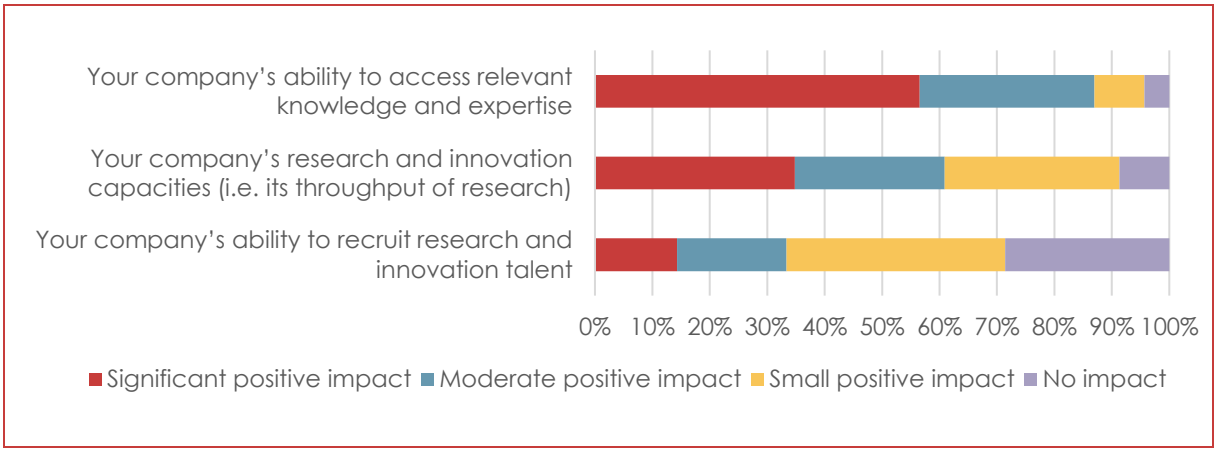


Source: Survey of industry partners, n = 23

G.3.3 *Knowledge and skills*

Question 17: To what extent has the BBSRC-funded CR&D project(s) positively impacted on:

Figure 50 Knowledge and skills-related benefits to industry partners in BBSRC CR&D projects

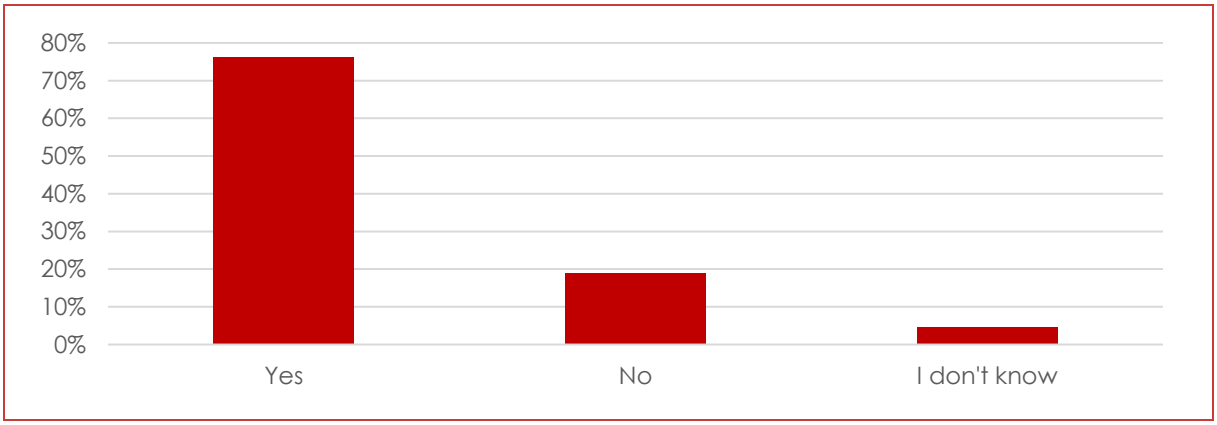


Source: Survey of industry partners, n = 23

G.3.4 *Innovation outcomes*

Q21: Has the BBSRC-funded CR&D project(s) lowered or removed barriers to innovation for your company?

Figure 51 BBSRC CR&D projects lowering or removing barriers to innovation for industry partners

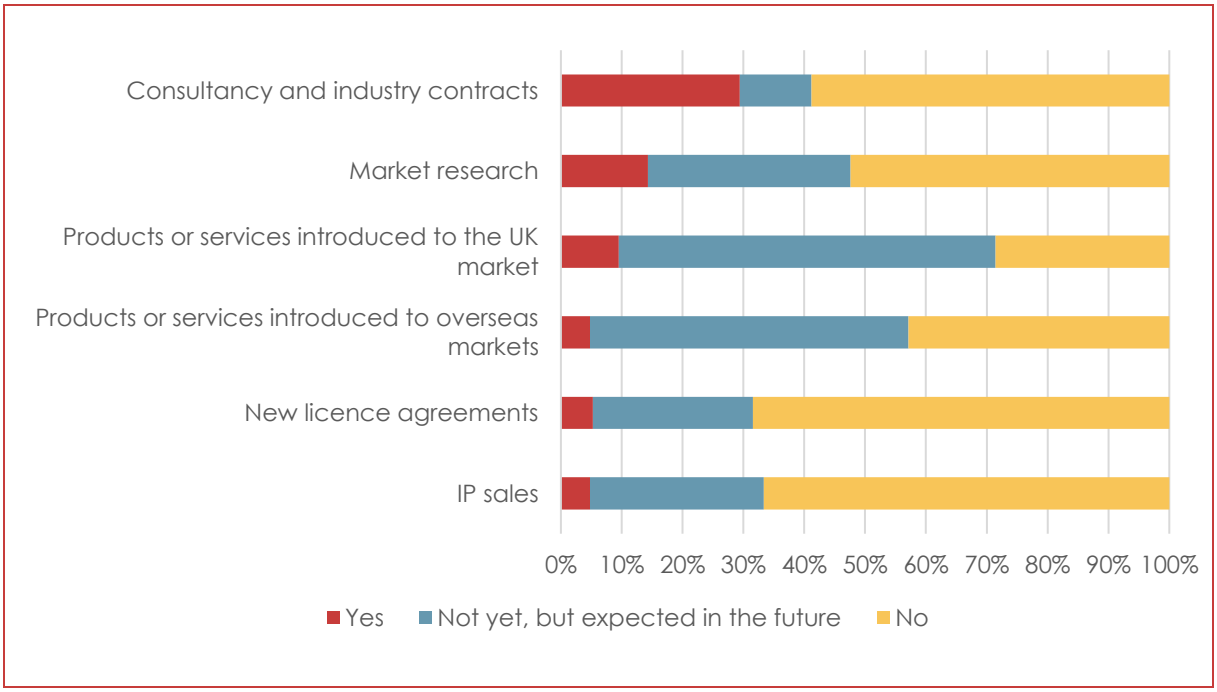


Source: Survey of industry partners, n = 21

G.3.5 *Commercial and economic benefits*

Q25: Has your participation in the BBSRC-funded CR&D project led to new commercial opportunities for your company?

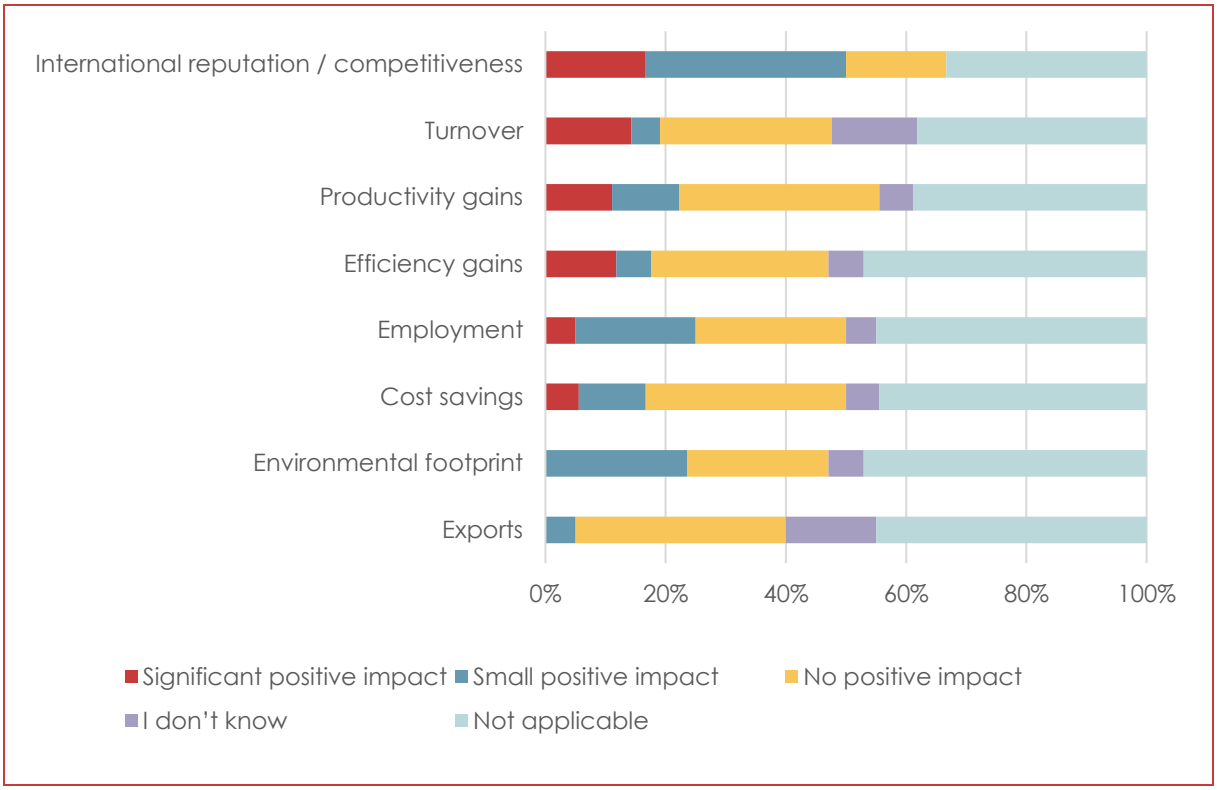
Figure 52 Commercial opportunities arising from BBSRC CR&D projects, industry partners



Source: Survey of industry partners, n = 21

Q26: To what extent has your participation in the BBSRC-funded CR&D project had an impact on your company in each of the following areas?

Figure 53 Impact of participation in BBSRC CR&D projects on companies

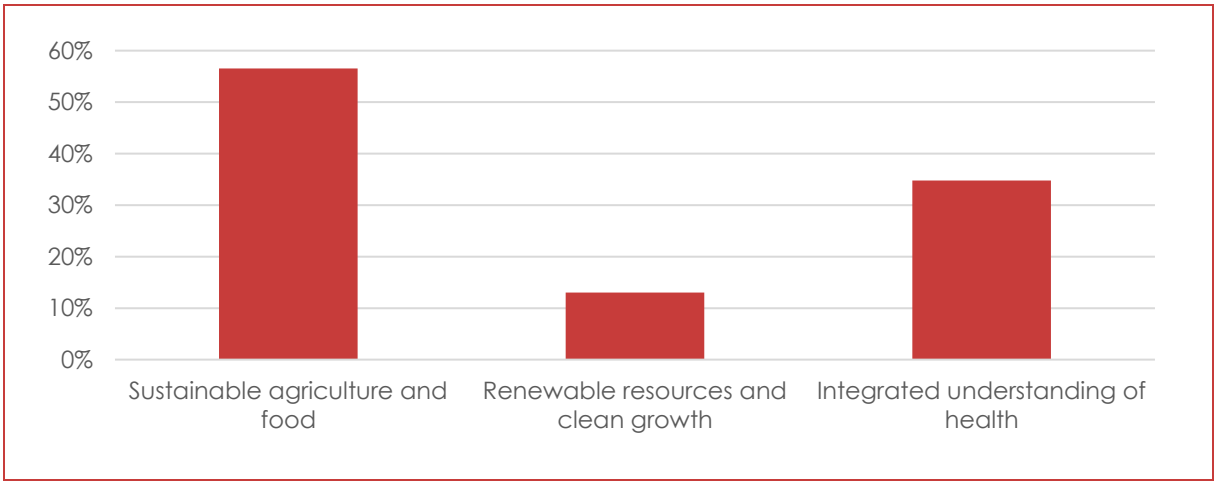


Source: Survey of industry partners, n = 21

G.3.6 *Wider economic, environmental or societal impacts*

Q27: Please indicate whether you believe BBSRC-funded CR&D project(s) has helped to deliver impacts in any of the following areas? (Please select all that apply.

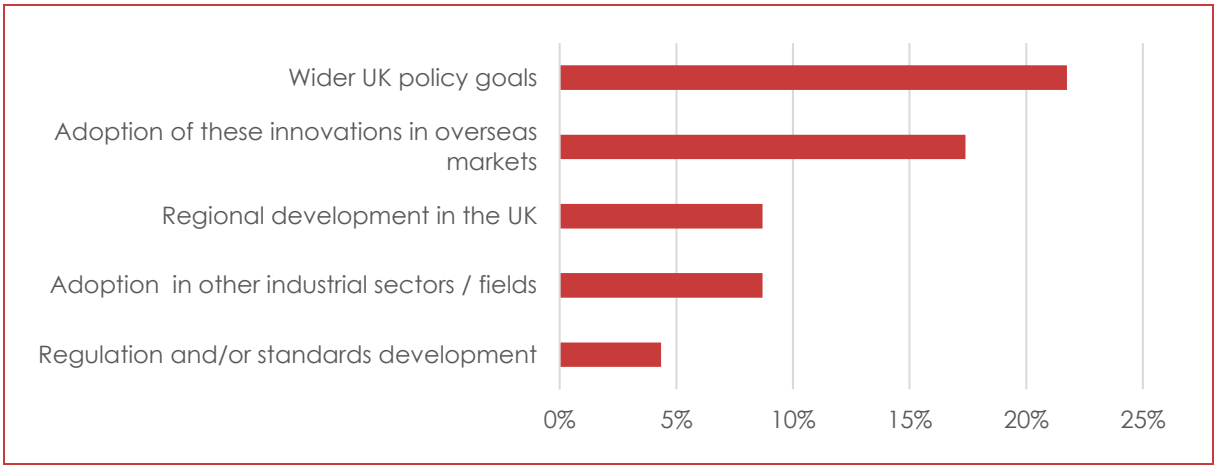
Figure 54 BBSRC CR&D project impact areas, industry partners



Source: Survey of industry partners, n = 23

Q28: Has your involvement in the BBSRC-funded CR&D project(s) led to any of the following wider benefits. (Please select all that apply)

Figure 55 Wider benefits from investment in BBSRC CR&D projects, industry partners

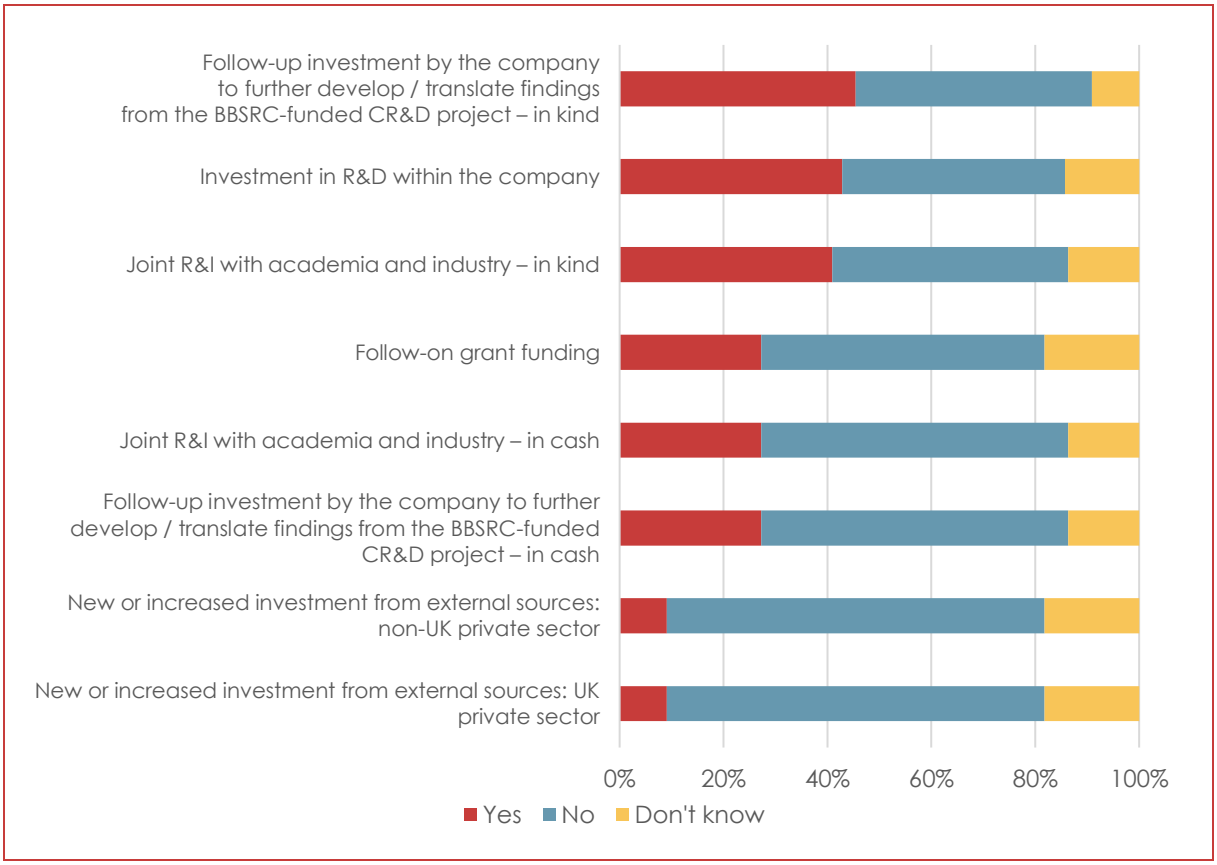


Source: Survey of industry partners, n = 23

G.3.7 Further funding and investment

Q29: Has participation in the BBSRC-funded CR&D project(s) led to further investment in R&D for any of the following:

Figure 56 Further investments enabled by BBSRC CR&D projects, industry partners

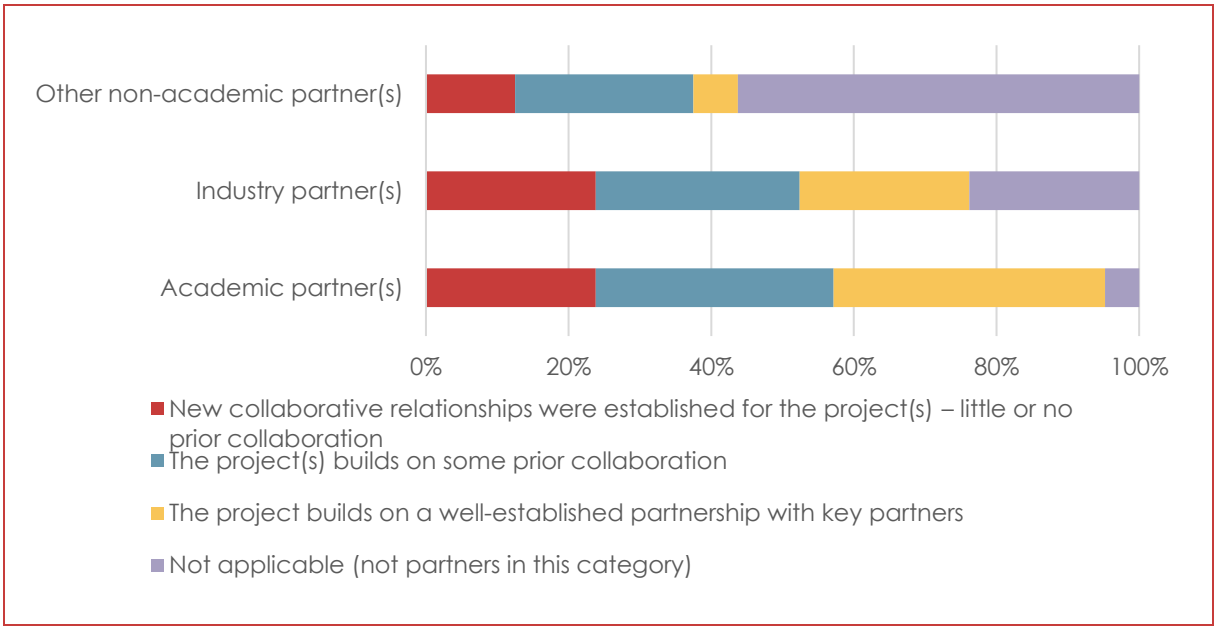


Source: Survey of industry partners, n = 23

G.3.8 *Networks and partnerships*

Question 33: To what extent did the collaboration within BBSRC-funded CR&D project(s) build on existing partnerships?

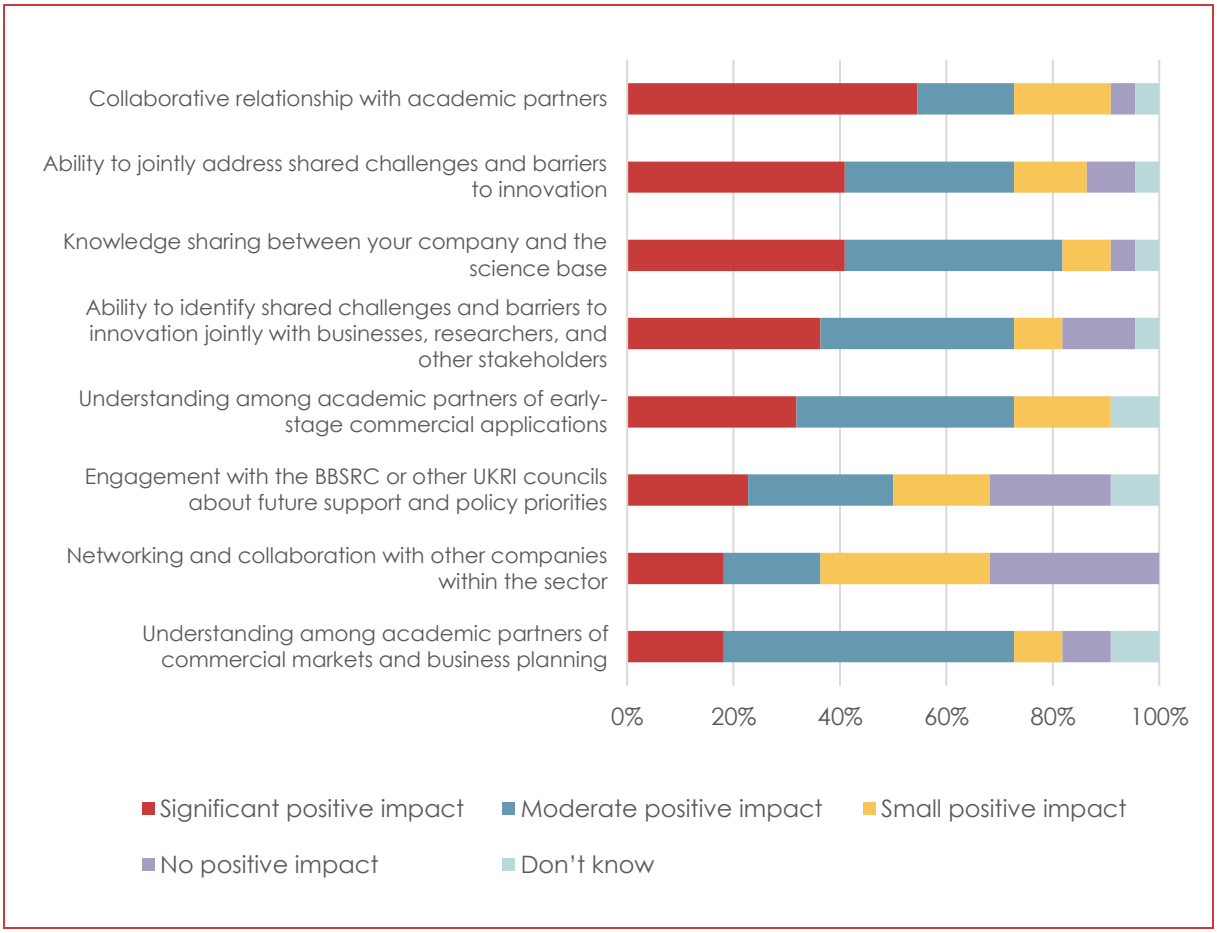
Figure 57 BBSRC CR&D partnerships by extent of pre-existing collaboration, industry partnerships



Source: Survey of industry partners, n = 21

Question 34: To what extent has the BBSRC-funded CR&D-funded project(s) had a positive impact on the following:

Figure 58 Positive impact of collaboration for industry partners



Source: Survey of industry partners, n = 23