Process Evaluation of the Catalyst Programmes

A Final Report to Innovate UK

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SQW

Contents

Contact:	Rebecca Pates	Tel:	0161 475 2112	email:	rpates@sqw.co.uk

Approved by:	Jonathan Cook Director	Date:	24/05/1818

Executive Summary

Introducing the Catalyst programmes

1. Innovate UK launched three Catalysts covering Industrial Biotechnology (IBC), Energy (EC) and Agri-tech (ATC) in 2013/14, designed to accelerate the progression of Research and Development (R&D) towards commercialisation. A total of £224m was invested by Department for Business, Energy and Industrial Strategy (BEIS), Innovate UK, the Department for International Development (DFID), Biotechnology and Biological Sciences Research Council (BBSRC) and the Engineering and Physical Sciences Research Council (EPSRC). Each Catalyst comprised different levels of award – for 'early stage' feasibility studies, 'mid' or 'industrial stage' research, and 'late-stage' experimental development grants – and the intervention rates, timeframes and scale of investment associated with each type of award was tailored to sector needs and stage of R&D. Funding was allocated through a series of competitions, which were framed by broad challenges that the programmes were seeking to address, rather than focusing on narrowly defined themes or solutions.

Study aims and approach

2. In September 2017, SQW was commissioned to conduct a process evaluation of the three Catalysts to:

    - examine how effectively the programmes have been delivered, which aspects were most effective, evidence of synergies between Catalysts, and lessons/good practice to inform future Catalyst(-type) interventions
    - assess the extent to which Catalyst processes (and broader factors) support or inhibit pathways to future impact
    - identify recommendations on how processes could be improved and scope for developing harmonised processes across different Catalyst models.

3. In addition to a desk review of data and documentation available for the Catalysts, the evaluation involved extensive consultation with 23 management and delivery staff and strategic leads, 10 panel assessors and monitoring officers, beneficiaries (60 via telephone, plus in-depth case studies with leads and collaborators for 15 projects), 35 organisations who had submitted an unsuccessful application into the Catalyst programme, and 14 external stakeholders across the sectors. The study also examined evidence on comparator programmes to identify potential transferable lessons from elsewhere.

Key findings

Which aspects of the Catalyst processes were most effective? What lessons/ good practice can be used to inform future Catalyst(-type) interventions?

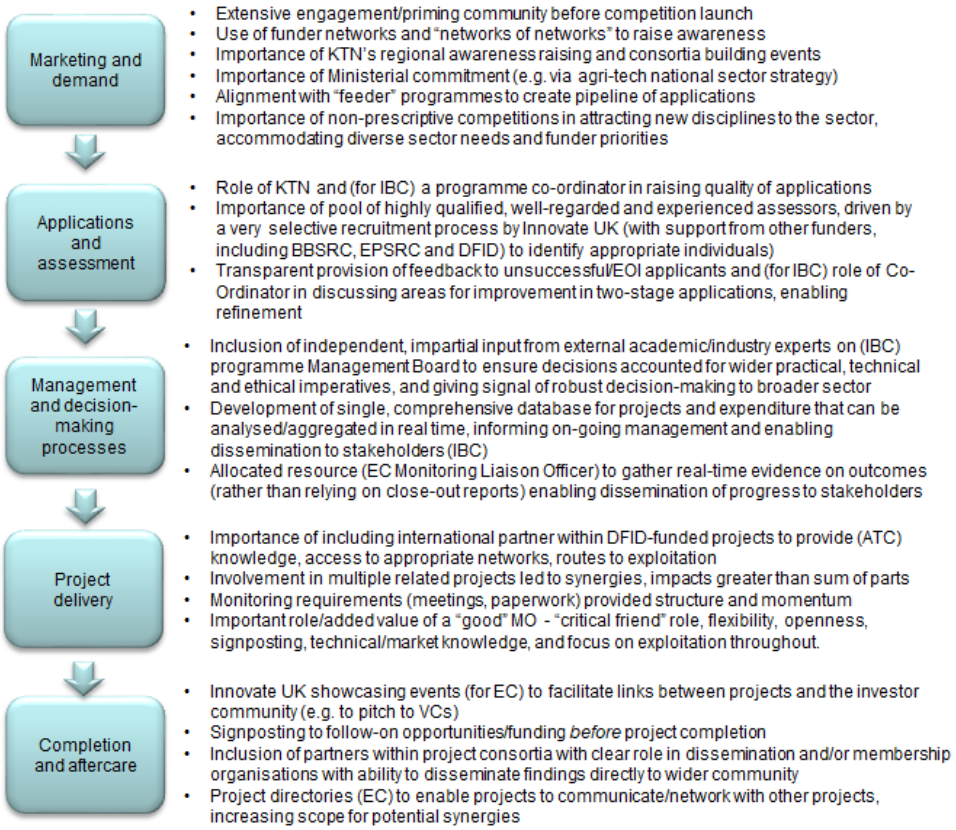
4. Many aspects of the Catalysts' processes have worked well. Effective promotion and marketing, particularly in partnership with the KTN, translated into strong demand over the

course of the programmes. Catalysts, and the thematic challenges they set out, were perceived as highly relevant to the three sectors involved. The Catalysts were seen as a pioneering way for funding bodies to work together to support multi-disciplinary research at different stages of the translational pipeline. Moreover, the model adopted broadly met the needs of its target audiences in terms of the potential to progress through different types of grant, the intervention rate, and the non-prescriptive nature of the competitions. The programmes appeared to be addressing their original market failures, especially in terms of investing in projects where the level of risk involved had deterred investment (either through own or external sources), and filled important gaps in the innovation funding landscape for translational R&D for the sectors in question.

5. The core processes for application, contracting and monitoring were largely in line with Innovate UK's and the Research Councils' 'standard' approaches and, in large part, these worked effectively. Decision-making processes and management structures have varied and (in some instances) evolved over time, and partnership working and communication between funding and delivery partners have, on the whole, been strong. Each Catalyst was generally perceived to have achieved a balanced portfolio of projects, reflecting broad-ranging demand, wide scope and the nature of the sectors involved, and included some high-risk, potentially transformational projects and 'game changing' technologies.

6. The evaluation has identified a number of processes that worked well in one or more of the Catalysts, and examples of good practice are summarised in Figure 1. Many of these are transferrable across the programmes, and relevant to future Catalyst-type interventions.

Figure 1: Examples of good practice



Source: SQW

7. The main sharing across the Catalysts has been implicit in the common design and implementation of the Catalyst model, drawing on the lessons of the earlier Biomedical Catalyst and standard Innovate UK and Research Council procedures. Other sharing has been modest, and ad hoc to help solve specific challenges. There was limited evidence of synergies between the Catalysts, in part reflecting the organic nature in which each programme developed and the lack of alignment between competition windows. Whilst there was some evidence of traction in a Catalyst model or brand, on the whole opportunities for synergies were not capitalised on. This was potentially a missed opportunity, especially where there were overlaps in technology areas, and the potential to share learning and encourage cross-sector collaboration (including through commercialisation opportunities).

The extent to which Catalyst processes and broader factors/processes support or inhibit pathways to future impact

8. Emerging effects were examined as far as possible in the evaluation, although for many projects delivery was still underway and there will inevitably be a lag before impacts are realised. That said, the evidence gathered to date suggested that the Catalysts have helped to bring about R&D investment that would not have been undertaken without the programme and/or have accelerated R&D activities. They have also led to new and strengthened collaborations, improved skills and knowledge development, and enabled progression through the Technology Readiness Levels (TRLs), all of which closely aligned with the Catalysts' objectives and underlying logic chains. A large proportion of beneficiaries consulted expected these benefits to translate into the introduction of new products/services to the market (in the UK and overseas), and business performance improvements relating to productivity and turnover gains in future. There was also some (albeit limited) evidence to suggest that the programmes had improved industry appetite, capability and confidence to apply for R&D funding, and created a pipeline of innovation projects for potential investors.

9. The Catalyst model and its processes appeared to be supporting pathways to impact. Undertaking R&D activities in collaboration has been crucial to enabling outcomes, and this in turn has been incentivised by both the Catalyst finance and the discipline/structure that the Catalyst models brought to projects. Other factors, such as a 'good' Monitoring Officer and the credibility associated with securing Catalyst funding were also important. There were, however, some processes that were sub-optimal, and risked inhibiting pathways to impact. For instance, there was a lack of a consistent approach to signposting and aftercare, and a lack of evidence to date to demonstrate dissemination by projects participants, Innovate UK and the Research Councils (e.g. to share learning and demonstrate the benefits of new technologies to help change attitudes across the wider agricultural sector). In addition, the curtailment of Catalyst funding has meant that relatively few projects have been able to progress through the different grant stages.

10. Within the projects themselves, strong project management and leadership of the lead partner was also critical to success, alongside a business's ability to design/implement sales and marketing strategies to enable new products/processes to reach the market, and recruit staff to expand operations. Some external factors influencing pathways to impact have applied across the three Catalysts (e.g. market growth, advancement/acceptance of new technologies) but many that were identified were relatively Catalyst-specific.

Areas for improvement, and implications regarding a harmonised model

11. Figure 2 summarises the 'principal' areas for improvement identified through this evaluation, i.e. priorities that should be addressed in a future Catalyst(-type) intervention. It also identifies a number of other processes which could be refined and adjusted, or (resources permitting) changed to a greater degree, in order to improve the efficiency and effectiveness of the Catalysts. Some of these recommendations are particularly relevant to the Catalysts and Catalyst-type programmes, and others are generally applicable to research and innovation programmes, including joint Innovate UK-Research Council programmes.

Figure 2: Recommendations for improvement

		Recommendations
Principal areas for improvement	Catalyst-specific	• Ensure sufficient longevity to enable projects to progress between grant types and fully maximise potential impact Catalyst model • Ensure projects/programme as a whole includes plan for knowledge exchange/dissemination (and accountability to deliver)
	Generally applicable	• Reduce duplication in processes between IUK/RCs, especially in terms of application, contracting, monitoring and close-out • Greater consistency in the role played by MOs, consider whether wider 'qualitative' roles should be included in job specification • Formal and comprehensive inclusion of signposting/next steps guidance (including *before* close-out) • Improve programme-level monitoring: i) addressing data discrepancies; ii) regular updates on progress
Other areas to consider	Catalyst-specific	• Provide greater clarity on timings of rounds and their scope, and communicate this effectively • Enable greater project-to-project engagement to exploit possible synergies (e.g. via directories, events)
	Generally applicable	• Extend reach to new SMEs, potentially facilitated by: time to build a community of interest; and support for SMEs that are new to the process; • Consider two-stage application rounds with a lighter touch EOI (which enables applicant to test idea, allows IUK efficiencies and reduces perceived duplication in current two-stage approach) • Address inconsistencies in assessor feedback where recommendations for improvement are contradictory, improve communications on moderation process to applicants • Enable knowledge sharing between assessors and MOs (respectively) • Address monitoring reprofiling burden and accelerate change requests

Source: SQW

12. A number of the issues identified above were notable in the evidence on other schemes in the UK and more widely, such as the challenges associated with extending the reach of innovation programmes, inconsistent monitoring practices, and resourcing aftercare support. The review of comparator schemes also demonstrated the value in commitment to longer-term programmes and purposively inviting the projects with greatest potential to apply for next-stage funding in order to enable a 'ladder' of progression for innovation ideas. Potential options for improving engagement with organisations that are less likely to take part in innovation programmes were identified from wider practice, including a 'light touch' expression of interest stage and interactive workshops.

13. The evidence from the evaluation indicated that, to a large extent, a common model has been adopted across the Catalysts, with a degree of tailoring in each Catalyst. A common model could, therefore, be deployed in the future across Innovate UK and the Research Councils, and with other funders as appropriate. This should include harmonisation of the model (e.g. funding ladder and grant stages), and its forms and processes for the core of the customer journey, including a consistent approach for Monitoring Officers and signposting/aftercare. Within this harmonised model, there is a need to allow tailoring, for example to reflect particular sectoral, technological or market contexts, and different funder objectives. In order to realise this harmonised model, some improvements to consistency and alignment between Innovate UK and the Research Councils are required, particularly in relation to a more

streamlined and seamless set of forms and processes (e.g. cutting out duplication in applications), and consistency in the support that beneficiaries receive from Monitoring Officers and funders as part of close out.

1. Introduction

1.1 In 2013/14, Innovate UK launched three Catalysts covering Industrial Biotechnology, Energy and Agri-tech, with a total funding of £224m from Department for Business, Energy and Industrial Strategy (BEIS), Innovate UK, the Department for International Development (DFID), Biotechnology and Biological Sciences Research Council (BBSRC) and the Engineering and Physical Sciences Research Council (EPSRC). Their purpose was to accelerate the progression of Research and Development (R&D) towards commercialisation through a series of collaborative R&D competitions, each comprising feasibility studies, industrial research and late-stage experimental development grants. These three Catalysts followed the earlier Biomedical Catalyst, which was launched in 2012.

Aims and objectives

1.2 In September 2017, SQW was commissioned to conduct a process evaluation of the Industrial Biotechnology, Energy and Agri-tech Catalysts. The study examined how effectively the programmes have been delivered, and identified lessons learned, recommendations on how processes could be improved, and scope for harmonisation between the three programmes. Whilst the focus has been on implementation rather than impact, SQW has explored emerging outcomes achieved to date, and highlighted key factors that were enabling or inhibiting pathways to impact.

1.3 The key research questions for the study, as set out in the original specification for the study, were as follows:

- Which aspects of the existing Catalyst processes are most effective?
- Could any changes to processes improve effectiveness and efficiency?
- To what extent do Catalyst processes support or inhibit pathways to future impact, and are any improvements needed?
- Which broader factors and processes support or inhibit the effectiveness of the Catalysts (e.g. the contexts and systems in which they operate)?
- What synergies have there been between Catalysts, and is there potential for developing harmonised processes across different Catalyst models?
- Are there any lessons for the design or delivery of new Catalysts?

1.4 More detailed research questions are presented in the table below.

Table 1-1: Key evaluation questions

Key question area	Topics
Which aspects of the existing Catalyst processes are most effective? Could any changes to processes	➢ Effectiveness of processes at different stages of the customer journey (from different perspectives), including: Initial engagement and marketing Application and assessment Contracting and approval

Key question area	Topics
improve effectiveness and efficiency?	Monitoring and delivery Project completion and aftercare ➢ Effectiveness of management and monitoring arrangements and processes ➢ Have the Catalysts achieved a balanced portfolio of projects? ➢ Have the Catalysts been a 'seamless conveyor/escalator' where projects have moved through the stages of grant?
To what extent do Catalyst processes support or inhibit pathways to future impact?	➢ Progress made to date (e.g. whether on track to deliver intended outcomes) ➢ Barriers/enablers to this with respect to Catalyst processes, including: How application processes encourage the types of projects (and collaborations) intended How selection reinforces fit with rationales and objectives of the Catalysts How monitoring used for remedial action How aftercare provides appropriate links to next steps Mechanisms are in place to ensure wider sector-level impact ➢ Are the Catalysts delivering outcomes that other support does/could not deliver?
How do any broader factors and processes support or inhibit the effectiveness of the Catalysts?	➢ Role of wider factors at different stages of the Catalyst process, e.g. take-up/pipeline, strength of applications, delivery of projects, taking projects to the next stage post-Catalyst ➢ Wider external factors, e.g. policy, market, technological, people/skills drivers ➢ Could any changes to processes improve effectiveness/efficiency and pathways to outcomes?
What are the synergies between Catalysts, and is there potential for developing harmonised processes across different Catalyst models?	➢ Identification of key differences in the processes between Catalysts, and the extent to which the approach reflects sector specific issues/context/landscape ➢ Pros and cons of different approaches, and how aligns with specific contexts (e.g. technological, market, organisational) ➢ Identification of any sharing or synergies between Catalysts ➢ Transferable lessons/good practice that can be implemented across Catalysts ➢ Scope for changes to bring about harmonisation
Are there any lessons for the design/delivery of new Catalysts?	➢ Synthesis of lessons ➢ Appetite for similar funding in future

Source: SQW

Approach

1.5 The approach adopted for this evaluation was primarily qualitative, and has involved the triangulation of evidence from a range of sources and perspectives in order to provide a rounded assessment of implementation and to identify recommendations on how this could be improved. This has included:

- a detailed review of data and documentation available, including programme business cases, competition launch materials and guidance, and a sample of application forms and close out reports

- the development of logic chains for each Catalyst programme
- 23 in-depth consultations with strategic leads and delivery partners across the three Catalysts[1]
- 10 consultations with panel assessors and monitoring officers involved across the Catalysts
- 14 consultations with external stakeholders in each sector, including Other Government Departments, Research Organisations, Sector Representative Organisations and the Knowledge Transfer Partnership
- 60 telephone consultations with Catalyst beneficiaries, spread across the various funding rounds and types of grant[2]
- 35 telephone consultations with organisations who had submitted an unsuccessful application into the Catalyst programme[3]
- a review of comparator programmes in the UK and abroad to identify lessons and good practice that could inform any future Catalyst(-type) intervention
- in-depth case studies with 15 projects, which involved a review of background documentation (application form and, where available, close out reports) and consultations with the lead and a small number of collaborators on each project.

1.6 We have also met with a Steering Group comprising Innovate UK, BEIS, DFID, BBSRC, the EPSRC and the Carbon Trust on four occasions during the course of the study.

Structure

1.7 This report is structured as follows:

- Section 2 provides an overview of the Catalyst programmes
- Section 3 presents findings on the effectiveness of the customer journey processes and areas for improvement
- Section 4 outlines emerging findings on additionality and outcomes
- Section 5 discusses management, governance and monitoring arrangements, their effectiveness and lessons learned
- Section 6 presents a synthesis of lessons from comparators programmes
- Section 7 sets out overall conclusions and lessons to inform the design of future Catalyst(-type) programmes.

[1] 7 from the ATC, 7 from the RC and 9 from the IBC.
[2] This included 21 AT, 25 En and 14 IB, which was broadly proportional to the number of projects in each Catalyst.
[3] This included 9 AT, 13 En and 12 IB, which was broadly proportional to each Catalyst.

1.8 The report is supported by two annexes: Annex A presents an analysis of the application and monitoring data made available to SQW for this study; and Annex B presents case study reports which have so far been signed off by project leads/collaborators consulted.

2. Overview of the Catalyst Programmes

2.1 In this Section, we present an overview of each Catalyst programme. This begins with an overview of the programme design and delivery including commonalities and differences between the Catalysts. To provide further context for the following chapters of the report, we provide a summary overview of the customer journey and logic chains for each Catalyst. We then present an analysis of the programme portfolio and progress to date based on the available monitoring data.

Figure 2-1: Key messages

- Each of the three Catalysts subject to this process evaluation drew to some extent on the model employed by the Biomedical Catalyst, tailoring different aspects to meet the needs of each sector:
  - ATC ran for six Rounds between October 2013 and February 2017. Its overarching aim was to accelerate the translation of research into practical solutions for application in agricultural and related sectors.
  - EC ran for five Rounds over May 2014 to June 2017. Funding was available for projects which could tackle all elements of the 'energy trilemma' of sustainability, flexibility and affordability of energy supply.
  - IBC ran for four Rounds over January 2014 to December 2015. It aimed to accelerate and catalyse the commercialisation of new IB products and processes through innovation and collaborative R&D.
- The strategic context and context-specific challenges differed between the Catalysts, although there were commonalities in rationale. These included a focus on addressing information failures, uncertainty and risk, and externalities associated with innovation whereby private firms underinvest in R&D because they cannot capture the wider societal benefits.
- All three Catalysts adopted a similar model to deliver the grants, with a competitive fund process comprising early stage feasibility studies, industrial research and late-stage experimental development. Key variations included differences in maximum intervention rates, grant values, and permitted project length.
- The customer journey was similar across all three Catalysts, with the largest variation at the application stage, e.g. whether a one or two-stage application was required.
- There were commonalities across the intended outputs, outcomes and impacts. For example, intended intermediate outcomes included new products/services progressed to/towards market, increased turnover and employment for project participants, and an increased take-up of new products/processes by industry.
- Monitoring data were limited but showed that, in total, the IBC funded 82 projects over four rounds, whilst the ATC funded 103 projects over five rounds (excluding those ATC projects which received DFID funding). Half of the IBC projects were early stage, whilst just over half of the ATC projects were industrial/mid stage projects (52%). A definitive number of projects funded by EC was not available.

Source: SQW

Programme design and delivery

2.2 The Catalyst approach to supporting innovation began in 2012 with the establishment of the **Biomedical Catalyst**. Delivered in partnership between the Medical Research Council and Innovate UK, the Biomedical Catalyst has been awarded funding until 2020.[4] It offers four types of grant awards for projects at different stages of development, from the early stage 'confidence in concept' awards, through to late stage awards for Phase II clinical trials or

[4] https://ktn-uk.co.uk/funding/biomedical-catalyst-2017-round-4-primer-award

equivalent. The Catalyst model was conceived as a different approach to standard funding models, with the intent that **the Catalyst would be used to fund projects through different stages of grant award** as they progressed up the Technology Readiness Level (TRL) spectrum towards commercialisation.

2.3 Each of the three Catalysts subject to this process evaluation drew to some extent on the Biomedical Catalyst model. The three then **tailored different elements of the model's design, often in order to meet the specific needs of each sector**. For example, intervention rates were adjusted by award type and Catalyst. The IBC also introduced two additional funding streams (one for early stage translational/pre-feasibility activity and another 'experimental development' stage for late-stage activity at the point of commercialisation[5]).

2.4 A short introduction to the key features of each Catalyst is provided below:

- ATC was the first of the three to start, and ran for six Rounds between October 2013 and February 2017. Some £70m in funding was available from BEIS, Innovate UK, BBSRC, and DFID spread over early, mid and late stage grant awards. The overarching aim of the ATC was to accelerate the translation of research into practical solutions for application in agricultural and related sectors.

- EC ran for five Rounds between May 2014 and June 2017. In total, £75m in funding was available from BEIS, Innovate UK, EPSRC and, for the final Rounds, DFID. The EC shared the same three grant types as ATC, but had different rules on the duration of projects. Funding was available for projects which could tackle all elements of the 'energy trilemma' of sustainability, security, and affordability of energy supply.

- IBC was the shortest of the three, running for four Rounds between January 2014 and December 2015. However, it had the largest amount of funding available both in total - £75.6m from Innovate UK, BBSRC and EPSRC – and also for individual projects. As discussed above, the IBC had five funding stages. The IBC aimed to accelerate and catalyse the commercialisation of new IB products and processes through innovation and collaborative R&D.

Context and rationale

2.5 The **strategic context and context-specific challenges differed between the Catalysts**. For example, IB was a relatively new industry when the IBC was launched, whilst the more established energy sector was having to confront new challenges posed by the energy trilemma. The resulting strategic opportunities to support the development of the UK's IB industry and to tackle the challenges of the energy trilemma provided context specific rationales for the Catalysts.

2.6 There were also **commonalities in rationale across the Catalysts**. These included a focus on addressing information failures, uncertainty and risk, and externalities associated with

[5] This was later withdrawn due to lack of demand - the sector was in the early stages of development when the Catalyst was introduced, and had matured, but there was perhaps insufficient time for projects to progress/insufficient demand at this level. This may, however, be worth considering in future and in the other two Catalysts which both noted the gap in follow-on financial support.

innovation whereby private firms under-invest in R&D because they cannot capture the wider societal benefits. The recognition that these market failures continue to apply as projects move up the TRL spectrum was a key rationale for the Catalyst offering different grant stages rather than, for example, only offering early stage grant awards.

Aims and objectives

2.7 The differing strategic context and context-specific challenges led to each Catalyst having sector-specific aims and objectives. That said, there **were a number of commonalities** across the three, namely to:

- increase private sector investment in collaborative R&D projects, both in business-to-business and business-to-research collaborations
- accelerate the translation and commercialisation of the UK's leading academic research into new products and processes
- generate improvements in economic growth, productivity (including through adoption of new products/processes) and competitiveness of the UK economy.

2.8 The **different objectives** could be both sector and funder specific. For example, BEIS placed greater emphasis on developing UK industry, whilst DFID had objectives focussed on deployment of technologies in sub-Saharan Africa and South Asia. Specific objectives for each of the Catalysts were as follows:

- **ATC** – to accelerate the translation of research into practical solutions for application in agricultural. DIFD had a further specific objective to develop, test and scale up novel approaches to innovation for sustainable intensification and reducing post-harvest losses in Africa.
- **EC** – to support the development of energy products, processes and services which could tackle the energy trilemma. Again, DFID had a further specific objective to support the transfer of technology and new products to sub-Saharan Africa and South Asia.
- **IB** – to accelerate and catalyse the commercialisation of new IB products and processes through innovation and collaborative R&D IB and bioenergy. More broadly, the IBC aimed to boost and grow the UK IB sector by raising the productivity and competitiveness of UK firms.

Inputs and activities

2.9 The **total financial inputs to each Catalyst were similar** although not identical - ranging from £70m for ATC up to £75.6m for IB - but the **sources of funding were different.** BEIS/Innovate UK provided finance to all three Catalysts[6], whilst BBSRC (ATC and IBC), EPSRC (IBC and EC), and DFID (ATC and EC) supported two Catalysts each.

[6] Only Innovate UK funded the IBC, not BEIS.

2.10 Each of the Catalysts was delivered according to a common format. A key feature of this was having an **open, non-thematic/prescriptive series of competitions**[7], on the basis that academics, experts and industry were best placed to decide where R&D and innovation activity should focus.

2.11 All three Catalysts adopted a similar model to deliver the grants, with a competitive fund process comprising early stage feasibility studies, industrial research and late-stage experimental development. There were also similarities in terms of the collaborative approach, where most early stage projects could be led by a UK business (alone, or in collaboration with other organisations) or a research organisation (only in collaboration with a UK business)[8], and mid-stage and late-stage projects had to be led by businesses.

2.12 However, there were differences between the Catalysts. These tended to reflect the needs of each sector (see Table 2-1). For example, there was **variation in the grant values available**, especially at the early - and mid-stage, and **intervention rates for different sized businesses**[9]. For instance, on early stage ATC projects the maximum intervention rate for SMEs was 55%, whereas both the EC and IBC had separate and higher intervention rates for micro/small businesses (70%) and medium businesses (60%). The **length of projects also varied** between the Catalysts. Using the late stage as an example, ATC projects could take a maximum of 18 months, whilst EC projects could take a maximum of three years.

Table 2-1: Mapping key features of each catalyst. ***Note: Data based on most recent, general competition rounds for each catalyst***

	Agri-tech	Energy	Industrial Biotechnology
Funding bodies	**BEIS, Innovate UK, BBSRC, DFID**	**BEIS, Innovate UK, EPSRC, DFID**	**Innovate UK, BBSRC, EPSRC**
Delivery bodies	**Innovate UK, BBSRC**	**Innovate UK, EPSRC**	**Innovate UK, BBSRC, EPSRC**
Total funding available	**£70 million**	**£75m**	**£75.6 million**[10]
Timeframe	**October 2013 – February 2017**[11]	**May 2014 – June 2017**[12]	**January 2014-December 2015**
Number of Rounds	**6**	**5**	**4**
Grant values available[13]			
Early stage	£150k to £500k	£50k to £300k	£2m to £5m (Translation) Up to £250k (Feasibility studies)
Mid-stage / Industrial research	Up to £3m (Up to £1.5m for Round 6, involving DFID)	Up to £1.5m	Up to £5m

[7] ATC and EC were deliberately broad; IB was more narrowly defined and targeted on the IB sector, but was still broad within this area.
[8] The exception appears to be translational research for IB, which is academic led.
[9] Intervention rates were determined by overall Innovate UK rules.
[10] £41.5m rounds 1 and 2 and £34m for rounds 3 and 4.
[11] The Round 6 closing date for full-stage applications.
[12] Application deadline for Round 5.
[13] All based on most recent competition rounds of respective Catalysts, unless otherwise stated.

	Agri-tech	Energy	Industrial Biotechnology
Late-stage	Up to £1m (Up to £800k for Round 6, involving DFID)	Up to £10m[14]	Up to £1m (Technical feasibility studies) Up to £10m (Experimental development)
Length of projects			
Early stage	Up to 18 months	3 to 12 months	3 to 5 years (Translation) Up to 12 months (Feasibility studies)
Mid-stage / Industrial research	Up to 3 years	Up to 3 years	Up to 3 years
Late-stage	Up to 12 months (Up to 18 months for Round 6, involving DFID)	Up to 3 years	Up to 12 months (technical feasibility studies) Up to 2 years (Experimental development)
Intervention rates by organisation type			
Early stage	SME: 55% Large: 45% Research: 100% of total eligible costs (capped at 50% of overall project cost)	Micro/small: 70% Medium: 60% Large: 50% Research: 100% of total eligible costs (capped at 50% of overall project cost)	**Translation:** Research: 80% of total eligible costs covered by Research Councils **Feasibility studies:** Micro/small: 70% Medium: 60% Large: 50% Research: 80% of total eligible costs[15] (capped at 50% of overall project cost)
Mid-stage / Industrial research	SME: 45% Large: 35% Research: 100% of total eligible costs (capped at 50% of overall project cost)	Micro/small: 70% Medium: 60% Large: 50% Research: 100% of total eligible costs (capped at 30% of overall project cost)	Micro/small: 70% Medium: 60% Large: 50% Research: 80% of total eligible costs (capped at 50% of overall project cost)
Late-stage	SME: 35% Large: 25%	Micro/small: 45% Medium: 35% Large: 25% Research: 100% of total eligible costs (capped at 30% of overall project cost)	**Technical feasibility studies:** Micro/small: 70% Medium: 60% Large: 50% Research: 100% of total eligible costs (capped at 30% of overall project cost) **Experimental development:** Micro/small: 45% Medium: 35% Large: 25%

[14] https://interact.innovateuk.org/competition-display-page/-/asset_publisher/RqEt2AKmEBhi/content/energy-catalyst-late-stage-awards-pre-commercial-technology-validation-round-3?controlPanelCategory=portlet_tsbcompetitionsearchportlet_WAR_tsbcompetitionsearchportlet

[15] Expressed as 100% and 80% under FEC in documentation.

	Agri-tech	Energy	Industrial Biotechnology
			Research: 100% of total eligible costs (capped at 30% of overall project cost)
Business and/or academic led and collaboration requirements			
Early stage	Projects can be led by a UK business (alone, or in collaboration with other organisations) or a research organisation (only in collaboration with a UK business)	Projects can be led by a UK business (alone, or in collaboration with other organisations) or a research organisation (only in collaboration with a UK business)	**Translation:** Academic only (although businesses could be partners and not receive funding) **Feasibility studies[16]:** Projects can be led by a UK business (alone, or in collaboration with other organisations) or a research organisation (only in collaboration with a UK business)
Mid-stage / Industrial research	Projects must be collaborative and led by a UK business	Projects must be collaborative and led by a UK business	Projects must be collaborative and led by a UK business
Late-stage	Projects must collaborative and led by a UK business	Projects must collaborative and led by a UK business	**Technical feasibility studies:** Projects must be collaborative and led by a UK business **Experimental development:** Projects must be collaborative and led by a UK business
For DFID funded projects	To include at least one partner from an eligible developing country alongside a UK business	To include at least one partner from an eligible developing country alongside a UK business	Not applicable

Source: Document review

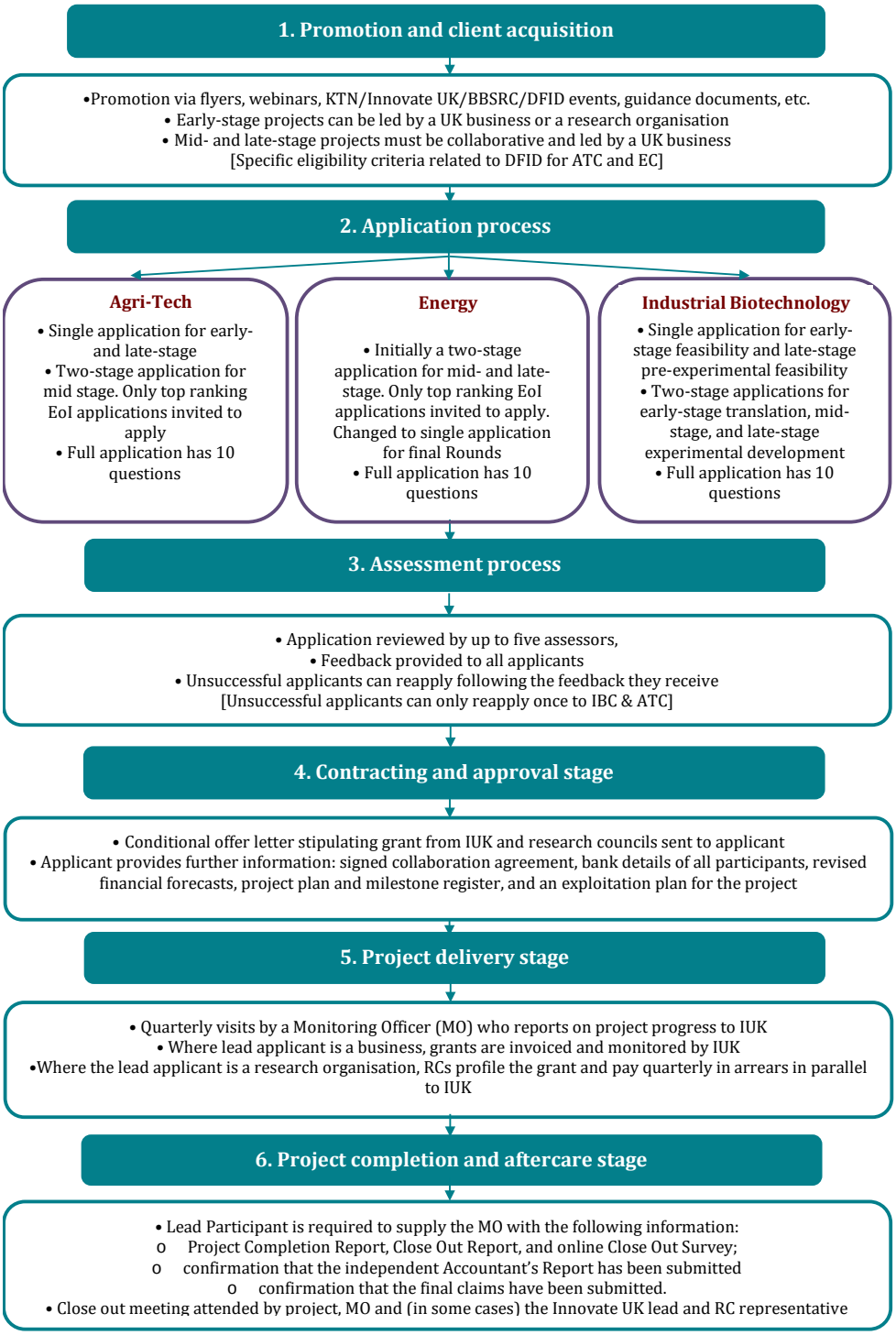
2.13 There have also been changes to these features over time, exemplified by the Agri-tech Catalyst as follows (similar changes occurred in both the Energy and IB Catalysts):

- The intervention rate changed in Round 3 for SMEs and Large companies applying for early - and mid-stage grants as it was considered that greater leverage could be achieved (partly given the higher-than-expected demand):
- for SMEs, from 75% to 55% for early-stage grants, and from 60% to 45% for mid-stage grants
- for large companies, from 65% to 45% for early-stage grants, and 50% to 35% for mid-stage grants.
- In Round 5, intervention rates for SME were divided into two different rates, one for Micro/Small companies, and another for Medium-size companies.

[16] These projects can have industrial partners (as sub-contractors) but they cannot receive funding directly.

2.14 The diagram below shows the common features of the customer journey. Where processes were similar for all three Catalysts, any differences are highlighted in square brackets, e.g. the role of the IB Catalyst Co-ordinator in monitoring translation grants. **The Catalysts differed most in their application processes**. The customer journey is explained in more detail in Section 3.

Figure 2-2: Outline customer journey



Source: SQW review of documentation and scoping consultations

2.15 Despite the differences between the strategic contexts and the objectives for each Catalyst, **there were commonalities across the intended outputs, outcomes and impacts**. For example:

- **Common outputs** included additional private sector investment in R&D, de-risking of projects thus enhancing their capacity to access/leverage investment, new IP generated and patents registered, and new/improved collaborations between industry and the research base.
- **Intended intermediate outcomes** included new products/services progressed to/towards market; increased turnover and employment for project participants, increased exports, take-up of new products/processes by industry, demonstration effects, and driving innovation in key sectors.
- **Longer term intended impacts** included increased productivity and economic growth for the UK economy, the development/creation of new markets in technologies funded by the Catalysts, and an improvement in the UK's international competitiveness.

2.16 There were also Catalyst specific intended outputs, outcomes and impacts. These included:

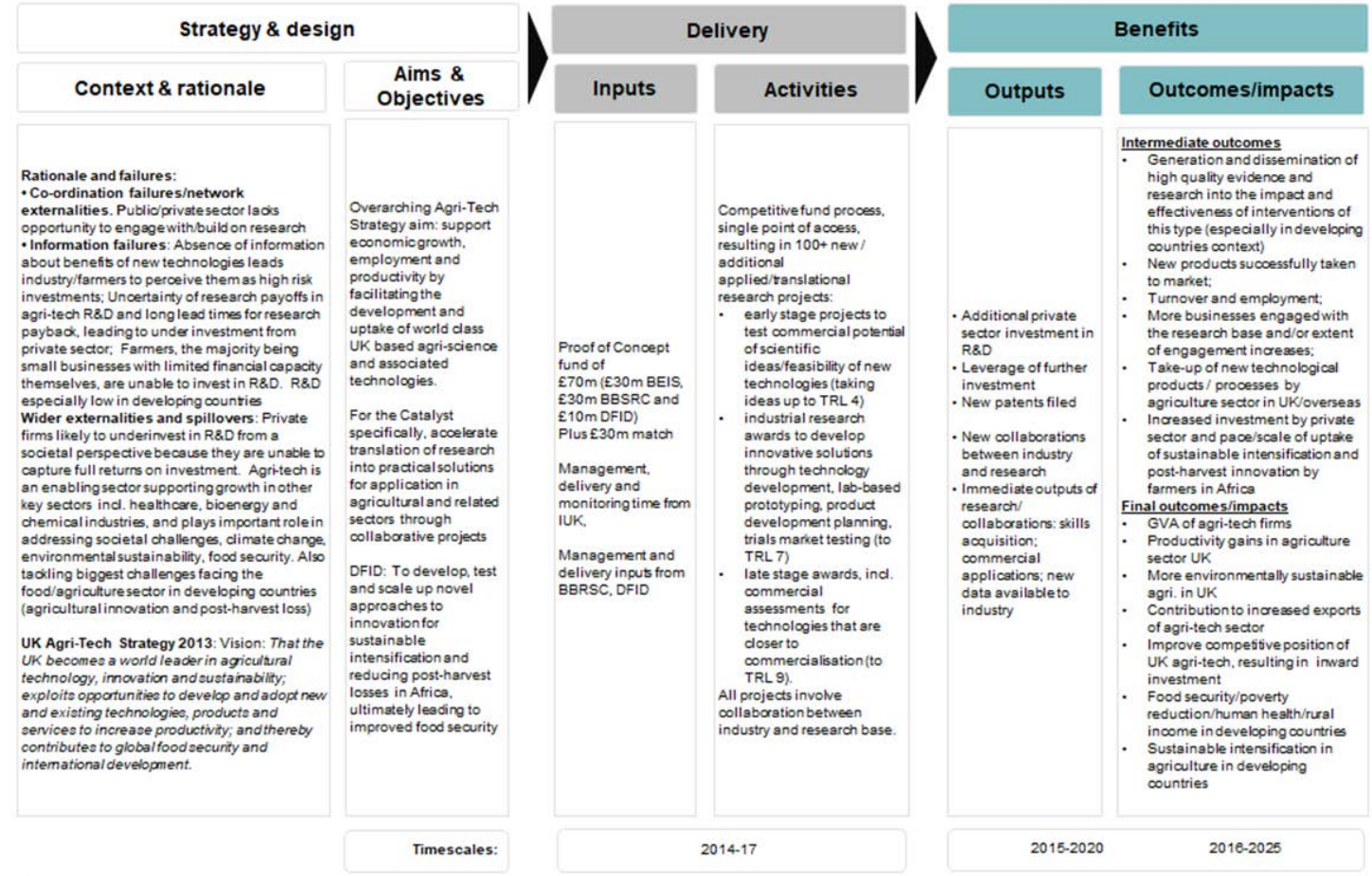
- **ATC** – More environmentally sustainable agriculture in the UK, and an increased pace/scale of uptake of sustainable intensification and post-harvest innovation by farmers in Africa.
- **EC** – Development of affordable and secure sources of energy supply which reduce greenhouse gas emissions, thus contributing to tackling the energy trilemma. Also, the development of affordable and reliable access to clean energy for poor households, communities and enterprises in rural, sub-Saharan Africa and South Asia, leading to better well-being for poor people and livelihood opportunities.
- **IB** – An improved competitive position of the IB-relevant sectors[17] in the UK, leading to the development of new/improved products and processes utilising bio-processes and resulting in inward investment. Also, contributing to a behavioural change amongst academic and industrial organisations involved in IB, leading to improvements in strategic/commercial planning, and skills.

Summary logic chains

2.17 The diagrams below present logic chains for each Catalyst based on the documentation reviewed and feedback from the consultations. This covers their rationale and strategic context, aims and objectives, inputs, and intended outputs, outcomes and impacts. Alongside this, we outline the theory of change, including key underpinning assumptions and potential risks. These logic chains were tested during the evaluation, and the case studies presented in Annex B include specific comments on the alignment between the projects and these logic chains.

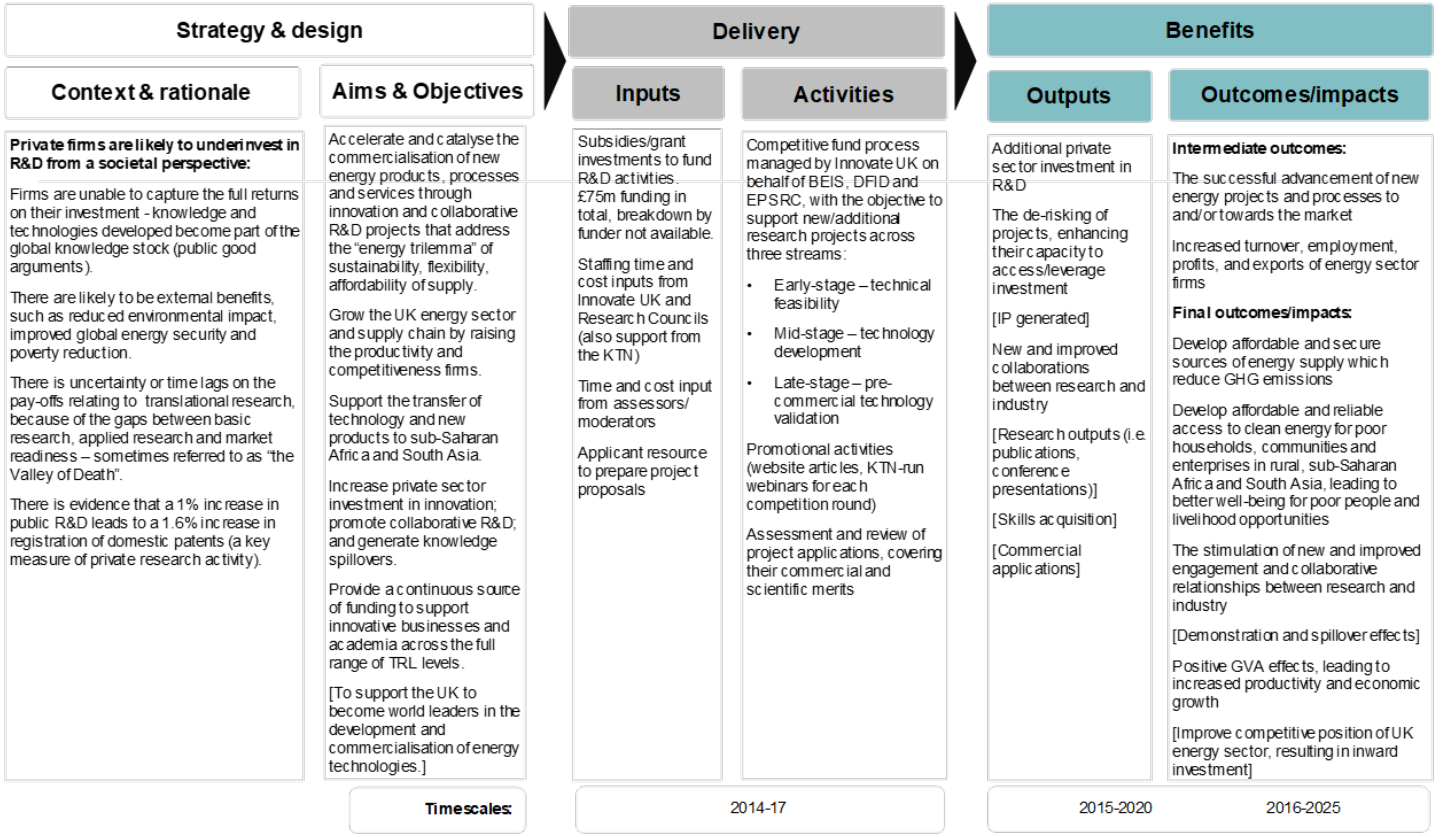
[17] E.g. chemicals, materials, pharmaceuticals, biopharmaceuticals and energy sectors.

Figure 2-3: Agri-tech logic chain



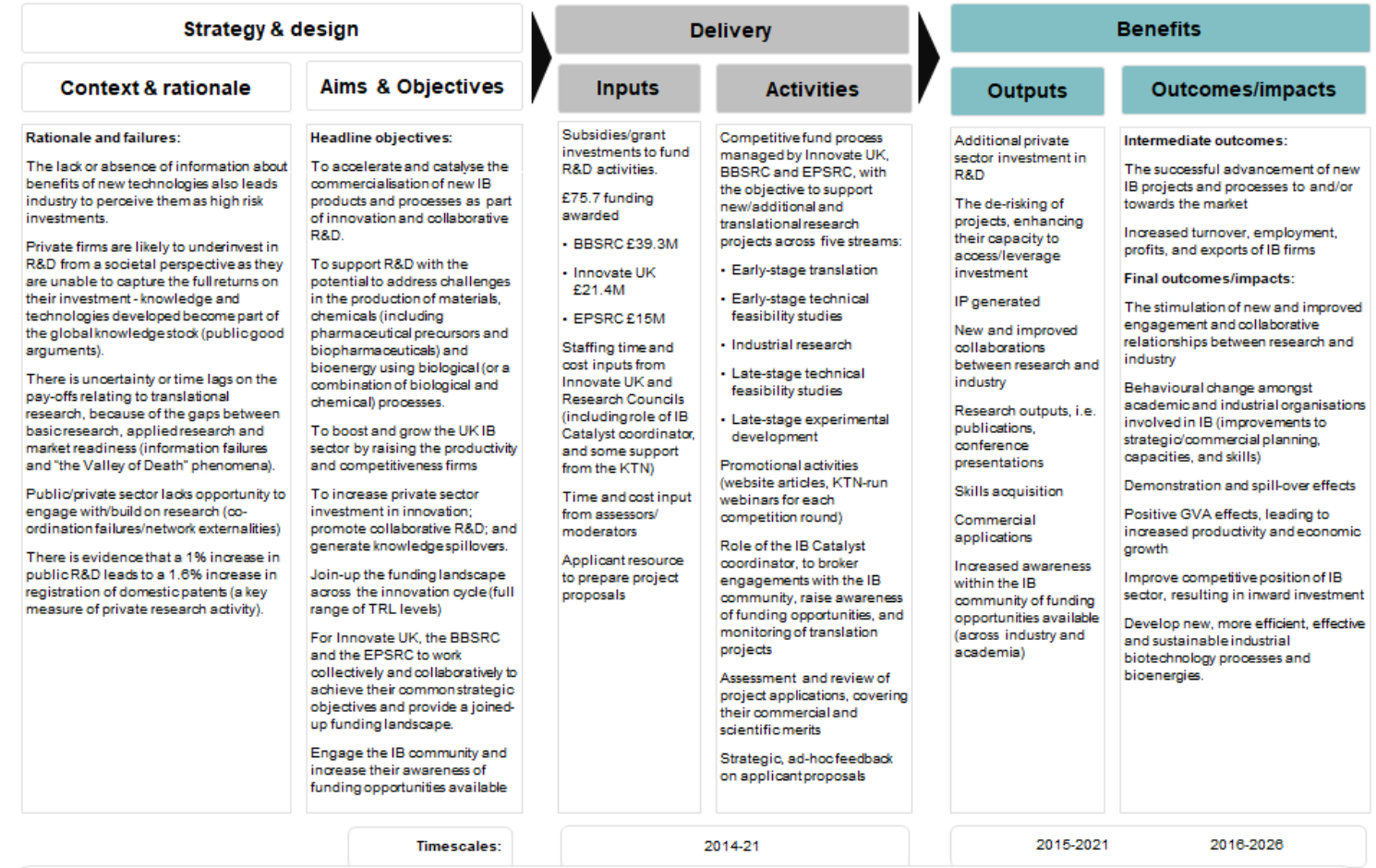
Source: Agri-tech Strategy, business case and evaluation framework; DFID business case

Figure 2-4: Energy Catalyst logic chain



Source: Based on consultations, where documentation has not been available, assumptions by SQW are in square brackets

Figure 2-5: Industrial Biotechnology Catalyst logic chain



Source: Based on consultations, where documentation has not been available, assumptions by SQW are in square brackets

Analysis of programme portfolio

2.18 In this sub-section we present headline findings from the analysis of data on applications and funded projects where data were available. Due to the limitations in data availability discussed in Annex A, this sub-section **only includes data for IBC projects, and those ATC projects which were funded by BEIS/Innovate UK and BBSRC** (i.e. excluding those receiving their funding from DFID funding). No EC funded projects are included in this section – as a result of gaps and inconsistencies within and across Innovate UK's datasets, which Innovate UK was unable to resolve at the time of drafting, SQW was unable to present an accurate analysis of data.

Applications (IBC only)

2.19 There were 309 applications to the IBC, just over a quarter of which were successful in receiving funding. The applications were **evenly distributed across the four rounds.** After independent assessor review, projects had to score 70 out of 100 marks to be considered fundable. Interestingly, of the 227 unsuccessful applicants, over a half scored 70+, reflecting the **high quality of applications submitted**.

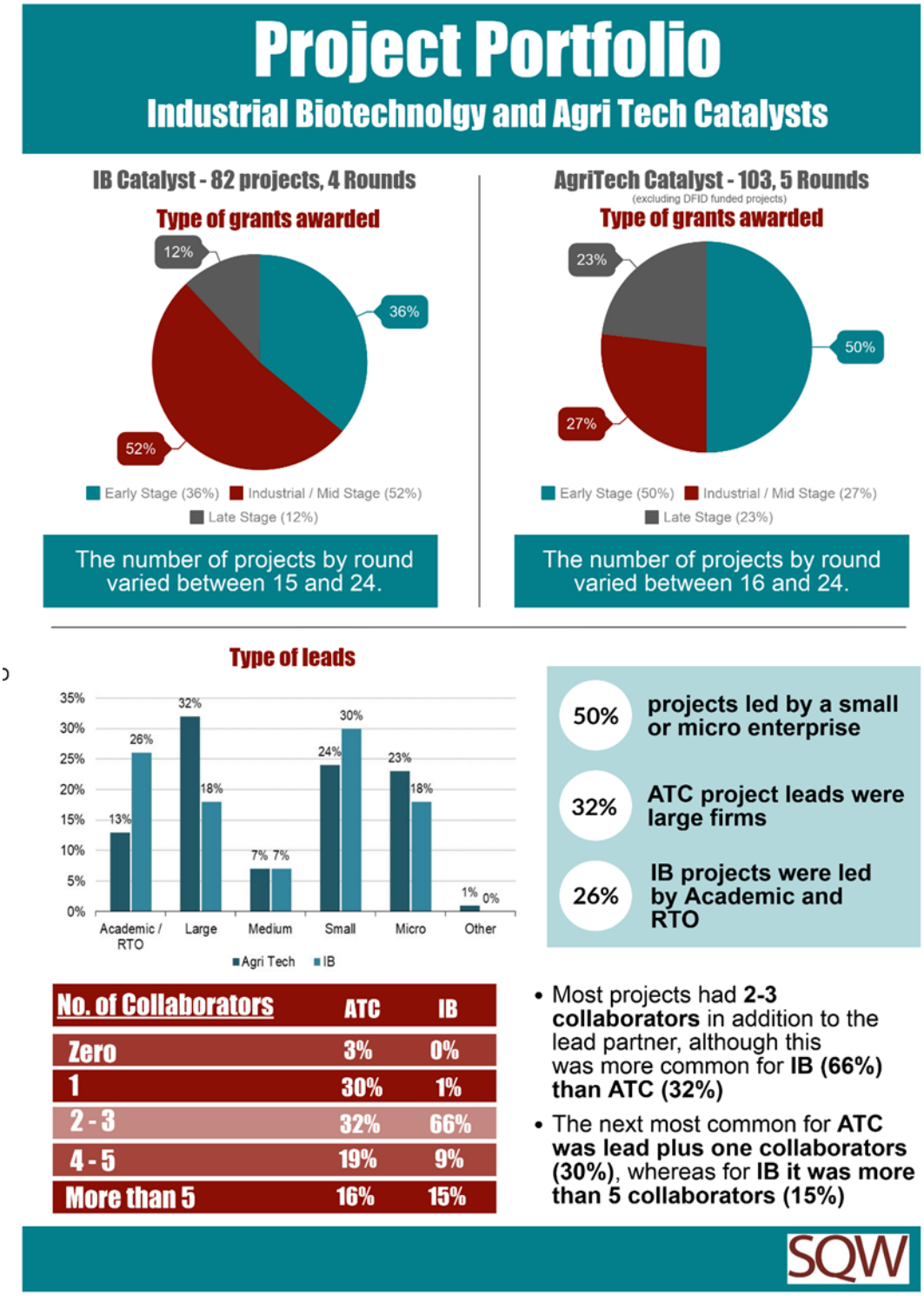
2.20 In terms of application characteristics, around **three quarters were for early stage (including translation) projects**, with a further fifth for industrial stage projects. Reflecting this, a high proportion of projects were expected to last either between 7-12 months (42%) or over 3 years (32%).

2.21 Full data on applications for ATC were not available, and so no key findings can be presented.

Project portfolio (IBC and ATC non-DFID only)

2.22 A summary of the projects funded by the IBC and ATC is provided in Figure 2-6 below, based on monitoring data provided to SQW by BBSRC and Innovate UK respectively.

Figure 2-6: Project portfolios, IBC and ATC only



Source: SQW analysis of MI data

3. Customer Journey

3.1 This Section examines the customer journey through the programme, highlighting commonalities and differences between the three Catalysts. It also reflects on the effectiveness of each aspect of the customer journey, factors that have influenced this, and any elements that could be improved.

Figure 3-1: Key messages

Many areas have worked well, with the following points particularly highlighted in the evidence

- Promotion and awareness-raising, and the translation of this into demand – this has been aided by extensive engagement with relevant communities before competitions were launched and the use of networks/other programmes to raise awareness
- The core process stages have, in the main worked well, i.e. application > contracting > monitoring
- The perceived relevance of the Catalyst for the projects, in particular the different funding stages and the specific issues that the Catalysts were seeking to address
- The design of the Catalyst model itself – this met the needs of target audiences (e.g. intervention rates, types of grants, non-prescriptive competitions)
- The role of the KTN and (in the case of IBC) IB Catalyst Co-ordinator to support applicants and raise the overall quality of applications submitted
- General view that the programme has achieved a balanced portfolio of projects, reflecting broad-ranging demand, wide scope and nature of the sectors, and including some high-risk, potentially transformational projects and 'game changing' technologies

Transferable lessons across Catalysts or similar programmes were identified:

- The need for sufficient longevity to enable projects to progress between grant types – the curtailment of funding did not help with this
- The importance of including an international partner in DFID funded projects as part of the team to provide access to appropriate networks and knowledge of key actors to break down barriers to exploitation during delivery (rather than after the project has closed)

The priority areas for improvement identified were to:

- Reduce duplication in dual processes between Innovate UK and Research Councils
- Address variability in the role that Monitoring Officers have played, considering formally whether wider qualitative roles should be included in the job specification.
- Include formally, and comprehensively, signposting/next steps guidance at close out (and/or before)
- Ensure projects include a plan for knowledge exchange and/or dissemination plan

Other areas to consider (resources permitting) identified were as follows:

- Continuing to seek ways of engaging and encouraging new SMEs
- Provide greater clarity on the offer – especially the timetable of competition rounds (number, timing and scale)
- Minor tweaks to the application form, and potentially consider introducing a lighter touch first stage that adds value for the applicant and eliminates inappropriate applications early, especially for large-scale projects
- Consider greater facilitated access to the programme (potentially via an enhanced KTN role or equivalent advice/support) for SMEs that are new to the process
- Communicate more effectively to applicants the process of moderation of assessor scores, and provide greater clarity in recommendations where assessor feedback is contradictory
- Address the monitoring reprofiling burden and speed up change requests
- Greater project-to-project engagement to exploit possible synergies

Source: SQW

Marketing and demand

Marketing and demand

3.2 On the whole, **demand for all three Catalysts was strong and increased over time**. According to management/delivery staff consulted, a number of factors have been important in generating demand:

- **Extensive engagement by Innovate UK and the Research Councils with the target community before competition launches**: High levels of demand for the IBC from the outset were aided by extensive engagement to raise awareness, which pre-dated the Catalyst launch. This engagement was partly undertaken as part of complementary programmes that were deliberately seen as part of a wider package (see point below). The EC also undertook a range of network-building activities early on to ensure the community was primed for the launch of the Catalyst. In comparison, the ATC struggled with low demand in the first Round – in part, this reflected the tight turnaround between the programme's launch and Round 1, and the newness of this type of intervention in agri-tech. However, from Round 2 onwards, the ATC was heavily over-subscribed.

- **The role of 'feeder programmes'.** Both the IBC and ATC management consultees indicated that other initiatives linked into the Catalyst programmes. In the case of IBC, the Networks in Industrial Biotechnology and Bioenergy (NIBBs) programme had been set up to help develop ideas to the proof of concept stage, and for the ATC, the Sustainable Agriculture and Food Innovation Platform helped to create a pipeline of applications.

- **The use of other networks/actors to raise awareness of the programmes**. The **KTN** played an important role in raising awareness through launch events, and briefing and consortia building events held at strategic locations across the UK. The latter were particularly effective in raising awareness, helping businesses make informed decisions on whether the competition was appropriate for them, and bringing together a critical mass of relevant people. The use of partner and/or funder **networks** (e.g. BBSRC's NIBBs and DFID networks) and wider 'networks of networks' (such as sector advisory boards, leadership forums and sector networks) were used effectively to raise awareness by all three Catalysts. The IBC also appointed an **IBC Co-ordinator** to support marketing activities and liaise with the IB community to build demand – management consultees felt that this role was very effective across these activities.

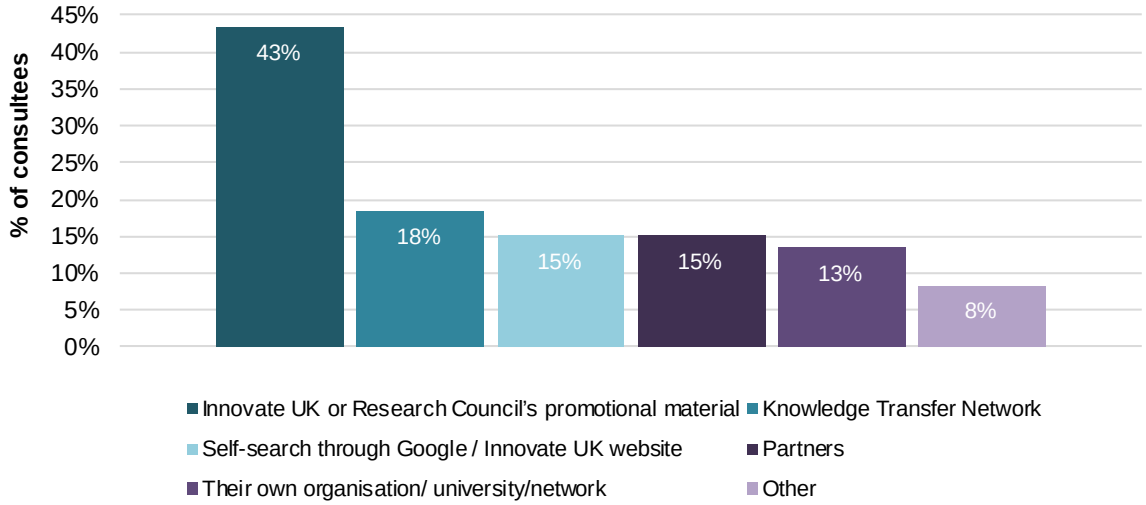
- Specifically for the ATC, the programme was an integral part of the **UK Agri-Tech Strategy**, which had significant ministerial backing and interest. This wider profile-raising of the Agri-Tech Strategy was seen as 'instrumental' in also raising interest in the ATC itself.

3.3 There was some debate around the extent to which the open, non-prescriptive themes covered by the Catalysts encouraged or hindered marketing efforts. For the IBC, the ability to target marketing and engagement activities more effectively because of a more tightly defined

competition was seen as a strength; whereas ATC consultees argued that the lack of narrow themes helped to widen demand (even though it did make marketing a challenge).

3.4 The findings above were corroborated by consultations with beneficiaries, where just under one-half of the 60 interviewed first became aware of the programme through Innovate UK or the Research Council's promotional activities (e.g. e-bulletins, website), and a further 18% became aware through the KTN (see Figure 3-2). Non-beneficiaries were also most likely to have found out about the Catalysts through Innovate UK's marketing activities, although during later competition rounds, referral from other programmes and the KTN was more common.

Figure 3-2: Beneficiary consultations: How did you first become aware of the Catalyst programme? (n=60)



Source: SQW analysis

Programme reach

3.5 Our consultations with beneficiaries suggested that the **majority had received support from Catalyst funders before engaging with the Catalyst programme**: 62% had received support from Innovate UK previously, and 18% had received support from BBSRC or EPSRC. Only 20% of project leads had not received support at all from Innovate UK or any Research Councils (alternative sources were not provided) prior to their involvement in the Catalyst – and the KTN was seen by management consultees as playing an important role in enabling this wider reach. Some beneficiaries expressed concern that the programmes focused on those already 'known' to Innovate UK and was not particularly accessible to new start-ups and those not already engaged in public sector R&D programmes.

ATC Case Study: Soilbio

The idea for this project was formed when the lead and a research institute met at an Innovate UK Roadshow. They shared an interest in developing a novel testing measure and understood the potential value of this to the UK agricultural industry. The lead partner had applied for ATC funding in an earlier application round but were unsuccessful. Their feedback indicated that they needed a larger, more experienced consortium to deliver the project. Their subsequent successful application included a larger consortium (aided by connections made at the Innovate UK event) with a better balance of research and commercialisation experience, and the inclusion of members with strong networks within the farming community.

3.6 This chimes with feedback from external stakeholders and some management staff, who

acknowledged that across all three Catalysts, **more could have been done to raise awareness amongst the wider business community**, especially amongst SMEs and/or businesses not already embedded in the innovation ecosystem. However, timing was an issue for the IBC in particular – the nascent nature of the sector meant that sector networks were only evolving in parallel to the Catalyst programme. This meant that the Catalyst did not have readily available networks to tap into over its relatively short lifetime. It was argued that had the Catalyst operated for longer, then the engagement with the wider community could have been improved as the sector evolved.

3.7 The **inclusion of DFID funding** in the ATC and EC helped to raise overall demand for the programmes, and enabled DFID to effectively engage with businesses who had not previously engaged with DFID programmes. The KTN and DFID's own networks played an important role in attracting applicants to the DFID opportunity, and the ATC found it much easier to target marketing and communicate the offer in Round 6 when the focus was on DFID funding only. However, throughout the programme the ATC found identifying partners in developing countries a challenge, particularly in the absence of any KTN-type activities in the target developing countries. A key lesson from the Catalyst experience was that forming collaborations for DFID-funded R&D projects was much more challenging than in a UK context, and introducing a brokerage function in developing countries may be useful in future programmes of this nature.

3.8 The Catalysts were also **designed to bring together partners who had not worked together previously** into new and interesting collaborations. The evidence suggests some success on this front. According to our consultations with beneficiaries, 47% of consultees had worked with *all* of their partners before and 18% of consultees had worked with *some* of their partners. Around one-third (32%) had not worked with their partners at all (although a few of these had known their partners but not worked with them before), and 3% did not have any partners in their project[18]. Where new partnerships had been formed, the KTN consortia building events were noted as playing a key role in enabling this.

Attractiveness of the Catalyst model

3.9 Across all three programmes, external consultees believed that **objectives** were clear, consistent and well understood. Across the beneficiary and non-beneficiary consultees, there were mixed views on the extent to which the Catalyst offer was clear, with some confusion over the scope, objectives, eligibility criteria and target audience (slightly more so for non-beneficiaries).

> '*Innovate UK and funding partners cannot expect to know everything in the sector, where demand or opportunities are – the market is best placed to know, and the wide themes allowed for this*' (Agri-Tech consultee).
>
> An Energy consultee liked the broad focus on the energy trilemma rather than a specific technology solution as '*innovative technologies don't sit within neat boundaries as they try to challenge and disrupt boundaries!*'

3.10 Across all types of consultee, the **model adopted** by the Catalyst was seen as appropriate and attractive given beneficiary needs. Four sets of points are noteworthy:

- All three Catalysts offered **awards for different stages of the development process**, with the expectation that this would provide a compelling pathway to exploitation. This proposition was

[18] This was permitted for late stage projects.

attractive to the sectors involved because it provided the flexibility to meet their varying needs, and some consultees explicitly referred to the ability to move through the stages in explaining why Catalyst funding was sought. However, whilst some beneficiaries did progress their projects through stages of funding, the short lifetime of the programme meant that this was limited to a small selection (within the Catalyst programme[19]). Linked to this, some of the ATC beneficiaries expressed concern that the timeframe for early and late stage grants was too short, often only covering one growing cycle which did not allow for sufficient data to be gathered.

- On the whole, beneficiaries and non-beneficiaries were satisfied with the **intervention rates.** Where issues were raised, the main area for concern was for micro/small and new start-ups, because they struggled most to secure match funding. Aside from that in both the beneficiary and non-beneficiary interviews, a minority that found intervention rates challenges for different project stages and for different reasons. There was no evidence to suggest that changes made to the ATC intervention rate influenced the level of demand.

- **The open and non-prescriptive series of competitions** was generally seen as a success. Feedback from management staff and external stakeholders suggested that it enabled the Catalysts to attract completely new and emerging technologies, including those that could not have been foreseen at the start (across all three Catalysts, but especially for nascent sectors like IB). Beneficiaries agreed, arguing it allowed industry to come forward with the best opportunities and 'disrupt' traditional sector boundaries. It was sufficiently broad to accommodate a wide audience (which was particularly important for diverse and fragmented sectors such as agri-tech) and the needs of different types of players across the relevant sectors. It could also accommodate the different priorities of multiple funding bodies under one programme. Moreover, this differentiated the Catalysts from other support available – in the case of the ATC and EC, wider support available at the time was more prescriptive in terms of its thematic focus.

- Having a **series of competition windows rather than a continuously open call** was considered appropriate by many of those consulted. It provided a deadline to motivate applicants – and marginally more beneficiaries were in favour of this compared to an open call. The competition windows also helped to define a structure/timetable for marketing events, and allowed for a more streamlined and efficient management process (especially noted by ATC and EC management consultees). Preference for a continuously open call predominantly came from ATC beneficiaries and non-beneficiaries (and a minority of external stakeholders), where competition windows did not always fit with the seasonality of the sector. Beneficiaries also argued that an open call would allow more time to establish new collaborations and write good quality applications. We note that there are good reasons for operating through competition windows (e.g. resourcing and organising assessment processes), and so on balance the

[19] They may have accessed follow-on funding from elsewhere – covered in Section 4.

approach is fit-for-purpose. One way to alleviate some of the issues would be to provide greater clarity over the scale and timing of competition windows, including future ones, in order to facilitate planning. This was highlighted by external stakeholders and beneficiaries. This would obviously depend on sufficient funding being available and committed into the future (rather than annually, as in the case of the Catalyst programmes to date), something that we would also recommend is done (in line with the fundamental basis of the Catalyst model).

Recommendations for improvement

3.11 On the whole, feedback on marketing and promotion of the Catalysts was positive – 62% of beneficiaries[20], and most non-beneficiaries and external stakeholders, believed promotion was good. Recommendations for improvement focused on the following:

- Improving communications with those already 'known' to Innovate UK, through **more targeted e-marketing** (some beneficiaries commented on 'information overload')
- Improving reach to those not already known to Innovate UK, through **other mechanisms** such as social media, trade press, linking to innovation centres and other initiatives, and possibly through greater outreach work (e.g. visits/calls to businesses), although the last of these would be particularly resource intensive
- Providing **greater clarity on the offer** (especially in terms of scope, objectives, target beneficiaries, eligibility criteria), **the application requirements** (to dispel perceived complexities/administrative burdens) and the **timetable of competition rounds** (number, timing and scale).

> '*A fixed deadline gives a sense of purpose when preparing an application form*' (Energy consultee)
>
> '*With a constantly open call, preparing the application could be pushed further down the priority list and so valuable time can be lost*' (Energy consultee)
>
> '*It seems sensible to have a deadline as all bids can be assessed against each other in a fair way*' (IB consultee)
>
> Another commented that deadlines were a useful tool to leverage authorisation to proceed (within the business)

- Greater **showcasing of projects funded** in earlier rounds (for example, in high profile publications) and **dissemination of past success rates** to help businesses, especially SMEs, make informed decisions on whether to deprioritise something else within the business in order to apply for funding (especially noted by ATC and IBC consultees), recognising this would need careful interpretation (for example, in the case of one - and two-stage application processes). One consultee believed the lack of information on success rates did deter some businesses from applying, especially if they were new to this type of funding or had already been unsuccessful in an earlier round.

[20] Of 58 responding to the question.

Application rationale and processes

Consideration of other funding sources and rationale for Catalyst application

3.12 As part of the consultations with beneficiaries and non-beneficiaries, we explored the extent to which they considered other funding sources before applying for the Catalysts, and if so, the rationale for choosing the Catalyst programme.

3.13 The evidence showed that just over half of beneficiaries did consider alternative sources of funding for their projects, demonstrating that the funding landscape did have some alternatives within it. The most common sources were EU programmes or internal funding (all Catalysts), or other academic or Research Council programmes (for IB beneficiaries only). None identified Venture Capital (VC) as an alternative option. Various reasons were given to explain why the Catalyst programme was preferred, and these included reasons that were closely related to the fundamental design of the Catalyst, its processes, and the market failure arguments identified in Section 2. The following were commonly-made points:

- The **Catalyst model** was most attractive/best suited to the project, especially in its scope to be industry-led, the grant stages and opportunity to progress through these stages, the non-thematic nature, its strategic alignment with business/academic interests, the opportunity to work in partnership with collaborators to alleviate risks, and – specifically in relation to Catalyst processes[21] – the perceived 'straightforward' nature of applications (compared to EU programmes).
- **Other funding options were not appropriate, attractive or feasible** – they were seen as 'piecemeal' and inappropriate for longer-term projects and/or for progression through TRLs (especially academic funding), intervention rates were too low, application processes were more bureaucratic, or the IP sharing restrictions made them unattractive.
- **The level of risk** involved meant that businesses could not justify internal funding, particularly for early stage projects, which linked back to the market failure rationales underpinning the Catalysts.

3.14 Many also argued that there was a **lack of alternative options,** especially ATC in the case of respondents, suggesting the programme did fill a gap in support.

3.15 The sample size is small so we need to be cautious in how we interpret the data, but the findings also suggested that: EC beneficiaries were notably more likely to consider alternative funding sources than IBC beneficiaries; and Industrial/mid-stage beneficiaries were much more likely to consider alternative sources compared to late stage applicants. However, there were no consistent differences in their rationale for choosing the Catalysts as opposed to alternative funding considered.

3.16 The picture was similar for non-beneficiaries consulted – a lower proportion had considered alternative funding (10 of the 35 respondents), but where they had done so, several had

[21] Given that these were based on standard Innovate UK (for businesses) and Research Council (for academics) processes, this reflects more widely the processes adopted by these agencies.

approached VCs but were deemed too risky for investment. Reasons for applying for Catalyst funding rather than other options were similar to those listed above.

3.17 The evidence above does suggest that **the Catalysts were addressing market and other failures** – particularly around the level of risk which has deterred internal and VC investment, co-ordination failures, and gaps in existing provision (especially around applied/late stage R&D) – and the **Catalysts' model and processes were seen as attractive** compared to alternatives.

Catalyst application process

3.18 On the whole, the **application *process* was relatively straightforward and effective.** Beneficiaries and non-beneficiaries generally felt that it was clear, appropriate and proportionate, but time-consuming.

3.19 Many had prior experience of bidding for Innovate UK (or similar) programmes in the past, and were therefore familiar with the process and did not require help from elsewhere. There was some concern from beneficiaries, non-beneficiaries, external stakeholders and assessors that **experience was key to successful applications**, with a risk that projects were judged on their ability to respond to application questions rather than necessarily the merit or potential of the idea. For example, beneficiaries argued that '*it's almost not worth applying unless you have someone with Innovate UK experience on the team*' and '*the Innovate UK application process is an art form. It is very difficult to be successful in your first few tries*'. Where industry leads did not have prior experience, it was common for academics within the team to lead the bid writing. Some businesses – both experienced *and* new bidders - hired professional bid writers as demonstrated by case study evidence highlighted here.

IBC Case Study: M-RIPPs
The lead organisation had a long history of prior engagement in R&D support, including a number of Innovate UK grant programmes. However, an external bid writer was still hired to support the development of the application. Once the academic partner had drafted a technical outline for the proposal, this was adapted and 'couched in Innovate UK language' by the bid writer. In this project, a consultant was subcontracted to not only put the application together, but also to manage the project.

IBC Case Study: ALGIPRO
In this project, the lead organisation held multiple IBC grants (and others) and had a separate bid writing team within the organisation to support their various technology experts put grant applications together. The bid writers collated technical inputs from the various partners involved, transferring them into the format and style required. The application was put together iteratively, with the bid writer coordinating the inputs from the various technical leads involved in the project, while also ensuring that key aspects in terms of routes to market exploitation and the key deliverables intended, were clearly set out.

3.20 The majority (80%) of beneficiaries found the **guidance documentation** to be clear, comprehensive and '*immensely useful*', as were the competition briefing events, consortia building events and webinars. Across the Catalysts, the **KTN and (in the case of IBC) IB Catalyst Co-ordinator** also offered a critical friend and advisory support to applicants, which was particularly valuable for SMEs and first-time bidders. All types of consultee argued the KTN/IB Catalyst Co-ordinator played an important role in ensuring that high quality bids were

submitted. Innovate UK was also contacted for minor queries, and was described by beneficiaries as '**very good and helpful**'.

3.21 Moreover, a number of beneficiaries found the *process* of completing an application useful in itself. The questions promoted a focus on exploitation and risk management, the structure of the application helped to cogently order the proposal, and it helped to develop relationships with partners. There is evidence in one of the ATC case studies, for example, of a business who was initially unsuccessful in their application taking on board feedback received to improve their subsequently successful bid.

3.22 As a result of these factors, a large proportion of **applications were of a high quality**. Even where success rates were low – as in the example of the ATC – this appears to be a reflection of high demand compared to funding available, rather than poor quality bids. In the case of IBC, many of the applications with assessment scores that significantly exceeded the minimum fundable threshold (by 10% or more) failed to secure a grant. Whilst this meant the programme was able to fund high quality projects (see sub-section below), some external stakeholders noted the potential risk that the community could disengage, e.g. if repeated good applications were ultimately successful. It also raised a question around the ability of those that were new to this kind of programme to compete against 'experienced bidders', and therefore the programme's ability to widen its reach.

3.23 Beneficiaries and non-beneficiaries did identify a small number of issues with the **application form** itself, with the following the most commonly made points:

- The scope of questions (and more broadly the Catalysts' objectives) were not always clear, making it difficult for applicants to refine their application to meet the programme's objectives (and therefore focus their efforts).
- Many (especially early stage award applicants) struggled to answer questions on market justification, outcomes/impact, additionality and added value, and would have appreciated more hints/tips for these questions.
- A number found it difficult to forecast financial data accurately/at the required level of detail, especially given the risky/uncertain/unpredictable nature of many projects.
- The format was not conducive for collaborative bid-writing (e.g. tracking changes or sharing the document).

3.24 In response to the first three points, standard Innovate UK application forms may benefit from some degree of tailoring to fit the funding gap the programme is seeking to address.

3.25 All three Catalysts employed a **two-stage application process** for different aspects of their programme (mainly the industrial/mid-stage grants). Across management consultees, this was seen as appropriate for larger projects – both EC and IBC found applicants took on board feedback received, and this was thought to have led to a more effective process overall and higher quality applications. For the IBC, the IBC Co-ordinator played an important role in discussing areas for improvement with the application after the Expression of Interest (EOI) stage. Even though the EC process appeared to result in better applications, the two-stage application process was removed, because applicants were being asked for the same

information twice. Views from beneficiaries on the value of a two-stage process were mixed. Those in favour indicated that '*though it required a greater time investment than other one stage applications, the feedback from stage 1 was clear and constructive, and ultimately helped us to deliver a better proposal*' (Energy consultee); whereas others argued the process was duplicative, time-consuming, and disjointed (the second stage did not feel like a follow-on from the first). Therefore, there were two different views on this: on the one hand it contributed to greater effectiveness through some higher quality applications; but on the other hand, for other applicants it resulted in less efficiency in the process with no added value.

3.26 All applications were initially submitted to Innovate UK, and only applicants who were successful in obtaining Research Council funding then had to complete Research Council application forms. Nevertheless, beneficiaries found the **dual application process for Innovate UK and the Research Councils** confusing and a duplication of effort. This was seen as an inefficiency in the process that should be addressed for future Innovate UK-Research Council programmes.

Recommendations for improvement

3.27 Recommendations to improve the application process focus on three key areas:

- First, addressing the issues raised above in relation to the **application form.**
- Second, addressing frustrations around the **two-stage application process**, potentially by introducing a lighter touch first stage that adds value for the applicant (in terms of clarifying scope/fit etc), yet avoids inefficiencies through duplication. The two stages could also enable the funders to eliminate inappropriate applications early and therefore use resources more efficiently both for funders and applicants. Issues around the dual Innovate UK and Research Council processes are not unique to the Catalyst programmes and are dependent upon wider organisational requirements, and therefore will be more difficult to address – the formal establishment of UKRI from April 2018 may provide an impetus to align processes.
- Third, beneficiaries and non-beneficiaries would like to see **greater facilitated access** to the programme and **interaction with Innovate UK**, particularly for SMEs and/or businesses who are new to the process. This could range from having a named contact at Innovate UK for clarifications, through to the inclusion of 'pitches' in two-stage application processes and more intensive 'hand holding' to guide applicants through the process. The latter, however, would be very resource intensive and could create challenges in terms of Innovate UK's impartiality in the process; the KTN, or other independent organisations, may be better placed to provide this.

Assessment and contracting

Assessment processes from the assessor and customer perspective

3.28 As illustrated in Section 2, once applications were submitted, they were assessed and scored. In this sub-section, we provide feedback on the process from the assessor and customer perspectives. Section 5 describes and reflects on the effectiveness of each Catalyst's assessment and decision-making processes (in the context of programme management and governance).

3.29 Each Catalyst had a **pool of assessors** who were drawn upon to review and score each application. Feedback from management staff and external stakeholders indicated that the assessors were highly qualified and experienced, and well-regarded experts in their field. The funders were very selective in their recruitment of assessors – being able to trust their opinions was imperative. Innovate UK, BBSRC, EPSRC and DFID all played a role in helping to identify and encourage specialists to apply to become assessors, which was important to ensure the programmes had a strong, interdisciplinary pool to draw upon. A good breadth of expertise was important, especially for ATC and IB, to reflect the diverse sectors. The ATC included an assessor with expertise in agriculture in developing countries, whereas concerns were raised by consultees that EC assessors lacked international development experience.

3.30 The assessors consulted were broadly **happy with the briefings and guidance received** to undertake systematic assessment. A little more detail on scope and lessons around what had worked from previous rounds would have been helpful. The budget available for each assessment was considered 'tight' by the assessors consulted, especially given the calibre of assessors and their associated day rates, but most were able to draw on prior experience in undertaking assessments. Formal **training** took place for IBC assessors, and some (but not all[22]) of the ATC assessors. This included a training workshop to discuss programme scope, scoring, and how to provide good quality and helpful feedback to applicants. In the case of the ATC, many of the assessors were also Monitoring Officers (MOs) which provided invaluable experience of what makes for a successful project (e.g. risk, project management and costs) that could be utilised in the application assessment process. Innovate UK provided good support and quick responses to assessors during the assessment process, although assessors would have appreciated more **feedback** once their assessment was complete (noted under ATC and IBC), which would have enabled a more consistent and effective process in subsequent rounds. In the main, assessors tended to 'self-calibrate' their scores. Some were invited on an ad hoc basis to ATC/INC Funders/Assessment Panel meetings, which they found extremely useful. Beyond this, assessors consulted did not take part in any **formal knowledge sharing** with their peers – whilst they recognised the need to maintain independence and draw on their own experience, they felt that lessons could usefully be shared to improve the effectiveness of their subsequent assessments.

3.31 Each application was assessed by 4 or 5 assessors, and then feedback was provided to the applicants. Some applicants found assessor feedback useful. For example, around one-third of the non-

> *'The Energy Catalyst feedback is some of the best feedback I have ever had…other funding competitions have provided a quarter as much of the feedback I received.'* [Non-beneficiary]

[22] E.g. ATC assessors consulted for this evaluation had not received training.

beneficiaries consulted said it helped to inform the next steps of the project, streamline their workplan and refine the project's scope.

3.32 However, both beneficiaries and non-beneficiaries expressed some frustrations with the assessment process. Some of these points are to be expected, and are common in schemes of this nature. The key points raised were as follows:

- **The lack of transparency in the decision-making process**. For example, one Energy beneficiary consulted was unsuccessful in their first attempt and successful in their second, even though the second attempt scored lower than their first.
- A frustration with the failure of high scoring bids, which was described as 'disheartening'.
- **The variability in assessor scores,** and the perception that one outlier score could significantly decrease an application's overall score. For example, one beneficiary commented that '*one assessor has the power to completely sink a proposal. It can often feel very 'luck of the draw' and it's commonplace to receive polarised scores*' and others associated outlier scores with assessors' misunderstanding of a proposal/technology. This issue was also raised during consultations with management staff and external stakeholders, where some EC consultees were concerned that variability in scores reflected a lack of technical expertise to make informed judgements or that scoring criteria were not consistently applied, and some IB consultees observed some inconsistencies arose in how assessors interpreted assessment criteria – whereas for the ATC, management staff felt that the use of five assessors allowed space for differences in opinion, which reflected the range of expertise assessing a bid (rather than being an issue per se). In practice, outlier scores were moderated, even if this was not communicated effectively to applicants. For example, ATC removed significant outliers, and the IB management board was important for identifying such cases and external moderation could be used where necessary (although in practice, this step was rarely used). For larger value IB translation stream projects, a telephone interview was also piloted as part of the moderation process in Round 4 to good effect – one potential translation stream project was ruled out as a result of this step, that may have received funding otherwise.
- **Unclear, inconsistent or contradictory feedback**. For example, one consultee received feedback that their project '*is not ambitious enough*' from one assessor, and '*totally unrealistic*' from another; other beneficiaries were frustrated with discrepancies between the application guidance and assessor feedback (in what should/should not be included in a response, or gaps identified by assessors where the applicant did not have sufficient space in the response form to provide all the detail requested). This made it difficult for applicants to ascertain how best to improve their application/project.
- **Overall, the lack of opportunity for discussion**, particularly where applicants felt there had been misinterpretation by assessors.

Contracting processes

3.33 The **contracting process appeared to operate smoothly**, following standard Innovate UK procedures. Across the three Catalysts, over three-quarters[23] of the beneficiaries consulted agreed that the contracting process was appropriate, proportionate and relatively straightforward. Many were familiar with the process given their prior experience working with Innovate UK.

3.34 The remainder of beneficiaries consulted found the contracting process difficult, predominantly due to the **volume of paperwork, extensive communication** with Innovate UK (which could appear 'disconnected' within the organisation at times), and **delays** in the process. The latter was particularly frustrating for short-term early/late stage projects if delays absorbed a substantial amount of delivery time, and for ATC applicants where it impacted upon their ability to start delivery in line with crop cycles/seasons etc. However, it was recognised that the due diligence process can take time and needs to be rigorous. The nature and scale of collaborations did impact upon the speed of contracting in some instances – particularly where collaborations were newly formed and/or large in scale.

Recommendations for improvement

3.35 Three recommendations were made in relation to assessment and contracting:

- The potential for **moderation of assessor scores** – or, where this already takes place, **communicating** this more effectively with applicants.
- In addition to feedback from each assessor, applicants would find it useful to have some **distilled, consistent feedback** on how the application/project could be improved looking forward.
- Where there are delays to contracting, keep applicants informed and consider flexibility in project delivery dates where appropriate.

ATC Case Study: BBG

The project lead had previously received funding from Defra, and then an Innovate UK Collaborative R&D grant, to develop the science behind an idea which is now the focus of a three-year industrial award through the Catalyst programme. The ATC project was awarded in Round 2 and is designed to develop the technological solution to more efficient resource use.

The lead emphasised how the R&D process is non-linear, and how projects identify new lines of enquiry or opportunities. Through the Catalyst programme, the lead company has been able to apply for another ATC industrial grant in Round 5 to explore these – and specifically new potential applications of the technology developed in the Round 2 project – in a new sub-sector. By delivering multiple projects, the lead argued that the impact will be 'more than the sum of its parts' in terms of their technological development as they learn from each other, and the potential sector-wide impacts of the technology in question (as the technology gains sufficient 'critical mass' to influence others). There was some concern that if the Catalyst funded a large number of small, unconnected projects the overall impact could be reduced.

Project delivery

Programme portfolio

3.36 Management consultees involved in all three Catalysts felt that the programmes had achieved a **balanced portfolio of projects,** reflecting the range of demand, wide scope and nature of the

[23] 77% of the 31 consultees who provided responses to this question.

sectors[24]. Whilst all Catalysts reserved the right to apply a 'portfolio approach' to ensure a breadth of projects, this was not heavily used in practice by any of the management teams[25]. Management consultees and external stakeholders argued that the Catalyst portfolios included some **high risk, potentially transformational projects and 'game changing' technologies**, which was seen as a key strength of the programme.

Progression through grant types, and involvement in multiple projects

3.37 As noted above, **very few projects have been able to move through the different grant types** within the Catalyst programme, so in that respect, the Catalysts have not acted as a 'seamless conveyor/escalator' through the commercialisation process[26]. The short lifetime of the programmes, including the premature curtailment, especially for the IBC, was the key barrier to this. The following examples illustrate this:

- An early stage ATC grant awarded in Round 1 could have commenced mid-2014, and been delivered over an 18-month period to late-2015. It could then have applied for an industrial award in Round 5, which closed in January 2016, but would have been competing with all other applications in the competition. Even if successful, it would not have been completed in time for a late stage award given the three-year duration of industrial projects.
- A mid-stage EC grant awarded in Round 2 could have commenced in mid-2015, but given mid-stage awards span three years, the project would not complete until after the programme had closed, and so the applicant would not have been able to progress to a late stage award.
- An early stage feasibility study awarded in Round 1 of the IBC could have commenced by the end of 2014 (the deadline for EOIs was May 2014, with a full application thereafter) and lasted 12 months to the end of 2015. The fourth and final competition round for the IBC closed in August 2015, so the project would have missed that deadline.

3.38 Where projects have been able to move from one grant type to the next within the Catalyst programme, the feedback to date has been positive. For one EC case study, where the project moved from an early to mid-stage award, the original early stage grant helped to de-risk the proposition and the ability to progress to a mid-stage grant has meant the technology has progressed far more than would otherwise have been the case. The ability to progress through grants was an important factor in attracting the lead business to the programme. Moreover, the ability to successfully demonstrate the technology in the early stage project enabled the lead to make a much more convincing case for follow-on funding at the mid-stage.

3.39 Some project leads were **involved in more than one project** (not progressing through grant types) and the case study evidence suggests this has led to synergies between projects. For example, one IB case study reported that involvement in two, complementary IB Catalyst -

[24] The ATC saw more applications from the crops and horticulture sectors compared to livestock, but this reflected the nature of the sector to some extent – UK research expertise in crops, the ability of sub-sectors to part-fund projects, and willingness/openness/drive to engage in R&D activities.
[25] For the IBC, certain parts of the IB community were more mature and prepared to apply initially – but the Catalyst saw a natural increase from across the breadth of the sector over time.
[26] They may have accessed follow-on funding from elsewhere – covered in Section 4.

funded projects had led to knowledge exchange and development within both projects. Another IBC case study found that by accessing multiple Catalyst grants, the business was able to accelerate various strands of activity simultaneously, speeding up the commercialisation process and allowing the business to grow at a much faster rate than would otherwise be the case. The ATC case study in the box here also demonstrates how multiple Catalyst projects will add to 'more than the sum of their parts'.

Project delivery and monitoring

3.40 Whilst an assessment of progress at a project level was beyond the scope of this evaluation, we discussed the extent to which projects were on track with beneficiaries and – crucially – factors and processes that were enabling or acting as a barrier to progress.

3.41 The majority of beneficiaries consulted (nearly 90%) believed they were on track regarding the delivery of activities and milestones. The remainder were behind schedule, due to technical difficulties, changes to project plans, or technologies taking longer to develop/validate/test than expected.

3.42 The main source of **support during the delivery** of projects came from the Innovate UK Monitoring Officer (MO, covered in detail below) and (more limited) contact with other representatives of Innovate UK or the Research Councils, mainly in response to issues such as variations or the departure of a consortium partner. Few had received support from elsewhere, although around one-third of those interviewed believed that additional support may have been useful, particularly where their MO adopted a 'tick box' approach to monitoring (as opposed to a more supportive approach). Suggestions included mentoring, market insights, signposting to follow-on funding, and networking opportunities with other Innovate UK projects. Some external stakeholders also commented on the limited extent of partnership working between the Catalysts and other programmes during the delivery process.

3.43 There were mixed views from beneficiaries on the monitoring requirements. The majority (around three-quarters) believed monitoring was an appropriate, proportionate and helpful process. For these respondents, monitoring had helped to maintain momentum, provided structure and a common purpose for partners to work towards (enabling more effective collaboration), and created an opportunity to reflect on what was working well (or not) and why. A similar proportion of beneficiaries felt quarterly meetings were a reasonable 'ask' and generally a productive use of time.

'*[The MO provided] invaluable guidance throughout the process. As first time Innovate UK beneficiaries, we really needed our hands held and he was more than happy to do so*' (Agri-Tech consultee)

'*We were really happy with our Monitoring Officer – they were well suited to our project and gave us the confidence, and process knowledge, to review the scope of the project.*' (IB consultee)

3.45 Table 3-1 summarises aspects of projects that have worked well, factors that have been critical to the success of projects, and barriers to delivery, based on feedback from There were mixed views from beneficiaries on the monitoring requirements. The majority (around three-quarters) believed monitoring was an appropriate, proportionate and helpful process.

3.46 Feedback on the MO appears to be dependent on the 'type' of MO involved in a project. Around three-quarters of beneficiaries consulted gave positive feedback on their experience of MOs. They argued that MOs added most value to the delivery process where they: (i) played a critical friend role, (ii) provided guidance and signposting, (iii) had reasonable technical and/or market knowledge, (iv) were pragmatic and flexible in their approach, and (v) had open, honest and regular communications. Conversely, MOs that adopted a 'tick box' approach to monitoring were not seen to be empowered to make decisions or lacked sector knowledge, and demanded excessive re-profiling of financial information.

3.47 There appears to be considerable variation across and within the Catalysts on the 'types' of MOs engaged in the programme. For example, some management staff and MOs consulted expressed concern that the EC's MOs have focused more on ensuring compliance with project plans rather than providing additional support, and that the lack of systematic hands-on support and guidance was a missed opportunity. By comparison, the ATC's and IB's MOs appeared to play more of a check/challenge and non-executive director role, with a clear focus on outcomes and routes to exploitation from the outset rather than solely project spend and milestones.

3.48 The MO role needs to be carefully balanced. The core role, as indicated by Innovate UK, was to provide a review and check on progress of projects. Additional support and advice is not formally part of the core role, and Innovate UK has to guard against any potential comeback where, for example, a project implements a suggestion of an MO that has an adverse effect on the project or organisation. Nevertheless, the evidence presented by beneficiaries indicated that some form of informal critical friend role – even if it is simply to pose questions, raise issues and point factually to other aspects of the innovation landscape – would be welcome in the future.

Table 3-1: What has worked well (or not) in project delivery

	Worked well / critical success factors	Worked less well / barriers to delivery
General	The flexible, hands off and pragmatic approach to programme management by Innovate UK The role of the MO, particularly where they: • provided a critical friend/non-executive director role • provided guidance, support, signposting and market insights • provided introductions to potential collaborators • expanded horizons beyond the immediate project, ensured a focus on exploitation • were pragmatic and flexible, 'discipline with empathy' • offered flexibility when appropriate (and have the authority to do so) • supported project management • brokered an open and honest relationship with the project lead/partners • had good technical understanding	The role of the MO where they adopted a 'tick box' approach to monitoring, were unable to provide informed or decisive guidance, and particularly where they demanded excessive re-profiling of financial information Inconsistencies between MOs on different projects in their interpretation of Innovate UK guidance/rules The process of making small changes to the project could be time-consuming, slow and convoluted. Slow processing of financial change requests can create financial uncertainty for partners. The lack of control by project leads over when consortium partners received funding - as a result, leads did not have sufficient leverage over performance/delivery on time Linked to the point above, some businesses experienced challenges working with Universities, with differences in pace and outlook (e.g. an academic focus on the next grant or publications, rather than market outcomes)
DFID-specific	A prerequisite of DFID funding in the ATC was the inclusion of a partner from the developing country which the project focused on (whether the project was solely DFID funded or not), and whilst many found it a challenge to find relevant partners, it has proved critical to ensure the projects have access to appropriate networks and knowledge of key actors to break down barriers to exploitation.	EC projects did not specify the need for international partners (unlike ATC), which was considered appropriate as EC projects had multiple funders (rather than solely DFID). However, consultees expressed concerns around the time then taken to build links with international partners before projects could be trialled in the field, delaying projects' impacts further.

Source: SQW analysis

Recommendations for improvement

3.49 Four key recommendations for improvement were identified under project delivery and monitoring:

- First, ensure the programme has **sufficient longevity** to enable projects to progress between grant types, and potentially consider a 'fast track' or ringfenced funding for successful projects to move to the next stage of grant.
- Second, ensure **consistency in the approach of MOs** (covered in more detail below), and consider formally including wider qualitative roles (such as mentoring, signposting) in the job specification.
- Third, on a practical level, address the reprofiling burden and speed up change requests.

- Fourth, ensure that all DFID funded projects **include a partner from the developing country** which the project focused to provide access to appropriate networks and knowledge of key actors to break down barriers to exploitation.

Completion and aftercare

3.50 The **project completion process was fairly similar across the Catalysts**. For each project, a **close out meeting** was held with the MO and (in some but not all cases) the Innovate UK Lead and BBSRC Lead where an academic partner was involved [27]. At this meeting a **close out report** was completed to capture evidence on performance against output/outcomes. These forms were generally fit-for-purpose, although there was some duplication between different funders' forms. The majority of beneficiaries consulted whose project had closed[28] found the completion process straightforward, and the paperwork proportionate to the grant received. The only notable issue raised was that the costs associated with project completion were not included within project costs. The case study evidence gathered to date suggests that Innovate UK presence at the close out meeting was highly valued. One DFID-funded case study also highlighted the importance of engagement with DFID at close out and/or earlier in the project delivery phase.

3.51 However, there does **not appear to be a structured, consistent approach to aftercare** following project completion. Innovate UK leads do provide signposting at the close out meeting for the ATC, or penultimate meeting in the case of IBC (where, if in attendance, BBSRC leads also provide signposting), and some ad hoc referrals were made to KTN where appropriate (e.g. ATC). As noted above, some MOs also focussed informally on routes to exploitation throughout project delivery (which includes consideration of follow-on support/funding) so were less reliant on signposting solely at the end of the process. In the case of the IB translation stream projects, the IB Co-ordinator, a well-connected member of the IB community, led on monitoring and ensured projects maintained a focus on exploitation.

EC Case Study: OakTec

This company felt that the aftercare process could be improved, and that the funders were in danger of falling into the 'fund and forget' trap. The importance of a clear pathway to take projects through the 'valley of death' was stressed. Despite the project receiving DFID funding, the partners had received little contact from DFID at the time of the evaluation. Greater engagement from DFID would demonstrate to project partners that DFID are aware of, and interested in, the technology developed and want to support its progression. Greater engagement would also help the partners to feel part of a system which follows through on specific opportunities, rather than just funding a wide range of single projects.

3.52 That said, management consultees expressed concern about the lack of formal/consistent approaches to aftercare, and the lack of resources available to improve this. External stakeholders also commented on the lack of a clear 'exit strategy' at the end of a project, and a plan to address remaining barriers to commercialisation.

[27] For some projects, especially IBC, Innovate UK leads attended the penultimate meeting (rather than final meeting) in order to discuss next steps and signposting. This was because it made sense to do this earlier than the very end of the project. For IB projects involving an academic partner, a representative of a research council providing the funding (BBSRC or EPSRC) would also attend.
[28] 17 out of 18 leads whose project had closed and responded to the question.

3.53 These views were corroborated by the beneficiaries consulted, where only about one-third of those who had completed their project[29] believed they had received any signposting or aftercare. Where it had taken place, it focused on the exploration of future options to take the project forward and was generally well regarded. Of the remaining two-thirds of respondents with closed projects, half of these would have found signposting or aftercare useful, particularly in terms of signposting to follow-on funding and/or relevant business support (e.g. exporting). The lack of follow-on funding within the Catalyst was a frustration, and meant there was a lack of continuity for a project. One respondent argued that a follow-on plan was needed earlier in the project (rather than at project completion) – because this was left to the close out stage, the project was then paused for up to 12 months as a plan was drawn up, resulting in the loss of an academic collaborator and a delay in achieving outcomes. The IBC sought to address this in part, with the Innovate UK lead attending the penultimate, rather than final, meeting to discuss next steps. In any case, it should be for project beneficiaries, rather than Innovate UK or the Research Councils, to consider and provide the impetus to developing the follow-on plan.

3.54 Concerns were also raised by external stakeholders consulted around the **lack of dissemination** at the end of a project, by the project applicants themselves, Innovate UK/funding partners or through complementary initiatives, to share learning, promote achievements and potentially facilitate follow-on funding (especially for ATC and IBC). Whilst consultees recognised the commercially sensitive nature of some projects, the need for dissemination was viewed as critical if the Catalysts are to impact upon the wider community. The EC appears to have made most progress here, introducing showcasing events where project beneficiaries can pitch their ideas to VCs and network with potential partners on future R&D activities. The approach of the EC involved bringing together groups of projects that started and completed around the same time. This made the process more efficient from a delivery point of view, and also created greater 'noise' and encouraged networking. IBC produced a compendium of funded projects, and Innovate UK (with support from DIT) also produced a booklet to promote ATC projects in the international context. The case studies also revealed project-level examples of dissemination activity undertaken to date on national and international platforms. These tended to be through very specific communities that were relevant to the project. However, despite these efforts, the view from a number of external consultees suggests that dissemination efforts have not been as widespread as was hoped.

> '(Attending the 'rushlite' showcase event] was a great way of giving out a good dissemination message' (Energy consultee).

> **ATC Case Study: Soilbio**
> A membership organisation who partnered on this project has led on the dissemination of findings. This has included presentations to practitioners in [the sub-sector's] R&D at a conference in Cambridge, to agronomists at a conference in Sweden and at a European precision agriculture event. Presentations of the overall project findings (Year 1) have been made to participating farmers, and same will be undertaken in Years 2 and 3.

3.55 Project leads also noted a **missed opportunity in linking up with other Catalyst projects**. Again, the EC has sought to address this by introducing project directories where project leads can learn about other projects and access contact details, and this has been positively received by beneficiaries. However, we were

[29] Of the 25 respondents to the question.

unable to point to any examples of where this had led to partnership working between projects in the case studies completed to date, or the consultations with beneficiaries.

Recommendations for improvement

3.56 Four recommendations are identified to improve the completion and aftercare process, some of which are relatively 'quick fixes', others would be more resource intensive (although arguably important to ensure outcomes/impacts are realised):

- **Tailor the close out form** where possible for type of actor (business or academic) and award (early, industrial/mid, and late), and reduce duplication in close out forms between funders.
- **Improve signposting** to follow-on funding and relevant business support, at project completion and *before* the project reaches the end to ensure continuity. Given that many projects were nearing the end or had just completed at the time of writing, there is still an opportunity to address this issue in a relatively cost-effective way – for example, via a factsheet, webinar or a workshop – followed up by more tailored support (from Innovate UK, KTN or others) for those who need it.
- Ensure projects include a **plan to** improve **dissemination** and share knowledge as the project draws to a close, to ensure the programme has impact beyond those directly involved. Notwithstanding IP and commercial confidentiality issues, there are a number of ways dissemination could be improved for example: by incorporating this within the project's requirements (and building this into the workplan, rather than after the funding ends); making better use of Innovate UK (and funding partners) networks and links to complementary initiatives to share learning and achievements across the programme as a whole; and learning from the EC's good practice of showcasing events to enable projects to better link with the VC community.
- **Create a forum for projects to network,** possibly establishing workshops or drawing on experience of the EC of using project directories.

4. Emerging findings on additionality and outcomes

4.1 In this Section, we present findings on project-level additionality, emerging outcomes, and the key factors that are enabling or inhibiting pathways to these outcomes. Whilst this is a process rather than impact evaluation, we indicate the extent to which the programmes were 'on track' to deliver intended outcomes, and identify any process-related factors in particular that were encouraging or preventing outcomes being achieved. There is a note of caution when interpreting the findings below – the sample sizes were clearly small, and the majority of outcomes were self-reported. Furthermore, given that many of the projects were still underway and the time lag to impact for R&D interventions of this kind, we would not expect to see widespread, quantifiable impact on employment and turnover (for example) to date. The ATC is part of a separate interim impact evaluation, where outcomes and additionality is being tested in more detail.

Figure 4-1: Key messages

- Additionality of the activities undertaken through the Catalysts appeared to be high.
- The programmes were found to be addressing market failures (especially risk) and gaps in the existing funding landscape. The evidence gathered to date also suggested that they were helping to accelerate R&D activities and enable new and strengthened collaborations, improve skills and knowledge, and enable progression through the TRLs, all of which closely align with the Catalysts' objectives.
- There was also some limited evidence to suggest that the programmes had improved industry appetite, capability and confidence to apply for R&D funding, and created a pipeline of innovation projects for potential investors.
- A large proportion of beneficiaries consulted expect these benefits to translate into the introduction of new products/services to the market (in the UK and overseas), and business performance improvements relating to productivity and turnover gains in future.
- Undertaking R&D activities in collaboration has been crucial to enabling outcomes, and this in turn has been incentivised by both the Catalyst finance and the discipline/structure that the Catalyst models brought to projects.

Source: SQW

Project additionality

4.2 In order to assess the extent to which the activities were additional, we asked the extent to which beneficiaries would have proceeded with their project anyway in the absence of Catalyst funding, and whether non-beneficiaries had been able to progress their activities despite not securing Catalyst funding. The responses are presented in the table below.

Table 4-1: Project additionality

Beneficiaries: In the absence of the Catalyst, would you have proceeded with your project anyway? (n=50; 10 non-respondents)	**Non-beneficiaries:** Having been unsuccessful in your application, have you proceeded with the activities anyway? (n=35)
• 42% would not have completed any activities without Catalyst funding • 58% would have proceeded more slowly or at a smaller scale (and for a small number, at a lower quality)	• 49% not completed any of the activities in the Catalyst proposal ➢ Most were early stage projects • 40% had completed some activities

Beneficiaries: In the absence of the Catalyst, would you have proceeded with your project anyway? (n=50; 10 non-respondents)	**Non-beneficiaries:** Having been unsuccessful in your application, have you proceeded with the activities anyway? (n=35)
• 0% would have proceeded to same scale/timing/quality	➢ Albeit smaller scale, later, lower quality or without collaboration ➢ 8 of these received other public funding (e.g. BBSRC, Scottish Enterprise or European Funding) and 3 had secured VC funding • 11% proceeded as planned: 2 used public sector funding (via another Catalyst programme and the Welsh Government) and 2 used funding from private sector sources (e.g. Venture Capitalist)

Source: SQW analysis

4.3 Overall, additionality appears to be high:

- **The Catalysts appear to have funded a large proportion of activities that would not have been delivered otherwise** – 42% of beneficiaries did not believe they would have progressed their projects at all, due to lack of internal funds, the risk involved, or lack of alternative funding options. Around half of non-beneficiaries consulted have not been able to deliver any activities since their unsuccessful Catalyst application; most of these were early stage projects where we would expect additionality to be highest.

- **The Catalysts were also bringing about R&D activity that would have taken more time or been at a smaller scale** (and to a lesser degree, to a lower quality). These scale, scope and timing effects were relevant for 58% of beneficiaries consulted. Moreover, for many of these beneficiaries, R&D would not have been undertaken in collaboration without Catalyst funding.

- Levels of deadweight amongst the beneficiary group consulted were low – none believed they would have proceeded with the activities as per their application without Catalyst support (although there is a possibility they are optimistically over-estimating the role of the programme in enabling activities). In comparison, 11% of the non-beneficiaries consulted have proceeded as planned in their Catalyst application, using funding from internal funds, other Innovate UK programmes (e.g. Smart), BBSRC or European Funding.

4.4 Whilst indicative, given the small sample, these findings do support the rationale for the Catalyst, and suggest it has helped to address market and other failures, particularly in relation to the level of risk, and gaps in the existing funding landscape. It also indicates that the programme has helped to accelerate R&D activities in many cases, and enabled businesses to engage in more collaborative R&D than would have been the case without funding, in line with the programme's objectives.

Emerging outcomes

4.5 There are two main sources of evidence that have informed the assessment of emerging outcomes: consultations with beneficiaries (through the telephone consultations and case studies), and then wider ('second-hand') evidence from consultations with management staff and external stakeholders.

4.6 To date, evidence from the consultations with 60 beneficiaries suggested the predominant outcomes observed so far related to improved skills and knowledge, new or improved collaborative relationships and progression through the TRLs, all of which closely align with the Catalysts' objectives (see Figure 4-2). In future, a large proportion of beneficiaries expect the activities and intermediate effects to translate into outcomes such as new products/services introduced to the market (in the UK and overseas), and performance improvements through productivity and turnover gains.

EC Case Study: Synaptec

There is a high level of additionality associated with this business's early and then mid-stage projects. As an early stage spin-out, the company did not have the financial resources to self-fund the development of their technology, and nor could they afford to pay to partner with their collaborators. With their technology at such an early stage, it was unlikely that the company could have attracted commercial investment and no other public sources of investment were considered suitable.

4.7 We have explored whether there were differences in outcomes achieved to date between the Catalysts or types of award and, whilst we need to be very cautious given low sample sizes, there were some initial themes that could be tested further through additional impact evaluation:

EC Case Study: Fraunhofer UK

According to those involved, undertaking the project as collaboration allowed it to be ambitious project. The lead could have combined some of the technologies itself, but would have been unable to add some capabilities and test in the field without the partners involved, which would have resulted in a weaker business case for further investment.

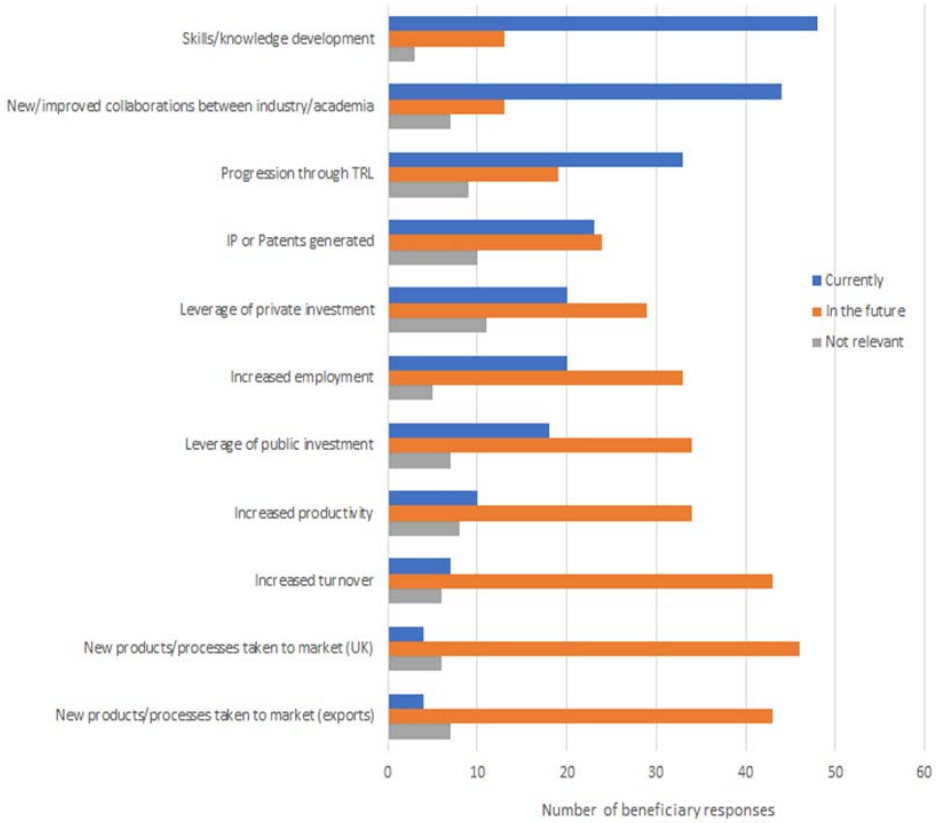
- **Improved skills/knowledge**: early and mid-stage projects were more likely to have an impact here to date (23 early stage beneficiaries consulted have observed this, and 19 beneficiaries from mid stage projects) compared to late stage projects (six have observed skills/knowledge improvement). There was little variation across the Catalysts.
- **New and improved collaborations**: there was little observable variation across the grant types or Catalysts.
- **Progression through the TRLs**: again, early and mid-stage projects were more likely to observe this (18 beneficiaries of early stage projects and 12 of mid stage projects) compared to late stage projects (3 beneficiaries), but there was little variation across the Catalysts.
- **New products/processes to market in the UK and abroad**: there was some variation by Catalyst (ATC and EC projects were more likely to have achieved this to date, which may reflect the varying speed in reaching markets for different sectors). Across all types of grant, the number of respondents who had taken new products to market was very small: for example, only 1 late stage beneficiary (from 10 answering the question) had reached UK markets, and 2 late stage

beneficiaries (from 11) had reached overseas markets; only 1 and 2 beneficiaries from early and mid-stage projects had taken products/processes to market in the UK respectively; and only 2 mid-stage projects had exported products/processes.

4.8 **Impacts on turnover, productivity and employment**: ATC projects were slightly more likely to observe impacts in these areas already (e.g. six beneficiaries have improved productivity, nine have increased employment) compared to EC and IBC. Again, whilst impacts were more prevalent across late stage projects, early and mid-stage projects had managed to generate some turnover and productivity improvements - and a higher proportion of early stage projects (10 beneficiaries from 26) had increased employment than late stage projects (two from 10 beneficiaries responding to the question), but again numbers are small.

Figure 4-2: Beneficiary consultation feedback

Have you observed any of the following outcomes to date, or expect to experience them in future?



Examples of outcomes achieved to date

Stimulated own investment

- Allocated more funding to internal R&D … creating a research centre (mostly made up of PhD candidates) - '*These outcomes are directly attributable to this R&D project…it really was a catalyst'.*
- Self-funded a new research station, 2 new FTEs employed…as direct result of the project.

Attracted private investment

- Secured VC investment in the business as a direct result
- Technology developed led to $0.5m investment by partners in US in demonstration plant.

Changing attitudes towards collaboration

- Strengthened existing relationships … made the company more open to collaboration.

Research & innovation outputs

- One new patent, and 2 new publications.

Progress to commercialisation

- Accelerated path to commercialisation, enabling business to engage with potential customers earlier and employ new R&D staff
- Progression along TRLs … the business is now seen as being at the forefront of research in this area.

Source: SQW analysis of consultations with beneficiaries (n=60)

4.9 Management and external stakeholder consultees largely relied on 'second-hand' evidence from their networks, known projects or more widely to provide a picture of outcomes achieved to date. This in part reflected data/dissemination issues (described in Sections 3 and 5) and the time lag before outcomes/impacts are realised for many projects. Outcomes observed to date included the following:

IBC Case Study: Fiberight

This project involved a consortium of seven partners in a round 1 late stage award. The lead had not worked with any of the partners before. Whilst the project achieved its milestones, this took longer than expected. There were some issues with partner drop out and, on reflection, consultees thought the initial timetable was too ambitious and had under-estimated the amount of time required for partners to get to know each other at the beginning of a project

4.10 **Improved industry appetite, capability and confidence to apply for R&D funding.** For example, consultees believed the ATC had helped to improve interest and capacity of the agri-tech sector to apply for R&D funding, and subsequent thematic funding competitions at Innovate UK have benefitted from this (illustrated by the high number of agri-tech firms applying under the life sciences theme, much higher than would have been the case without ATC).

4.11 Creating new collaborations which would not otherwise have existed, leading to follow-on collaborative R&D activities and strengthened supply chains.

BC Case Study: M-RIPPs

In terms of wider benefits, the academic partner found the experience of working with an industrial partner for the first time has helped to achieve a better understanding of how to progress with the commercialisation (via a new, spin-out company) of a related stream of research.

4.12 For ATC, the programme had helped companies to **survive** and given them the **capacity/skills/confidence** to go on to do bigger/better things (even if the Catalyst project itself was not successful).

4.13 In the case of the EC, the creation of a large **pipeline of innovation projects** which potential investors can be directed towards, which in turn has helped projects to **access more private funding** than they would have been able to otherwise.

Pathways to impact

4.14 A range of project-related and external factors have played a role in enabling or inhibiting progress of the Catalysts to date. Key messages from the consultations with management staff, external stakeholders and beneficiaries are summarised in Table 4-2. Crucially in terms of process factors, the evidence suggests that collaboration and finance have been important factors in enabling outcomes to be realised, and finance and the structure provided by the programme were important incentives/enablers to encourage collaboration.

EC Case Study: Synaptec

The Energy Catalyst programme itself was considered important in generating collaboration benefits (such as the ability to undertake R&D in new areas), not only because of the finance but also because of the framework it provided. The programme is an accepted way to form and then run a collaboration amongst partners who had not previously worked together. Even if private funding had been secured, the Energy Catalyst framework, including the Innovate UK collaboration agreement, made it easier to form and manage the collaboration than would have been the case without the framework.

4.15 Other factors, such as a **'good' MO** and the **credibility** associated with securing Innovate UK funding were also important. Within the project itself, **strong project management and leadership of the lead partner**, and good **partnership working between the consortium**, were also critical factors. Through some of the case studies, it became evident that consortia that comprised partners which had worked together in the past were able to initiate delivery and take advantage of the 'known' skills and strengths of partners quickly, enabling the project to deliver outcomes as planned.

4.16 This said, one underlying aim of the Catalysts was to stimulate new collaborations between organisations. As illustrated in the case study box for the IBC project, for some new consortia it took longer than expected for partners to get to know each other and their capabilities at the beginning of the project, and allowing additional time for this is a lesson for new collaborations. It is important to note that this was not an issue for all new collaborations.

ATC Case Study: Farmex

This ATC late stage project followed an earlier Innovate UK CR&D grant which developed a real time monitoring tool/system for the pig production sector. The majority of partners were involved in both projects, and therefore knew each other's capabilities well. Other factors that enabled the successful delivery of this project included strong and well-structured project management, a clearly defined focus for the project and close alignment between this and partners' own interests/business strategies, and including a number of prime producers (which was particularly important for this late stage project to demonstrate the tool's impact to other farmers in the sector).

4.17 For later stage projects, a business's ability to design/implement **sales and marketing strategies** to enable new products/processes to reach the market, and **recruit** staff to expand operations, are also important.

4.18 Some external factors apply across the three Catalysts (e.g. market growth, advancement/acceptable of new technologies) but many that were identified are relatively specific to each Catalyst (e.g. huge volatility in agricultural sector, which already has tight margins, making it difficult for businesses to justify investment in uncertain technologies).

Table 4-2: Factors enabling or inhibiting pathways to impact to date

Project related factors

Catalyst-related factors

- Genuine and effective collaboration is critical (c.87% of the 60 beneficiaries consulted cited collaboration as a significant factor in the success of a project), and the Catalyst provided a framework for this. This includes:
  - Quality relationships
  - Bilateral knowledge exchange
  - Open communications
  - Often, pre-existing relationships (leading to quicker and more effective delivery)
  - Complementary skills and knowledge, incl. academic technical expertise
- Finance (c.40% of the 60 beneficiaries consulted cited finance as an enabling factor, especially for the ATC and EC), and the important role this plays in buying out time for SMEs to focus on R&D and incentivising the collaborative aspect. For example, one ATC consultee highlighted the importance of finance in increasing scale of project, and therefore samples and confidence in predictive ability.
- Other factors noted were the role of a 'good' MO, the discipline and 'structure' of the monitoring process (which helps to accelerate the process), the importance of the Innovate UK 'rubber stamp' and 'traction' in the wider innovation ecosystem
- Conversely, concerns over the lack of dissemination were raised, particularly in terms of the Catalyst's ability to impact on the wider community (beyond those directly involved), as well as the lack of follow-on/signposting to enable a project to reach the market (see Section 3)

Other project-related factors

- Project structure, management, strong leadership and open communications from the lead organisation, clear responsibilities
- Effectiveness of the collaboration
- Clarity and shared objectives
- Presence (or absence) of international partners in DFID projects with appropriate networks to break down barriers to exploitation
- Inclusion of partners with strong networks in the agricultural community (for large scale data collection and dissemination), and/or involvement of end users (especially in late stage)

Internal factors (within the business involved)

- The capability and capacity of the lead to develop sales strategies and marketing plans to take a product/process to market
- The ability of the business to attract the skilled labour necessary to scale-up once product/process reaches market

Wider factors

Positive

- Market growth (across all Catalysts)
- Advancement in supporting technologies (and cost reductions), and growing acceptance of technologies (across all Catalysts)
- Supportive UK/EU policy and profile raising (e.g. UK Government's promotion of the agri-tech sector)
- For ATC, Brexit is increasing awareness of need to innovate/invest in innovation to ensure future proofing business, and the need to automate given likely labour constraints arising from withdrawal from EU

Negative

- Market competition (noted by EC beneficiary)
- Brexit, and potential loss of academic input in on-going R&D
- Market/price changes
- For ATC, huge volatility in agricultural sector, with tight margins – making diversion of resources to invest in uncertain technologies is a difficult proposition
- The lack of further funding available to take the project to the next stage
- Poor rural broadband, hindering the functionality of some new technologies (ATC).

Source: SQW

5. Management and governance

5.1 In this Section, we discuss the Catalysts' approaches to management and governance of their respective programmes, including decision-making processes, their effectiveness and lessons learned. Because each Catalyst has adopted a slightly different approach to management and decision-making, we present the findings for each Catalyst in turn. We then present findings on the effectiveness of programme-level monitoring processes, and reflect on the extent to which sharing and synergies are evident between the Catalysts.

Figure 5-1: Key messages

Management, governance and decision-making processes

All Catalysts used funding panels within respective funding organisations. The process of developing a proposed list of projects to fund in each round was iterative. Each Catalyst produced a ranked list of application scores, but then has a different decision-making process. All three Catalysts clearly allocated funding on the basis of quality, and have employed very limited 'portfolio management' with regard to strategically shaping the types of projects funded.

Each Catalyst had a different structure for managing the programme. For example, the ATC and EC did not have a formal management group, and had issues-based bilateral discussions with funding partners; whereas IBC had a Management Board, comprising funders and external experts from academia and industry.

There were a number of lessons learned from the process of managing the Catalysts and examples of good practice which could be shared across the three programmes. For example:

- Strong and open partnership working between the management/funding partners was critical and needed to be proactively cultivated from the outset.
- The efficiency of management processes could be improved by developing integrated application systems, contracting processes and monitoring requirements between the organisations involved from the outset.
- The inclusion of independent, impartial input from external experts from academia and industry on the IBC Management Board has worked well – it ensured that award decisions accounted for wider practical, technical and ethical imperatives, and provided a signal to the broader IB community that decision-making processes were robust.

Programme level monitoring

The monitoring process worked effectively from the perspective of management/delivery staff involved. The process was relatively open and transparent between MOs and the projects, and the involvement of a 'good' MO was seen as an important factor in the successful delivery of a project. MOs would appreciate training and/or formal mechanism for knowledge sharing with their peers to share good practice and improve consistency in approach.

There were inadequacies and inconsistencies in monitoring data held within Innovate UK (for ATC, EC and IBC), and there have been issues in getting the monitoring processes and systems at various partner organisations to align. In addition, there was an appetite from funders and external stakeholders for greater dissemination of real time data on the shape of the portfolio and progress to date. These could not be met given deficiencies and gaps in data available.

Sharing and synergies

The main sharing across the Catalysts has been implicit in the common design and implementation of the Catalyst model. Other sharing was informal and ad hoc to help solve specific challenges.

There was limited evidence of synergies between the Catalysts. Whilst there was some evidence of traction in a Catalyst model or brand, on the whole opportunities for synergies were not capitalised on.

Source: SQW

Management and governance by Catalyst

Agri-Tech: management and governance processes

Approach to management and governance

5.2 The ATC did **not have a formal management group**. Innovate UK led on day-to-day management, working closely with BBSRC which oversaw academic funding and monitoring. Innovate UK has ad hoc, usually issued-based **bilateral discussions** with DFID. The management process was considered by all parties involved to be rigorous yet pragmatic, with strong partnership working and open communication and engagement with relevant groups at appropriate times. The programme originally had an 'officials group' but this petered out once funding was allocated – a similar, **informal group of funders** re-emerged later to focus on outputs/outcomes via fortnightly calls. The **Agri-Tech Leadership Council** provided high-level governance initially, but provided little steer since the programme began – this was deliberate to avoid any possible conflicts of interest.

5.3 Overall, the lack of a formal management group has not been to the detriment of effective delivery on a day-to-day basis, but it has depended heavily on strong and transparent partnership working between key delivery and funding bodies.

Decision making processes

5.4 In terms of the process for assessing applications, the scores from five assessors were combined for each application, and the overall scores were then ranked. This was then submitted to a **Funders Panel**, along with associated feedback from the assessors. The Funders Panel comprised Innovate UK, BBSRC, DFID and BEIS, and a selection of assessors. Once ranked, the applications were funded from the highest-ranking application through the list until the funding allocated to the competition round was expended. Nominal budgets of £10-15m were set for each competition round, but there was some flexibility in this. The focus of the Panel meetings was then on applications close to the funding threshold (although in practice, a large proportion of applications were above the funding threshold, and therefore fundable but not funded). This effectively meant that **applications were funded on the basis of quality**. Any major concerns with applications (for example, where they were bidding for a very large share of the funding available, or where there were major outliers in assessor scores) were usually discussed and resolved by Innovate UK/BBSRC/DFID bilaterally prior to the meeting. BEIS observed at the meeting and provided some strategic oversight on the profile of spend and alignment to the Agri-Tech Strategy, but was keen not to 'interfere' with funding decisions.

5.5 Overall, the process was deemed **robust and efficient** by management staff and external stakeholders consulted. However, some consultees felt that the Funders Panel **added limited value** to the decision-making process, beyond an 'administrative check'. As noted in Section 3, the management team adopted a relatively **light touch approach to portfolio management**, and did not intervene to shape the types of projects funded because the applications submitted naturally reflected the range of Agri-Tech sub-sectors. Nor did the management team/Funders Panel feel the need to shape the portfolio to ensure it delivered against the Catalyst's objectives–management staff argued this 'fit' was determined by the

assessors (although assessor feedback indicated some uncertainty around scope). In the event the management team observed an imbalance across the portfolio, the they may have intervened more – and possibly considered introducing a formal management board and/or external advisory group to help inform strategic/difficult decisions.

5.6 However, there was some concern from two key external consultees that the decision-making process was **too responsive and not sufficiently strategic**, with the risk that (what appeared to be) a 'scattergun' approach would not lead to the greatest impact overall. Most agreed that the programme achieved a balanced portfolio of projects which were (broadly) in line with the programmes (broadly defined) objectives, but some questioned whether the approach adopted was the most efficient way to reach this position. That said, the approach was aligned with Government's shift towards more 'open' support for the sector, rather than the narrowly defined thematic competitions that preceded the Catalysts (e.g. via Innovation Platforms between 2010 and 2014).

5.7 Once projects were funded, any issues in delivery or performance were escalated appropriately by the MOs to Innovate UK and, according to the MOs consulted, support from Innovate UK was described as 'very good' when needed. Where appropriate, major concerns were discussed and addressed bilaterally with BBRSC and/or DFID.

Energy Catalyst: management and governance processes

Approach to management and governance

5.8 The EC initially had an external **Advisory Board.** This met twice a year to discuss the overall EC project portfolio and whether the objectives of the programme were being met, rather than to review specific details of which projects were funded. It was envisaged that the EC Advisory Board would help to steer the EC towards targeting funding calls at specific technologies, and also help to reach new applicants if the overall level of demand was low. The latter point was particularly valued and it was reported that the Advisory Board **enabled effective communication with the wider community** via the high profile individuals on the Board.

5.9 However, as it was decided that the EC should retain a broad focus on the energy trilemma, the Advisory Board had little practical input. In addition, the EC Advisory Board was felt to be duplicating the government backed **Energy Innovation Board** which could also assist if high level strategic input was required. Therefore, although it was thought to be well run, the EC Advisory Board was disbanded.

5.10 As a result, there was no formal mechanism to discuss the progress of the Catalyst, and how best to support on-going projects. **Bilateral contact** between partners therefore became more frequent than multilateral contact, and this shift was felt to be a weakness. In response, conference calls between all partners were held and it was suggested that, if the EC was to continue, a co-funders board may be considered to facilitate more formal multilateral communication.

5.11 One further issue on governance and partnership working was highlighted **in relation to Round 5** by EC partners and applicants. After the funding call had been launched, DFID and EPSRC were told by BEIS and Innovate UK that they could not provide funding for this Round. The amount of funding available was therefore less than applicants had expected, meaning

that only a relatively small number of them were successful in being awarded funding. This was felt to be potentially damaging for any future Rounds as applicants would lose confidence that the EC actually had the funding available.

Decision making processes

5.12 The EC decision making process initially had **three distinct phases**: an independent review of the applications by up to five assessors; a Moderation Panel to discuss assessor scores; and a Funding Panel to agree which projects to fund.

5.13 The **Moderation Panel** was still formally in existence at the time of the evaluation, but was not thought to be particularly effective because it was difficult for a single panel to check whether an application fulfilled the various criteria set out by the different funders. Therefore, for Rounds 4 and 5, **each funding body assessed** the fit of projects above the fundable threshold (from the highest score downwards) in relation to their strategic objectives. Bilateral conversations and emails between the funders were then used to agree a preferred list of projects prior to **formal sign off at the Funders Panel**.

5.14 This process seemed to work well, although consultees noted a **variability in assessor scores** and some concerns were raised over the lack of international development experience amongst the assessors. In addition, from an external perspective, it was felt that DFID's, and to a lesser extent the EPSRC's, role in the decision-making process was ambiguous. For example, consultees were unclear whether DFID would assess whether an entire project was Official Development Assistance (ODA) compliant, or whether they would only assess whether the part of the project that DFID was funding was ODA compliant.

5.15 Overall, the decision-making process was thought to ensure that all funded projects were of the highest quality possible, and that they would contribute to tackling the energy trilemma – a core objective of the EC. Consultees also agreed that the EC had **achieved a balanced portfolio of projects**, both in terms of technology focus and the geographical distribution of lead organisations. Whilst there were systems in place to achieve this, e.g. **reserving the right to apply a 'portfolio approach'** to ensure a breadth of projects and also the right to preferentially select a project which had been successful in a previous Round, these were not heavily used in practice. The EC Advisory Board therefore did not have to intervene to shape the project portfolio.

5.16 Once projects were funded, **MOs were responsible for relaying any project performance issues** to Innovate UK, including time extension, partner change, and scope change requests. Project partners were able to raise these issues at the quarterly MO meetings, or by phone or email in between the meetings.

IB: management and governance processes

Approach to management and governance

5.17 The IBC had a **Management Board** to encourage collaboration across the partners involved and manage the added complexity of a programme with five funding streams. This was initially chaired by the BBSRC, but set to rotate between the funding partners on a two-year rolling basis. As IB funding was halted within this period, the role of the BBSRC in chairing the

Management Board was, in practice, never rotated. The Board has worked effectively overall and helped to address hurdles relating to the operational differences between Innovate UK, BBSRC and EPSRC and their incompatible back-office systems. Partnership working has been strong, but there could have been more thought on how differences in systems may affect the partnership prior to the IBC launch. After the early formation of the Management Board, **external experts from academia and industry** were invited to attend alongside representatives from funding partners to ensure award decisions took into account wider practical, technical and ethical imperatives. Their inclusion also provided a signal to the broader IB community that the decision-making process was robust. The Management Board found this independent, impartial input helpful, especially when making more difficult decisions.

Decision making processes

5.18 The IB decision making process was comprised of four phases:

- an independent review of the applications by up to five assessors (the list of assessors was put together jointly and mostly led by BBSRC)
- bi - and multi-lateral discussions (normally done informally) to arrive at a set of 'scenarios' to take to the Management Board
- a meeting of the Management Board to agree which set of projects ('a scenario') to fund
- the financial sign-off of the agreed upon projects by each partner involved (a Funders Panel for Innovate UK, and an RCUK financial sign-off process for the BBSRC and EPSRC).

5.19 In terms of changes to decision making processes, the BBSRC supported the expansion of the pool of assessors very early in the implementation of the IB Catalyst. The reason was to more effectively and comprehensively cover the IB-relevant sectors (to supplement a perceived lack of expertise coverage in bioenergy, in particular).

5.20 The iterative approach to working through funding scenarios was regarded as important. This was valued not only in terms of ensuring strategic objectives were met through the application of a 'portfolio approach', but also in terms of accommodating the translation stream. The inclusion of one high value translation project could have significant implications on the number of projects that could be funded in other streams (one Translation grant could be equivalent to 15 Feasibility Studies in grant value), and also altered the funding contributions of partners across these streams significantly. The presence of external experts on the Management Board were regarded as helpful in this respect for validating that the proposed list of agreed upon projects met the portfolio requirements and objectives of the programme.

5.21 A further advantage of the Management Board, and the frequency with which they convened, was the ability to review progress within the portfolio. This was supported by prior efforts to collate IB data into a comprehensive dataset, and provided the ability to shape future decision-making and address any issues or risks that arose. For example, recognising that two beneficiaries were involved in a large number of projects each, the Management Board

arranged meetings with each to assess the level of risk posed, with a view to implementing steps to mitigate this.

5.22 The role of the Management Board as a decision-making authority was not widely understood at the outset, but a better awareness was achieved over time. This was achieved through improved communications between Management Board attendees and their counterparts responsible for financial sign-off within each organisation. Although this was not deemed to be the most efficient process, it was regarded as effective given constraints faced in terms of the existing governance structures within each partner involved.

5.23 In Round 4, the IBC piloted a telephone interview stage for translation stream applications. This new step was included following a suggestion from one of the external experts appointed to the Management Board. As the projects were large-scale and high-value, it was regarded as important to have an additional opportunity to clarify points that could be important to making a funding decision. This proved very useful, and at least one project was identified as ineligible at that interview which would have likely received funding had this stage not been introduced.

Programme level monitoring

5.24 The Catalyst monitoring processes largely follow Innovate UK's standard procedures, alongside separate monitoring activity undertaken by the Research Councils. All Monitoring Officers (MOs) were sub-contracted by Innovate UK. The process **worked effectively** from the perspective of management/delivery staff involved, and provided a good focus and discipline for projects. One MO consulted described the process as 'robust, well understood, responsive, respected and workable'.

5.25 The Catalysts have a **Monitoring Scores Report**, completed by MOs on a quarterly basis for each project. This tracked any changes to funding, partners involved, scope or the timetable, and then provided a score and commentary on performance for cost, exploitation, management, risk, scope and timing. The criteria provided by Innovate UK for monitoring scores were helpful, but MOs drew heavily on other monitoring and wider experience in order to make judgements on performance. This report was the primary source of monitoring evidence – alongside data on spend and milestones at the project level – used to track performance and inform on-going delivery in real time. These appeared to have worked effectively from the perspective of most MOs and management staff. That said, MOs consulted noted that bilateral communication took place between the MO and projects/Innovate UK on a far more regular basis to ensure issues were dealt with promptly.

5.26 The monitoring process appears to be relatively **open and transparent between MOs and the projects**, with scores shared with, and explained to, projects. However, there was some concern that this may make MOs reluctant to provide critical feedback to avoid damaging their relationship with the project, and a confidential channel for feedback to Innovate UK might have been useful.

5.27 As discussed in Section 3, the **involvement of a 'good' MO** was seen as an important factor in the successful delivery of a project. The MOs consulted recognised the importance of focusing on intermediate outcomes and exploitation right from the start and throughout the process, and they played an important role in helping to keep projects on track. However, MOs were

not offered **training**, and there was no formal mechanism for MOs to **share experiences and learning** – a number of the MOs consulted felt this could be useful to improve the implementation of monitoring on the ground.

5.28 Whilst the process of monitoring projects and gathering data appeared to have worked well, consultees suggested that **significant improvements could be made to the analysis and use of monitoring data**, particularly in relation to the following:

- There have been some **issues in getting the monitoring processes and systems at various partner organisations to align** (particularly between Innovate UK and the Research Councils), creating confusion and duplication for the beneficiaries involved. In addition, change requests had to be communicated via email, for example from Innovate UK to BBSRC or EPSRC to ensure that both funders were aware, whereas they could have been done once on a centralised system.
- There was **limited evidence readily available on output and outcome performance in real time.** Most data were gathered through close out reports on a project-by-project basis, but only once projects were complete and this was not aggregated on a regular or systematic basis to provide a picture of performance across the programme and then shared with stakeholders.
- On a practical level, SQW has encountered **significant issues in attempting to gather and aggregate monitoring data** for the ATC and EC. This partly related to different datasets being held independently by Innovate UK and the Research Councils but also – and perhaps more significantly – to major discrepancies, inconsistencies and gaps *within* Innovate UK data. As discussed elsewhere in this report, this has made it very difficult to make a definitive and accurate assessment of basic programme performance, such as number of projects funded and spend to date.
- Linked to the point above, there was an appetite for **real time data amongst funders and external stakeholders** but very little has been made available to date, e.g. on the portfolio characteristics, project performance, an aggregated picture of performance against outputs/outcomes achieved, and remaining barriers to innovation.

5.29 The IBC has sought to address many of the issues above during the programme, and now provides an example of good practice in this respect. BBSRC invested a considerable amount of resource in the development of a comprehensive dataset enabling partners to track and assess the portfolio in real time, which has proved to be very valuable in managing the programme effectively and communicating progress with external stakeholders. BBSRC also kept up-to-date a database of all the applications submitted for the IBC, enabling strategic and portfolio management decisions to be made at each stage of the assessment process, taking into account the programme as a whole rather than each competition round separately. In addition, for translation stream projects, the IB Catalyst Co-ordinator also reviewed evidence on outcomes from the close out reports every six months.

5.30 The EC has also sought to address this issue around lack of real-time outcome data to some extent, by including an additional field in the Monitoring Scores Report to cover the latest position on outcomes. This helps to identify strong projects for dissemination purposes, such as for Ministerial briefings. In addition, the EC has included call-off time in their MO liaison officer contract, which has been used to gather evidence on outcomes across the portfolio, and the management team has recently begun sending questionnaires to projects to gather evidence on outcomes.

Recommendations for improvement

5.31 The following recommendations are made for monitoring of the Catalyst programmes:

- Consider the introduction of **training** and/or formal mechanism for **sharing practice** between MOs, to help with learning and improve consistency in approach.
- Introduce significant improvements to the **consistency and accuracy** of monitoring data held within Innovate UK (ATC and EC), and consider establishing a single database for each Catalyst which can be interrogated in real time.
- **Improve the aggregation and dissemination** of monitoring data on portfolio characteristics and programme performance (including outputs and outcomes[30]) to external stakeholders. This could include **transferring good practice** (e.g. IBC's comprehensive dataset, use of the IB Catalyst Co-ordinator/EC MO liaison officer to gather real-time evidence on outcomes, and the EC inclusion of performance against outcome targets in the Monitoring Scores report) across Catalysts.

Sharing and synergies between the Catalysts

5.32 The principal evidence on **sharing across the Catalysts has been implicit in the common design and implementation** of the Catalyst model. In particular, two key themes were identified with respect to sharing at an overall programme design level:

- Interviews with strategic and operational leads for the three Catalyst programmes covered in this evaluation highlighted how they had drawn from the Biomedical Catalyst model as a starting point for refining the model to suit their own Catalysts. This included using the three grant stages as a ladder of progression towards commercialisation (albeit with the Industrial Biotechnology Catalyst adapting this to five) and the use of key mechanisms for promotion such as the Knowledge Transfer Network.
- Second, the processes have been evidently common – although this has largely reflected the standard processes used by the delivery agencies/funders, in particular Innovate UK and the Research Councils, rather than reflecting sharing specifically for the Catalysts.

[30] Note: this would need careful articulation of attribution to the Catalyst.

5.33 **In delivery of the Catalysts, sharing has been modest, and on an informal and ad hoc basis** as issues have arisen, rather than through deliberate and systematic means. Examples that were identified in the consultation process included the following:

- The Energy Catalyst learned from the Agri-Tech Catalyst in integrating DFID funding. For instance, the Energy Catalyst drew on the Memorandum of Understanding that had been used when DFID joined the Agri-Tech Catalyst, and it also adopted some of the processes used by the Agri-Tech Catalyst, e.g. to assess the suitability of international partners.
- Leads from individual organisations have shared practice where they have been involved across different Catalysts. For example, BBSRC leads shared tips on managing the customer journey process drawing on their experience across the Agri-Tech and Industrial Biotechnology Catalysts.

5.34 There was **very limited evidence on synergies across the Catalyst programmes**, largely because each was run as a separate programme with no specific attempts to exploit cross-cutting themes. There were three exceptions to this, where modest synergies were evident:

- There were scale benefits in having a common model with the same or similar processes. In some ways a harmonised model existed, though here there were still opportunities to refinement and improvement. The scope for having a harmonised model is discussed in Section 7.
- The Catalyst model had a degree of traction with applicants. This was evident in the applicant feedback, with some identifying the overarching purpose of the Catalyst as particularly suited to their needs. This reflected the intent to support innovative ideas from early stage through to commercialisation as part of a progression, and also the fact that Catalysts were focussed on particular priorities, albeit broad ones. This meant that some applicants saw how their organisation or technology fit within a priority around, for instance, the energy trilemma. It is important to note in this context that the extent of traction or brand value of the Catalyst model was limited to an extent, and some applicants indicated that they simply saw it as another funding stream.
- Related to the previous point, a very small number of applicants have been involved in more than one of the Catalysts. This has been limited, though there were examples whereby unsuccessful applicants were able to learn and adapt their project, ultimately being successful in applying to another Catalyst. In a similar vein, organisations that operated across technology areas have been able to draw on more than one Catalyst to support their R&D and innovation efforts.

5.35 Beyond these points, **there have potentially been missed opportunities to exploit synergies between the Catalysts**. There were some overlaps in the technology areas that could have been (or could still be) exploited given the potential wider applications (such as bioeconomy, which spans all three Catalysts). A conscious decision was made to delineate scope clearly between the Catalysts to avoid ambiguity for potential applicants. Whilst we recognise benefits from a management perspective of allocating projects to one Catalyst only (rather than attempting to co-fund), there have been no attempts to consider overlaps or

facilitate networks between projects/project partners once the projects were underway. In this context the Energy Catalyst did seek to do this within the Catalyst itself, through the directory of projects and the showcase events. Similar activities or consideration of overlaps across the Catalysts (e.g. through sharing across strategic and operational leads) could have facilitated greater synergies – though of course the benefits of such actions are very uncertain and difficult to demonstrate.

Recommendations for improvement

5.36 The following recommendations are made for sharing and synergies across Catalyst-type programmes in the future:

- Consider the **development of a harmonised model** that can easily be deployed in similar joint Innovate UK-Research Council priority areas in the future – as well as when other funders may be relevant. A proposal for the model is set out in Section 7.
- Building on the good practice of the EC, through the showcases, **consider any areas for joint showcases or directories of projects** where there may be overlaps between Catalysts – e.g. in relation to the bioeconomy.
- Under UKRI, **consider any mechanisms through which programmes can better share practice and ideas** – e.g. for Catalyst-type programmes of Industrial Strategy Challenge Fund Programmes.

6. Lessons from comparators

6.1 In order to provide context to the findings from the evaluation of the Catalysts and to inform lessons going forward, a brief review of comparator cases in the UK and internationally was carried out as part of the study. This section sets out the findings from this review.

Figure 6-1: Key messages

A number of the issues and challenges identified with respect to the Catalyst were apparent in the evidence on other schemes in the UK and more widely.

For example, challenges associated with extending the reach of innovation programmes, inconsistent monitoring practices, and resourcing aftercare support were all identified in international examples. In addition, governance and management models also varied across the examples reviewed.

This said, a number of lessons were identified in the evidence, including:

- For funders, there is a need to commit to the longer-term programmes that were the original intention of the Catalyst model or to ensure complementarity with the wider funding landscape. This is critical in facilitating a ladder of progression for innovation ideas.
- More resourced targeted marketing, utilising links with regional and local partners, a 'light touch' expression of interest stage, and interactive workshops were all identified as potential ways of engaging with organisations that may be less likely to take part in innovation programmes.
- Aftercare support and signposting were identified as important in maximising impact of programmes – though they need to be properly resourced to be effective.
- An alternative model for facilitating progression is to fund a wide range of early-stage projects, and then to purposively invite the best to submit applications for subsequent stage funding.

Approach to the comparator review

Focus of the review

6.2 The review has focussed on areas that were identified in the interim report where there was scope for improvement in the Catalyst programmes. The purpose was, therefore, to identify whether practice from elsewhere could offer potential options to addressing these areas for improvement. The key issues for improvement that had been identified are set out below.

Table 6-1: Issues for consideration

Programme design and management

- Governance structures, reflecting differences in approach across the Catalysts (e.g. role and composition of management group/advisory board, inclusion of external/independent experts)
- Moving up the ladder of support (from early to mid to late stage grants)
- Weaknesses in programme level monitoring data, including aggregation of performance/output data from disparate set of projects, and how data can be used to inform management and external stakeholders

Promotion and encouraging applications

- Raising awareness amongst the business community (of the programme offer, and project results), especially amongst those not already embedded in the innovation ecosystem
- Linking to other initiatives to promote the programme
- Issues in the application form and supporting guidance – e.g. dual RC/Innovate UK processes

Project delivery and support

- Balance between compliance and consultative roles provided by monitoring officers, with the latter adding more value
- Knowledge sharing between monitoring officers (and assessors)

- Lack of a structured, consistent approach to aftercare, including signposting to follow-on funding

Comparators included

6.3 In order to select the comparators for review, a pragmatic approach was taken, which involved:

- seeking recommendations from those consulted in the early stages of the evaluation – identifying similar schemes that individuals were aware of, both in the UK and elsewhere
- drawing on our own experience and knowledge of innovation programmes
- a desk-based review to identify, in broad terms, the nature of a long list of comparators, with sifting to develop a final shortlist for more detailed review.

6.4 The final shortlist was selected based, pragmatically, on whether there was information that could be obtained that would provide sufficient evidence to inform the research. The shortlisted programmes adopted a range of approaches to catalysing innovation. Several were quite similar to the Catalyst model – offering competitive grants to support innovative projects and collaborations in the mid-TRL range. Others were broader programmes that included business and innovation support functions alongside funding (i.e. grants and/or loans). The sectoral and technological focus of the identified programmes also varied. Several were open to all sectors, whereas others set out to address specific technology and market areas. In addition, some programmes were focussed on societal and international development challenges. For each programme, it is important to consider the context or sector specific factors that have shaped each initiative, as these will inform the extent to which lessons are transferable to the Catalysts or potentially similar programmes in future.

6.5 The list of programmes and agencies reviewed is presented in Table 6-2**.** Other programmes/ agencies were reviewed in brief, but due to an absence of information or evidence they were not used.

Table 6-2: Comparators reviewed

Comparator	Summary
1. Biomedical Catalyst (BMC), UK	*The objective of the BMC was to support the growth of the UK life sciences sector through the delivery of innovative life sciences products and services quicker and more quickly into healthcare by providing support to academic - and business led R&D.* *Relevance: same/similar model to Catalysts*
2. Smart Programme (Smart), UK	*The overarching aims of the Smart Programme were to encourage SME investment in R&D, raise their innovation capabilities, and accelerate new products/services/processes to market through the provision of grants. Three types of grants were made available to support different levels of technological readiness: Proof of Market, Proof of Concept and Prototype Development grants.* *Relevance: similar customer journey process; grant scheme at different stages of innovation*
3. Aerospace Technology Institute	*An initiative designed to maintain and grow the UK's competitive position in aerospace design and manufacture through grant funding to support innovative projects and capital investments.*

Comparator		Summary
	Programme (ATI), UK	
4.	**Shell Foundation (Shell), Africa, Asia and Latin America**	*The Shell Foundation co-develops and implements new business models and social enterprises to bring about sustainable development in Africa, Asia and Latin America.* *Relevance: international development context*
5.	**DHI Subsidy Scheme, Netherlands**	*A subsidy scheme established to support Dutch SMEs - in any sector - with demonstration, feasibility, and investment preparation projects in emerging and developing countries.* *Relevance: similar subsidy scheme covering different innovation stages, and also with international development context*
6.	**Commission for Technology and Innovation (CTI), Switzerland** (now Innosuisse)	*The CTI (now Innosuisse) is Switzerland's science-based innovation promotion agency. They provide R&D project funding alongside collaboration, innovation and business support to universities and business (including start-ups and SMEs). They also operate the Swiss Competence Centers for Energy Research.*
7.	**Grand Challenges Canada, Canada** (implementation partner for the Development Innovation Fund – Heath)	*An organisation setup to implement the Development Innovation Fund – Heath – designed to mobilise scientific communities in Canada and the low and middle-income countries to address health challenges through the competitive selection and funding of projects through a set of targeted and innovation-driven sub-programmes.* *Relevance: competitive grant scheme at different stages of innovation, and with international development focus*
8.	**Tekes, Finland** (now Business Finland)	*Tekes – the funding agency for technology and innovation in Finland - run programmes designed to provide grants and loans (to SMEs, large businesses and research institutions) to support innovative projects. They also support projects with the potential to grow in international markets, but that are deemed too risky for private investment.*
9.	**Industrial Research Assistance Program (IRAP), Canada**	*IRAP support SME growth through the provision of a range of business and innovation support services and funding grants.* *Relevance: competitive grant scheme at different stages of innovation*
10.	**Africa Enterprise Challenge Fund (AECF), Sub-Saharan Africa (24 countries)**	*Designed to stimulate innovation and private sector development in agricultural and renewable energy sectors through grants, concessional loans, technical assistance, and support in linking to follow-on investors. The focus is on low income, remote, fragile and marginal environments in 24 Sub-Saharan African countries.* *Relevance: funding instruments are similar; focus on agri-tech; and international development focus*
11.	**Office of the Chief Scientist, Israel** (now the Israel Innovation Authority)	*OCS provide a series of grants and incentive programmes to stimulate collaboration between industry and academia to produce advanced technologies and innovative products in Israel. These include the KAMIN, NOFAR and MAGNETON programmes.* *Relevance: funding instruments are similar, and similar focus on research-industry collaborations*

Source: SQW consultations and desk review

6.6 The remainder of this section sets out the findings and lessons under four headings:

- programme design and management

- promotion, awareness and application processes
- project delivery and support
- wider lessons

Programme design and management

Governance structures

6.7 Across the programmes reviewed there were varying ways in which governance and management structures were established, and there is no clear example of good practice. Nevertheless, drawing on three examples in particular – the Biomedical Catalyst, the Shell Foundation, and Grand Challenges Canada – four common areas of practice were notable:

- the use of awarding committees and panels, informed by a panel of assessors
- evidence on the merits to providing specific training or knowledge-sharing opportunities for assessors
- the role of overarching advisory boards – especially relevant to changing contexts or where the strategic direction of a programme needs to be continually reassessed
- the value of governance structures that include expertise across various domains (academic, clinical, technical, industry and investment perspectives).

6.8 In common with the Catalysts, a feature of many of the programmes reviewed was the use of awarding committees and panels tailored to the nature of the programme, often informed by a panel of assessors. They can take various forms to suit the specific nature of a programme. Within the Biomedical Catalyst, for example, the nature and role of these panels varied across the funding streams available. The programme included three different types of project selection panels:

- Confidence-in-Concept Panel: for Confidence-in-Concept (CiC) awards by the Medical Research Council.
- Developmental Pathway Funding Scheme (DFPS) Panel: for all Early Stage applications led by academics.
- Major Awards Committee (MAC) Panel: for all Early Stage applications led by firms and all Late Stage applications (led by firms or academics).

6.9 Each panel adopted a different approach, ranging from a simple scoring process by an independent panel of experts and a line draw (CiC) to a more intensive process that incorporates an interview stage with a final round of anonymous electronic voting by panellists based on scoring criteria in three areas: quality, impact, and productivity (the MAC). The latter process, the MAC Panel, was an intensive process that convened 8-12 academic, clinical, industry, technology and investment experts, covering the full range of translational disciplines, and reviewed applications over two to three days. This process was suggested to

provide a high degree of scientific and commercial scrutiny commensurate to the value and duration of the funding.

6.10 The Biomedical Catalyst also made adaptations to these processes to increase their effectiveness over time. For example, specifically for applications that focussed on medical devices and diagnostic tools, it was decided to create a bespoke assessment process from Round 3 onwards in response to a large number of applications in this technology area. In addition, due the substantial size of Early Stage awards offered through the programme, the MAC Panel process incorporated interview rounds in order to ensure that the large award sizes received sufficient scrutiny (notably, the IB Catalyst did something similar for translation awards). The evaluation of the programme suggested that 'further guidance and support could have helped some applicants to prepare for this stage'. The evaluation also suggested that the disproportionate focus of the assessment panels on the scientific demonstrability of applications may have limited the potential for riskier projects to be advanced that were at more preliminary (less demonstrable) stage of development.

6.11 Many programmes use a panel of assessors to support assessment processes. As part of the Biomedical Catalyst evaluation, it was suggested that regular catch-up meetings or training for assessors may be valuable. As assessors typically work in isolation – with few, if any, opportunities to share learning – specific training or knowledge-sharing could support a greater alignment in thinking across assessors. This is in line with feedback received across the Agri-tech, Energy and IB Catalyst assessors, and has the potential to allow assessors to benchmark their own scores. It was suggested that training and meetings that had taken place on the Smart programme were useful in this respect.

6.12 The Grand Challenges Canada model was notable for the adoption of a collaborative approach to governance, with responsibilities for the delivery of the Development Innovation Fund for Health (DIF-H) programme divided across the members of the consortia, as follows:

- Grand Challenges Canada – the implementation body for the delivery of DIF-H
- Canada's International Development Research Centre (IDRC) – responsible for disbursing funds to Grand Challenges Canada, managing evaluations and audits, and being accountable to the Canadian government for DIF-H
- Canadian Institutes of Health Research (CIHR) - responsible for reviewing applications in response to GCC grant calls.

6.13 This division of labour was generally reviewed as effective in the approval of funding to programmes and projects. CIHR, in particular, ensured 'that funded projects are scientifically rigorous at their earliest stages'.

6.14 For both the Biomedical Catalyst and Grand Challenges Canada programmes, issues did arise as a result of the variations in governance structures, and linked to the divisions of labour within them. For the Biomedical Catalyst, the different nature of each of the three streams was not always made clear. For example, some academic applicants were also unsure as to why they were being directed through a particular panel, and so why an additional interview was required.

6.15 For Grand Challenges Canada, 'opportunities to guide program developments scientifically have been missed and the scientific rigour of projects cannot be guaranteed' due to the involvement from the CIHR post-assessment. An overarching Scientific Advisory Board, which sought to provide scientific oversight and leadership, did have the potential to ameliorate the issue identified above, but was limited in the advice it could provide, especially at project-level, due to time and resource constraints. More recently, specialist external support teams known as 'platforms' have been implemented to support the re-appraisal of projects as they progress. This step included inputs from business and scientific experts, and was regarded as important for identifying and supporting companies onto their Transition to Scale programme (more details below in relation to moving up the ladder of support).

6.16 Finally, the value to employing governance structures that include expertise across various domains was evidenced as part of the Shell Foundation's work. The Shell Foundation Board of Trustees included senior leaders from the Shell Group and leading figures from sectors related to their areas of focus, particularly in terms of international development, but also in terms of the investor/VC community. It utilised Board Committees to assist in good governance and decision-making – e.g. Investment and Audit and Risk Committees that included experts in relevant fields. The range of expertise across these structures was regarded as a key strength, and important for adapting to changing needs and priorities. This structure may be particularly important when operating in a dynamic, international development focussed setting. Whilst the variety of perspectives and breadth of expertise on the board may minimise the extent to which poor decisions are made (e.g. because of it limits the gaps in knowledge), this does provide a challenge to defining and delivering a unified strategy. From the point of view of the Shell Foundation, this was not regarded as a major challenge.

Ability to move up the ladder of support (from early to mid to late stage grants)

6.17 Sufficient longevity in programmes as well as clear links between funding stages and/or between complementary programmes are required to facilitate the progression through the innovation ladder.

6.18 In the UK, the Smart programme was designed to provide pathways for supported projects to move up the ladder of support – advancing from early-stage proof of market or feasibility studies, to later-stage grants that develop prototypes and establish routes to market. The Smart evaluation highlighted, for example, the 'pulling factor' of a well-defined, staged development path was as highly attractive to businesses. Importantly, the Smart programme also recognised its place within the broader innovation ecosystem and proved effective as a 'stepping stone' to other forms of available innovation support (including other Innovate UK and EU-backed schemes, as well as private funding). The Smart programme was funded for a long period of time, enabling projects to advance up the ladder of support.

6.19 The strengths to such an approach were also identified in international examples in Finland and Israel. In Finland, the innovation agency, Tekes, provides support in a range of thematic areas for periods of 4-6 years, with funding targeted across projects at different rungs of the innovation ladder (from research intensive to product development projects close to commercialisation). In Israel, the Israel Innovation Authority (formerly Office of the Chief Scientist's–OCS) invests in a set of complementary programmes designed to target different stages of the innovation cycle, including from fundamental and applied research (KAMIN

programme), to feasibility stage (NOFAR programme), and to more advanced stages of commercialisation (MAGNETON programme). Like the Smart programme, these initiatives have been operating over a significant number of years, which allows an individual project sufficient time to progress through the programmes on offer.

6.20 Therefore, from the evidence, the original intent and design of the Catalyst programmes – to provide a pathway through grants towards commercialisation – was correct. However, the ability to achieve this has been limited by funding curtailment, and so, at the time of writing, as projects complete there is a need to help beneficiaries identify the next steps through alternative provision.

6.21 Other models have refined this ladder of support, and the comparator review identified alternative approaches. Grand Challenges Canada, for example, supports the progress of projects by funding a range of proof of concept projects across several targeted and innovation-driven areas. The best of these are then invited to participate on their Transitions to Scale programme. The Shell Foundation adopts a similar approach. Shell first identifies the issues that underpin major social and environmental challenges, co-creates new social enterprises designed to address them, and then supports the best of these ideas with financial and non-financial support to accelerate their growth and foster their replication. To support this process – and in response to gaps in enabling infrastructure and other barriers that were constraining the adoption, replication and growth of co-created business models – dedicated 'market-enablers' (such as supply chain service providers, financial intermediaries and 'catalytic institutions') were brought on board to support the development of the projects and to help address barriers to scaling.

Analysis, use and sharing of monitoring data

6.22 The deficiencies in programme-level monitoring data, and how it is used to inform programme management, were not unique to the Catalysts (nor the UK). Several of the programmes/agencies reviewed had similar areas for improvement to the Catalysts – such as the ATI evaluation–including in terms of challenges faced in the collection and analysis of monitoring data across multiple partners. This impeded programme management and also evaluation and impact assessment. The effective collection of data can be used to inform and improve the delivery of their respective programmes. This proved important for the changes to the assessment processes of the Biomedical Catalyst (noted above), as well as changes to the delivery model of the Shell Foundation (as noted in the wider lessons section below).

6.23 Taking an international example, the summative evaluation of the Development Innovation Fund (Heath), where Grand Challenges Canada was the implementation partner, recommended a *'more systematic, transparent, and consistent'* approach to monitoring, and specifically for an *'audit trail connecting raw data to final results claims'*. Like the Catalysts, parallel databases were in use for different elements of the programmes on offer, which precluded the possibility of aggregating the data to inform delivery. For CTI in Switzerland, there was a recommendation for the development of a system to ensured standardised and systematic impact assessment. As part of this, there was also a recommendation to contractually oblige project partners to participate in regular surveys to capture outcomes and impacts.

Promotion, awareness-raising and applications

6.24 The evidence from comparators highlighted that similar challenges exist elsewhere in reaching a wider range of organisations than might usually apply and/or take part in innovation programmes. There did not appear to be any silver bullets to solving this, though a number of ideas and recommendations were identified in the literature, including how the application process could be made more amenable to would-be applicants that are new to accessing programmes.

6.25 The Biomedical Catalyst (BMC) evaluation highlighted a generally high level of awareness within the business community, investors and the academic community. This success was attributed to a range of profile and awareness-raising activities that were similar to those identified in the three Catalysts subject to this evaluation, as follows:

- webpages on Innovate UK and the Medical Research Council's website
- briefing events and webinars (supported by the KTN)
- wide engagement with, and leverage of, relevant networks and industry associations.

6.26 More distinctive events that served to raise and maintain the profile of the BMC included the announcement of the programme by the Prime Minister in December 2011 alongside the Life Sciences Strategy, and annual visits to 15-20 of the most strategically important universities – including repeat visits where a university was involved in an unsuccessful application. The latter point may be an important means to maintaining relationships with key universities.

6.27 The evaluation of the BMC evaluation also highlighted some weaknesses in the programme's approach to promotion. The evaluation highlighted the potential for improved cross-promotion of the BMC between the Medical Research Council and Innovate UK, with a recommendation to operate a common website to ensure consistency. The evaluation also highlighted that, despite high awareness of the programme in general, the specific routes through the various funding streams were less clearly understood, which may have limited the ability of applicants to decide how to optimally engage with the programme.

6.28 Several programme evaluations highlighted imbalances in the reach of schemes, with an over-focus on well-trodden parts of sectors or geographies. As well as the Biomedical Catalyst, where there was a disproportionately high number of grants in the South East and 'Golden Triangle' areas of the UK and insufficient coverage in areas such as diagnostic tools developers and digital health, similar issues were highlighted with respect to the CTI in Switzerland and Canada's Industrial Research Assistance Programme (IRAP):

- The CTI programme, for example, was suggested to benefit from high awareness amongst research facilities, but less so amongst the business community, particularly with SMEs.
- The IRAP's existing size and networks meant that very limited awareness raising activities took place. This was fine in the context of obtaining sufficient interest in the programme, because the existing networks were extensive, but highlighted

the importance of continually refreshing these to draw new organisations in. The programme has now committed to begin engaging more broadly.

6.29 The comparator review identified several ways in which awareness could be raised amongst under-represented groups, and how applications from such groups could be encouraged.

- Whilst potentially most relevant to where partners are required in developing country contexts (e.g. Agri-tech and Energy where there were international development objectives), the African Enterprise Challenge Fund's approach to promotion included dedicating a significant proportion of programme costs to developing new market materials to support each funding window. This obviously has implications for the funding of programme management.
- The evaluation of CTI's R&D programme in Switzerland highlighted that greater coordination with regional actors could help to benefit the programme's reach. In the UK context, Innovate UK's regional managers, and the role of devolved and local-level partners and programmes would be highly relevant in this context.
- One particularly valued feature of the Biomedical Catalyst's application process was the inclusion of application workshops offered by the Medical Research Council. The evaluation highlighted the 'highly tailored and interactive nature of these guidance sessions' helped academic project leads in particular to develop strong applications.
- The Dutch DHI Subsidy Scheme employed a specific step in its application process that could encourage applications from those that have not taken part in similar programmes in the past. The scheme included a 'quick-scan' phase at the start of the application process to reduce the burden on SMEs. SMEs applying to the scheme must first produce a 'quick scan' document to summarise their project. This is followed-up with feedback from the assessors and an invitation to the full application process if the project is deemed to have sufficient potential. This appears to be less onerous than the first stage that was adopted by some of the Catalysts, and so might promote a higher rate of application, particularly from organisations with less experience in applying for innovation subsidies (or funding in general). This may also reduce the costs of applying for those whose ideas are ultimately viewed as not having potential.

Project delivery and support

Role of Monitoring Officers

6.30 The evaluations of the Biomedical Catalyst and Smart identified many of the same areas for improvement around the roles and effectiveness of monitoring officers. This is perhaps unsurprising given that these schemes, and the Catalysts subject to this evaluation, employ the same standard process and pool of Monitoring Officers from Innovate UK.

6.31 This feedback was also highlighted in relation to the African Enterprise Challenge Fund. Here, grant managers were highlighted as having larger impacts on beneficiaries where their own expertise of the landscape and networks could be leveraged. This was used to good effect in

supporting beneficiaries' engagement in further collaborative work (including with other programme beneficiaries).

6.32 Finally, a recommendation was made as part of the ATI evaluation to ensure that monitoring officers receive feedback on the various assessment and due diligence processes to ensure that they are sufficiently briefed on issues and risks previously identified, and therefore best able to provide support to applicants to mitigate any potential issues.

6.33 There were no specific solutions or lessons relating to the role of monitoring officers; rather the evidence indicated that consistency is a challenge on other programmes elsewhere. More constructive lessons were identified with respect to support more widely, including aftercare, issues to which we now turn.

Approach to support, including aftercare and follow-on finance

6.34 Canada's IRAP represents a flagship programme offering a range of services to SMEs, from funding through to advice and support. The complementary sets of activities are designed to support innovative SMEs to secure funding as well as maximise their potential through their 'Concierge Service'. The 'Concierge Service' is designed to support SME's by providing 'a single point of access to assist them in identifying government programs and services that best meet their needs'. Similarly, the African Enterprise Challenge Fund offers a 'connect match-making service' to support beneficiaries in their search for follow-on investors.

6.35 This is potentially an important lesson for the Catalysts, and to innovation funding more generally in the UK. However, it should be noted that such a service needs appropriate resourcing. The evaluation of IRAP suggested that the Concierge Service was under resourced and was best serving 'later stage, high potential clients'.

6.36 A further lesson on exploitation was identified in Israel. As part of the OCR's NOFAR programme – a feasibility-stage grant programme to promote collaborative innovation projects in biotechnology and nanotechnology – collaborating companies are provided with the first right to negotiate commercialisation of research results with the research institution (which is provided with all the rights to the knowledge accumulated in the research phase), which can lower risk and promote increase industry-academia collaboration.

Wider lessons for the international development context

6.37 Three further lessons were identified from the comparator review, with particular reference to developing country contexts:

- First, the Shell Foundation changed its model in response to lessons from their early phase of development. This resulted in a shift to an 'enterprise-based' approach, as described earlier, whereby enterprises are co-created and the best are picked to accelerate to scale with co-investment. Over time, they have found that entrepreneurs require patient, flexible grant funding. This patient approach, potentially as part of a wider package of support, may be of relevance to Catalyst models designed to bring forward innovations with a mix of economic and social objectives.

- Another lesson from the Shell Foundation was the recognition that projects, especially in developing contexts, required a focus on human capital to be viable in the long term. This is likely to be important for Catalysts where skills are required for adoption and diffusion of innovations – extending the point above around wider support.

- Finally, the African Enterprise Challenge Fund reoriented its model, changing from a single fund running annual grant competitions supporting agribusiness projects, to a more responsive competition platform that was reactive to demand in different sectors, themes or geographies. This ensured that projects were timely and relevant. This may be important for Catalysts operating in dynamic areas where markets and demands are changing.

7. Conclusions

Conclusions on key points

Which aspects of the Catalyst processes were most effective? What lessons/ good practice can be used to inform future Catalyst(-type) interventions?

7.1 Many aspects of the Catalysts' processes have worked well. Effective promotion and marketing, particularly in partnership with the KTN, has translated into strong demand over the course of the programmes. Catalysts, and the thematic challenges they set out, were perceived as **highly relevant** to the three sectors involved. The Catalysts were seen as a pioneering way for **funding bodies to work together to support multi-disciplinary research across the translational pipeline**. Moreover, the model adopted **broadly met the needs of its target audiences** in terms of the potential to progress through different types of grant (early, industrial/mid, and late), the intervention rate, and the non-prescriptive competitions. Evidence gathered through this evaluation suggested that the programmes were addressing their original market failures, especially in terms of investing in projects where the level of risk involved had deterred internal and VC investment, and **filled important gaps in the innovation funding landscape for translational R&D** for the sectors in question.

7.2 The **core processes** set up for the application, contracting and monitoring processes were largely in line with Innovate UK's and the Research Councils' 'standard' approaches, and appeared to have **worked effectively**. The KTN and the programme co-ordinator (in the case of the IBC) have played an important role in supporting applicants and raising the quality of applications, which has been high across all three Catalysts. The pool of assessors comprised highly qualified experts, with a breadth of knowledge and experience. Decision-making processes and management structures have varied and (in some instances) evolved over time, and partnership working and communication between funding and delivery partners has been strong.

7.3 Each Catalyst was generally perceived to have achieved a **balanced portfolio** of projects, reflecting broad-ranging demand, wide scope and the nature of the sectors involved, and included some high risk, potentially transformational projects and 'game changing' technologies. The projects consulted for this evaluation appeared to have made or be making good progress (although some have experienced challenges associated with the technical aspects of their innovations), and there was some evidence to suggest that organisations delivering more than one project had benefited from synergies between the projects (even if very few have progressed from one grant type to another within the Catalyst). Many of the beneficiaries consulted pointed towards the **critical role of a 'good' MO** in providing qualitative inputs to project delivery (e.g. a critical friend role) and ensuring projects made progress towards their intended outcomes.

7.4 The evaluation has identified a number of processes that have worked well in one or more of the Catalysts and examples of good practice. These are summarised in Table 7-1 alongside a brief commentary on the extent to which the lessons are transferrable and/or have worked in a specific context.

Table 7-1: Summary of effective processes and good practice in implementation, the Catalyst(s) which have demonstrated these processes, and the extent to which the lessons are transferable and/or context specific

	Effective processes and good practice	ATC	EC	IBC	Transferability / context specific factors
Marketing and demand	Extensive engagement / priming community before competition launch		✓	✓	Particularly useful for nascent sectors
	Use of funder networks and 'networks of networks' to raise awareness of opportunities	✓	✓	✓	Timing issues – nascent nature of IB meant the Catalyst struggled to maximise links with sector networks given embryonic nature of networks themselves
	The role of the KTN in delivering regional awareness raising and consortia building events	✓	✓	✓	Regional approach important, particularly to engage potential applicants across the country/target hotspots of activity in line with strategic priorities
	Importance of national sector strategy demonstrating Ministerial commitment to raise profile of programme	✓			Example specific to ATC, and its integral role in the UK Agri-Tech Strategy, but potentially applicable to other sectors
	Alignment with 'feeder' programmes to create pipeline of applications	✓		✓	Particularly useful for nascent sectors, though potential to be used more widely
	The non-prescriptive approach to competitions, and its ability to 'disrupt' traditional sector boundaries, attract new disciplines to the sector, accommodate diverse sector needs and funder priorities	✓	✓	✓	Particularly important to reflect diverse and fragmented nature of agri-tech
Application and assessment	Role of the KTN and (in the case of the IBC) a Co-ordinator in raising quality of applications	✓	✓	✓	Transferable, dependent on (KTN/other) capacity. Role of programme co-ordinator requires careful management of relationships/conflicts of interest
	Pool of highly qualified and experienced assessors, well-regarded experts in their fields, driven by a very selective recruitment process by Innovate UK/other funders	✓	✓	✓	Transferable lesson – degree of quality has resource implications
	Transparent provision of assessor feedback to unsuccessful applicants and EOI applicants, enabling refinement of plans	✓	✓	✓	Transferable
	Role of the IBC Co-ordinator in discussing areas for improvement in between EOI and full application with the applicant, leading to better quality bids			✓	Applicability to two-stage competitions. Requires careful management of relationships/conflicts of interest

	Effective processes and good practice	ATC	EC	IBC	Transferability / context specific factors
Management and decision-making processes	The inclusion of independent, impartial input from external experts from academia and industry on programme Management Board – this helped ensure decisions accounted for wider practical, technical and ethical imperatives, and was a signal of robust decision-making processes to the broader sector			✓	Transferable. Potential challenges in identifying 'sector representatives', especially in diverse sectors, managing conflicts of interest, and maintaining manageability.
	Development of single, comprehensive database for projects and expenditure that can be analysed / aggregated in real time, informing on-going management and enabling dissemination to stakeholders			✓	Transferable
	Allocated resource (Monitoring Liaison Officer) to gather real-time evidence on outcomes (rather than relying on close out reports) enabling efficient dissemination of progress to stakeholders		✓		Transferable
Project delivery	The importance of including international partner as part of the team in DFID-funded projects to provide knowledge and access to appropriate networks to assist with exploitation	✓			Transferable to DFID funded projects (and non-DFID funded projects with scope to exploit technologies in developing countries). Note importance of KTN-type consortia building function/networks or brokerage function to facilitate this process.
	Organisations leading multiple related projects has led to synergies and impacts that are greater than sum of parts (even where these have not progressed from one grant type to another within the Catalyst)	✓	✓	✓	Transferable
	Monitoring requirements (meetings, paperwork) provided structure and momentum	✓	✓	✓	Transferable
	The important role and added value of a 'good' MO that played a 'critical friend' role and exhibited flexibility and openness in their approach. As part of this, good MOs were found to provide signposting, have technical/market knowledge, and encouraged focus on exploitation throughout.	✓	✓	✓	Transferable. Note that approach and quality of MOs was variable; not all were seen as 'good' MOs. Also, quality of MO has resource implications, but considerable value added to process (and progress/potential impact of projects)
Completion and aftercare	Showcasing events hosted by Innovate UK to facilitate links between projects and the investor community (e.g. to pitch to VCs) and enable projects to network		✓		Transferable – VC links most applicable to industrial/mid and late stage projects, networking between projects applicable to all stages of grant

Effective processes and good practice	ATC	EC	IBC	Transferability / context specific factors
Signposting to follow-on opportunities/funding *before* project completion			✓	Transferable. Variable consistency across and within the Catalysts on this – in part, dependent upon MO's approach
Inclusion of partners within project consortia with clear role in dissemination and/or membership organisations with ability to disseminate findings directly to wider community	✓	?	?	Transferable, although potentially most applicable to industrial/mid and late stage projects
Project directories to enable projects to communicate/network with other projects, increasing scope for potential synergies (although no evidence to date of projects using directory to form new collaborations)		✓		Transferable, applicable to all stages of grant

Source: SQW

The extent to which Catalyst processes and broader factors/processes support or inhibit pathways to future impact

7.5 It was early days for the assessment of outcomes and impacts, although emerging effects were examined as far as possible. The evidence gathered to date suggested that the Catalysts have helped to bring about **R&D investment** that would not have been undertaken without the programme and/or have accelerated R&D activities. They have also led to **new and strengthened collaborations, improved skills and knowledge development, and enabled progression through the TRLs,** all of which closely aligned with the Catalysts' objectives and underlying logic chains. A large proportion of beneficiaries consulted expected these benefits to translate into the introduction of new products/services to the market (in the UK and overseas), and business performance improvements relating to productivity and turnover gains in future. There was also some (albeit limited) evidence to suggest that the programmes had improved **industry appetite, capability and confidence** to apply for R&D funding, and created **a pipeline of innovation projects for potential investors.**

7.6 The Catalyst model and its processes appeared to be supporting pathways to impact. Undertaking R&D activities ***in collaboration*** **has been crucial to enabling outcomes**, and this in turn has been incentivised by both the Catalyst finance and the discipline/structure that the Catalyst models brought to projects. Other factors, such as a 'good' MO and the credibility associated with securing Innovate UK funding were also important. There were, however, some processes that were sub-optimal, and were at risk of inhibiting pathways to impact – the **lack of a consistent approach to signposting and aftercare, and the lack of dissemination** observed to date by Innovate UK, the Research Councils and projects themselves.

7.7 Within the projects themselves, strong project management and leadership of the lead partner was also critical to success, alongside a business's ability to design/implement sales and marketing strategies to enable new products/processes to reach the market, and recruit staff to expand operations. Some external factors influencing pathways to impact have applied across the three Catalysts (e.g. market growth, advancement/acceptable of new technologies) but many that were identified were relatively Catalyst-specific.

Synergies between Catalysts

7.8 The main sharing across the Catalysts has been implicit in the common design and implementation of the Catalyst model, drawing on the lessons of the earlier Biomedical Catalyst and standard Innovate UK procedures. Other sharing appeared to be modest, informal and ad hoc to help solve specific challenges. There was **limited evidence of synergies** between the Catalysts – although the case studies pointed towards some synergies between projects (funded by the Catalyst and other programmes) which were being led by the same organisation. Whilst there was some evidence of traction in a Catalyst model or brand, on the whole opportunities for synergies were not capitalised on. This was potentially a **missed opportunity**, especially where there were overlaps in technology areas.

Areas for improvement, including to inform future Catalyst-type interventions

7.9 The evaluation has identified several key areas where the Catalysts' processes could be improved. In Table 7-2 we summarise the 'principal' areas for improvement - i.e. priorities that should be addressed in any future Catalyst(-type) intervention - based on their scope to make a substantial difference to the effectiveness and potential impact of the programme. In addition to the recommendations above, there were a range of other processes which could be refined and adjusted, or (resources permitting) changed to a greater to degree, in order to improve the efficiency and effectiveness of the Catalysts.

7.10 A number of the issues that the evaluation identified were not necessarily specific to the Catalysts. Instead, they reflected the processes employed in Innovate UK and Research Council competitions, and even the common types of issues encountered in research and innovation programmes more widely, as found in the comparator review. Therefore, the issues in Table 7-2 are split into: (i) those which are particularly relevant to the Catalyst and Catalyst-type programmes, and (ii) those which are more widely applicable to research and innovation programmes.

Table 7-2: Areas for improvement in processes

	Recommendations
Principal areas for improvement	
Catalyst-specific	• Ensure sufficient longevity to enable projects to progress between grant types and fully maximise the potential impact of the Catalyst's fundamental model/design • Ensure projects and the programme as a whole includes a plan for knowledge exchange and dissemination (and accountability for delivering this)
Generally applicable	• Reduce duplication in processes between Innovate UK/RCs, especially in terms of application, contracting, monitoring and close out (as far as the organisational restrictions allow – the move to UKRI may aid this) • Greater consistency in the role played by MOs, and consider whether wider 'qualitative' roles should be included in job specification • Formal and comprehensive inclusion of signposting/next steps guidance (including *before* close out) • Improve programme-level monitoring: i) addressing data discrepancies; ii) regular updates on progress
Other areas to consider	
Catalyst-specific	• Provide greater clarity on timings of rounds and their scope, and communicate this effectively • Enable greater project-to-project engagement to exploit possible synergies (e.g. via directories, events)
Generally applicable	• Extend reach to new SMEs, potentially facilitated by: time to build a community of interest; support for SMEs that are new to the process; and two stage application rounds with a lighter touch EOI (see point below) • Consider introduction of lighter touch EOI stage that adds value to applicant (in testing idea) and Innovate UK (in terms of efficiency) and reduces perceived duplication in current two-stage approach • Address inconsistencies in assessor feedback where recommendations for improvement are contradictory, and improve communications on moderation process to applicants • Enable knowledge sharing between assessors and MOs (respectively) • Address monitoring reprofiling burden and accelerate change requests

Source: SQW

7.11 A number of the issues and challenges identified above were notable in the evidence on other schemes in the UK and more widely. For example, challenges associated with extending the reach of innovation programmes, inconsistent monitoring practices, and resourcing aftercare support were all identified in international examples. In addition, governance and management models also varied across the examples reviewed. The review of comparator schemes also pointed towards:

- the value in commitment to longer-term programmes, which is critical in facilitating a ladder of progression for innovation ideas
- (linked to the previous point) the potential option of funding a wide range of early-stage projects and then to purposively inviting the best to submit applications for subsequent stage funding as a model to facilitate progression
- the effectiveness of targeted marketing, utilising links with regional and local partners
- a 'light touch' expression of interest stage and interactive workshops to engage with organisations that may be less likely to take part in innovation programmes
- the importance of aftercare support and signposting in maximising impact of programmes – and the need for these activities to be properly resourced if they are going to be effective.

Implications regarding a harmonised model

7.12 The evidence from the evaluation indicates that, to a large extent, a common model has been adopted across the Catalysts, with a degree of tailoring in each Catalyst. There is a strong case, therefore, for a **harmonised Catalyst model** that could be deployed in the future across Innovate UK and the Research Councils. The model could also be communicated and implemented where there is support from other funders, with appropriate incorporation of the objectives of other funders. Within this harmonised model, there is a need to **allow tailoring**, for example to reflect particular sectoral, technological or market contexts, and different organisational objectives.

7.13 In Figure 7-1, we set out the core components of a harmonised model, with a visual depiction of the model alongside a description of how different elements would be harmonised and where there would be scope for tailoring. Harmonisation ought to be possible in:

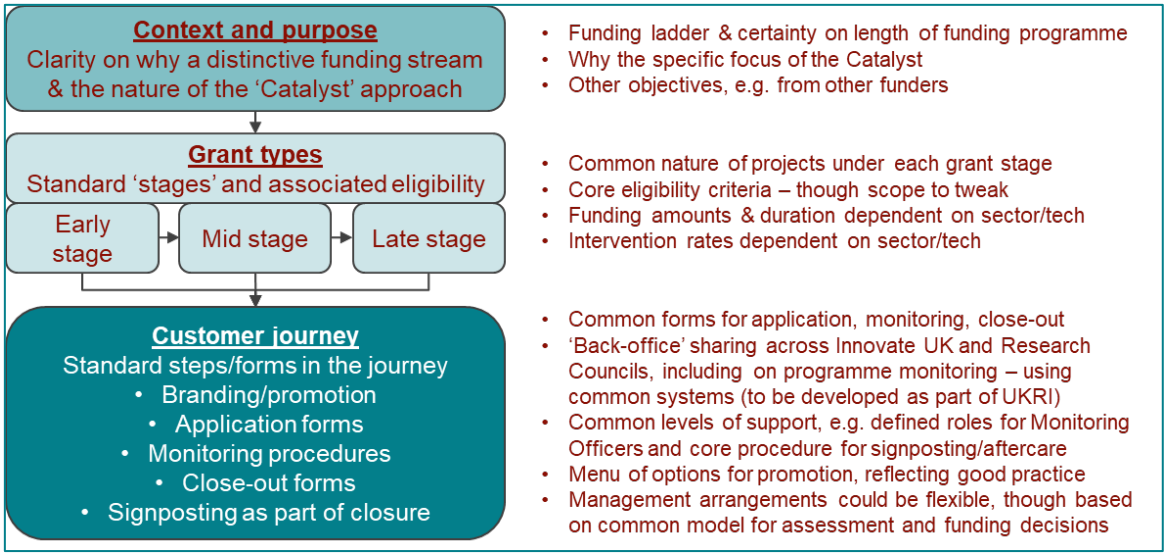
- the essence of the Catalyst approach, i.e. its funding ladder, and the need for a justification of a specific targeted competition
- the grant stages, and the types of projects/degree of technology readiness that are appropriate under each stage
- forms and processes for the core of the customer journey, including a consistent approach for Monitoring Officers and signposting/aftercare
- back-office processes.

7.14 Tailoring would be required in a number of areas, in particular:

- where other funders are involved, so that the Catalyst's purpose reflects broader objectives, such as relating to international development or specific societal challenges
- funding amounts available and intervention rates where sectoral, technological and market contexts can be important, e.g. some technology developments may require greater amounts of funding, and others may be able to attract greater leverage thereby requiring lower intervention rates
- promotional actions and management arrangements could have some variation to reflect existing communities of interest and institutions.

7.15 In order to realise this harmonised model, **some improvements to consistency and alignment between Innovate UK and the Research Councils** are required. In particular, a more streamlined and seamless set of forms and processes are required (e.g. for applications), and action is needed to ensure genuine consistency in the support that beneficiaries receive from Monitoring Officers and funders as part of close out.

Figure 7-1: Towards a harmonised model



Source: SQW

Annex A: Data Analysis

A.1 This annex presents headline findings from an analysis of Innovate UK monitoring data undertaken by SQW. Data leads at Innovate UK provided SQW's evaluation team with several datasets including: 'Funders Panel Report', 'FO14', 'FO09' and 'Monitoring Scoring Report'. The BBSRC provided the 'IB catalyst master spread sheet'.

A.2 SQW has encountered a number of issues with the data provided (primarily for the ATC and EC) and considerable effort has been invested to resolve these with Innovate UK. The datasets suffered from coding errors on basic key indicators such as the type of grant (e.g. whether a project was early, mid or late stage), inconsistencies within and across Innovate UK's datasets (e.g. on the number of projects funded), and gaps (e.g. spend to date). As a result, SQW has only been able to present a very partial picture of the Catalyst portfolio and performance to date. As agreed with the Steering Group, this report only focuses on the IBC, where complete data was available from BBSRC and a partial analysis of ATC data (excluding projects funded by DFID).

A.3 The analysis below is broken down into three key subsections. The first section focuses on a comparison between successful and unsuccessful applicants, providing a breakdown by the different types of grants, by round, by scale of grant requested, by duration of projects as well as an assessment of the scores each application received. The second section provides an analysis of those projects that were funded by the ATC and IBC. Again, the analysis provides a breakdown by type of grant and by round. It also provides an overview of the type of leads and collaborators involved. The final section provides an overview of the latest monitoring scores data provided by Innovate UK in October 2017, for both the ATC and IBC.

A.4 Total number of applications across four rounds for the IB catalysts were 309, of which 27% were successful. Around three quarters of all applications were for early stage grants alone, with a further one-fifth for industrial stage. Only 18 applications were for late stage projects. Industrial research projects appeared to have the highest success rates (36%) amongst all type of grants, albeit the sample sizes between the three grants vary greatly.

Table A-1: Proportion of applications by type of grant

Type of grant	% Successful	No of applications
Early[31]	24%	230
Industrial	36%	61
Late	22%	18
Total	**27%**	**309**

Source: IB catalyst master spread sheet

A.5 The number of applications submitted in each round were fairly evenly distributed – no particular round appeared to be over or undersubscribed. Having said this, the proportion of successful applications appears to have dropped over time. It was above the average (27%) in rounds 1 (29%) and 2 (30%), but lower in rounds 3 (25%) and 4 (22%).

[31] Includes translational projects.

Table A-2: Number of applications for the IB Catalyst

Catalyst	No of applications	% Successful
Round 1	26%	29%
Round 2	26%	30%
Round 3	25%	25%
Round 4	24%	22%
Total	**309**	**27%**

Source: IB catalyst master spread sheet

A.6 Just under a half of all applicants requested for a grant in excess of £1m, though only 20% of these were successful in receiving any funding. Around a quarter of applicants applied for between £100k - £199k, of which 34% were successful in receiving any funding. Note, very small proportion (7%) of applicants applied for grants between £500k - £999k.

Table A-3: Scale of grant requested and proportion successful

	Scale of grant requested	% Successful
£25,000 - £49,999	0%	0%
£50,000 - £99,999	3%	13%
£100,000 - £199,999	28%	34%
£200,000 - £499,999	15%	39%
£500,000 - £999,999	7%	23%
> £1,000,000	47%	20%
Total	**309**	**27%**

Source: IB catalyst master spread sheet

A.7 A high proportion of projects were expected to last either between 7-12 months (42%) or over 3 years (32%). These numbers largely reflect the high number of applications for early and translation type projects. Note, only translation projects were eligible to take more than three years to complete. A further 16% also applied for projects expected to last between 2-3 years, of which 36% were successful in receiving funding, highest among all types of project, albeit with a much smaller sample size.

Table A-4: Proportion of applications that were successful (i.e.as a % of all applications) by duration of project

Duration	Duration stated in application	% Successful
0 - 6 months	1%	0%
7 - 12 months	42%	34%
1 - 2 years	8%	19%
2 - 3 years	16%	36%
Over 3 years	32%	14%

Duration	Duration stated in application	% Successful
Total	309	27%

Source: IB catalyst master spread sheet

A.8 Up to five assessors, who each scored the applications out of a hundred marks, reviewed all applications submitted to the IB Catalyst. The applications were then ranked according to the average score, with the top applications securing funding. The minimum threshold for a fundable project was 70 marks. Interestingly, of the 227 unsuccessful applicants, over a half scored above 70 marks, reflecting the high quality of applications submitted under the programme.

Table A-5: Bid performance

	Successful	Unsuccessful
Above 70	100%	57%
Under 70	0%	43%
Total %	**100%**	**100%**
Total number of applications	**82**	**227**

Source: IB catalyst master spread sheet

Projects funded (ATC & IB)

A.9 In total, 103 projects were funded under the ATC programme in the first five rounds. Note, the 103 figure excludes those projects that received DFID funding. The IB catalyst funded 82 projects over four rounds.

A.10 In contrast to IB, where half of projects funded were early stage (50%); for ATC it was the industrial/mid stage projects (52%). Having said this, the proportion of IB early stage projects per round dropped over time, falling from a peak of 63% in round two to 38% in round 4. In the contrary, the proportion of IB late stage projects increased over time, very similar to ATC.

Table A-6: Type of grants awarded across rounds for each of the three Catalysts

Round	Early stage	Industrial / Mid Stage	Late Stage	% total	Total number of projects
Agri-Tech					
1	33%	58%	8%	100%	24
2	39%	57%	4%	100%	23
3	41%	41%	18%	100%	22
4	27%	53%	20%	100%	15
5	37%	53%	11%	100%	19
All rounds	36%	52%	12%	**100%**	**103**
IB					
1	43%	35%	22%	100%	23
2	63%	21%	17%	100%	24
3	53%	26%	21%	100%	19

Round	Early stage	Industrial / Mid Stage	Late Stage	% total	Total number of projects
4	38%	25%	38%	100%	16
All rounds	**50%**	**27%**	**23%**	**100%**	**82**

Source: ATC monitoring data and IB catalyst master spreadsheet

A.11 As expected, a higher percentage of projects funded in the earlier rounds for both the IB and ATC have been completed, compared to projects funded in the later rounds. Interestingly though, a much higher percentage of IB projects (52%) have been completed compared to ATC (29%). This somewhat reflects the high proportion of early stage projects funded under the IB, which are of shorter duration compared to industrial mid/stage projects[32].

Table A-7: Project status by round for the two catalysts

Round	Closed	Live / Final Claim	No information / On Hold	% total	Total number of projects
Agri-Tech					
1	38%	63%	-	100%	24
2	35%	65%	-	100%	23
3	36%	64%	-	100%	22
4	27%	73%	-	100%	15
5	5%	95%	-	100%	19
All rounds	**29%**	**71%**	**-**	**100%**	**103**
IB					
1	61%	35%	4%	100%	23
2	63%	38%	0%	100%	24
3	58%	37%	5%	100%	19
4	19%	44%	38%	100%	16
All rounds	**52%**	**38%**	**10%**	**100%**	**82**

Source: ATC monitoring data and IB catalyst master spreadsheet

A.12 Project status by type of grant reflect the expected duration of projects, that this a higher proportion of the early and late stage project are completed, compared to industrial stage projects which tend to be of longer duration.

Table A-8: Project status by round for the two catalysts

Round	Closed	Live / Final Claim	No information / On Hold	% total	Total number of projects
Agri-Tech					
Early	51%	49%	-	100%	37
Mid	2%	98%	-	100%	54
Late	83%	17%	-	100%	12
All stages	29%	71%	-	**100%**	**103**

[32] Although there were a small number of translation project which can take more than three years to complete.

Round	Closed	Live / Final Claim	No information / On Hold	% total	Total number of projects
IB					
Early	66%	27%	7%	100%	56
Mid	18%	73%	9%	100%	22
Late	50%	0%	50%	100%	4
All stages	52%	38%	10%	**100%**	**82**

Source: ATC monitoring data and IB catalyst master spreadsheet

A.13 The table below provides an overview on the type of leads that were awarded grants across rounds for each of the two catalysts. Although the share of grants being led by SMEs and micro business were somewhat similar between the two grants, there were some differences in the share Academics/RTO and Large businesses. Agri-tech had much larger percentage of projects being led by large business (32% vs. 18%), whereas IB had larger percentage of Academics/RTO leading projects (26% vs. 13%). The split between the different types of leads did not appear to change much over rounds for either of the two Catalysts.

Table A-9: Type of leads across rounds for each of the two Catalysts

Round	Academic / RTO	Large	Medium	Small	Micro	Other	Total %	No. of projects
Agri-tech								
Round 1	8%	33%	13%	33%	13%	0%	100%	24
Round 2	13%	35%	4%	22%	26%	0%	100%	23
Round 3	14%	27%	9%	18%	32%	0%	100%	22
Round 4	13%	27%	0%	33%	20%	7%	100%	15
Round 5	16%	37%	5%	16%	26%	0%	100%	19
All rounds	**13%**	**32%**	**7%**	**24%**	**23%**	**1%**	**100%**	**103**
IB								
Round 1	30%	4%	9%	35%	22%	0%	100%	23
Round 2	21%	21%	8%	33%	17%	0%	100%	24
Round 3	26%	21%	5%	26%	21%	0%	100%	19
Round 4	25%	31%	6%	25%	13%	0%	100%	16
All rounds	**26%**	**18%**	**7%**	**30%**	**18%**	**0%**	**100%**	**82**

Source: ATC monitoring data and IB catalyst master spreadsheet

A.14 Number of collaborators on each funded project ranged from zero to thirteen. In comparison to Agri-Tech, the IB Catalyst was much more skewed towards projects with 2-3 collaborators. Having said this, Agri-tech had a higher percentage or projects with 4-5 collaborators (19%) compared to IB (9%).

Table A-10: Number of collaborators by Catalyst (funded projects)

	Agri-Tech	IB
None (i.e. Lead only)	3%	0%
1 (i.e. Lead plus one partner)	30%	11%
2-3	32%	66%
4-5	19%	9%
More than 5	16%	15%
Total %	**100%**	**100%**
Total number of funded projects	**103**	**82**

Source: ATC monitoring data and IB catalyst master spreadsheet

A.15 Compared to type of leads, a much higher percentage of collaborators were Academics/RTOs, particularly for IB (43%). Moreover, there does not appear to be any significant changes in the type of collaborators over the different rounds, albeit actual sample sizes do differ.

Table A-11: Type of collaborators across rounds

Round	Academic / RTO	Large	Medium	Small	Micro	Other	Total %	No. of projects
Agri-tech								
Round 1	30%	34%	4%	15%	16%	1%	100%	74
Round 2	31%	25%	8%	18%	16%	2%	100%	93
Round 3	28%	31%	3%	20%	15%	3%	100%	61
Round 4	29%	22%	10%	12%	24%	2%	100%	41
Round 5	39%	16%	6%	22%	14%	2%	100%	49
All rounds	**31%**	**26%**	**6%**	**18%**	**17%**	**2%**	**100%**	**318**
IB								
Round 1	40%	16%	13%	19%	11%		100%	62
Round 2	48%	17%	5%	21%	10%		100%	82
Round 3	42%	15%	16%	20%	7%		100%	55
Round 4	39%	34%	5%	13%	9%		100%	56
All rounds	**43%**	**20%**	**9%**	**18%**	**9%**		**100%**	**255**

A.16 The data leads for the IB catalyst also provide a breakdown of funding by source (see below). SQW was unable to receive equivalent data for any of the other two catalysts.

Table A-12: IB funding by source

	Innovate UK contribution	Sum of EPSRC contribution	Sum of BBSRC contribution	Sum of IB Catalyst funding	Sum of Industrial contribution	Sum of Requested from IB Catalyst
Translation	£-	£12,326,767	£29,410,824	£41,737,592	£1,913,245	£42,610,673
ES Feasibility	£4,779,842	£426,083	£2,118,628	£7,324,553	£2,316,356	£7,330,874

	Innovate UK contribution	Sum of EPSRC contribution	Sum of BBSRC contribution	Sum of IB Catalyst funding	Sum of Industrial contribution	Sum of Requested from IB Catalyst
Industrial Research	£14,989,257	£2,223,900	£8,048,757	£25,261,914	£10,770,064	£25,313,229
LS Feasibility	£1,634,079	£-	£-	£1,634,079	£1,047,309	£1,634,079
Grand Total	**£21,403,178**	**£14,976,750**	**£39,578,210**	**£75,958,138**	**£16,046,974**	**£76,888,855**[33]

Source: IB catalyst master spreadsheet

Performance (ATC & IB)

A.17 SQW analysed the latest monitoring scores for all projects, with the exception of the IB Catalyst Translational stage projects. Average scores across the two Catalysts range from 2.0 to 5.0. Whilst both the ATC and IB scored the lowest on costs, IB also scored low on timing. Both ATC and IB appear to do better on risk. The score that differs between the two catalysts is on exploitation, where IB appears to be doing relatively much better.

Table A-13: Agri-tech & IB average monitoring scores (higher scores = better performance)

	Average Cost Score	Average Exploitation Score	Average Project Management Score	Average of Risk Score	Average of Scope Score	Average of Timing Score
Agri-tech	**3.3**	**3.6**	**3.7**	**3.8**	**3.8**	**3.6**
Early Stage						
- Round 1	4.3	3.6	3.9	3.8	3.6	4.0
- Round 2	4.4	3.7	3.8	4.0	3.6	3.7
- Round 3	4.1	4.0	4.2	4.1	4.2	4.1
- Round 4	2.5	4.0	3.5	3.8	4.0	4.0
- Round 5	3.3	3.9	3.3	4.0	4.0	3.4
All rounds	**3.9**	**3.8**	**3.8**	**3.9**	**3.9**	**3.8**
Industrial Research						
- Round 1	3.0	3.6	3.8	3.6	3.6	3.6
- Round 2	2.6	3.3	3.5	3.8	3.8	3.4
- Round 3	3.0	3.4	3.8	3.6	4.0	3.3
- Round 4	3.6	3.5	3.9	4.0	3.9	3.6
- Round 5	2.6	3.3	3.3	3.3	3.7	3.2
All rounds	**2.9**	**3.4**	**3.6**	**3.7**	**3.8**	**3.5**
Late Stage						
- Round 1	3.0	3.5	3.5	3.0	3.5	2.5
- Round 2	4.0	3.0	2.0	4.0	3.0	4.0

[33] Note: in practice, the budget for IBC was £75.6m; comprising £41.5m in rounds 1 & 2 and £34m for rounds 3 and 4. The original budget was not all spent.

	Average Cost Score	Average Exploitation Score	Average Project Management Score	Average of Risk Score	Average of Scope Score	Average of Timing Score
- Round 3	2.5	3.8	3.8	4.0	4.0	4.0
- Round 4	4.0	3.7	4.3	4.0	4.0	4.0
- Round 5	2.0	4.5	4.0	4.0	3.0	2.0
All rounds	**3.0**	**3.8**	**3.8**	**3.8**	**3.7**	**3.4**
IB	**3.6**	**3.9**	**3.9**	**3.9**	**3.8**	**3.6**
Early Stage						
- Round 1	4.0	4.1	3.9	4.0	3.9	4.0
- Round 2	3.7	3.9	4.2	3.9	3.7	3.7
- Round 3	3.5	3.8	3.8	3.8	3.9	3.5
- Round 4	3.7	3.8	4.2	4.0	3.3	3.7
All rounds	3.7	3.9	4.0	3.9	3.8	3.7
Industrial Research						
- Round 1	3.3	4.1	3.8	4.1	3.5	3.5
- Round 2	3.6	3.2	3.6	4.0	4.0	3.2
- Round 2	3.2	3.6	3.4	3.6	4.0	3.6
- Round 4	2.8	4.5	4.0	4.0	4.0	3.5
All rounds	3.2	3.9	3.7	4.0	3.8	3.5
Late Stage						
- Round 1	5.0	4.0	4.0	4.0	4.0	4.0
- Round 3	5.0	5.0	4.0	4.0	4.0	4.0
- Round 4	4.0	3.0	4.0	4.0	3.5	4.0
All rounds	**4.5**	**3.8**	**4.0**	**4.0**	**3.8**	**4.0**

Source: SQW analysis of Innovate UK monitoring scores report

Annex B: Case Studies

B.1 This Annex includes case studies on projects shown in the table below.

Table B-1: Case study summary table

Name	Project	Round	Type of grant
Agri-Tech Catalyst			
Acidophil	Natural product derived parasiticides for the protection of food animals	5	Industrial
Berry Garden Growers	Developing a decision support system to improve crop management, yield forecasting and resource use efficiency in UK soft fruit production	2	Industrial
Farm Energy and Control Services	Real-time information systems for precision pig production	4	Late
SoilEssentials	Assessment of SOIL quality using a BIOindicator	3	Industrial
Energy Catalyst			
Anvil Semiconductors	Vertical cubic GaN LEDs on 150mm 3C-SiC substrates	4	Mid
Fraunhofer UK	Cable Lifetime Enhancement via Monitoring using Advanced Thermal and electrical Infrastructure Sensing	4	Early
ITM Power Trading	Enabling Electrolyser Manufacturing Capability	2	Mid
Oaktec	Multi Gas World Engine for Distributed Generation of Electricity	4	Mid
Synaptec	Wide-Area Instrumentation of Power Networks using Existing Infrastructure	3	Mid
Industrial Biotechnology Catalyst			
Centre for Process Innovation	Alginates by Production Scale Fermentation and Epimerisation	1	Industrial research
Fiberight	Driving down the cost of waste derived sugar	1	Late
Ingenza	Enhanced Productivity and Functionality of Modified Ribosomally Produced Peptides	2	Industrial research
Perlemax	Enhanced Biofuel Production via Integrated Microbubble Technology	3	Industrial research
University of Oxford	New Routes to Driving Enzyme-Catalysed Chemical Synthesis Using H2 Gas	3	Translation

Source: SQW

Acidophil

Introduction

B.2 Acidophil Ltd, the lead organisation for the 'Natural product derived parasiticides for the protection of food animals' project, was unsuccessful in its application for a Round 5 Agri-Tech Catalyst application in 2016 (details are shown in . Later in 2016, additional funding became available and Acidophil were notified by Innovate UK in case they wished to resubmit their application. In the intervening time, Acidophil's programs had advanced and instead of requesting funding for two and a half years, with Innovate UK's permission a revised application covering a shorter 12-month subset of the original proposal was submitted. However, after resubmitting its application, Acidophil was notified that the additional funding had been withdrawn. In 2017, additional funding again became available from Innovate UK, but with a deadline end of the end of March 2018 which would only allow time for an 8-month project. Acidophil resubmitted its application under the same title. The application included a new internal Acidophil project lead and changes to the scope of the project (see below for more details). The project aimed to address food security issues in agriculture by reducing the cost of manufacturing parasiticides for use in the cattle industry. At the time of the evaluation, the project was close to completion.

Table B-2: Project overview

	Original Application (2015)	**Final Re-submitted Application (2017)**
Catalyst	Agri-Tech	Agri-Tech
Round	5	5
Type of grant and amount awarded (by source)	Industrial - £2,598,943 from Innovate UK	Industrial Research - £308,000 (and £200,000 for Isomerase) from Innovate UK
Project start and duration	3 year duration - Unsuccessful application	September 2017 – 7 months (originally 8 months)
Lead and collaborators involved	Lead: Acidophil Ltd – Micro - Cambridge Collaborator: Isomerase Therapeutics Ltd - Micro - Cambridge	Lead: Acidophil Ltd - Micro-Cambridge Collaborator: Isomerase Therapeutics Ltd - Micro - Cambridge

Source: SQW

B.3 This case study was conducted during March 2018 and involved a face-to-face consultation with Acidophil, as well as a SKYPE consultation with Isomerase.

Context

B.4 R&D is considered to be the 'bread and butter' for both Acidophil and Isomerase. Acidophil's business model incorporates collaborative research and has evolved to hire sub-contractors and academics to collaborate on their projects. Its prior engagement with Innovate UK involved receiving a Smart award in 2015 and a successful application for a Manufacturing and Materials grant in 2016. Isomerase has also received three Industrial Biotechnology Catalyst funding grants.

B.5 The consortium partners have collaborated on previous projects. Two further sub-contractors that are not formal partners on the project include Domainex and New Path, both located in Cambridge.

Overview of the project

B.6 The project involved undertaking six work packages which included (but were not restricted to): achieving a target level of microbe production of 400mg per litre; demonstration of how project-specific molecules work; creation of another project-specific molecule; and manipulation of current procedures to address other parasites. Isomerase was responsible for one of the work packages and the subcontractors provided their inputs on certain elements of the work packages.

B.7 The project has been on track/exceeding expectations for four of the work packages. A fifth work package, involving finding a suitable receptor, was not successful as it did not show required functionality and therefore a Project Change Request (PCR) form was submitted suggesting an alternate use of the allocated funding and an additional work package which was accepted.

B.8 Without the Catalyst funding, the project would still have happened. However, it would have taken longer as funding from other sources (such as private investment) would have been required and this would have taken time. In addition, it is likely that only elements of the project would have happened.

Project Outcomes

B.9 The project has progressed the technology as intended. As a result of the funding, Acidophil was in the process of filing for new Intellectual Property (IP) and have progressed through the Technology Readiness Levels (TRL), reaching around TRLs 6/7 (having tangible assets). Acidophil launched an independent animal health company, Chalante Ltd, in November 2017 to conduct innovation to support animal health, well-being and performance[34]. Through Chalante, Acidophil aims to sell its process to the UK and international market. The findings from the project, and the underlying IP, will be used as part of the pitch to Venture Capitalists, as Acidophil seeks external investment to develop Chalante[35].

B.10 Consultees believed that the Catalyst has added value to the project as it has facilitated skills and knowledge development by the addition of Domainex (attributable solely to the Catalyst grant) and the brainstorming sessions conducted with consultants, advisors and Contract Research Organisations who were all leaders in their own fields. Overall, the Catalyst has enabled small companies to progress their work more quickly that would otherwise not have been possible, and to a more advanced state independent from private equity finance. However, in this context, Acidophil's long standing collaboration with Isomerase would have continued regardless of the Innovation grant.

B.11 Project factors that have enabled the outcomes included the funding itself, the feedback from the prior application form and the Knowledge Transfer Network, the support from the Monitoring Officer (explained below) and the collaboration. Alongside the inputs (time and effort) of the consortium, the nature of the collaboration and the relationship between the collaborators was seen to be the driving force of the project, '*if you can't trust your partner you can't deliver*' (consultee). They have sought to de-risk most work packages during the project and there were no wider external/contextual issues, although the uncertainty of changes in regulation due to Brexit was a concern.

[34] Taken from Chalante's website.
[35] Chalante is raising a 'Series A' round to promote innovation (Acidophil will be one of the co-investors in the round).

B.12 Consultees agreed that the Agri-Tech had a profile as an option for R&D in the agricultural sector as it was the only Innovate UK Catalyst specific to the sector. Other Innovate UK programmes (e.g. Materials & Manufacturing grant) may be relevant, but the scope was broader and not specific to agriculture.

Effectiveness of Catalyst processes

Awareness and marketing

B.13 Both consultees were already familiar with Innovate UK through their prior work, colleagues, the KTN, and their own collaborators. They believed that Innovate UK, as an entity, is promoted well, and all relevant information was available online. Suggestions for how they could improve included:

- disseminate more of the project successes
- promote Innovate UK to students in their final year of university (either bachelors, masters or doctoral programmes) through an event/workshop which highlights projects, what students can do and expect, what happens when projects get funded etc. in order to stimulate innovation early in careers
- send emails that are better targeted - Innovate UK's emails are sent out to everyone on their mailing list and emails specifically targeted, say, for sectors relevant to Agri-Tech would have a greater chance of being read.
- For the earlier application, working with what was then the Technology Strategy Board represented a unique opportunity to advance this program beyond what was possible with internally available funds. Isomerase indicated that they preferred working with Innovate UK due to prior positive experiences.
- Consultees believed the **competition window** needs a deadline as it ensures government money is available to support the projects and the Catalyst remains competitive. Both the **eligibility and intervention rate** matched the requirements of the project. Acidophil initially found it difficult to understand and locate Innovate UK's definition of a micro business in the guidance documents. **Suggestion**: have a section in the guidance stating what types of companies will not be funded.

Application processes

B.14 The application was led by Acidophil with respective sections on technical requirements and financials filled in by Isomerase. Acidophil took 4-5 weeks to complete the application for the revised project. Isomerase drew on the previous unsuccessful application, and so completing the forms was quick (although in general they usually find Innovate UK applications to be time-consuming). The feedback received on previous unsuccessful application also helped to inform the bid and plan the current project. The financial aspect was challenging (e.g. forecasting the project six months before the project had started) and some of the information requested was not seen as relevant to the project scope.

B.15 The project lead found the evidence requested (e.g. the use of a Gantt chart) to be a good model to adopt, not only on the project but for their work more generally within the company. The

process of applying for funding and the experience of delivery, for Acidophil's previous project helped inform this current project in terms of setting out the expectations for what is needed and the intended outcomes.

Contracting and monitoring

B.16 Consultees had mixed opinions on how straightforward the contracting process was. Having the experience of undertaking the contracting process for prior Innovate UK grants helped, although if they were new to the process, then further support from Innovate UK would be required. On prior occasions, Innovate UK's helpline had been contacted and assistance was efficient in resolving issues. Innovate UK had not intervened in this process and only requested to see the collaboration agreement. It was noted from Isomerase that if academic partners were involved then there would be IP issues, which would complicate the contracting process.

B.17 The difficulty with the process was the quick deadline for the new contract submission as quotes from subcontractors were requested to be submitted by the next day and the project lead worried that the urgent requests would reflect negatively on Acidophil's reputation. The monitoring process was strongly appreciated and found to be efficient and useful. The fact that invoices needed to be submitted every quarter helped keep the subcontractors in place. The style of monitoring reports, however, differed between Catalysts, and greater consistency would have been appreciated.

B.18 The Monitoring officer for this project was seen to be very effective, efficient and practical; he was considerate of the context of the project and minimised bureaucratic processes. In addition to this, he answered questions promptly, helped with the PCR form, and requested summary monthly updates, which consultees valued as they encouraged learning and reflection. Having an external person (in the form of the monitoring officer) was helpful to provide structure to reviewing progress, and Acidophil's project lead has incorporated this method into their way of working more widely. Additional support was not necessary for the project as the Monitoring Officer, Acidophil colleagues and consortium partners were able to resolve all issues.

B.19 Processes that did not work so well included the following:

- **Submitting the PCR**
  - it was a lengthy process as it took ten days to organise as additional people needed to be included. The level of paperwork required however was not common knowledge and it would have been useful to know in advance to manage expectations and offset any anxiety.
- **Monitoring requirements**
  - Acidophil noted a lack of written guidance on some key issues leading to ambiguity. For example, the guidance from the monitoring officer for the Manufacturing and Materials grant was that all invoices to be submitted and paid, whereas the monitor officer for the Agri-Tech advised just required invoices to be submitted. Consistent written guidance would remove this ambiguity across Innovate UK programmes.

- It was also noted that the offer letter, for this project, did not explicitly specify the conditions for payment of invoices for the last quarter of the project. This led to a misunderstanding between the project lead and the auditors which has delayed the auditor's report. Similarly to the point above, the offer letter should define consistent requirements across Innovate UK programmes.

Project duration

- As explained in the introduction, Acidophil originally applied for a three-year project, but was eventually awarded an 8-month project. The reduction in project duration reduced the scope of the project.
- Due to a one month delay in receiving the grant notification, the project duration was effectively reduced to seven months because Innovate UK had imposed a completion deadline of 31 March 2018. This restricted the success of the project achieving its outcomes. In addition, Innovate UK did not communicate the delay to the project team which added uncertainty both to the project and within the consortium.

Completion and aftercare

B.20 At the time of the consultation, the project was ongoing and so no completion/aftercare had been experienced. Future funding options was a key area where signposting would be appreciated.

Lessons

B.21 Both consultees have good experiences with Innovate UK and valued the funding as it accelerated the delivery of the work packages, enabled collaborations with the sub-contractors and strengthened the working relationship between the partners. The Monitoring Officer and the monitoring processes he suggested were useful and have been implemented in the wider work of Acidophil.

B.22 The key areas for improvement include having readily available information on the processes of PCR; have consistent methods, which are documented, for monitoring requirements across Catalysts; and ensuring the grant notification is received on time or delays are communicated.

Berry Garden Growers

Introduction

B.23 Berry Garden Growers (BGG) is a co-operative of major soft fruit producers across the UK, and is a major supplier of berries to the UK market. The company has led four ATC projects: the focus of this case study is on an industrial project entitled '*Developing a decision support system to improve crop management, yield forecasting and resource use efficiency in UK soft fruit production*' (hereafter referred to as 'BerryDSS' project), which was awarded an industrial stage grant in Round 2 of the ATC programme. At the time of the case study research, the project was on-going. The purpose was to develop and deploy innovative technology and a decision support tool to integrate weather forecasting with water and nutrient supply systems, thereby improving the precision of water/fertilizer/energy inputs under varying environmental conditions. Ultimately, this is expected to improve consistency and quality of fruit supply (and reduce waste), resource efficiency and grower margins – and enable the sustainable intensification of soft fruit production.

Table B-3: Project overview

Catalyst	Agri-Tech Catalyst
Round	Round 2
Type of grant and amount awarded (by source)	Industrial stage £184,132 of Innovate UK/BEIS funding awarded
Project start and duration	Start date: 01/01/16 Duration: 3 years
Lead and collaborators involved	Berry Garden Growers – large business, Kent (lead) NIAB EMR – RTO, Kent Delta-T Devices Limited – Small business, Cambridge Weatherquest Limited – Micro business, Norwich Netafim UK Limited – Small business, Skelmersdale, Lancashire

Source: SQW

B.24 The applicant initially submitted an unsuccessful application for this project in Round 1, and was subsequently successful in Round 2. The research for this case study was conducted during late March and April, and involved a face-to-face consultation with BGG and a telephone consultation with NIAB EMR.

Context

B.25 BGG has been involved in R&D activities for over 20 years, commissioning research or undertaking this in-house on behalf of the co-operative's members. Likewise, NIAB EMR also has a longstanding history of R&D activity in the sector. The 'BerryDSS' project directly followed on from a pre-commercial R&D project funded by Defra (known as Hort-LINK), which completed in 2012 and was focused on improving water use efficiency and crop yields in strawberries. This identified research questions to be considered by the ATC project, which could progress the idea towards commercialisation by integrating weather forecasts with changes in water demand to enable more efficient resource use[36]. The project has also built upon learning other earlier projects, including two AHDB-funded projects completed in 2013, and an Innovate UK

[36] Increasingly important given the new water abstraction licensing authorisation regime introduced by Defra in January 2018.

Collaborative R&D (CR&D) grant completed in 2017[37]. The output of the CR&D project was a GP2 controller (a closed loop irrigation and fertigation control system), and growers are already starting to invest in this technology. Algorithms/systems developed by the ATC project in relation to weather forecasting and water demand/supply will feed into the GP2 controller at the end of the project to improve the accuracy of yield forecasts.

B.26 Most of the partners involved in the ATC project had worked together before. BGG and NIAB worked together on the Hort-LINK project, and both BGG and NIAB worked with Delta-T and Netafim (then Eden Irrigation Consultancy) on the CR&D project and a number of other R&D projects. Weatherquest was relatively new to the group, but had worked with BGG previously.

Project delivery and outcomes

What the project has involved

B.27 The project sought to address problems around the lack of integrated appliances to manage the use of inputs to the growing process, including water, fertiliser and energy. The project involved five main workstreams: the first four have been completed to date, and have produced algorithms to predict water demand in strawberries, new fertiliser demand formulae, and develop models relating to environmental metrics. The fifth workstream, on-going at the time of writing, was to integrate the first four workstreams, test and refine the algorithms, and deploy the technology at six BGG commercial grower sites. The results were to be gathered and analysed in the months following the case study research.

B.28 Without the ATC, BGG thought some of the activities could have been funded through the co-operative's EU Operational Programme plan – this might have been undertaken in collaboration, but it would have taken 3-4 years longer to get results. NIAB may have progressed small aspects of the project without ATC, but each aspect would probably have been undertaken in isolation and not in collaboration. The evidence suggests, therefore, that the ATC programme has brought about R&D at a larger scale, more quickly and more collaboratively than would otherwise have been the case. The collaborative aspect of the programme was seen as critical to delivering results – it has required a collective mindset to address the challenge in question, and the benefits of each partners' contribution has been greater than the sum of the parts.

What has worked well or not

B.29 Following the ATC award, Netafim withdrew from the project - the original partner (Eden Irrigation Consultancy) was bought out by Netafim UK after the application was submitted, and Netafim's holding company did not believe they were eligible for Innovate UK funding. This took some time to resolve with Innovate UK – the change request process was described as 'incredibly burdensome', which delayed the project start by 12 months. Netafim is still involved in the project, but on a 'non-funded' basis.

B.30 Despite the difficult start, the project has progressed well so far and has largely caught up on time lost at the outset. Consultees noted a number of factors have enabled success to date:

[37] This explored the influence of strawberry genetics and weather on water demand, and identified critical points where physiological processes were interrupted and the yields were affected

- A **clearly defined rationale** at the outset was enabled by BGG's close working with its membership in particular to identify and prioritise challenges faced by the sector.
- They created the '**right' consortium** to address the challenge (with appropriate skills and track record), and all partners had clear roles and responsibilities, which was combined with some flexibility as the project evolved. Linked to this, working with **known partners** has helped as they know each other's capabilities, and have used them to best effect from the outset. **Strong leadership and partnership working** has been critical, with honest and open communication across the consortium.
- There has been **regular communication** across the consortium. In addition to quarterly monitoring meetings, the group has met monthly (via SKYPE) to discuss progress, risks and exploitation plans. This ensured that any issues were addressed promptly, rather than waiting for the quarterly meeting. Each member of the consortium has been allocated responsibilities for different parts of quarterly reporting, to ensure engagement and commitment to the monitoring process.
- A specific **sub-group** within the consortium was tasked at the outset to develop a clear exploitation plan. This sub-group has ensured that exploitation has remained at the forefront throughout the project.

Outcomes

B.31 Even though the project was still underway at the time of the case study research, the partners consulted for this case study have already observed a number of outcomes. Both consultees felt the **relationships** between all consortium members have been strengthened as a result of participation in the project. They have also benefited from a significant amount of **knowledge development**, and the project has contributed to a significant and growing body of work around decision support systems in the soft fruit sector. Key to this has been the **inter-relationship and synergies between projects** that BGG and NIAB are involved in (both other ATC projects, and projects funded through other programmes). In practical terms, it has enabled lessons to be shared between projects (e.g. what works/research questions arising from R&D) and will provide future routes to market (e.g. via planned demonstration of the new technology at the 'Water Efficient Technologies' (WET) Centre, integration of the algorithms developed into the GP2 tool). For BGG, the ability to secure funding for multiple, complementary R&D projects in this area has made a significant impact on their ability to build a critical mass of evidence and develop holistic and 'game changing' technologies – this was seen as critical using the research to have influence across the sector. BGG was starting to see changes in attitudes and behaviour across the grower community – for example, growers were starting to invest in the GP2 controller developed through the earlier CR&D project, and this tool will incorporate outputs from the ATC project by enabling integration with weather forecasting. As a result of creating an inter-related package of projects, the route to market of the ATC project was expected to be accelerated.

B.32 Partners have also **gained skills** from the ATC project. For example, NIAB's experience of managing/delivering the ATC project has enabled them to deliver other R&D projects more effectively, e.g. routinely using risk registers for other projects, as a result of the ATC experience. The consultee's approach to delivering R&D projects is 'more professional'.

B.33 Learning and emerging findings from the ATC project were also enabling BGG and NIAB to **attract further R&D funding.** For example, the 'BerryDSS ' project has subsequently informed a successful Round 5 ATC bid for industrial funding to test and apply the systems and sensors developed in a different soft fruit context (raspberries – Innovate UK 102640). NIAB was also incorporating the findings into new bids for R&D funding (with the same collaborators) to combine the technologies developed with other software to develop new products.

Effectiveness of Catalyst processes

Awareness and marketing

B.34 BGG was signposted to the ATC programme by Innovate UK after the successful completion of the Hort-LINK project. BGG was on Innovate UK mailing lists, which the consultee felt communicated the competition opportunities effectively. However, more advance warning of the timing of competitions (and more account of the seasonality of the sector) would have been helpful to enable BGG to plan its R&D programme.

B.35 The ATC model was attractive for the sector, particularly in terms of its agri-tech focus and (theoretical) ability to progress through the three types of award (even though in practice, there was insufficient time for industrial projects like this - which was funded in Round 2 - to complete and progress to late stage). It was noted that since the closure of the ATC programme, organisations like BGG and NIAB were struggling to secure funding in other, broader competitions (such as health and life sciences) because they cannot compete with medical/pharma companies. As a result, it has become increasingly difficult for agri-tech businesses to secure follow-on funding to progress their ideas.

B.36 BGG develops a prioritised list of challenges/R&D needs from its members and in discussion with his Grower Research Advisory Panel, and regularly considers a wide range of funding opportunities in order to address these. In the case of the ATC, no other funding streams were seriously considered – in part because it seemed a natural follow-on from the Hort-LINK project. In addition to being dedicated to the agri-tech sector, consultees argued that the ATC filled a gap in the support landscape - other funding available at the time focused on basic research rather than translation, or was too small scale to test in commercial settings.

Application processes

B.37 As noted above, most of the partners had previously been involved Hort-LINK project – and BGG and NIAB had also known Weatherquest for some time - so creating the consortium was straightforward.

B.38 NIAB led the proposal writing, with inputs from BGG and other partners. Initially the bid was unsuccessful in Round 1, so partners reapplied successfully in Round 2. The first application scored relatively highly, so the application did not need to be changed significantly. There were mixed views on how useful the assessor feedback was – one consultee found it useful, and enabled them to improve the quality of the application. The non-thematic nature of competition windows was also helpful – it meant there was an opportunity to resubmit in a future round. However, there was also some concern that assessors were misreading aspects of the application, and there was no opportunity for a conversation with the assessor or Innovate UK to clarify. The consultee

suggested that a pitch/interview stage could be useful to answer queries and articulate a project's fit with other research.

B.39 Both consultees were familiar with the Innovate UK application process. Therefore, whilst the two-stage application process for an industrial stage award was more resource intensive, they were clear on how to transfer material across from the EOI to full application. Having a clearly defined project and intended outcomes was helpful in this respect. The dual application process with BBSRC was less efficient – NIAB had to retrospectively fit the Innovate UK application form into the Je-S system which was laborious, but this process has been streamlined since.

B.40 A considerable amount of time was needed to produce a good application - BGG estimated that the application process absorbed 2-3 weeks of time across the partnership, and NIAB estimated around five days for its own input – but this was considered proportionate to the size of the grant available and the experience of application writing at the time (NIAB has since become more efficient). The consortium found the application guidance helpful, and did not receive any external support to write the application.

B.41 Consultees expressed some concern with the ATC assessment process, particularly in relation to the lack of an 'oversight committee' that could take into account past experience (e.g. applicants who had successfully delivered similar R&D projects in the past), projects of strategic and/or national importance, and to identify potential synergies between projects to maximise potential impact (there was a concern that applications were reviewed in isolation by assessors). There was also some frustration that each competition round was overly focused on distinct, separate projects each time, with limited scope for specific follow-on funding for research questions or opportunities arising from previous ATC projects. There was a risk that the programme funded a multitude of disparate and small projects.

Contracting and monitoring

B.42 The contracting process was relatively straightforward (once the issue noted above in relation to Netafim had been resolved). However, consultees noted that the 'baseline approval process' (in between grant award and grant confirmation letter, e.g. due diligence, risk assessments, forecasting) was slow and burdensome – and applicants incurred considerable costs which had not been accounted for in the project budget. Having a single contact at Innovate UK to manage the process would have been helpful.

B.43 The monitoring process generally worked well. However, reflecting on their experience across projects, both consultees commented on the variability in the approaches adopted by Innovate UK's monitoring officers (MOs). Some operated like auditors, whereas others dedicated considerable time, were more flexible, provided guidance, and contributed to debate very well. The latter 'made the project successful' because they struck the right balance between formal monitoring and wider support/guidance/questioning. The lack of consistency was particularly frustrating for organisations involved in multiple ATC projects.

B.44 BGG and NIAB have not received any wider support to deliver the project, and did not feel this was required. However, one consultee noted that for researchers involved in projects for the first time, training on Innovate UK's finance and project management approach/requirements would have been helpful.

Completion and aftercare

B.45 Feedback on the completion and aftercare process was not available as the project was on-going. However, consultees noted the importance of projects having exploitation plans in place, and the need for a mechanism to ensure they are implemented after project completion. They also highlighted the importance of including partners in the consortium with a clear route to market – for example, BGG has direct access to a large number of growers through its co-operative. The project partners have provided updates to the wider grower community on the project (what it is doing and why) at BGG's annual conference and other grower workshops across the UK.

Lessons

B.46 Key lessons arising from this project were as follows:

- Developing an exploitation plan at the outset, with a clear pathway to market, nominating partners within the consortium with responsibility to progress this, and including partners with direct access to the market.
- The added value and synergies arising from interrelated projects / organisations involved in multiple projects
- Potentially the need for greater portfolio management to join the dots between projects and need for sufficient time for projects to progress through the ladder of support.
- The value in working with 'known' partners in delivering projects effectively, alongside strong leadership, clearly defined roles and responsibilities, and regular, honest and open communication.

Farm Energy and Control Services

Introduction

B.47 Farm Energy and Control Services Limited (Farmex) is a micro-enterprise specialising in the development of electronic monitoring and control systems for farm facilities. The company has led two Agri-Tech Catalyst (ATC) projects: the focus of this case study is on the project entitled '*real-time information systems for precision pig production*' (RISPPP), which was awarded a late-stage grant in Round 4 of the ATC programme. The project was delivered in 2016 by a consortium led by Farmex and involving technology and farm building companies, a vet, nutritionist and prime producers. It involved a full, large-scale commercial pilot of an **electronic system/toolkit designed to remotely monitor on-farm utilities/inputs (such as temperature, feed, water, energy use) in real time,** and integrate and analyse the data. The results were then combined with support from a vet and nutritionist to help interpret the data, and ensure that pig producers can make informed decisions in response. The aim was for the tool to become part of farmers' day-to-day production management processes, enabling greater precision farming. The ultimate objective was to optimise animal welfare, improve productivity (enabling pig farmers to convert inputs into protein more efficiently) and minimise environmental impacts.

Table B-4: Project overview

Catalyst	Agri-Tech Catalyst
Round	Round 4
Type of grant and amount awarded (by source)	Late stage £119,788 of Innovate UK/BEIS funding awarded
Project start and duration	Start date: 01/01/16 Duration: 1 year
Lead and collaborators involved	Farmex Limited – micro business – South East (sub-contracted Primary Diets as part of the team) ARM Buildings Limited – medium sized business – West Midlands (sub-contracted Dicam Technology Limited) DA & EM Skinner – micro business – Scotland DC & RJ Allen & Partners – small business – South East Stockcroft Limited – small business – South East Yorkwold Pigpro Limited – medium sized business – Yorkshire Garth Pig Practice Limited – small business – South East JM Sankey – micro business – North West

Source: SQW

B.48 The research for this case study was conducted during March and April 2018, and involved an in-depth consultation with the project lead at Farmex and follow-up consultations with partners at Yorkwold Pigpro Limited (a prime producer) and ARM Buildings Limited.

Context

B.49 Farmex has a long history of R&D activity and growing interest in the opportunities associated with the 'Internet of Things' for the farming sector. Farmex, ARM and four of the prime producers had previously received a Collaborative R&D (CR&D) grant from the (then) Technology Strategy

Board as part of the Sustainable Protein Production scheme[38]. This project developed the software and sensor tools in late 2014, which were then tested as a full commercial pilot in the ATC project during 2016. The vet and nutritionist were not involved in the CR&D project, but were 'known' to Farmex and other partners. Beyond the CR&D project, partners had engaged in R&D activity to varying degrees: some, such as ARM, were more active in this space, making incremental improvements to their building design using new and innovative technologies; others had undertaken aspects of process innovation prior to the CR&D/ATC projects (but often would not label it formally as R&D).

B.50 Farmex's second ATC project was a Round 4 industrial award, which at the time of the case study research was just over half way through its 30-month lifespan. Whilst the project was using the software and sensor tools (developed above) to create an integrated diagnostics system for bacterial detection in poultry farms, there were limited synergies between the two ATC projects in practice.

Project delivery and outcomes

Project delivery and learning

B.51 The RISPPP project sought to demonstrate the toolkit on a larger scale, and identify any adjustments that might be needed to ensure the model (i.e. the electronic system and interpretation support, packaged under a subscription model) provided sufficient value to pig producers for it to be commercialised more widely. During the project, the prime producers involved paid a heavily discounted subscription to the toolkit.

B.52 The project achieved its formal milestones during its 12-month duration, and is now commercially available (all of the prime producers involved have continued with their subscriptions, albeit at below market rates). However, fine-tuning the ICT system in the full commercial environment was slightly more complicated and took longer than originally anticipated. In particular, it took longer to process and analyse the large volume of data generated, turn this data into useful 'knowledge' and then apply it in the farm context. One collaborator consulted thought they were about half way to achieving the goal by the end of the project, and about 75% of the way now. The findings of the project have been disseminated regularly in trade press by the lead.

B.53 For the lead partner, given their long history in R&D activity, the consultee believed that the ATC funding had accelerated the R&D – the main factor in speeding up the process was the collaborative approach, providing greater volumes of data and wider expertise compared to what would have happened otherwise. ARM agreed that the R&D activities would have taken longer (around a year) and would not have involved all of the collaborators. The prime producer consulted thought that, without ATC, it may have taken forward some of the activities on a smaller scale (e.g. 1 or 2 of the 30 sites, rather than 5) but this would have taken much longer (3-5 years, rather than 12 months) and probably would not have been done in collaboration with others.

B.54 There were a number of lessons on what had worked well, as follows:

[38] The CR&D project was informed by an earlier Regional Improvement and Efficiency Partnership (REIP) funded project led by Farmex, which explored the better use of monitoring systems across prime producers in Yorkshire.

- Having a clear purpose (particularly in relation to exploitation), which was shared by all partners involved. This helped to maintain commitment throughout the project and reduce the risk of mission creep.
- **Prior experience of collaboration between partners involved**. The collaboration worked together very effectively for this project, in part because they already knew each other. The lead was confident that the 'right' partners were involved from the outset, which meant the project could deliver effectively and quickly. It has also helped that the prime producers had previous insight to the technology from the CR&D project, so appreciated its potential value and bought into the plan before the application was submitted.
- **Developing a well-structured project**. The process of the ATC has been helpful by giving the project structure for (a) the collaboration/partnership working and (b) maintaining momentum in the project delivery itself.
- **The project has benefited from strong leadership**, with passion and drive for the project. Administrative and planning aspects of the project have been thorough, and the lead has utilised partners' strengths to best effect. The two collaborators consulted both felt that their roles and responsibilities were clear from the outset.
- Linked to the point above, **the feedback loop has been short and regular** between Farmex, ARM and the prime producers. All partners were proactive, regular and open in discussing what was working well or not, rather than communications being entirely driven by the project lead, which was deemed critical for a relatively short late stage project.
- From the prime producer's perspective, **the project has effectively integrated into the 'day job'**, rather than being seen as another task to add to the workload.

B.55 A major barrier to the delivery of this project – and specifically the ability to monitor inputs remotely via the electronic system – was the **coverage and quality of broadband provision** in remote rural areas. Whilst the team worked round the issue with satellite links in some places, the issue absorbed a lot more time and resources than expected, and is a major risk to the commercial roll-out of the technology in the future.

Outcomes

B.56 Due to the technical challenges (noted above) and slow rate of market uptake, the lead consulted for this case study believed the toolkit was unlikely to generate the level of sales projected in the ATC application in the short-term. The projections were based on using digital marketing to reach the target audience, but there are still some barriers in the extent to which the sector engages with digital platforms. Also, because the use of real-time precision farming tools in pig production is so new, the need to raise awareness of the opportunities this presents (for example, in reducing costs, risk management and animal health) is ongoing.

B.57 That said, there were a number of emerging benefits for those involved:

- All of the prime producers involved have **continued to subscribe to the toolkit** (albeit at a reduced subscription rate, as noted above), and there is evidence to show

that at least one of the prime producers has **encouraged non-participating farmers to invest in the technology**.

- The prime producer consulted for this case study has experienced **direct benefits to the business** by monitoring and correcting deficiencies in the input systems/built environment, which has led to 'tens of thousands of pounds' **savings.** Indeed, the prime producer consulted wished that they had been 'bolder' in the original proposition and invested on a larger scale at the outset.
- **Knowledge creation and sharing** amongst partners has been significant. For example, the prime producer commented on how the firm's staff have been engaged in analysing the data generated through the toolkit, which has developed their data analysis and interpretation skills. Developing these skills has been critical, allowing for a faster feedback loop between the monitoring and response on the farm. Also, being able to view data across the consortium has helped the prime producer benchmark its activities and identify areas for improvement – having a large consortium including prime producers has helped in this respect.
- The **strength of relationships** between partners has increased as a result of the project. Many have continued to work together to progress the technology further since the ATC project closed, using their own funds, in recognition that they can add more value to their own work by working together on common interests. Moreover, consultees argued they are more likely to collaborate in future having seen the value in doing so through ATC.
- For ARM Buildings, the data generated through the project has given them **greater confidence in the capabilities** of the technology, and this differentiates them from competitors.
- One of the collaborators consulted was now **more aware of funding opportunities** available to fund riskier R&D activity – and more likely to bid for these in future.

B.58 For this project, the ATC funding appears to have brought about the outcomes above **more quickly** than would otherwise have been the case. According to consultees, ATC processes have been a key factor in enabling this, providing (a) structure, discipline and momentum, and (b) mechanisms to enable collaboration. Progress has also been enabled by a number of external factors, including the ongoing drive for more efficient food production, animal health concerns and reduction in the use of antibiotics nationally, and the increasing use of smart phones to host the technology.

Effectiveness of Catalyst processes

Awareness and marketing

B.59 Farmex was approached directly by Innovate UK and encouraged to apply for ATC funding, following the successful completion of the earlier CR&D project. Alternative sources of funding were not considered at the time – the availability of Innovate UK funding prompted the company to take the idea further.

B.60 Consultees felt that if a business has registered with Innovate UK, communications and marketing of competitions is relatively good. However, there were some concerns that the mailing list was dominated by academics/some industry suppliers but few prime producers, and that the notifications could be better targeted (for example, to businesses in the sector, and/or to potential project leaders with strong track records in delivering successful R&D projects), with a clear timetable issued in advance.

B.61 The Catalyst model was seen as appropriate to meet business needs. The broad themes were helpful, allowing applicants 'scope for imagination in devising a challenge' and opportunities for quite niche technologies such as RISPPP. However, 12 months was felt to be a very short timeframe for a late stage project wanting to test a product at a full commercial scale, especially given the pig production cycle.

Application processes

B.62 Creating the collaboration for this project was relatively straightforward, given that most had worked together previously on the CR&D project. The involvement of prime producers as 'end users' was critical for the project, enabling wider testing in a variety of commercial environments. This is a key lesson for late stage projects. Moreover, they had a shared interest in applying new technologies to their day-to-day work, and so the prime producers were all keen to engage in the ATC project.

B.63 Farmex led the application writing process, and all partners reviewed a draft. The time involved was 'quite an investment' from Farmex in particular, but the lead had previous experience of applying for Innovate UK grants which gave them confidence. The collaborators consulted said they did not have the capacity or capability to take on the administration associated with application (nor delivery) of the project. It is important for the lead to shoulder the majority of this if programmes such as this are to attract small prime producers. Innovate UK was supportive throughout the application process. However, a single point of contact would have been more efficient for both the applicant and Innovate UK - for example, by allocating applicants to an account manager.

B.64 One consultee suggested the potential value in a 'light touch' EOI stage to reassure applicants that proposals are appropriate, and to avoid any timewasting. Businesses are very busy, and applications absorb a considerable amount of time, so it is difficult to prioritise if they don't know the chance of success. Whilst the application for the RISPPP project was single-stage, Farmex have been involved in two-stage applications, and have found the feedback received after the EOI stage very useful to adjust their proposition.

Contracting and monitoring

B.65 The contracting process was straightforward. It involved a thorough process, which consultees acknowledged was important given the use of taxpayer money. The only recommendation put forward was to explain the contracting process more explicitly in the application guidance, so applicants knew the time inputs required in advance.

B.66 The lead consultee emphasised the importance of a good working relationship with the monitoring officer. He noted that good MOs played more of the critical friend-type role and ensured the project focused on exploitation throughout, and MOs often invested more time to

provide this support than was formally part of the MO contract. The monitoring arrangements were very efficient for this project, aided by a template for all partners to input on a quarterly basis.

Completion and aftercare

B.67 The project completion process was relatively straightforward. There was some frustration that the costs associated with this were not factored into the project budget, but required a substantial amount of paperwork before the project could be closed. Direct interaction with Innovate UK at the close out meeting was valuable. It provided an opportunity to raise issues about the process and for Innovate UK to feed back on the project's performance. However, signposting and aftercare since has been very limited. In future, project-specific aftercare would be useful - for example, this might include peer-to-peer networking/advice from someone who has successfully exploited similar products/into similar markets. Innovate UK could also help to identify opportunities for synergies with other projects and (whilst recognising commercial sensitivities) do more showcasing of projects – as one collaborator commented, '[we] all feel too alone'. Even though this was a late stage project, there was some degree of uncertainty around next steps for the toolkit.

Lessons

B.68 Key lessons from this case study were as follows:

- The value of ATC processes to provide structure, discipline, momentum, and mechanisms to enable collaboration, enabling technology progression/ commercialisation benefits to be realised more quickly than would otherwise have been the case.
- The advantages of pre-existing collaborations, enabling projects to get up to speed and deliver quickly, and reducing the risk about partner capability/involvement from the outset.
- The involvement of prime producers as 'end users' was critical for the project, enabling wider testing in a variety of commercial environments (this is particularly important in a sector where contexts plays a critical role in the success or otherwise of a technology, but vary considerably across the country).
- The need for more signposting and aftercare, to ensure the project has a clear route to market (even if it is a late stage project) and to maximise synergies between projects.

SoilEssentials

B.69 SoilEssentials has led three Agri-Tech Catalyst (ATC) projects and been involved as a partner in one other. This case study focusses on the 'Assessment of SOIL quality using a BIOindicator' ('SoilBio') project, which at the time of writing was still on-going. Launched in December 2015, the aim of SoilBio was to develop a novel test of soil quality combining biological measurements of soil with the standard chemical and physical measures. The project received funding for UK-wide data collection and analysis, and dissemination activities. At the time of the case study research, the intention was to complete by the end of November 2018.

Table B-5: Project overview

Catalyst	Agri-Tech
Round	3
Type of grant and amount awarded (by source)	Industrial £718,975 sought
Project start and duration	December 2015, three-year ongoing project
Lead and collaborators involved	SoilEssentials – SME, Scotland Scottish Agronomy – Research, Scotland James Hutton Institute - Research, Scotland James Hutton Ltd – Research, Scotland Scottish Rural College – Research, Scotland Barfoots of Botley – Large, South East

Source: SQW

B.70 SoilEssentials and James Hutton Institute had previously applied to the ATC for funding for SoilBio before receiving round 3 funding.

B.71 The research for this case study was conducted during March 2018 and involved a face-to-face consultation with SoilEssentials and telephone consultations with James Hutton Institute and Scottish Agronomy.

Context

B.72 SoilEssentials is a precision agriculture specialist that provides year-round, integrated solutions to improve agricultural efficiency. It offers a suite of products and services, ranging from geo-referencing tools to soil sampling, and is the authorised Trimble dealer for Scotland, North of England and Northern Ireland. Research has been an area of importance for the company since 2000: it is currently developing new technologies across six R&D projects in collaboration with UK universities, research institutes and commercial companies.

B.73 At the time of the case study research, SoilEssentials was active in a range of publicly-supported R&D and innovation projects, at various stages covering early, industrial and late stages. This included other ATC funding, other Innovate UK competitions (e.g. the Crop and Livestock Disease Challenge competition) and other agency, e.g. UK Space Agency funding to support the development of KORE™, a web-based precision farming tool box that uses satellite and crop models, drones, sensors and software to deliver solutions to problems such as food waste, traceability and diffuse pollution.

B.74 SoilEssentials had worked with two members of the SoilBio consortium, James Hutton Institute and James Hutton Limited, on previous and current research projects, including an ATC project researching methods of improving yield stability in UK blueberries.

Overview of the project

B.75 The SoilBio consortium included a variety of research expertise, commercialisation and commercial experience. The expertise and project role of each partner is detailed in Table B-6.

Table B-6: SoilBio consortium

Partner	Area of expertise	Project role
SoilEssentials	Precision agriculture specialists with experience in product development through funded research projects.	Project management, sample collection for biological testing and development of software to display SoilBio results.
James Hutton Institute	Research institute for land, crops, water and the environment.	Pioneered the science behind the project, designed the data-collection strategy and led on the physics soil sampling.
James Hutton Ltd	Commercialisation of IP and expertise from its work with James Hutton Institute.	Original project management and guidance on commercialisation of SoilBio.
Scottish Rural College (SRUC)	Research expertise in crop and soil centres.	Soil chemistry analysis
Scottish Agronomy	Membership organisation specialising in arable research, advice and information dissemination.	Dissemination of information arising from SoilBio.
Barfoots of Botley	Commercial growers of exotic crops (e.g. asparagus, butternut squash and courgette)	Provide fields of exotic crops for data collection sampling and to offer a commercial insight.

Source: SQW

B.76 The three project partners interviewed for this case study reported that SoilBio was, at the time of the research, proceeding closely to the original workplan, with a few deviations. It was reported that the collaboration was working well: the partners have discrete roles that effectively utilise their expertise.

B.77 There have been examples of cross-learning within the consortium: SoilEssentials has developed a better understanding of soil ecology and SRUC has gained insights into how its databases are used and how they could be more user-friendly. Monthly meetings were used for general internal updates, and these complemented the quarterly monitoring meetings. This regular communication was cited as a key driver of the project's success to date.

B.78 The data collection team encountered unanticipated difficulty recruiting their target number of farms in England. This was because the consortium did not have established network connections in England and were therefore dependent on National Farmers' Union (NFU) forums and cold-calling. This resulted in a slight reduction in their overall sample. In hindsight, they would have included an English or UK-wide farming membership organisation in the consortium.

B.79 Scottish Agronomy has led on the dissemination of information arising from SoilBio. In 2017, it presented findings from SoilBio to: practitioners in Soil Health R&D at the GREATSoils Project conference in Cambridge; agronomists at a conference in Sweden; and a European precision

agriculture event. In March 2018, Scottish Agronomy presented the initial findings of year 1 SoilBio analysis to the participating farmers. It intended to do the same for the farms involved in years 2 and 3.

B.80 It was reported that without ATC funding for SoilBio, the consortium would not have been able to proceed with their research into biological measurements of soil quality. The complex soil sampling process for SoilBio, although funded, is considerably less profitable to SoilEssentials than commercial soil sampling. The ATC grant helped the consortium to cover the sampling costs and to offset the risk of being too resource-constrained to deliver commercial work.

Project outcomes

B.81 At the time the research was conducted, the analysis of soil samples from the year 1 data collection period had been completed. The emerging results have been promising for SoilBio: they indicated an association between the biological, chemical and physical parameters. This was the first stage in their proof of concept and has given partners confidence in the market potential of SoilBio. The results also provided supporting evidence for other soil quality research relating to crop rotation and the optimal periods for sampling. The samples collected will form the largest soil based collection the UK for 20 years. This will provide a unique national resource of archived soil DNA, which will be made available to UK academia for future soil research.

B.82 The intended project outcome was to move the product closer to market and ready for a late stage award, ideally under ATC. In the long-term, SoilBio has the potential to reduce UK on-farm inputs and narrow the difference between the potential and average yield a grower can achieve. Moreover, SoilBio has highlighted a potential new marketing approach for SoilEssentials: the final product will provide a continuity across their suite of products and services that can be marketed as a combined, bespoke support package for farmers and businesses at each stage of the crop cycle.

B.83 These outcomes have been, and will be, amplified by the current policy landscape. In recent years, the UK Government and Scottish Government have placed increased importance on preserving soil quality: in October 2017, the UK Government launched the Sustainable Soils Alliance (SSA) to 'reverse soil health decline and work together to restore [UK] soils to health within one generation.'[39] This has given SoilBio a higher profile within the agricultural community and amongst policy makers. The research is well-placed to provide the framework required to effectively measure soil health, and the UK's progress towards protecting it.

B.84 Discussions indicated that the key risk to achieving these future benefits is whether SoilBio can be commercialised at an appropriate price for business uptake. The consortium had not secured follow-on finance at the time of the consultation. They were considering both additional grant support from other Innovate UK funding streams and commercial opportunities, such as franchising the service to agronomy companies.

B.85 SoilEssentials has experienced unintended benefits as a result of SoilBio: the project delivery has led to improvements in the KORE™ platform that would not have happened otherwise; and members of their team have developed new transferrable skills, particularly in database competencies. Moreover, the company has experienced a significant change in their client group away from smaller, Scottish farmers towards larger agricultural businesses both national and

[39] www.sustainablesoils.org

international. The consultees estimated that at least three of these new business customers were a result of their interaction with the ATC.

Effectiveness of Catalyst processes

Awareness and marketing

B.86 The ATC Programme was well-known by the consultees prior to securing funding for SoilBio: they had all worked on previous ATC funded projects and demonstrated a comprehensive understanding of Innovate UK's offer. They first became aware of the programme via the Innovate UK mailing list, the KTN and other organisations in their network. All consultees felt that the ATC was well established within their industry and that its marketing was clear and informative.

B.87 The consortium did not apply for alternative sources of funding for SoilBio. The SoilBio concept was still unproven and they felt it was unlikely to secure private sector support. ATC was preferred over other funding sources because it provided sufficient support for research partnerships between industry and academia; and because of its timeliness, given the rising political interest in soil health issues. Consultees did not feel that the ATC offer was unique but thought that it was well-aligned with the scope of the project and the ambitions of the consortium.

Application processes

B.88 The idea for SoilBio was formed when SoilEssentials and the James Hutton Institute met at an Innovate UK Roadshow in Edinburgh. They shared an interest in developing a novel measure of soil quality and understood the potential value of soil biology research to the UK Agricultural industry. SoilEssentials applied for ATC funding for SoilBio in an earlier application round but was unsuccessful. The feedback indicated that they needed a larger, more experienced consortium to deliver the project.

B.89 SoilEssentials and James Hutton Institute reapplied for the ATC in Round 3 with a larger consortium with a better balance of research and commercialisation experience. They also included members with strong networks within the farming community. The application was written collaboratively by the consortium: the questions were allocated to the partner with relevant expertise and synthesised by the project lead for submission. This was reported to have worked well.

B.90 The ATC application process was felt to be very similar to the consultees' experience of other grant applications. However, one consultee suggested some improvements to the online application portal: the interface seemed overcomplicated and counterintuitive.

Contracting and monitoring

B.91 The project management role was transferred from James Hutton Limited to SoilEssentials after the first year of the project following resource constraints, which led to delays in project delivery and communication issues. The Project Change Request form was simple to complete and the process went smoothly. All three consultees felt that this change had been beneficial to the project.

B.92 The consultees spoke highly of their Monitoring Officer: they were dedicated to the project's success, had relevant expertise and provided useful market insights. In previous ATC projects,

consultees had experienced considerable variation in the quality of Monitoring Officers and so the SoilBio Monitoring Officer was particularly valued. The consortium's impression of the reporting requirements changed throughout the duration of the project: initially, the processes provided a valuable structure but as the project progressed the reporting was felt to be more onerous. The consortium now has external administrative support for reporting. Moreover, the project partners thought that the finance reporting template could be made more flexible.

Lessons

B.93 The key lessons for future Catalyst projects were the importance of good project management, a clear project idea and effective partnership working between the consortium. This case study also highlighted the importance of detailed planning for large-scale data collection. Moreover, the consortium's commitment to data dissemination has given them a significant profile within the industry and has strengthened relationships with farmers across the UK that could be used in later research projects. All three consultees felt that the ATC was invaluable to delivering the SoilBio concept.

B.94 The main potential improvement highlighted for future Catalyst models is to maintain the current funding available for academic partners. The success of SoilBio and the consortium's other projects is contingent on research-industry collaboration. They would be disappointed to see further reductions in the intervention rate in future funding programmes.

Anvil Semiconductors

Introduction

B.95 Anvil Semiconductors Ltd (Anvil) has led two Energy Catalyst projects. This case study focuses on the Round Four mid-stage project 'Vertical cubic GaN LEDs on 150mm 3C-SiC substrates'[40]. The aim of the project was to develop a process to produce LEDs that are more efficient.

B.96 High efficiency LEDs are viewed as a replacement technology for incandescent light bulbs and compact fluorescent lamps. This project aimed to exploit the business opportunity to produce high efficiency LEDs. The project involved combining Anvil's existing IP in growth of cubic silicon carbide on silicon wafers, the University of Cambridge's (UoC) expertise in GaN growth on large area Si substrates and Plessey Semiconductors Ltd's (Plessey) capabilities of large volume production of LEDs. The technology developed in the project is expected to reduce the cost of LEDs by approximately 50% and increase efficiency by 10%. Resulting benefits from the project were intended to include reducing emissions – LED lights are up to 80% more efficient than traditional lighting such as incandescent light bulbs. According to the Earth Policy Institute, replacing incandescent bulbs with LEDs could reduce the energy consumed by more than 65%. As such, the technology developed will also result in improved security of supply, by reducing the demand for electricity. Moreover, the introduction of LEDs within households and commercial premises will reduce costs. According to GOV.UK website, some 17% of a households' electricity was used for lighting in 2013. Finally, there are expected benefits for developing countries in the long run – reducing the cost and efficiency of LEDs will advance the adoption in developing countries where low energy lighting, particularly solar powered, can bring benefits to education and health care. At the time of the case study research, this project was expected to be completed by June 2018.

Table B-7: Project overview

Catalyst	Energy
Round	4
Type of grant and amount awarded (by source)	Mid Stage Funding sought - £972,602
Project start and duration	01/02/2017 – 16 months
Lead and collaborators involved	Anvil Semiconductors Ltd – Micro, West Midlands University of Cambridge – Academic, East of England Plessey Semiconductors Ltd - Medium, South West

Source: SQW

B.97 The project was fully funded by DFID, as the benefits of the technology were expected to accrue to both developed and developing countries, as discussed above.

B.98 This project was a direct continuation of a Round Two early stage feasibility project called 'To demonstrate the potential to make low cost, high efficiency LEDs using 3C-SiC substrates'. The initial project demonstrated cubic GaN growth on large diameter wafers and fabricated basic LEDs, confirming early feasibility of the technology. The project involved the same consortium of partners and was completed in December 2016.

[40] GaN = Galian Nitrade, SiC = Silicon Carbide

B.99 The case study was conducted during March 2018 and involved a face-to-face consultation with Anvil and a telephone consultation with the UoC.

Context

B.100 Anvil was formed in 2010, and at the time of the research was still in its early stages of development, having five FTEs and still being at pre-revenue stage. Anvil's core business model centres on generating income through licensing, with emphasis on R&D activities, rather than full-scale production. Anvil's expertise lies in SiC for power devices. Its R&D activities in developing processes for more efficient LEDs is viewed to be outside core business. The company has offices in Coventry and Cambridge and is backed by Business Angels and early stage VCs.

B.101 Prior to receiving Energy Catalyst funding from Innovate UK, Anvil was a recipient of several other R&D grants including a Smart Proof of Concept grant in 2011/12 (£51k), Innovation Voucher in 2013/14 (£5k), Buildings Better Connected feasibility study grant in 2013/14 (£6k), and Tech Inspired Innovation grant in 2014/15 (£25k). It has also recently secured grants from Innovate UK's 'Accelerating the commercial application of compound semiconductors' programme (£250k).

B.102 Although Anvil has a large network of industrial and academic partners, it was the Energy Catalyst project specifically which brought the collaboration together (discussed further below). Since the first Catalyst project, the relationship has remained strong and partners have collaborated on a number of other R&D projects, including the second mid-stage Catalyst project.

Overview of project delivery

B.103 Anvil secured a grant of around £10k prior to receiving the first early stage Catalyst grant for initial feasibility testing of their technology. It collaborated with the Cambridge Centre for Gallium Nitride at UoC, which had state of the art equipment, including multiple growth reactors, compatible with commercial LED production systems, as well as a wide range of characterisation equipment allowing all aspects of the material to be studied.

B.104 The collaboration with Plessey was established later on, through a contact at the UoC who had previously worked for Plessey. Plessey is a privately owned, UK company, and a market leader in bringing LEDs into the lower cost, mainstream world of semiconductors, with its GaN-on-Silicon technology. Plessey was brought into the collaboration to support commercialisation as an end user of the technology. Plessey had a relatively small role on the initial feasibility project, but for the mid-stage grant the funding was split equally between the three partners.

B.105 The mid-stage project encountered one major challenge which caused some changes in the original work plan, notably to the timings. The problem related to equipment failures and the delay in bringing new equipment on line. The collaboration had to look elsewhere for the equipment mid-way through the project, causing delays. The project team approached the Compound Semiconductor Centre (CSC) in Cardiff, which held similar equipment. Although the CSC did not become a formal partner on the project, it was subcontracted to continue the process. The project team had to apply for a three-month extension, which was permitted by Innovate UK. The actual delay caused by the equipment failure is thought to be around at least six months. The delays have meant that, at the time of this case study research, the project is still at risk of not

completing on time and not achieving all of its key milestones. The major issue will be the short timeframe that Plessey will now have to complete the final part of the project.

B.106 Anvil believed that the technology would not have been developed had it not been for the Energy Catalyst funding. As mentioned above, core business for Anvil is primarily power devices, rather than LEDs, which require knowledge and IP that it does not have and therefore considered too high risk. For a small company, that is still at pre-revenue, taking high risk and making a case to spend on developing a product outside the core business can be difficult.

B.107 Consultees at UoC had similar views, and doubted whether they would have been able to develop the technology without the Energy Catalyst grant. Although the consultees acknowledged UoC might have been able to access other sources of funds, the Energy Catalyst was considered to be unique, as it encouraged collaborations to be made between academia and industry. This is not normally the case with alternative sources of funding, such as other grants available from the Research Councils.

Project delivery and outcomes

B.108 At the time of writing the mid-stage project was yet to be completed and so many outcomes were still to occur. Nevertheless, and despite the issues discussed above, consultees reported a number of achieved outcomes, one being the creation of a spin-out company, Kubos Semiconductors Ltd.

B.109 Kubos is a spin out from UoC and Anvil, created to further develop and commercialise the c-GaN for high efficiency, low cost LEDs. It will use IP licensed from both Anvil and UoC, and is thought to be around two-to-three years away from being able to License the technology to major LED manufacturers. Kubos is currently looking for private investment. It already has strong supply chains in place, which include Norstel AB, Plessey, UoC and CSC.

B.110 Both Anvil and UoC have also leveraged further public investment as result of the Energy Catalyst project. UoC secured an EPSRC grant of around £480k for a project directly related to the technology developed through the Energy Catalyst project. Moreover, the consultees at UoC said the continuation of funding is crucial for retaining staff, and although the funding may not have increased employment, it definitely allowed the university to retain high skilled jobs.

B.111 The consultees also reported a number of research outputs that have resulted from the Energy Catalyst project. UoC has published six articles on the technology, and has presented at several international conferences, including Rushlight 2018. Anvil have also been invited by Innovate UK to pitch their technology to a group of investors, which took place in April 2018.

B.112 The collaboration between academia and industry has resulted in knowledge transfer and skills development. The consultees noted the working culture can be very different between the two, and so the project provided an opportunity to learn from one another and bring the technology closer to commercialisation. Consultees at UoC noted academics at times can focus too much on the R&D activity, and less so commercialisation. The industrial partners on the project ensured the collaboration had sight of commercialisation process too.

B.113 One unintended outcome from the project has been Anvil's collaboration with the CSC. This occurred because of issues with the building at UoC, and having to look for alternative options. The collaboration with the CSC was seen to be a success, and a partnership that Anvil hoped to continue and strengthen.

Effectiveness of Catalyst processes

Awareness and marketing

B.114 Both Anvil and the UoC had received several Innovate UK/TSB grants in the past, and as a result were already on the direct mailing list, where it first received information about the Energy Catalyst programme. The consultees felt the programme was well advertised, as it was seen to be oversubscribed.

B.115 The consultees did not feel the promotion of the programme needed any significant improvement. The Innovate UK funding website was easy to locate and navigate. For those organisations unaware of the EC programme, consultees viewed this as a failure of the organisations concerned rather than a failure in promoting the EC programme. The consultees thought that any company looking to develop a product and requiring funding to do so would know of the Energy Catalyst programme.

Application processes

B.116 Anvil and UoC completed the bulk of the main application. The lead contact at UoC was responsible for completing the technical sections, specifically around the cubic GaN technology. Although Plessey did provide some comments on the application, it did not provide any substantial inputs.

B.117 As the mid-stage project was a direct continuation of the early stage feasibility study, writing the mid-stage application did not take too much time, as most of the content already existed from the previous application. The application for the mid-stage project was submitted one month before the completion of the early stage project. The early success of the first project meant it was logical for the collaboration to apply for follow on mid-stage funding.

B.118 In comparison to other funding application forms such as Horizon 2020, the Innovate UK application was viewed to be much clearer and more succinct. The experience of having completed several Innovate UK application forms before made this specific Energy Catalyst application much easier to complete. Consultees mentioned that the form itself had improved over the years, as questions were now clearer and guidance documents more useful. Moreover, although Anvil did not seek any support for this specific application, it was aware of support KTN had provided to other applicants. Consultees did not believe any additional support was required in completing the application forms.

B.119 Anvil did communicate with the technical lead at Innovate UK to confirm whether LEDs were applicable for DFID funding or not. Members of the project team had previously worked with the technical lead, and so did not have much problems in seeking advice on the general scope of the call.

Contracting and monitoring

B.120 The contracting and monitoring process was similar to other Innovate UK grants that Anvil had received in the past, and so the process was as expected. As the project had only three partners, all of which had already previously worked together, the collaboration agreement and other contracting documents were completed relatively smoothly.

B.121 Based on experiences from other Innovate UK projects, consultees noted that the monitoring process could vary greatly, depending on who the MO is. Where some MOs provide flexibility, others may not and are strict in terms of how exactly they want quarterly reports to be completed. The paperwork involved in the monitoring process can at times feel too much, especially for a small company that may have limited resources. Moreover, there were some questions that seemed particularly irrelevant, and at times meant answers were provided just to fill in the boxes on the forms. One example was quantifying the potential impact of an early stage project, which was viewed as near-to-impossible to do. There is a need to reduce the amount of paperwork involved in early stage projects, to allow partners to focus on the actual technical parts of the project.

Completion and aftercare

B.122 At the time of writing the mid-stage project had not yet completed. However, consultees were able to provide feedback on the completion and aftercare process at the end of the first early stage project.

B.123 The close out report was viewed to be quite straightforward. The quarterly reports meant the project team had a good record of all the activities that had taken place. However, consultees did mention issues related to the format of the document. The close out report was in PDF format, and when printed, the document lost its formatting. Moreover, only one person could access the document at once. Although this is not such an issue where there are only three partners on a project, it can be an issue when the consortium is larger.

B.124 In terms of aftercare, the Catalyst programme was recognised and appreciated for its clear pathway for progress. The three stage grants showed Innovate UK was backing potential 'winners', where successful projects had a clear route to apply for subsequent funding. As mentioned above, the partners applied for the mid stage grant one month before completing the early stage project. The consultees acknowledged that once a late stage project had successfully completed, the onus would be on the organisations themselves to find subsequent funding. The project has created a spin-out, Kubos, which was intended to be the vehicle to commercialise the technology. The partners were not sure at this stage whether they would be applying for a late stage grant.

Lessons

B.125 Overall, the consultees were satisfied with Energy Catalyst programme, and appreciated its relevance and pathway provided to support translating research into commercial realities. The main areas of improvement were around the paperwork. Although the type of information required seems sensible, the logistics of completing the forms can be frustrating.

Fraunhofer UK

B.126 The Fraunhofer Centre for Applied Photonics ('Fraunhofer UK') was the lead partner on six early stage Energy Catalyst projects. This case study focusses on a project called 'Cable Lifetime Enhancement via Monitoring using Advanced Thermal and electrical Infrastructure Sensing' ('CLEMATIS'). Launched in April 2017, CLEMATIS aimed to test the feasibility of using multiple types of sensing system on power cables in the field. This involved combining Fraunhofer UK's expertise in the existing technologies of distributed temperature sensing (DTS) and distributed acoustic sensing (DAS) with project partner Synaptec's proprietary technology which can monitor current and voltage. Eventually, it is hoped that the sensing technology will allow underwater cables to be monitored – an increasingly important aim given the rise in offshore energy generation.

Table B-8: Project details

Catalyst	Energy
Round	4
Type of grant and amount	Early £133,728 sought
Project start and duration	April 2017, ongoing one year project
Lead and collaborators involved	Fraunhofer UK – RTO, Scotland European Marine Energy Centre (EMEC) - SME, Scotland Systems Engineering and Assessment Ltd (SEA) – Large, Scotland Synaptec – Micro, Scotland

Source: SQW

B.127 CLEMATIS was a direct follow on from a successful desk based feasibility study known as ORCHIDS (Offshore Renewable energy Cable Health using Integrated Distributed Sensor Systems). This was a Round 2 Energy Catalyst project which ran over late 2015 and early 2016.

B.128 The research for this case study was conducted during February and March 2018 and involved separate face-to-face consultations with Fraunhofer UK and Synaptec, as well as a telephone consultation with EMEC.

Context

B.129 Fraunhofer UK was established in 2012. As a Research and Technology Organisation (RTO), Fraunhofer UK had been involved with R&D projects before receiving support from the Energy Catalyst. However, prior to ORCHIDS, Fraunhofer UK had not worked with EMEC (a research and test centre for marine energy) or Synaptec, whilst CLEMATIS was the first time they had worked with SEA.

B.130 As part of a study for the Offshore Renewable Energy Catapult, Fraunhofer UK identified three potential uses of photonics in the offshore sector. The first of these, using lidar with wind turbines, led to a Round 1 Energy Catalyst project. The second potential use of photonics that Fraunhofer UK identified, namely cable monitoring, was the subject of ORCHIDS. After the successful completion of the desk based ORCHIDS project, CLEMATIS aimed to trial the novel combination of three sensors in the field.

Overview of the project

B.131 CLEMATIS involved six work packages in addition to overarching project management. The technical work to develop a combined acoustic and temperature sensor was undertaken by Fraunhofer UK, whilst both Fraunhofer UK and Synaptec were involved in combining the three different sensor technologies and testing these in the lab. The other partners, EMEC and SEA, conducted industrial engagement and used the results to help inform the development of a business case. In January 2018, the combined distributed temperature, acoustic and electronic sensors were tested onshore at EMEC.

B.132 At the time of the evaluation, partners had submitted a change request to Innovate UK for a project extension. Unrelated to CLEMATIS, a developer wanted to use EMEC's facilities to test a new offshore power generation system. This was a good opportunity for the CLEMATIS partners to test their cable monitoring system on a live undersea power cable being used by the developer. The original scope of CLEMATIS only included onshore testing so conducting undersea testing as part of the project would allow the technology to develop further than initially expected.

B.133 Partners reported that CLEMATIS could not have gone ahead without public funding because the technology was at unexpected too early stage to attract private investment, and the partners could not afford to fund the project themselves. Whilst the project may have been able to attract non-Catalyst public funding, potentially from European sources, none of these alternative sources of finance offered the benefits of Catalyst (as discussed below), and the finance may only have been available at a later date. Energy Catalyst therefore provided timing and quality additionality.

B.134 Despite the geographic distances between partners, they reported that the project had been well managed. Monthly conference calls were held via skype to keep all partners updated, whilst Fraunhofer UK also used internal Gantt charts and the structure provided by the quarterly monitoring officer (MO) meetings to manage project delivery. Partners also thought that having a relatively short project helped to keep them focussed as they had to deliver to relatively tight timescales. Making sure all partners were clear on the project objectives and their respective roles at the application stage was noted as an important factor in ensuring that no time was wasted in clarifying these once the project begun. Finally, the prior relationships between three of the partners – built during ORCHIDS – also helped the cohesion of the project team on CLEMATIS.

B.135 No major unexpected barriers to delivery were noted and the technical challenge of building an innovative system in the lab and moving it to trials in the field in a short time was overcome.

Project outcomes

B.136 CLEMATIS has supported the development of the cable monitoring technology to Technology Readiness Level (TRL) 5. Should the undersea trial go ahead, the technology would advance to TRL 6 as it would have been demonstrated in an operational environment. Partners also developed new knowledge as part of the project, e.g. EMEC gained a better understanding of the technology development process that their clients go through, and Synaptec has generated new IP and applied for a patent. Dissemination activity planned at the time of writing included a presentation at the SPIE Commercial and Scientific Sensing and Imaging conference in Florida in April 2018. Partners reported that the above outcomes would not have been achieved to the same quality or as quickly without the Energy Catalyst.

B.137 CLEMATIS strengthened existing relationships which may lead to further projects in the future (despite an unsuccessful joint application for an Energy Catalyst Round 5 project). The added value of undertaking CLEMATIS as a collaboration was that it allowed a more ambitious project. Fraunhofer UK could have combined the temperature and acoustic sensors itself, but would have been unable to add electrical sensing capability without Synaptec. Without EMEC, Fraunhofer UK and Synaptec would not have been able to test their sensors in the field, nor would the business case have been as well informed without EMEC and SEA's input.

B.138 Unexcepted benefits have been realised to date, with spillover benefits also expected in the future as a result of CLEMATIS. As a relatively new organisation, an unexpected benefit for Fraunhofer of being involved in the Energy Catalyst was raising their profile in the UK innovation landscape, for example by appearing in the Energy Catalyst project directory and going to the showcase event (see below). In addition to the positive environmental spillover benefits that are expected if and when the CLEMATIS technology is commercialised, spillover benefits are also expected for offshore energy generation and transmission firms as they are the end-users of the CLEMATIS technology. Companies testing their novel energy generation systems using EMEC's facilities in the future will also benefit from the enhanced cable monitoring capability that EMEC will be able to offer. This monitoring capability will assist EMEC's internal cable maintenance too.

B.139 Partners reported that the Energy Catalyst developed a profile as an option for R&D in the sector because of good publicity of funding calls, networking events and webinars, and because of the attractiveness of the programme itself, e.g. having different grant stages.

B.140 Although not confirmed at the time of writing, the possibility of doing undersea trials at EMEC as discussed above would be an important enabling factor. The growth of the offshore energy industry, partly caused by increased government emphasis on offshore as opposed to onshore wind power, will be important in increasing demand for a commercial version of the technology developed in CLEMATIS.

B.141 The CLEMATIS technology needs further field testing to prove robustness and longevity, for example, before it can be commercially adopted. Two major risks to this are technical barriers being encountered during this process, and partners not being able to obtain sufficient finance to further develop the technology.

Effectiveness of Catalyst processes

Awareness and marketing

B.142 Partners could not remember how they first became aware of the Energy Catalyst, suggesting that it may have been via an Innovate UK email or at a KTN event.

B.143 Support from the Energy Catalyst was preferred to other sources of finance because of the benefits of the Catalyst model. These benefits included the good fit between the focus of the Catalyst on the energy trilemma and the project objectives, and specific eligibility and intervention rate advantages over other schemes. For example, early stage projects could be led by RTOs and allowed RTOs to claim up to 50% of the funding which was attractive to Fraunhofer UK. The Catalyst was also preferred for the ORCHIDS project because of Fraunhofer UK's positive initial experience with the Energy Catalyst on the Round 1 WAYFARE wind lidar project.

Application processes

B.144 The initial connection between Fraunhofer UK and EMEC that resulted in ORCHIDS was made by EMEC's business development manager. The University of Strathclyde was a founding collaborator in Fraunhofer UK, and Strathclyde spin-out Synaptec also became part of ORCHIDS. For CLEMATIS, SEA was added as another collaborator because of its market knowledge.

B.145 As lead partner, Fraunhofer UK was responsible for developing the application form, with assistance from EMEC and Synaptec on the technical questions. Partners compared the short application form favourably to those of other funding programmes, especially Horizon 2020.

B.146 Three minor issues were raised. First, more space to expand on the technical details would have been appreciated. Second, the ability to add sub-headings, bold and italics into the application would be helpful in allowing partners to emphasise key points. Finally, the move from MS Word to online application made it harder to keep internal records of what had been submitted and meant that Fraunhofer UK had to create a word document so that all partners could input into the draft application.

Contracting and monitoring

B.147 The contracting process was thought to be broadly fine, although three issues were raised about communication from Innovate UK. First, it was noted that the financial approvals could take longer than expected, thus delaying project start dates. Second, some emails from Innovate UK went to the project lead only, whereas some emails went to the lead and all partners. The reason for the different approaches was not clear, nor was whether the project lead was always expected to forward emails onto the project partners. Finally, internal Innovate UK processes could potentially be improved on communicating unique partner circumstances from previous projects. For example, if an applicant had been granted a non-standard overhead rate on a previous project, this was not automatically carried forward to a subsequent project, thus requiring the applicant to justify again the reasons for a non-standard overhead rate.

B.148 The monitoring process was thought to work well, with the monitoring officer (MO) and quarterly meetings helpful in keeping the project on track. However, it was suggested that requiring face to face meetings each quarter – as opposed to only for the first and last meetings - was unnecessary given the increasingly widespread use of skype, etc. as well as the Energy Catalyst's own aim of reducing carbon emissions. Another suggested improvement was to produce a short guidance document which would clarify the rules on in-kind support for claims purposes as these were not always clear to partners.

Completion and aftercare

B.149 As discussed above, the partners were hopeful that CLEMATIS would be extended beyond the original end date so the project had not been formally closed at the time of the evaluation. However, two issues were raised from experience on past projects and in preparation for the closing of CLEMATIS. The overlap between some questions on the Project Completion Report and Project Close out Report was noted. Minimising or eliminating this duplication would reduce the administrative burden on applicants. Second, there was confusion about the changing close out process itself. This had been verbally communicated to Fraunhofer UK but no written confirmation had been received at the time of the evaluation. Fraunhofer UK was therefore nervous about submitting close out documents online only (as per the verbal instructions)

because the Conditional Offer Letter specified that close out documents had to be submitted in MS Word versions. Fraunhofer has therefore submitted online and MS Word versions, even though this takes longer.

B.150 The Rushlight Energy Catalyst showcase was thought to be a useful way to build the profile of the technology that was being developed, and also the project partners themselves. The Showcase was also a good opportunity to find potential partners that have already demonstrated through their involvement in Energy Catalyst that they are open to collaborative R&D projects.

Lessons

B.151 Partners did not identify any major areas for improvement in future Catalyst (-type) programmes. The relatively minor issues raised mainly related to improving communication between Innovate UK and projects, whether this was at the contracting or completion stage.

B.152 CLEMATIS illustrated the importance of strong project management, and in taking unexpected opportunities to benefit the project as they arise.

ITM Power Trading

B.153 ITM Power Trading Ltd (ITM) was the project lead for the 'Enabling Electrolyser Manufacturing Capability' project. The project aimed to address the technical challenges associated with production scale up and low-cost manufacturing of membrane electrode assemblies (MEAs) for electrolysers, in order to meet future demand. At the time of the evaluation, the project was completed.

Table B-9: project overview

Catalyst	Energy
Round	Round 2
Type of grant and amount awarded (by source)	Mid-stage for £529,280
Project start and duration	January 2016 for 24 months
Lead and collaborators involved	ITM Power Trading Ltd – Medium – Sheffield Escubed Ltd – Micro – Wetherby Gwent Electronic Materials Limited – Small - Pontypool

Source: SQW

B.154 ITM has received multiple grants across different Catalysts with Innovate UK and its current and collective experiences are portrayed in this case study.

B.155 The case study was conducted during March 2018 and involved a face-to-face consultation with ITM. Escubed was unable to take part in the evaluation and Gwent Electronic Materials was not contacted due to its limited participation in the project. During the consultation with ITM, two project members attended, the first was responsible for writing the application and the second was the project lead.

Context

B.156 ITM has routinely undertaken R&D activity since their establishment in 2001. R&D activity is core to their business with c.70% of this activity conducted internally and the remaining 30% with collaborators, including other businesses and universities. It has received grants for approximately 20 R&D projects in the past 10 years from Innovate UK and other sources such as the Department for Business, Energy and Industrial Strategy's Energy Entrepreneur Fund.

B.157 The project was the first time ITM had collaborated with Escubed and Gwent Electronic Materials. However, Gwent Electronic Materials left the project shortly after the notification of the successful grant, because it no longer saw commercial sense in the project – and so in practice it was not a collaborator on the project.

Overview of the project

B.158 ITM's aim was to develop a screen printing technique 40 times faster in production speed than current electrolyser methods, and to manufacture two inks that could be applied successfully to membranes. Escubed was a previous supplier of ITM which now, as a collaborator, tested the inks for quality control. Upon the departure of Gwent Electronic Materials from the project, all ink manufacturing was done by ITM.

B.159 The milestones of the project were completed on time and without Innovate UK funding the consultees expected that the project would have proceeded a few years later either through internal funds or other public funding. The funding therefore brought forward both the project and its outcomes.

B.160 ITM could not identify any Innovate UK processes that worked particularly well (or not) for the project. It did not receive any additional support from Innovate UK, or other organisations, as the internal team was able to resolve any issues that arose. Because of this, no further support was necessary. ITM did receive support from the Monitoring Officer regarding the monitoring requirements throughout the project but the support did not include any networking, which would have been useful.

Project Outcomes

B.161 The project was successful in its aims to develop a screen printing technique 40 times faster in production speed however, during the project, it was only able to manufacture one of the two inks (in paste form) that could be applied onto membranes (the second ink was only successful after the Innovate UK grant). In addition to this, new quality control techniques have been developed. As a result of the project, the technology has progressed towards the market with Technology Readiness Levels (TRL) increasing from 3 to 6. If the technology does reach the market, then there will be productivity benefits (aided by the improvements in production speed), and environmental benefits through: a) ensuring less ink is wasted; and b) reducing CO2 emissions by using electricity generated by hydrogen.

B.162 The ability to have a working prototype has attracted a potential collaborator (a well-established manufacturer of machines) and this has resulted in immediate commitment to take the project further. The emerging learning and/or findings however, will not be disseminated from the project due to its commercially sensitive nature.

B.163 Without the Catalyst funding, most of the benefits would be achieved over a longer time-period. However, the relationship building with Escubed as a collaborator (and not as a supplier) would not have happened until a later stage. The strength of the relationship between ITM and Escubed has increased throughout the project, and ITM acknowledged Escubed's contributions in terms of 'know-how' that ITM did not have. A key message for successful collaborations, identified by ITM, was for consortium members to be clear on each other's roles in the project, during the application, project delivery and after project completion.

B.164 The strength of the collaboration and the structured monitoring process helped keep the project focused on achieving its outcomes. Externally, the slow shift in market demand for hydrogen-based fuel has an increased likelihood of helping the project and ITM in the future. At the time of the case study research, the risks to taking the technology forward were low as ITM had trialled small scale screen printing (through Manufacturing Technology Centre's machinery) which was successful and their recent attempt at large-scale printing was also a success.

Effectiveness of Catalyst processes

Awareness and marketing

B.165 The role of ITM's staff member who wrote the application is to look for grants the company can apply for and therefore had been aware of Innovate UK from the beginning of their role and regularly checks the portal for updates. No other sources of funding were considered although if they had European partners then European funding could have been sought.

B.166 ITM believed that the promotion of the Catalyst was 'done well', as exemplified by the highly competitive calls. However, it was understood that the monitoring aspect and overall assessment of the application could be off-putting to a company that was applying for the first time, and therefore better communication or explanation of the application processes was needed.

B.167 In general, ITM applies for public funding if a project involves collaborators (in order to pay for their contributions) and if there are high risks associated with the technical nature of a project. The showcase event, when first launched, was attended and helped set the scene of the broad opportunities available. A recommendation for Innovate UK is to continue to provide shorter project durations (e.g. 12-18 months compared to longer-term projects of 3-4 years) as it helps keep the consortiums' focus on the project.

B.168 Regarding the Energy Catalyst's profile in the R&D sector, ITM commented that Innovate UK as an organisation was recognised as an option for R&D in the sector more so than the Energy Catalyst – in general, people usually talk about Innovate UK schemes and not the Energy Catalyst scheme per se.

Application processes

B.169 As mentioned earlier, Escubed was a supplier for ITM and its role as a collaborator in the project was a natural progression. Gwent Electronic Materials was identified through a search for a particular type of ink manufacturer, which was a straightforward task.

B.170 As lead partner, ITM was responsible for developing the application with input from partners based on their technical specialisms and financial requirements. Initially, there were numerous phone calls to define the project and work packages. The application took 10 working days for ITM and they estimated one working day each for their collaborators. The application process was a two-stage process though ITM preferred having a single-stage process to minimise time – the additional two months for the second stage was seen as frustrating as they would prefer to spend their time on expediting research compared to filling in application forms.

B.171 Experiences through previous projects has taught ITM a few lessons:

- deliverables should be differentiated to easily monitor progress
- deliverables which aggregate to more than one page should be 'cut-down' to reduce the administration of a project
- projects need to be more streamlined and focused to ensure deliverables have achievable outputs.

B.172 Feedback in general from previous applications helped identify what the assessors were looking for. In particular, ITM has found that what is obvious for the project lead may not be obvious for the assessor, and so key aspects need to be explained clearly.

B.173 The new online portal used for submitting applications was strongly disliked for several reasons: it was not conducive to collaborative bids; it was very time consuming to navigate; it only enabled one question to be seen compared to the whole application; and it did not allow partners to see each other's financial details. ITM viewed it as 'really strange and frustrating' to use.

Contracting and monitoring

B.174 The contracting process was proportional and clear. The template for the contract has been the same for every Innovate UK grant they have undertaken and due to their prior experience, the process becomes quicker each time. The template was no longer available online, and a recommendation was that it should be made available again as it is useful for companies (in general and their collaborators) that do not have any Innovate UK contracting experience.

B.175 A general comment made by ITM was that they have seen the time taken for contracts to be sent out and amendments to be made (from Innovate UK's side) take longer than previously.

B.176 Traveling for face-to-face quarterly meetings (which in this instance meant from Sheffield to Southampton), as enforced by the Monitoring Officer, seemed excessive to ITM. It was suggested that web-calls be an option, which is the case for European funding where project leads travel every 6 months and have monthly web calls. ITM argued that if the Monitoring Officer was comfortable with how the project was progressing then web-calls would be more useful. Flexibility was needed with the grading of the monitoring requirements (and the use of the red flags), as the current 1% deviation seemed too strict, particularly if the context around the 1% deviation itself was not a large issue. For ITM, due to the nature of their project, there were uncertainties and difficulties in forecasting costs for prototypes and therefore the 1% deviation was too restrictive.

Completion and aftercare

B.177 Usually the project completion process for Innovate UK has been fine and involved a close out report and a technical report. However for this project, there was a new procedure which involved submitting an online survey (of 40 pages) called 'Qualtrics' instead of a close out report, which was time consuming and the questions were not clear.

B.178 Innovate UK's Innovation Lead came to the last meeting and it was useful to show them the progress that ITM had made, especially to show the use of taxpayers' money and for the Energy Catalyst to gain a clearer understanding of the work undertaken by ITM. No suggestions for improvement were provided. No aftercare/signposting were provided, which was not needed as the next steps were to be conducted in house.

B.179 The project directories provided by the Energy Catalyst on projects were not useful for ITM as potential investors of ITM will look on the stock market.

Lessons

B.180 Innovate UK processes in general work well and ITM highlighted more regular funding calls would be useful. The opportunity, provided by Innovate UK, to include academics into projects was positively received by ITM. However, based on their collective experience of collaborating with academics on prior projects, ITM has realised that academics can be expensive to include, are not commercially savvy and are not timely with regards to the delivery of their work which can slow the pace of the project. Because of this, their use of academics will only occur should the academic's contribution be crucial to the project.

B.181 A few improvements include allowing visibility of the online application form (all sections and partners' contributions), increasing the % deviation (in the monitoring reports) to be more flexible to the context of the project and enabling quarterly meetings via telephone/internet to be an option instead of compulsory face-to-face meetings.

OakTec

B.182 OakTec has led two Energy Catalyst projects. This case study focuses on the ongoing Multi Gas World Engine for Distributed Generation of Electricity ('WEDGE') project, with an estimated end date in mid-2019. WEDGE received DFID funding to build a prototype of a multi-cylinder engine which could be used as a cleaner, more efficient source of power in developing countries than the existing small diesel generators – especially for static power generation.

Table B-10: Project details

Catalyst	Energy
Round	4
Type of grant and amount	Mid stage £789,420 sought
Project start and duration	March 2017, ongoing 30 month project
Lead and collaborators involved	OakTec – Micro - North West EP Barrus - Large – South East

Source: SQW

B.183 WEDGE was a direct successor to a 12 month Round 1 early stage project which ended in early 2016 called Biogas Engine for Distributed Generation of Electricity ('EDGE'). OakTec was the sole participant in this project. EDGE allowed OakTec to investigate the performance of its single cylinder Pulse-R™ engine using impure bio-gas produced by anaerobic digestion from agricultural waste as a fuel source.

B.184 The research for this case study was conducted during March 2018 and involved a face-to-face consultation with OakTec, and a telephone consultation with EP Barrus ('Barrus').

Context

B.185 OakTec is a micro-enterprise dedicated to the commercialisation of its novel Pulse-R engine, and prior to its first Energy Catalyst project, OakTec had undertaken various R&D activities. For example, in 2014 OakTec received funding from the Niche Vehicle Network (NVN)[41] to design and build a test and development version of the Pulse-R engine as part of a project called PREMO. The engine demonstrated power and fuel efficiency with low emissions in laboratory testing. The Energy Catalyst EDGE project was then used to develop a full prototype of the engine, which was subsequently placed into a vehicle as part of a second NVN funded project. The WEDGE project aimed to build on this and develop a multi-cylinder engine.

B.186 During the PREMO project, OakTec discovered that engine distributor Barrus was interested in gas engines. The two companies started a dialogue and decided that by the time of the WEDGE application, the technology was suitably developed for Barrus to become a partner in the project. Barrus had not been involved in any publicly funded R&D projects before WEDGE.

Overview of the project

B.187 The two project partners reported that WEDGE was proceeding according to plan at the time of the case study research. The collaboration between the two project partners was working well:

[41] The Niche Vehicle Network is supported by the Office for Low Emission Vehicles, Innovate UK, the Advanced Propulsion Centre and the Department for Business, Energy and Industrial Strategy and is managed by Cenex

OakTec led on the technical development of the multi-cylinder engine; and Barrus provided market knowledge. The technical aspect of the project involved investigating whether adjacent cylinders in a multi-cylinder engine could act as superchargers for each other. This would further improve the performance of the Pulse-R engine.

B.188 The technical aspect of WEDGE was enhanced by OakTec's involvement in a nine month Industrial Strategy Challenge Fund (ISCF) project led by manufacturer Productiv. The ISCF project was ongoing at the time of the case study research and aimed to develop a single cylinder pre-production prototype engine. By tailoring the ISCF project to fit with the WEDGE timetable, OakTec was hopeful of being able to combine the single cylinder engines into a multi-cylinder development engine to test in WEDGE before finalising a new multicylinder design. This would be more efficient than building a multi-cylinder test and development engine from scratch as originally envisaged. The two projects were therefore seen as 'more than the sum of their parts.'

B.189 Both partners in WEDGE have already undertaken dissemination activity at industry events and trade fairs such as the Low Carbon Vehicle Show, Future Powertrain Conference, and the Engine Expo in Germany.

B.190 It was reported that without Energy Catalyst funding for EDGE, OakTec would not have been able to proceed with the development of the Pulse-R engine because of the monetary and time costs involved. Similarly, OakTec could not have afforded to undertake the WEDGE project without financial support. OakTec did examine the possibility of attracting venture capital (VC) funding for WEDGE but the technology was still too early stage and thus too risky for VCs to invest in. The financial support also allowed Barrus to become a project partner – without this support Barrus would not have engaged in technology development with OakTec as Barrus is primarily an engine distributor, not a developer.

B.191 The strong personal relationships and mutual confidence between partners was important for WEDGE. The discrete definition between the core skillsets of OakTec and Barrus also meant that each partner was clear on their responsibilities. The project has not faced any major barriers to delivery and has been well managed through weekly conference calls and regular face-to-face meetings in addition to the quarterly meetings with the monitoring officer.

Project outcomes

B.192 The main emerging outcome is the successful advancement of the Pulse-R engine towards the market, aligning with the underlying logic model for the Catalyst as a whole. Moving from the early to mid-stage Catalyst grants allowed OakTec to develop the technology further than would otherwise have been the case. The WEDGE project also gave OakTec's business greater solidity as the confirmed 30-month funding meant OakTec did not have to rely on finding alternative, potentially short term, funding opportunities to progress its technology. Both partners also gained skills as a result of the project. For example, OakTec improved its technical skills, whilst Barrus developed its knowledge by being involved in engine tests which it would usually expect manufactures to undertake prior to its engagement.

B.193 The project has built a collaborative relationship between the partners. The added value of the collaboration in WEDGE is that the extensive market knowledge of Barrus both helped to shape the technical specification that OakTec worked to, and was also intended to provide a route to market in the future.

B.194 An unexpected benefit of being involved with Innovate UK through the Catalyst was OakTech joining the Prime Minister on a trade mission to India in 2016. This allowed OakTech to make new contacts, raised OakTech's profile, and gave them increased credibility in the eyes of potential customers and collaborators. Major environmental spillover benefits are expected to be realised if and when the Pulse-R engine is used in developing countries instead of highly polluting, inefficient diesel generators.

B.195 Important external enabling factors in the success of WEDGE included the NVN and ISCF projects mentioned above. The timing of WEDGE with new European emissions regulations coming into force in January 2019[42] could be another enabling factor. Along with a growing environmental awareness, partners expected that the tighter regulations would be important in creating future demand for Pulse-R engines both in the UK and abroad.

B.196 The long-term objective for OakTec is the commercialisation of a robust, efficient, low emission gas engine that can be used for static power generation in the developing world, or as a range extender for electric vehicles. There are technical and engineering challenges to overcome during the remainder of WEDGE. Following completion of the project, the major risk is not being able to secure sufficient finance to commercialise the Pulse-R engine.

Effectiveness of Catalyst processes

Awareness and marketing

B.197 Following the initial NVN project, OakTec looked for R&D funding opportunities related to power generation to support the development of their technology. As OakTec was part of the NVN, it received updates from Innovate UK and KTN on funding programmes. OakTec was attracted to the Energy Catalyst in particular because it felt that the model met its needs. For example, an early stage project could last for 12 months which OakTec knew would allow it to make a lot of progress in a relatively short period of time if it set ambitious goals. In addition, the Energy Catalyst's focus on having a positive social impact by tackling the energy trilemma also fit with OakTec's wider (beyond profit) goals. Finally, the ability to move from one grant stage to another and progress towards commercialisation was also important to OakTec.

B.198 It was suggested that the Catalyst could have been more widely promoted. OakTec felt that it was 'seeing the same faces' at Innovate UK/KTN briefing sessions but that other firms outside of this pool of regular contacts would also benefit from being involved in the Energy Catalyst.

B.199 An issue was raised over the structure of the Catalyst. The funding round structure meant that OakTec was without R&D funding support between the end of EDGE (March 2016) and the start of WEDGE (early 2017). During this period R&D work had to be put on hold, thus extending the time before Pulse-R could be commercialised.

Application processes

B.200 OakTec used a consultant bid writer to help develop the EDGE application because OakTec did not want its innovative technology to be let down by a poorly explained application. By the time of WEDGE, OakTec was more confident in how to write an application so it did not use external support. The feedback on the EDGE application was also useful in developing the WEDGE

[42] Non-Road Mobile Machinery Stage V emission standards

application, as was the knowledge that OakTec had successfully demonstrated its technology in EDGE so it could make a more convincing case for future funding.

B.201 No major issues were raised with the application form or the application process. However, it was suggested that the different sections of the application should be weighted, rather than scored equally. It was felt that the most weight should be given to sections on innovative technology and market opportunity as this would give the most innovative projects a greater chance of being funded.

Contracting and monitoring

B.202 The contracting and monitoring processes were felt to be appropriate. Retaining the same Monitoring officer (MO) as the project moved through the grant stages was regarded as helpful because this meant that the MO was familiar with both the partners and project so no time was lost in bringing a new MO 'up to speed'. More broadly, the importance of having a good relationship with the MO was noted. For example, the MO can help smooth the path between acceptance and starting the contract by helping to address issues with Innovate UK if any delays occur.

B.203 The quarterly MO meetings were useful for partners to receive guidance from the MO. The timing of the meetings was considered appropriate; three months was long enough for the project to demonstrate significant progress, but short enough that Innovate UK could stay involved in the project. The '_connect' portal also worked well for uploading monitoring data.

Completion and aftercare

B.204 The project completion process was helpful to OakTec, because of the contact with the Innovate UK lead and the links and networks that were facilitated. Whilst OakTec had met the Innovate UK lead before being involved in the Catalyst, ensuring that he was kept up-to-date with developments at OakTec was regarded as helpful in enabling future benefits. For example, at the Round 5 launch event, the Innovate UK lead introduced OakTec to the Shell Foundation who in turn introduced OakTec to a potential customer in Mexico. This connection could help OakTec to spread its technology into new markets.

B.205 OakTec also attended the Rushlight Energy Catalyst showcase event. This was perceived to be a useful networking opportunity for finding potential collaborative R&D projects, but less useful for building customer/supplier links.

B.206 OakTec felt that the aftercare process could be improved, and that the Energy Catalyst funders were in danger of falling into the 'fund and forget' trap. The importance of a clear pathway to take projects through the 'valley of death' was stressed. Despite the WEDGE project receiving DFID funding, the partners had received little contact from DFID at the time of the evaluation. Greater engagement from DFID would demonstrate to project partners that DFID was aware of, and interested in, the Pulse-R engine and wanted to support its development. Greater engagement would also help the partners to feel part of a system which follows through on specific opportunities, rather than just funding a wide range of single projects.

Lessons

B.207 The key lessons for future Catalyst projects were having a clear project concept, and good relationships between project partners to be able to deliver on that concept. This case study also illustrated the benefits of being fully involved in the innovation ecosystem as this has allowed OakTec to work on non-Catalyst R&D projects to develop their technology and further expand their network. The Catalyst instrument itself was clearly invaluable and a key draw to OakTec, because of the staged funding and the alignment of its objectives with the company's ethos.

B.208 The main potential improvement highlighted for future Catalyst (-type) models is having structured project aftercare and a clear pathway for projects to follow as they move from early stage R&D right through to commercialisation.

Synaptec

B.209 Synaptec has led two Energy Catalyst projects. This case study focuses on the ongoing Wide-Area Instrumentation of Power Networks using Existing Infrastructure project ('the second project'). This project aimed to prototype and test a novel distributed photonic sensing technology for the power industry. At the time of the evaluation the project was ongoing with an estimated end date in mid-2019.

Table B-11: Project details

Catalyst	Energy
Round	Round 3
Type of grant and amount	Mid Stage £1,108,346 sought
Project start and duration	July 2016, 3 year ongoing project
Lead and collaborators involved	Synaptec – Micro, Scotland University of Strathclyde – Academic, Scotland NPL Management – Large, London Instrument Transformers Limited – Small, Scotland Bellrock Technology - Micro, Scotland

Source: SQW

B.210 The project was a direct successor to an early stage project (Low-Cost Distributed Multi-Parameter Sensing for Energy Networks, 'the initial project'), which was funded in Round 1 of the Energy Catalyst in 2015/16. This initial project was also led by Synaptec, with the University of Strathclyde as their sole partner. The initial project allowed Synaptec to demonstrate the feasibility of their core technology, and the second project was designed to develop products based on this technology.

B.211 The case study was conducted during February/March 2018 and involved a face-to-face consultation with Synaptec, as well as a telephone consultation with the University of Strathclyde. The other partners were contacted but declined to take part in the case study.

Context

B.212 Synaptec was spun-out of the University in Strathclyde in 2014 to commercialise research that the University's Institute for Energy and Environment had been working on since the mid 2000s. Prior to engagement with the Energy Catalyst, Synaptec had not worked with Innovate UK. However, co-founders of Synaptec and colleagues who remained at the University of Strathclyde had previously received academic grants, for example from the EPSRC.

B.213 The initial project therefore involved individuals from Synaptec and the University of Strathclyde that already had close working relationships. The second project involved a wider number of partners that were already known to Synaptec and/or the University but with whom the individuals concerned had never worked. This included another Strathclyde spin-out, Bellrock Technology Ltd, a well-established supplier to the power industry, Instrument Transformers Limited, and NPL, which launched NPL Scotland in collaboration with the University of Strathclyde in 2015.

Overview of the project

B.214 Synaptec's technology uses photonics, rather than electronics, to monitor power systems.[43] The initial project successfully confirmed the feasibility of this approach. The second project, to develop pre-commercial sensing systems, was mid-way through delivery at the time of the evaluation, and the seven work packages (WP) were proceeding as planned. Some WPs only involved one partner, e.g. University of Strathclyde was responsible for WP5 on long term sensor reliability, other WPs involved two partners, e.g. WP4 on sensor metrology involved Strathclyde and NPL, whilst others involved multiple partners, e.g. WP2 on the development of voltage and current transducers involved Synaptec, Strathclyde and ITL.

B.215 Some project milestones have been moved back because of technical issues encountered during the project, but the only major change from the proposal has been the withdrawal of an intended partner. This partner, a manufacturer of equipment for power transmission, was intended to provide guidance and whilst key individuals were supportive, their legal team would not allow the company to sign the collaboration agreement. However, because the company were included as a 'no cost' partner, their withdrawal did not prevent the project going ahead. Whilst not impacting on the technical delivery of the project, it has represented a risk to achieving expected future outcomes as discussed below.

B.216 A high level of additionality was reported for both projects. As an early stage spin-out, Synaptec did not have the financial resources to self-fund the development of their technology, nor could they afford to pay to partner with their collaborators. With their technology at such an early stage, it was unlikely that Synaptec could have attracted commercial investment and, as discussed below, no other public sources of investment were considered suitable.

B.217 No major barriers to delivery were cited for either project, and the structured approach to project management appears to have been a key strength. In addition to the quarterly Monitoring Officer meetings attended by all partners, each partner submits a monthly update email. This helps to keep all partners focussed on the project and informed of each other's progress.

Project outcomes

B.218 The initial project successfully demonstrated Synaptec's technology, and the second project has progressed the technology towards the market as expected in the underlying logic model for the Energy Catalyst. Both Synaptec and the University of Strathclyde have been able to disseminate learning through academic journal articles and conference papers.

B.219 New research collaborations have also been formed by the second project, and the existing Synaptec-Strathclyde link has been strengthened by both projects. The added value of the collaboration in the second project has been to bring in more and different expertise. This has allowed the project to deliver in more areas than if Synaptec and Strathclyde had continued working together. An example of this has been the digital inputs from Bellrock.

B.220 The Energy Catalyst programme itself was considered important in generating these collaboration benefits not only because of the finance but also because of the framework that it has provided. The Catalyst programme was an accepted way to form and then run a collaboration

[43] The sensing technology can provide wide area monitoring by using existing optical fibres installed as part of the power network. This is expected to provide high quality data for a broad geographic area more cost effectively than current monitoring systems.

amongst partners that had not previously worked together. Even if private funding had been secured, the framework provided by the Catalyst, including the Innovate UK collaboration agreement, made it easier to form and manage the collaboration than would have been the case otherwise. An important external enabling factor was the market pull, partly driven by the increasing government focus on the energy trilemma.

B.221 At the time of the evaluation, partners estimated that the technology was at TRL 7. It will require deployment on a live power network before it can be fully commercialised. If this is successful, a major expected spillover benefit relates to helping to tackle the energy trilemma: reducing costs to consumers though savings on network operators' monitoring costs; improving the security of energy supply by allowing more effective monitoring and fault detection; and reducing emissions through the integration of low carbon technologies.[44]

B.222 Other than overcoming technical challenges, the main risk to achieving the longer-term benefits is that the end users do not adopt the technology. Synaptec have tried to minimise this risk by having conversations with end users (including grid equipment manufacturers or network operators) and, as discussed above, tried to include one in the second project. However, this was not successful so Synaptec are currently developing a technology which they *think* will be a commercial success but has an element of uncertainty. It was suggested that focussed promotion of the Energy Catalyst from BEIS, Innovate UK and industry regulators could help bring larger companies into R&D projects at an earlier stage, and thus inform their path to commercialisation.

Effectiveness of Catalyst processes

Awareness and marketing

B.223 Although they could not be certain due to the time elapsed, consultees believed that they first became aware of the Energy Catalyst through the University of Strathclyde's grant office. Synaptec explored other funding opportunities but felt that the Energy Catalyst was the most appropriate funding source for both their initial and second projects. This was because of the timing of Round 1, which coincided with Synaptec's launch, the ability to move from one grant stage to another, the alignment of the Energy Catalyst in tackling the energy trilemma with Synaptec's own goals, and the intervention rates offered, which were more attractive than other options (e.g. Scottish Enterprise programmes). This shows that key features of the Catalyst model, namely the transition between grant stages and the focus on specific technology areas/challenges, were important factors.

B.224 Other alternative sources were rejected because they did not always allow business-academic collaborations, and, in the case of working with a major industrial player, due to the reduced control Synaptec would have in the development of its technology.

B.225 A specific issue was also raised about the conditions attached to RTO involvement. RTOs are only eligible to incur a maximum of 30% of project costs for mid stage projects. This cap makes it difficult for a project to involve more than one RTO even if this would be beneficial for the project. A potential solution could be to raise the 30% cap if two or more RTOs are involved in a project.

[44] Including renewable energy which is generated at multiple sites into the existing energy network increases the monitoring and control challenges. Improved monitoring using Synaptec's technology will help to tackle these challenges

Application processes

B.226 As lead partner, Synaptec was responsible for developing the application, with input from individual partners based on their technical specialisms and financial requirements. Synaptec was supported by non-project University staff with previous application/assessment experience, in particular to review and comment on Synaptec's draft application form.

B.227 The application process was commented on favourably compared to those for other sources of finance. For example, it was stated that the word limits were useful in keeping answers focussed, and that the application form did not require excessive amounts of detail. However, as an academic partner, the University of Strathclyde had to complete a separate application form for the EPSRC. Whilst the effort required to do so was proportionate to the scale of grant received, harmonising Innovate UK and EPSRC application forms would be welcome to reduce duplication, and the time and costs of application.

B.228 The feedback on Synaptec's Round 1 application was useful in informing the style and content of their Round 3 application. However, it was noted that not all assessor feedback was helpful, for example asking for more detail in a word-limited form. It was also suggested that the feedback could be presented more clearly to allow applicants to more easily differentiate the feedback from different assessors.

Contracting and monitoring

B.229 The contracting process was regarded as clear and appropriate. However, the time taken to complete the contracting process was too long as Synaptec only received their grant confirmation letter shortly before the project was due to start. This caused problems for collaborators who needed to hire new staff for the project because the hiring process could not be started before the project financing was formally approved.

B.230 The support provided by the Monitoring Officer was appreciated, including the proactive signposting of project partners to potential future collaborators. Meeting the Innovate UK lead at a quarterly meeting was useful in giving Synaptec a greater knowledge of Innovate UK and its priorities, as well as being able to 'put a face' to Innovate UK because the Monitoring Officer, although Innovate UK's representative, was a subcontractor.

Completion and aftercare

B.231 The project completion process was appropriate and the structured nature of the completion report was appreciated as this made it easy to fill out. However, project aftercare could have been improved. For example, there was no formal conversation between Innovate UK and the lead or collaborators about how to take their project forward. Whilst the move from early to mid-stage Energy Catalyst grant awards has been invaluable for product development, there were wider areas of business development where support would have been appreciated, for example on future exporting. More structured follow on support from Innovate UK would help Synaptec and partners to enhance the long term impact of the initial Energy Catalyst grant.

B.232 The Rushlight Energy Catalyst showcase event was regarded as a good opportunity to meet other projects, although it was suggested that it would be more useful if there were more guided networking opportunities, e.g. in a speed dating style, rather than the more informal approach

adopted. The directory of Energy Catalyst projects was recognised as a good way of helping to find potential future collaborators, even if Synaptec did not manage to find any through this route.

Lessons

B.233 Partners were very happy with the majority of aspects of the Energy Catalyst. For example, key features of the Catalyst model, namely the transition between grant stages and the clear focus on the energy trilemma, were important factors in partners identifying the Energy Catalyst as the appropriate funding route.

B.234 Partners only identifying minor changes to further improve the Catalyst model. These included speeding up the contracting process, and making improvements to project aftercare or signposting to help facilitate longer term impacts.

Centre for Process Innovation

B.235 Alginates by Production Scale Fermentation and Epimerisation ('ALGIPRO') is an Industrial Biotechnology ('IB') Catalyst funded industrial research project led by the Centre for Process Innovation ('CPI') in collaboration with two commercial end-users: AlgiPharma (a clinical stage pharmaceutical SME, based in Norway) and the Nutrition and Health division of DuPont (technically UK-based, although the team is based in Norway). The DuPont team was previously part of FMC Biopolymer, a Norwegian SME, prior to their acquisition by DuPont. In addition to the formal partners, SINTEF – an independent contract research organisation based in Norway – was a key sub-contractor on the project, bringing expertise in fermentation processes.

B.236 Alginates are currently used extensively as an active pharmaceutical ingredient in medicines and food products due to their unique properties. At present the vast majority of alginates are derived from seaweeds. However, as the use of alginates becomes more widespread, new methods of production will be needed to meet growing demand, as the supply of seaweed derived alginates is at (or close to) its sustainable limit. The ALGIPRO project seeks to address this challenge by developing and optimising a non-seaweed based process for scaling up the production of alginates through microbial fermentation.

Table B-12: Project overview

Catalyst	Industrial Biotechnology
Round	Round 1
Type of grant and amount awarded (by source)	Industrial Research Grant value: £427,977 *Note: AlgiPharma funded by Innovation Norway*
Project start and duration	April 2016 – September 2018 (30 months)
Lead and collaborators involved	Lead: Centre for Process Innovation (CPI) Collaborators: Algipharma and DuPont (formerly FMC Biopolymer)

Source: SQW

B.237 The objective of the work was to test the fermentation process at scale (one at 10,000 litres, and other at 750 litres) for two different applications tailored to the needs of each end-user involved, as follows:

- AlgiPharma; the production at scale of alginates with a low molecular weight suited to the production of novel medicinal products to fight infection and multi-disease resistant bacteriaincluding cystic fibrosis, chronic obstructive pulmonary disease, and weed management, among other applications.
- DuPont: the production at scale of alginates with a high molecular weight for use in the production of food products.

B.238 The ALGIPRO project builds on pre-existing research by all of the partners involved, including a previous collaborative R&D project - AlgiPharma Scale-up Fermentation of Alginate Oligomers ('ALGIFERM') – involving the CPI and AlgiPharma (with SINTEF as a sub-contractor). Importantly, both the ALGIFERM and ALGIPRO projects received funding as part of an innovation collaboration framework agreement between the innovation agencies in the UK (Innovate UK) and Norway (Innovation Norway). In terms of the ALGIPRO project, the IB Catalyst funded the work of the UK-based partners (CPI and DuPont) and Innovate Norway funded AlgiPharma's activities (including

the work of the sub-contractor, SINTEF). The ALGIFERM project pre-dated the IB Catalyst as it was jointly funded by Innovate UK (Technology Strategy Board at the time) and Innovation Norway.

B.239 The case study was conducted during March 2018 and involved a face-to-face consultation with the CPI team, as well as separate telephone consultations held with AlgiPharma and DuPont.

Context

B.240 All of the partners involved had prior experience in the successful application of public R&D grants. For example, AlgiPharma had successfully been awarded R&D grant funding from sources in the UK (Innovate UK), the EU (Horizon 2020 and FP7, among others), Norway (Innovation Norway and Norwegian Research Councils), and the US. The CPI and DuPont were similarly extensively involved in collaborative R&D projects funded via a number of sources.

B.241 Importantly, the ALGIPRO project itself represented a piece of follow-on work to an initial feasibility study – the ALGIFERM project. The ALGIFERM project represented the first collaborative project funded as part of the framework agreement between the innovation agencies of the UK and Norway.

B.242 In terms of the history of collaboration between the partners involved, AlgiPharma, the team from FMC Biopolymer (prior to their acquisition by DuPont) and SINTEF were experienced collaborators. The FMC Biopolymer team (now part of DuPont) and AlgiPharma (itself a spinout from FMC Biopolymer) had both engaged with SINTEF previously to exploit their expertise in the fundamental science behind the lab-scale fermentation of alginates. The CPI was brought into the earlier feasibility study, ALGIFERM, for several reasons. First, through the cooperative arrangement between Innovate UK and Innovation Norway, the CPI was endorsed as an example of a UK-based organisation with significant potential for collaboration with Norwegian partners. A second reason was the suggestion from SINTEF to AlgiPharma that the CPI was expert in the scaling-up of industrial biotechnological processes, and one of the best placed within Europe to support the planned project. Finally, AlgiPharma knew of a large company in Norway - Borregaard - that had already successfully engaged with the CPI in similar work, and recommended them. Based on this information, AlgiPharma contacted the CPI to explore the potential to engage in the ALGIFERM work. Following a site visit, it was agreed that they would put an application together. For the more recent ALGIPRO work, DuPont was added to this collaboration following a recommendation from the KTN to include a large UK-based commercial partner in the project.

Project overview and delivery

B.243 The ALGIPRO project is made up of a series of work packages designed to develop hybrid alginate compounds at a commercially viable scale. The collaboration between the three partners was regarded as vital to achieving project outcomes, due to unique expertise and capacities. For example, both AlgiPharma and DuPont provided end-user perspectives and knowledge, with very similar interests in the project's outputs, but for quite different applications. The CPI provided expertise in the scaling-up of industrial biotechnology processes, and SINTEF (as a sub-contractor) the expertise in the alginate fermentation technology area (at lab scale).

B.244 All of the project partners involved have regularly been involved in collaborative R&D work and have received funding from a wide range of UK, Norwegian, European and other international funding sources. AlgiPharma alone suggested that it has received over £35m in grant funding since it was founded in 2006.

Project outcomes

B.245 At the time of the case study research, the project was due to successfully come to a close in September 2018, on time and to brief. Key milestones have included the following:

- Progress made in terms of producing some alginate strains at scale (10,000 litres).
- Progress in overcoming challenges associated with working with, and separating target compounds from, highly viscous substances.
- Progress in conducting market and regulatory assessments necessary to support future commercialisation/exploitation of work.
- The technology has advanced from TRL 3 to TRL 4-5.

B.246 In addition to project-related milestones, the various partners have learned a significant amount. The CPI, in particular, has benefited from amassing new knowledge in the handling, processing and separating products out of highly viscous materials at a large scale – which at the time of the case study research remained one of the more significant challenges to the project's progress. The work has also helped the CPI enhance their expertise in molecular biology and to improve their use of 'in silico' computer modelling of the processes involved (e.g. through the deployment of computational fluid dynamics modelling). The latter was expected to reduce the need for lab and clinical work, and to accelerate and reduce the cost of future developments in the technology area. For DuPont, similar benefits have been realised for their team – a team only just settling into the DuPont organisation following the acquisition of FMC Polymer 6 months previously. The interviewees suggested that they had learned a lot about fermentation processes during the course of the project, which was helping to pave the way for more in-depth engagement with other divisions of DuPont with expertise in fermentation. This was raising the potential for future benefits to arise through synergies within DuPont, as well as accelerating the integration of the team into the organisation. Another output realised to date was the presentation, by AlgiPharma of some of the early findings of the ALGIPRO work at conferences.

B.247 Another key benefit as part of this work was the deepening of the relationships between project partners. Building on the feasibility study, the relationship between the CPI, AlgiPharma and SINTEF has been further strengthened during the course of this project. Further, the relationship between DuPont and the CPI – the first engagement between the two organisations – has also developed, and both organisations were open to deepening their relationship further through follow-on work. Testament to the progress made and trust being developed between the partners were the follow-on projects that had been bid for and won by the project partners. For example, the project partners had secured follow-on funding from Innovation Norway to further advance the development of downstream process of alginates. This work was about to get underway at the time of writing this case study. Another example of the developing trust between partners was the plan for DuPont to send staff over to the CPI facility to further develop each other's capacities in the technology area.

B.248 An unexpected wider benefit has been the increased interest from Innovation Norway in the Innovate UK model. A member of Innovation Norway was, at the time of the case study research, in contact with the CPI team, and planned to attend future meetings to learn from Innovate UK's open-access approach to pilot-scale innovation projects, as well as how project monitoring is conducted (something Innovation Norway do not yet do).

B.249 Although the project was largely on track, there have been some delays due to personnel issues at the CPI. Specifically, a key member of staff left resulting in substantial delays as the team had to wait for a suitably qualified member of staff to become available. These delays have not affected the final milestones, nor the project's timetable.

B.250 Other, wider factors have supported the progress made to date. One factor included learning generated from other projects being conducted by the project team in related areas. One example included a project conducted by SINTEF - funded by Innovation Norway - which developed a new alginate strain with more optimal properties for the ALGIPRO work. This development helped to 'remove a whole processing step' that was required under the initial project scope - needed when using the original strain of alginate (as developed in the feasibility study) - and has, as a result, helped to keep the project on track to achieve its objectives on time - following the noted delays. This new alginate strain also created an opportunity to develop a second alginate process to scale.

B.251 In terms of expected benefits in the future, the CPI team anticipated that this work would help to de-risk the use of non-GMP processes by big pharmaceutical companies in drug and chemical development. The pharmaceutical industry is very tightly regulated, but the consultee from CPI believed that there could be a role for non-GMP processes which may offer the opportunity to significantly reduce the costs associated with the production of alginates, and other compounds. More work was expected to be needed to change the perception of industry, but this work has the potential to make a small contribution to de-risking non-GMP processes.

Effectiveness of Catalyst processes

Awareness and marketing

B.252 The ALGIPRO project and its precursor, the ALGIFERM feasibility study, were exceptional in the sense that they arose out of a framework agreement between the innovation agencies of the UK and Norway. The Catalyst programme became the vehicle used to fund the involvement of the UK-based organisations involved in ALGIPRO, while Innovation Norway funded the work of AlgiPharma (and their sub-contractor, SINTEF).

B.253 The CPI was aware of the IB Catalyst programme and had in fact been a repeat applicant and grant holder on the scheme. The CPI considered that the programme was very effectively marketed in the UK. In terms of the project partners, both the AlgiPharma and DuPont teams (each based in Norway) were not aware of the IB Catalyst prior to being directed to the scheme as part of the framework agreement and their engagement with the CPI, as well as the Knowledge Transfer Network (KTN).

B.254 The project partners did consider other routes to funding at the time of application. An application was made for an EU Horizon 2020 grant, though this was unsuccessful.

Application processes

B.255 In summary, the application process was regarded as straightforward, smooth and proportionate to the level of support on offer. The accompanying guidance was helpful, in particular for the Norway-based partners with more limited experience with the process. Similarly, the briefing event was viewed as useful, even for an organisation such as the CPI which frequently put together applications of this nature. When compared with EU grants (e.g. Framework Programme or Horizon 2020 grants), the IB Catalyst application was regarded favourably due to its short and less administratively burdensome format.

B.256 Practically, the application process was largely coordinated by the CPI, but supported by significant scientific inputs from the partners involved, The CPI employs a team of experienced bid writers to lead on putting applications together, and was very experienced with the Innovate UK application format (including multiple applications to the IB Catalyst programme). The ALGIPRO application also benefitted from the pre-existing completed application for the ALGIFERM feasibility study. In turn, both the ALGIFERM and ALGIPRO applications have been used to support the noted follow-on project applications.

B.257 One point of feedback raised was the effectiveness and purpose of the two-stage process. The interviewees noted that the application forms between stages were very similar, differing only in terms of a few extra clarification points. This duplication could be an area to review if this format is used in the future.

B.258 The team has not needed any support from outside the collaboration to support the application or delivery of the project.

Contracting and monitoring

B.259 The contracting process was relatively protracted, but this was due to the challenges associated with navigating the commercial sensitivities that are inherent to R&D collaborations involving private companies, rather than anything to do with the programme per se. In fact, interviewees regarded the IB Catalyst as 'very patient' during this period, ensuring it ran as smooth as possible without imparting any further delays.

B.260 Monitoring was regarded as broadly useful and not overly onerous. As the monitoring officer involved was not a subject-expert, opportunities to provide advice on project progress and routes to market were limited. Nevertheless, the monitoring officer has 'helped to refocus on exploitation and dissemination of activities'. Overall, however, the advisory roles of a monitoring officer were not regarded as a particularly important, and so this was not an issue.

B.261 More generally, and drawing on the CPI's experience across other IB Catalyst and Innovate UK project grants, there was a suggestion that the quality of monitoring officers can vary considerably in quality, particularly in terms of mixed approaches to managing changes to the scope of innovation projects that were regarded as a natural consequence of the innovation process. Higher quality monitoring officers understand that project plans can change and are flexible to adapting plans to achieve the best possible outcomes. The CPI also noted that monitoring officers seem to have 'less and less ability to approve changes', resulting in quite minor changes needing sign-off from more senior Innovate UK staff – this causes small, and possibly needless, delays.

Lessons

B.262 The ALGIPRO work represented an important collaborative project formed as part of a framework agreement between Innovate UK and Innovation Norway. The IB Catalyst programme provided a suitable model to fund the UK-based partners involved in the project, the CPI and DuPoint. The view of the project partners was that the ALGIPRO work would likely have proceeded at a slower pace without the IB Catalyst programme, as no other suitable grant opportunities were available at the time.

B.263 In terms of the IB Catalyst model used to fund this project, it was regarded as quite similar to other Innovate UK and EU (Horizon 2020 projects) in nature, although the focussed targeting was viewed as highly beneficial for the IB sector. In this respect – and as multiple grant holders within the IB Catalyst programme - the CPI regarded the closing of the IB Catalyst as a 'massive hole' in the funding landscape for industrial biotechnology – one that is greatly missed by the sector.

Fiberight

B.264 Fiberight Ltd has led two Industrial Biotechnology (IB) projects. This case study focuses on the completed Round One late stage project, 'Driving down the cost of waste derived sugar'.

B.265 Sugar is an essential raw material used in industrial bioprocessing and is currently produced from agricultural biomass (first generation sugars). It is prone to supply and cost variation, causes negative environmental impacts due to land, pesticide and petrochemical use, and has an adverse social impact due to the conflict with food resources. This project aimed to demonstrate pilot scale feasibility for a process to produce sugar by high yield hydrolysis of cellulose extracted from municipal solid waste (MSW) to replace food grade sugar in industrial bioprocessing. The sugar could then be used to produce, for example, bioethanol – the green fuel component in petrol - as well as other high value chemicals such as those used in construction materials and intermediates in chemical processes. As such, the sugar from the waste would substitute for the sugar currently produced from crops, which require land, pesticides and fuel to grow and harvest. The project was expected to bring about both environmental and economic benefits including less waste to landfill, and the derived sugar would be sustainable and cost competitive. This project was completed in March 2016.

Table B-13: Project overview

Catalyst	Industrial Biotechnology
Round	1
Type of grant and amount awarded (by source)	Late stage Funding sought - £601,522
Project start and duration	01/04/2015 – 12 months
Lead and collaborators involved	Fiberight Limited – Micro, South Wales Centre for Process Innovation Ltd – Medium, North East University of Leeds – Academic, Yorkshire and the Humber Aston University – Academic, West Midlands Rebio Technologies Ltd – Small, North West (dropped out after project start) University of Bath – Academic, South West (replaced ReBio) Knauf – Large (Multi-national) – formal project partner but did not receive IBC funding Novozymes - Large (Multi-national) – formal project partner but did not receive IBC funding

Source: SQW

B.266 The second project Fiberight led was a Round Four early stage project called 'Reducing contamination risk and increasing yields in the production of platform sugars from UK mixed solid waste'. The second project was not directly related to the Round One project, but did use some of the technology and opportunities discovered in the earlier project. At the time of the evaluation, this project was still ongoing and was expected to be completed by April 2018.

B.267 The case study was conducted during February/March 2018 and involved a face-to-face consultation with Fiberight and a telephone consultation with the University of Leeds.

Context

B.268 Fiberight is a UK SME, and a subsidiary of the wider Fiberight LLC based in the US. Founded in 2008, Fiberight LLC is a clean technology company, primarily focused on transforming municipal solid waste (MSW) and other feedstocks into next generation renewable biofuels, with cellulosic ethanol as the core product. Fiberight UK was established in 2009 and leads Fiberight's R&D programme to further optimise the core process and develop new processes and value chains for a range of higher value materials and products. As such, although most of the R&D activity happens in the UK, initial commercialisation has occurred in the US, where the company has pilot and demonstration plant facilities.

B.269 The Round One IB Catalyst grant was the first that Fiberight had received from Innovate UK. Fiberight had not collaborated with any of the partners prior to the project; however, some collaborators had previously worked with each other e.g. University of Leeds (UoL) and the Centre for Process Innovation (CPI) had an existing relationship.

Overview of project delivery

B.270 The consortium of seven partners covered the entire supply and value chain, and contributed proprietary technology and commercial expertise. Whilst Fiberight was the project lead, the key partner was the CPI, because of the type of high-tech equipment that it had to offer. The CPI received around 60% of the total project funding. Fiberight took the materials generated by CPI, and then distributed them to the other partners for further testing. The 15% of funding Fiberight received was mostly for project management activities.

B.271 Fiberight initially approached CPI to discuss the project and determine what external support was required. The two academic collaborators were identified through various connections. The Institute of Process Research and Development (IPRD) at the UoL was recognised as having distinct facilities and expertise not available at the CPI. Fiberight visited the IPRD before writing the application, viewing their facilities and getting a better understanding of how their expertise would fit the project. In addition to this, two multinational companies, which did not receive any of the project funding, provided support. Knauf tested applications for bioresin manufacture, and Novozymes provided expertise in, and supply of, industrial enzymes.

B.272 The project was able to achieve all of its major milestones, although the process did take slightly longer than expected. There were two key reasons for this. First, ReBio dropped out of the project because its business priorities changed, moving away from converting sugars to ethanol. The University of Bath was identified as the replacement, since it had done some original work for ReBio. Partners appreciated Innovate UK's flexibility in allowing the University of Bath to become a formal project partner.

B.273 The second key reason was that the initial timetable was too ambitious, as the lead underestimated the amount of time required for partners to get to know each other at the beginning of the project. For example, Fiberight had difficulty in communicating what was required to the large team at CPI. In subsequent projects of this nature, Fiberight has built in more time to project plans for partners to understand each other's working style during the early stages of the project.

B.274 A high level of additionality was reported for the project. The collaboration with CPI was identified as the key enabling factor for the success of the project. As a small company in the UK,

Fiberight would never have been able to fund the use of CPI resources privately, and it was seen to be high risk for Fiberight LLC to invest its own private resources. In addition, by accessing multiple Innovate UK grants at once, Fiberight was able to accelerate various strands of its core business simultaneously, allowing the business to grow at a much faster rate, and speeding up the process to commercial pathways.

Project outcomes

B.275 The project achieved greater outcomes than initially anticipated, and the processes under testing moved closer to market adoption. Having said this, most of these benefits have occurred in the US, and a relatively small proportion in the UK.

B.276 The processes developed through the IB Catalyst project allowed Fiberight UK to persuade management at Fiberight LLC to upgrade its demonstration plant to test the process on a larger scale in the US. This required an investment of around $500k.

B.277 In addition, Fiberight LLC recently announced the completion of a $70m project financing for its MSW processing facility being constructed in the US. The facility will have 180,000 ton-per-year capacity to convert MSW into high-value commodities. The first phase of the construction will include using information from the Catalyst projects to retrofit the sugar production. As such, although the IB Catalyst project has not directly led to an increase in turnover yet, it is expected to do so in the near future. Again, this is expected to be accrued in the US.

B.278 Within the UK, Fiberight has been successful in leveraging further public investments, mainly through further Innovate UK funding. It secured another IB Catalyst grant in Round Four, as well as two Innovate UK materials and manufacturing grants. The total value of these project was estimated to be around £2.5m. The funding has created and safeguarded high value R&D jobs. Fiberight UK has employed two additional FTEs since the first IB Catalyst project.

B.279 The IB Catalyst project has created new and improved collaborations with universities, the CPI, and large multinational companies. These collaborations have continued on further Innovate UK projects covering other technology and process developments. The Innovate UK funding was recognised as the key enabling factor, which gave multinational companies such as Knauf the confidence to invest in follow-on projects with Fiberight. These collaborations have resulted in knowledge transfer, and allowed the technology to move closer to commercialisation.

B.280 The project also brought about a number of unintended outcomes, the key one being an increased profile of the business with UK government agencies. Members of Fiberight now sit on the steering committee for the Office for National Statistics, advising the government on how to improve data collection on waste materials. Fiberight has also attended various workshops related to the Industrial Strategy Fund. Moreover, Fiberight disseminated the findings of the project at several different conferences, including Recycling Waste Management (RWM) exhibition, the UK's largest waste management show.

Effectiveness of Catalyst processes

Awareness and marketing

B.281 Fiberight could not recall exactly how it became aware of the IB Catalyst programme, but mentioned three potential sources: a contact at CPI who previously had worked for Fiberight; the

Innovate UK website, which it actively reviews for potential R&D funding; and engagement with the KTN.

B.282 Fiberight did consider other Innovate UK grants available at the time of its application to the IB Catalyst, although it could not recall exactly which ones. The IB Catalyst call was preferred because of the collaborative nature of the scheme, and in particular because it enabled Fiberight to access the facilities at CPI. A small company like Fiberight would never have access to its own facilities given the costs associated, and so the ability to collaborate with the CPI was critical to the project.

B.283 One suggestion for improving the marketing of the IB Catalyst programme was to separate it from other Catalyst schemes – '*they are trying to sell the Catalyst as a single programme which makes it appear as a one size fits all policy*' even though '*each Catalyst is playing its own role for their relevant different industries*'. As such, it was recommended that the marketing activities should emphasise these differences, and highlight that the programme is bespoke for the IB sector.

Application processes

B.284 CPI, which has experts in writing funding bids, including for Innovate UK grants, wrote the bulk of the application. Fiberight and CPI representatives met to discuss the key points of the application, and CPI then used wrote an initial draft. Fiberight and other collaborators were then involved in editing the draft and filling in any key gaps in the responses to the application form questions. The process took around four to six weeks to complete.

B.285 In general, consultees spoke favourably about the application process. The application form itself was found not to be too difficult. This was Fiberight's first application to Innovate UK and Fiberight commented on the important role that CPI played in writing the application – '*without their support, the process would have been much more difficult*'. Although the questions asked were not seen to be too difficult, the consultees noted that the application required a lot of resources from an SME, which can be daunting – '*if you are a very small company, and you look at the grant form for the first time, you just shut down and do not do it'.* Further, the consultees noted that for a first time applicant it could be difficult to know what exactly Innovate UK is looking for. The CPI helped to ensure appropriate balance in the application, because Fiberight would have focused more on the technical side, and less so on the commercialisation side – '*it's about getting the balance right and this is where CPI helped greatly*'. The consultees recommended a better support structure for first time applicants in particular, where Innovate UK may potentially be missing out on good innovative projects. Having said this, after the first application, subsequent applications became much easier, as it allowed applicants to develop networks with Innovate UK's technical leads.

B.286 Aside from this, the amount of space provided in the application form to answer each question was seen to be quite short. Comparing it to Horizon 2020, which is a much longer form, it was noted that where '*Horizon 2020 asks applicants to reveal too much sensitive information, Innovate UK asks for too little – it needs to be somewhere in the middle*'.

Contracting and monitoring

B.287 Although the contracting stage did take around five to six months to complete, Fiberight believed this was less to do with Innovate UK processes, and more to do with the relatively large consortium involved in the project. The most difficult part was getting the collaboration

agreement in place. Each partner had their own sensitivities in terms of IP, with varying legal departments. Getting the collaboration agreement is much easier where collaborators have already worked with each other before, as proved to be the case in subsequent applications.

B.288 Moreover, with the contracting stage taking so long, it affected the original project plan. Individual partners had moved on with technology development during this time lag, which resulted in slight changes in scope of the project. Fiberight praised Innovate UK for providing flexibility to make changes at the start of the project.

B.289 The consultees also praised the monitoring requirements and role of the MO. Although the monitoring requirements were quite cumbersome, the quarterly meetings provided good discipline and ensured the project was on track to achieve its objectives. Furthermore, the MO was flexible in allowing changes to be made.

Completion and aftercare

B.290 Although no formal signposting was done by Innovate UK at the end of the project, the connections made with the Innovate UK lead, and the early success in the project, meant that Fiberight knew it would be applying for further grants to develop other types of process. Since this specific project had completed the late stage, Fiberight UK sought private sector finance to advance the process to commercialisation.

B.291 The route to commercialisation was seen to be very difficult in the UK due to a lack of private finance. Fiberight has had to rely on its US based company to look for investors – '*the UK does not have the same appetite for risk to get through the valley of death*'. Although the R&D activity happened in the UK, the commercialisation activities are focussed in the US. Consultees believed that there was not much that Innovate UK could do in this regard, as the onus of commercialisation should be on the private sector. However, it was a shame that the full benefits of the R&D activity could not be realised within the UK.

Lessons

B.292 Two key lessons were identified in this case study. First, the amount of time it can take for partners to get to know each other, particularly when the consortium is large. This needs to be factored into the project plans. Second, the commercial pathway after a late stage grant is still unclear, as the availability of private finance is still relatively weak in the UK. In this case, Fiberight had to look to the US for potential investors, where the appetite for risk is greater. As such, the benefits of UK public funded R&D activities are being accrued elsewhere.

Ingenza

B.293 Enhanced Productivity and Functionality of Modified Ribosomally Produced Peptides (M-RIPPS) was an Industrial Biotechnology (IB) Catalyst funded industrial research project led by Ingenza Ltd (Ingenza) in collaboration with the Universities of Aberdeen and St Andrews (later involving Oxford University, rather than St Andrews, following the transfer of the lead academic).

B.294 Ribosomally Produced Peptides (RIPPS) are regarded as promising classes of compounds with the potential to treat a range of diseases (e.g. infections, cancer and inflammation). At present, they are extremely costly to produce and modify, even in small quantities. The objective of this project was to develop a technology platform to produce modified RIPPs. The project combined the academic expertise of two universities with a history of collaborative research in combinatorial synthetic biology, with the industrial expertise of a leading UK SME in industrial biosynthesis.

Table B-14: Project overview

Catalyst	Industrial Biotechnology
Round	Round 2
Type of grant and amount awarded (by source)	Industrial Research Grant value: £462,896
Project start and duration	August 2015 – October 2018 (38 months)
Lead and collaborators involved	Lead: Ingenza Ltd. Collaborators: University of Aberdeen and University of St Andrews (subsequently University of Oxford)

Source: SQW

B.295 The M-RIPPS project built on a series of academic research grants, involving the Universities of Aberdeen and St Andrews – several funded by the BBSRC. The project also directly followed a BBSRC and Innovate UK (at the time the Technology Strategy Board) funded feasibility study - Enhanced Discovery and Scalable Synthesis of Therapeutic Cyclic Peptides (SynBio). The SynBio project, completed in March 2015, was led by the University of Aberdeen in collaboration with the University of St Andrews and Ingenza. The project proved the feasibility of a 'plug 'n' play' technology platform capable of simply and quickly producing an array of RIPPs at scale, and led directly to the M-RIPPS project

B.296 The case study was conducted during March 2018 and involved a face-to-face consultation with Ingenza, as well as separate telephone consultations held with the principal investigators at the Universities of Aberdeen and Oxford (at the time of the interview, the academic had moved from St Andrews).

Context

B.297 Ingenza has a long history of prior engagement in R&D support dating back to its establishment in 2002. This includes a number of Innovate UK (including under TSB) grants. The research teams at the two Universities involved have a long history engaging with research councils to obtain research grants, but have only more recently engaged in collaborative R&D projects with industry.

B.298 In terms of the history of engagement of the M-RIPPS partners, the two research groups at the Universities involved were long-term collaborators. The SynBio feasibility study represented the first collaborative project between these research groups and Ingenza. The relationship with Ingenza arose partly from existing personal connections between the principal investigator at the University of Aberdeen and the CEO of Ingenza, but particularly followed a KTN-run Innovate UK workshop that spurred this relationship into action through the identification of an area in which to collaborate formally. Ingenza had previously worked with other research groups at the University of Aberdeen, but the feasibility study was the first instance with this research group.

Project overview and delivery

B.299 The M-RIPPS project was made up of a series of work packages designed to develop a technology platform ('a system of cell factories') capable of making a range of hybrid compounds at a commercially viable scale. The route to commercialisation was expected to be a spin-out company that may either license the platform, or produce/co-develop M-RIPPS for the pharmaceutical sector. In terms of impacts, this will likely lead to the production, testing and screening of a range of 'new to market' therapeutics with the potential to treat a range of diseases.

B.300 The collaboration between the three partners was regarded as vital to achieving project outcomes, due to 'unique expertise' in the following areas:

- Ingenza: experts in understanding the performance and requirements of bio-systems at industrial scale, and with capabilities to engineer microbial expression systems and establish efficient fermentation-based manufacturing.
- University of Aberdeen: experts in the structures and mechanisms of enzymes.
- University of St Andrews: expertise in molecular biology and biochemistry to support the development of biological mechanisms to produce M-RIPPS.

B.301 As initially envisaged, the project intended to use the platform to develop a bespoke library of M-RIPPS for that could be sold or licenced to industry – who could then test for therapeutic and market potential. This final milestone was altered during the project delivery phase in response to a realisation that this final milestone would not de-risk the technology sufficiently to have wide industry appeal, following feedback from a leading pharmaceutical company. The change made was to re-focus the final milestone of the project on the development of a small number of new-to-science, hybrid compounds (rather than to develop a library of already known classes of compounds) to demonstrate the potential of their platform to industry - thereby de-risking the platform for industrial investment and use. This realisation also prompted a follow-on IB Catalyst Round 4 project to further develop, test and screen specific M-RIPPS as exemplars to demonstrate their value, and that of their platform, to industry. In all other respects, the project was progressing well and as expected. This Round 4 project was initially considered fundable by Innovate UK, but is yet to be confirmed due to revisions to ISCF driven funding priorities.

B.302 Finally, during the project, the principal investigator at St Andrews moved to Oxford University. Although this resulted in complications in terms of administration and contracting between the parties involved on a bilateral basis, this process was straightforward from the point of view of IB Catalyst administrative and contracting processes.

Project outcomes

B.303 To date, the project team has been able to demonstrate the ability to produce the enzymes necessary to make an existing class of compounds in a predictable and modular way. They are close to demonstrating the same ability for hybridized compounds. They have identified the screening system needed to test the compounds for specific applications. This will be developed in subsequent project(s). In addition, the academic partners have published two research papers aligned with the M - RIPPS research, with further papers expected from the data generated as part of this work.

B.304 The ultimate objective of this project was to prove that it is possible to develop a generic and adaptable engineered microbial platform to produce native, derivatised and hybridized M-RIPPS compounds - i.e. for the latter, those in which the structural features of one class can be incorporated into another. These can then be screened for activity against otherwise intractable targets in drug development (e.g. in protein-DNA and protein-protein interactions). In terms of commercialisation, it was expected that a spin-out company that would offer the possibility to produce or co-develop bespoke RIPP compounds for the pharmaceutical sector, or to license the technology platform directly. From an impact standpoint, this will open up the possibility to screen a range of completely novel, 'new to market' therapeutics with the potential to treat a range of hitherto challenging diseases.

B.305 The collaboration between the partners has strengthened as a result of this project, building on the relationship formed as part of the feasibility study. Ongoing engagements in the form of the possible follow-on project was seen as testament to the value and effectiveness of the collaboration.

B.306 In terms of other benefits, the principal investigator from St Andrews (now Oxford University) suggested that the experience of working with an industrial partner for the first time has helped to achieve a better understanding of how to progress with the commercialisation (via a new, spin-out company) of a related stream of research.

B.307 Ingenza reported that, due to the range of complementary projects underway (several of which have received IB Catalyst-funding), a range of opportunities for synergies have been identified and exploited to accelerate progress made on the M-RIPPS work. For example, strong complementarities across the two projects involving the project manager, in which learning and developments have been shared – specifically on a project developing M-RIPPS in microalgae for use in aquaculture and animal health and nutrition. In terms of the academic partners, a range of related research activities similarly supported the M-RIPPS project.

Effectiveness of Catalyst processes

Awareness and marketing

B.308 Ingenza first became aware of the IB Catalyst when it was under development via their CEO's role on the Industrial Biotechnology Leadership Forum (IBLF). Subsequent to that, Ingenza was able to keep up to date with the programme via various sources, but particularly via KTN events and direct interactions. The academic institutions involved suggested that their awareness of the IB Catalyst arose via multiple contact points, including via communications within their own institutions, via materials produced by the KTN, Innovate UK and the Research Councils, and via

the EU's ERA-NET newsletter. Broadly, all partners involved felt that the programme was 'very well marketed' and was likely to have reached the majority of the sector.

B.309 No other sources of funding were considered for this project, because no other funding options were identified where it would be possible to pull academia and industry together for a risky project of this nature.

Application processes

B.310 The partners were able to develop the application by building on the feasibility study application. Ingenza engaged with an external contractor – specialised in bid writing and project management, particularly on Innovate UK grants – to coordinate and support the development of the application. One academic partner estimated that pulling together the technical outline involved around 50 hours of input over 2-3 weeks. This input was then adapted and 'framed in the required Innovate UK language' by the external contractor, which was regarded as straightforward due to their prior experience.

B.311 The form itself was regarded as 'fairly standard' and good overall, with the one exception that the finance teams of the academic partners found the format of the finance section 'confusing'. It was suggested that because the format used was quite different to that used by the Research Councils – that they were more used to – it required extra work to check that their inputs were correct.

B.312 The two-stage nature of the application process was regarded as broadly effective, and the opportunity to receive and adapt an application for the second stage following some feedback was regarded as a 'very fair' and valued part of the process.

Contracting and monitoring

B.313 The contracting and monitoring processes were broadly regarded as effective. It was noted that, due to complications in terms dealing with the legal aspects of IP generated through the work, the contracting process between the partners was protracted. As the IB Catalyst grant had been dispersed before these contracting issues were resolved, it did result in some pressure from the IB Catalyst team for the issue to be resolved. It is important to note that a subsequent IB Catalyst project, considered fundable as part of Round 4, was one of the projects that has suffered considerable delays and uncertainty due to the budgeting issues that affected all Catalyst programmes. Although this was frustrating, feedback from the partners suggested that the IB Catalyst team did a 'reasonable' job communicating progress during this period, which helped to somewhat ameliorate their frustrations.

B.314 In terms of monitoring, all partners viewed the process as helpful and their monitoring officer as effective and objective-focussed (as opposed to a rigid focus on the original project plan, as can sometimes be the case). The partners did suggest that due to the expense of convening the various partners involved, some of the quarterly meetings could be conducted online. One academic partner suggested that one face-to-face meeting and three online meetings per year would be an effective and cost-effective format.

Completion and aftercare

B.315 The project was still underway at the time of the case study research and was expected to complete, on time, in October 2018. As such, it was too early to provide feedback on the IB Catalyst completion and aftercare processes.

Lessons

B.316 Overall, the project partners felt strongly that the IB Catalyst model was of considerable value. At the time of their application, this was the only source of funding available to support the academic-industry collaboration necessary for achieving the M-RIPPS outcomes. The only alternative for Ingenza would be to pay the Universities for access to their expertise and equipment, which – as an SME – would not be feasible without financial support. While they did feel that Innovate UK's current Health and Life Sciences ('HLS') competition could support a project of this nature today, it would very much depend on the details of the scope.

B.317 As noted, Ingenza highlighted the significant synergies that they have been able to benefit from, and expect to benefit from further, as a result of engaging in multiple IB Catalyst projects in related areas. The IB Catalyst model (in addition to other public R&D support from Innovate UK and other competitions) has allowed Ingenza to not only engage in valuable academic-industry collaboration, but also to access bespoke equipment, attract otherwise risk averse industrial end-users and engage in new areas of industrial biotechnology, which has allowed the company to diversify their capabilities and has supported its growth.

Perlemax

B.318 Perlemax Ltd was the project lead for the 'Enhanced Biofuel Production via Integrated Microbubble Technology' project. The project aimed to enhance bioethanol production via integration of microbubbles. At the time of the evaluation, the project was ongoing.

Table B-15: Project overview

Catalyst	Industrial Biotechnology
Round	3
Type of grant and amount awarded (by source)	Industrial Research stage - £779,193 by Innovate UK (£964,548 after a project change request)
Project start and duration	January 2016 – 3 years (3.5 years after a project change request)
Lead and collaborators involved	Project Lead: Perlemax – Micro – Sheffield Collaborator: Suprafilt – Small – Rochdale Collaborator: University of Sheffield – University – Sheffield (comprised of academic Professors, post-doctoral research associates, masters students and technicians)

Source: SQW

B.319 To inform the application for this project, Innovate UK funded a consortium-building seminar to help identify collaborators. Perlemax was unsuccessful in its first application but was successful with a revised bid in the next competition round.

B.320 The case study was conducted during February/March 2018 and involved a face-to-face consultation with two members of Perlemax (the project lead and a technical expert) and a telephone consultation with the University of Sheffield (UoS).

Context

B.321 Prior to this grant, Perlemax was involved in R&D activity, predominantly associated with the characterisation, optimisation and implementation of fluidic oscillation[45] for microbubble generation. R&D activity with other organisations such as water companies (e.g. United Utilities, Yorkshire Water, Wessex Water etc.) had also been conducted. Prior to this project, Perlemax had undertaken one project funded by Innovate UK and one funded by FP7[46], and, at the time of the consultation, was working on five Innovate UK funded projects (one under the Energy Catalyst, two under Surface Engineering and Coating for High Value Manufacturing, one under the European Research Area (IB) and the remaining project under the IB Catalyst (covered by this case study). The UoS team had undertaken many collaborative projects internally, across universities and with other industrial partners; the team involved in this project had collaborated on two Innovate UK funded projects to date, including this project.

B.322 Perlemax had worked with UoS and Suprafilt on previous projects but not together on an Innovate UK grant. At the time of the consultation, Suprafilt had passed the majority of their allocated budget to Perlemax, due to other business priorities.

[45] Fluid oscillation is a mechanism used to produce microbubbles on the order of <1mm in diameter Rehman et al (2015)
[46] European Union's Research and Innovation funding programme for 2007-2013 – now called Horizon2020

Overview of the project

B.323 Perlemax's aim was to implement microbubbles to enhance the aerobic propagation of yeast and enhance anaerobic fermentation of wheat mash into ethanol.[47] At the time of the consultation, propagation had been successfully demonstrated[48]. A pilot plant was in the process of being constructed in order to demonstrate an industrially relevant scale of these innovations. The UoS contributed lab scale research and facilities for the pilot plant, Perlemax provided the IP, knowhow and expertise for implementation of fluidic oscillation at all scales and Suprafilt's role was to fabricate the pilot plant, a role which has now been assumed by Perlemax.

B.324 The technical aspects of the project were progressing as intended, although they had been delayed due to turnover of post-doctoral students within UoS and the departure of Suprafilt from the project. This had resulted in a six-month extension to the project (both from Innovate UK and EPSRC). Whilst seen initially as a challenge, the departure of Suprafilt has not adversely affected the project in technical terms (beyond the timescales), and Perlemax has been able to take greater control of the project.

B.325 Both consultees believed that, without Innovate UK funding, the project may still have happened, although it would have been over a longer timeframe due to the difficulties in finding alternative funding, and at a lower scale due to the scale of the funding required. In addition, there may have been fewer collaborators involved – although some form of collaboration was required to ensure access to the required knowledge and skills. UoS added that there would have been a lower quality of research input, potentially through the use of Masters students instead of post-doctoral students.

B.326 Support was received from the Monitoring Officer for monitoring requirements and writing the Project Change Request forms (PCR); no other support during project delivery was needed from Innovate UK or elsewhere as the Monitoring Officer facilitated a straightforward reporting process. The ability to have numerous projects funded by Innovate UK has enabled Perlemax to share learning across its R&D activities and, overall, accelerate its innovations.

Project outcomes

B.327 At the time of the consultation, the case study had been successful in achieving a lab-scale test of the fermentation process and had progressed through Technology Readiness Levels (TRLs) from 4 to 5 with the aim of reaching levels 6 or 7 by project completion. Consultees reported significant knowledge development regarding the processes as a greater understanding of microbubbles was achieved through extensive testing with yeast. If the process is commercialised then it will lead to more efficient processes as 1) there will be greater, more viable biomass generated during propagation, leading to 2) enhanced fermentation and 3) further fermentation enhancement due to reduced ethanol toxicity on the yeast with anticipated outcomes[49].

B.328 The UoS team had benefited in terms of working with a new private sector partner, and believes there could be further opportunities for collaborative work in the future. An unexpected benefit has been the discussions to widen the scope for microbubbles to be used in other industries such

[47] This will be achieved via the yeasts' ability to exist for longer in a higher ethanol environment, in addition to *in situ* and *ex situ* ethanol stripping and low oxygen dosing during fermentation.
[48] Demonstrations were both in a pure system and an industrially relevant mash system at the lab scale.
[49] The overall anticipated outcome of these innovations are to reduce OPEX (reduced cooling costs in fermenters and reduced steam requirement for distillation), CAPEX (reduced distillation requirement – both thermal and molecular sieve) and increase revenue (increased ethanol production rate).

as the food and drink industry (more specifically for low/no alcohol beer and frothing of coffees). UoS added that it is also looking at yeast through a physiological perspective (compared to biological) which was not expected at the outset.

B.329 Consultees believed that, without the Catalyst project, the benefits could have occurred over a much longer timeframe, and likely at reduced scale and quality. Within the lead organisation, there is a difference in opinion in the extent to which outcomes would have been achieved. Once consultee stated the benefits would not have happened at all and the second consultee stated the extent of benefits without Catalyst support would have been dictated by the scale of the funding that could have been sourced from elsewhere.

B.330 Project related factors that have enabled success include the consortium's efforts and specialised roles in the collaboration, guidance from the Monitoring Officer and the reflective process in explaining the details of the technology within this project to the Monitoring Officer and Perlemax's stakeholders. No wider external/contextual factors have helped, however, at the time of the Case Study research, policy changes in the UK's regulation of E10[50] had hindered the project as ethanol is currently not used within the UK and exported to Europe[51]. At the time of the Case Study research, the two largest risks identified included not being able to successfully extract ethanol using microbubbles at the large-scale pilot within the timeframe of the project and potential changes in market attitudes towards the method.

Effectiveness of Catalyst processes

Awareness and marketing

B.331 Both consultees were already familiar with Innovate UK and agreed the IB Catalyst had a very strong profile for R&D in the sector. UoS added that it is working with other organisations (e.g. multinationals through to SMEs) to lobby via the NIBB (Networks in Industrial Biotechnology and Bioenergy)[52] to reinstate the Catalyst to support the development of sustainable products, reduction in greenhouse gases and for the development of the circular economy. If the IB Catalyst does not continue, the consultee believes that there is a risk that the UK, as a nation, will lose competitive advantage in this technology field. Therefore, it is not the promotion that needs to be improved, but rather the availability of funding through the Catalyst or some equivalent IB dedicated funding stream.

B.332 Perlemax would usually have sought other public funding to support the project but in this instance the IB Catalyst was the only funding opportunity available. UoS was aware of the IB Catalyst through the NIBB and therefore it was difficult to comment on the promotion of the Catalyst as a whole. UoS believed the Catalyst was preferred for the funding as the project was already at a higher TRL stage than was eligible under other funding provision (e.g. charities such as Leverhulme Trust).

B.333 The eligibility and intervention rate offered by Innovate UK fitted perfectly with the requirements of the project. Perlemax thought the 70% intervention rate was generous considering some European funding offers 60%. The Catalyst's model, with different stages of funding (early, mid

[50] The RAC defines E10 as '*a biofuel made up of 90% regular unleaded and 10% ethanol. Unlike regular unleaded petrol, ethanol absorbs carbon dioxide, partially offsetting greenhouse gas emissions'*.
[51] The Renewable Transport Fuel Obligation decision was made in September and ratified this month which included a cap of 2%.
[52] NIBB was created by BBSRC to provide a direct link to the IB Catalyst

and late), was seen to encourage the development of the project through the TRLs. The competition approach, with fixed deadlines and a broad thematic focus, worked well for consultees. There were suggestions for Innovate UK to announce the funding calls earlier to enable project leads to find collaborators and to encourage SMEs to proactively track when funding windows are likely to be open. The substantial reduction to intervention rates for subsequent calls within the IB competition calls has markedly reduced the attractiveness of such funding opportunities such that additional industrial money is required to make them work, from a financial perspective.

Application processes

B.334 Perlemax believed the consortium, consisting of an academic and industrial partner, helped contribute to the successful application. However, Perlemax did not find the application form intuitive as it was difficult to know what level of background knowledge assessors would have – and so how much detail Perlemax needed to provide. The application form was inflexible and the guidance was not as useful as consultees drew on their past experiences of writing applications. Perlemax suggest applicants who are applying to Innovate UK for the first time will be disadvantaged in being successful when compared to experienced applicants.

B.335 As lead partner, Perlemax was responsible for developing the application with revisions from partners based on their technical specialisms and financial requirements. The EPSRC form was submitted by the UoS. It was commented that the separate EPSRC and Innovate UK forms could be simplified, perhaps into a single application. The application form took three working days to put together once all information was collated (however the time taken to gather the information could not be recalled). The application was a one-stage process however, Perlemax prefers having two-stage process as if the project is not eligible, it's time is saved in filling out the full application form. Feedback on unsuccessful and successful project applications was seen to help guide the type of content that assessors find useful.

Contracting and monitoring

B.336 The contracting process, identified by one consultee was straightforward and took less time than Perlemax had experienced previously with Innovate UK, and the second consultee added it was still very long considering the complexity of the process. The UoS was also prompt in signing necessary contract documentation, and so the whole process was quick. No suggestions for improvement were given except that for a quicker turnaround from contracts (for both the application and project change request process) which would be helpful.

B.337 The quarterly monitoring meetings were beneficial to consultees to keep the project and the management of the financial cycle on track. However for a three-year project, one consultee from Perlemax suggested having meetings every four months (rather than quarterly) due to the time taken for processes to take place or products that have been purchased to arrive. For example, due to the procurement rules of the University (for approval, purchase and then delivery), it took six months to purchase and receive some of the required equipment. Perlemax added that, from its experience in other projects, some academic partners, initially, did not fully understand the requirement associated with quarterly meetings because Research Council grants often involve reporting at the end of the project only. This has since improved with the academics now fully engaged.

B.338 Consultees agreed that the Monitoring Officer for this project was 'excellent' as, in addition to helping with the monitoring requirements, he also 'cut through the bureaucracy' of filling out the three PCR forms[53] and helped guide the project. Perlemax had different Monitoring Officers for each of their projects funded by the IB Catalyst. This caused some difficulty as each Monitoring Officer had requested the monitoring reports to be filled out in different ways resulting in a lack of consistency between projects. For example, one Monitoring Officer requested the monitoring form to be filled out by Perlemax and another Monitoring Officer preferred to fill it out himself based upon meeting notes etc. Perlemax suggested for Innovate UK to adopt a consistent reporting structure across Monitoring Officers.

Completion and aftercare

B.339 The project is ongoing and so no completion/aftercare had been experienced as yet.

Lessons

B.340 Both partners had good experiences with the IB Catalyst and valued the funding as it accelerated the development of the innovation project. The key areas for improvement included: streamlining the application process (application form and guidance notes specific to call to inform the level of background knowledge of assessors), potentially, reducing the quarterly meetings to four-monthly meetings to allow time for products/processes to be completed, especially as it is a longer-term three-year project; having consistent methods for monitoring requirements across and within Catalysts; and reducing bureaucratic processes when applying for a project change.

[53] The three PCRs include a change in project finances, a project extension (to EPSRC) due to staff churn within UoS and a project extension (to Innovate UK) due to Suprafilt leaving.

University of Oxford

B.341 A range of common chemicals used in pharmaceutical drug, food and fragrance production rely on fine chemicals that are of a complex nature with a high degree of purity. Hydrogenation reactions, the addition of hydrogen gas (as electrons and protons) to a molecule, are used in a large share (10%-20%) of industrial chemical processes that produce fine chemicals. Traditional approaches to hydrogenation reactions are costly, because they require expensive purification strategies to discard a range of by-product compounds generated as part of the process due to low levels of 'selectivity[54]'. They are also not very 'green', because they use metal reagents[55] which are toxic and in finite supply.

B.342 Increasingly, biocatalysts (enzymes isolated from the cells of bacteria) are being used to speed up reactions and increase selectivity. While this offers the potential to reduce the costs of purification, such methods are also currently comparatively expensive to implement at industrial scale. At present, 'helper molecules' (e.g. nicotinamide adenine dinucleotide, 'NADH') are needed to power the hydrogenation reactions, which require 're-charging' after every use. Carbon-based power sources (e.g. sugar) are the most typical means of 're-charging', which presents a barrier to traditional biocatalysis being truly 'clean' and 'green'.

B.343 New Routes to Driving Enzyme-Catalysed Chemical Synthesis Using H2 Gas ('HydRegen') was a 5-year Translation stream project funded by the IB Catalysts and led by the Vincent Group at the University of Oxford. The aim of the project was to combine principles from chemistry and the power of biology to develop, demonstrate and de-risk a new 'cleaner', 'greener' and cost-effective approach to hydrogenation at an industrial scale – and using industry standard equipment/reactors. More specifically, the HydRegen project sought to develop a system of enzyme-modified beads designed to re-charge NADH molecules using hydrogen gas, one of the cleanest electron (power) sources available.

Table B-16: Project outcomes

Catalyst	Industrial Biotechnology
Round	Round 3
Type of grant and amount awarded (by source)	Translation stream Grant value: £2.9m
Project start and duration	2016 – 2020 (4 years)
Lead and collaborators involved	Lead: Oxford University No formal collaborators

Source: SQW

B.344 The technology has a wide range of potential applications, from pharmaceuticals to flavourings and fragrances.

B.345 The IB Catalyst funding was regarded as critical to the success of the HydRegen work. While an alternative route to market would have been possible – by spinning out a company and seeking investment – this would have changed the nature of the project significantly. For example, it is very likely that the team would have had to invest time and effort into securing new funding on an ongoing basis, which would not only have slowed down the project, but increased the risk that

[54] The ratio of product formation rate – e.g. the quantities of the desired compound produced in relation to other byproducts
[55] substances or mixtures used in chemical reactions and/or analysis

it would fail (if funding could not be secured). Another benefit to IB Catalyst funding was that they could carry out the work as a University research group, as opposed to a private spin-out. It was suggested that companies are more willing to engage with a University, compared to private companies, due to the relative lack of commercial sensitivities. The project was, therefore, expected to eventually spin-out a company to commercialise the new system under development.

Context

B.346 The HydRegen project followed a series of research and proof of concept grants, including an initial £1.1m, 5-year European Research Council (ERC) Starting Grant to support research into hydrogenase enzymes, awarded in 2010. A result of this work was – once the results had been obtained – the full potential of a new approach to enzyme-catalysed chemical synthesis using H2 gas was understood (the basis of the HydRegen work) as an important avenue of research with commercial potentials. A patent was filed in 2011, and shortly thereafter a £115k, 1-year Proof of Concept grant was secured to begin exploring the potentials of this approach. This grant supported the forming of the industrial relationships and knowledge required to translate the concept from lab - to industrial-scale. Further key support and grants received include:

- EPSRC CASE studentship October 2012 – September 2015, with Johnson Matthey[56] as industrial partner.
- BBSRC iCASE studentship from September 2015 to September 2019, with Johnson Matthey Catalysis and Chiral Technologies as industrial partners.
- A mentoring package, including the development of a relationship with GlaxoSmithKline (GSK), following being awarded the Overall Emerging Technologies Prize at the Royal Society of Chemistry's Emerging Technology finals.
- A £5,000 BBSRC Metals in Biology Network in Biotechnology and Bioenergy (NIBB) Business Interaction Voucher with GSK (a consequence of the mentoring package, above), from November 2014 to April 2015.

B.347 Subsequent to receiving the above grants and support, the team made an unsuccessful application to Round 1 of the IB Catalyst. The team needed to secure further funding to retain the key research staff required to progress the work. The team made a funding application to the Brian Mercer Charitable Trust, which was also unsuccessful. Before securing a Round 3 IB Catalyst award, the team was able to secure BBSRC Metals in Biology funding, which acted as bridging funding to retain the staff needed to advance the HydRegen project.

B.348 The grants, awards and industrial relationships described represent the first, significant instance of engagement with industry on work with a commercial objective by the Vincent Group team.

Project overview and delivery

B.349 The HydRegen project was led by the Vincent Group at the University of Oxford, with no formal project partners. The project has been instituted with an Industry Advisory Board to ensure that the research team works closely with industry, and that the research carried out is directed towards solving key, commercial problems. The project also employed the Centre for Process Innovation (CPI) as a sub-contractor to benefit from their industrial experience – specifically to

[56] A global, diversified company operating in several sectors, including chemicals

support the scale-up of enzyme production. The inclusion of the CPI followed from a recommendation received as part of the IB Catalyst application process (more details below). On the research side, the team was comprised of scientific expertise in a number of relevant fields, including fundamental biochemistry, molecular biology, chemistry, chemical processing and chemical engineering. This included involvement from academics based at different academic institutions, who have supported progress to date but have not been funded as part of the project.

B.350 As the work has progressed, the team has also been supported by the Oxford University technology transfer team and has undertaken business training to support the commercial aspects of the project, including an objective to spin-out a company mid-way through the project.

Project outcomes

B.351 The HydRegen project - underway by January 2016 - had just entered its third year at the time of case study research. The project was still at a relatively early-stage, but had made progress in gaining a better understanding of the possible routes to market, as well as opening up entirely new fundamental research opportunities. For example, as part of this work, the team had identified opportunities to apply the HydRegen technology as part of a flow or continuous production process – as opposed to a batch process – which was seen as an important field of research to develop cost-effective biocatalytical processes at industrial scale. In terms of progress to date, the following outcomes had been achieved to date:

- Three academic papers published in peer-reviewed journals (three papers were even featured on the cover), with more in development, and presentations at a range of academic conferences.
- A range of public engagement activities based on the HydRegen work, including: the development of a podcast; an animation; events, games and talks in schools; the development of an online platform to inspire and inform school students about Industrial Biotechnology and the HydRegen technology; and EPSRC events at the Royal Society. This work was partly supported by a Mathematical Physical and Life Sciences (MPLS) public engagement with research award.
- The team had secured a second BBSRC iCASE studentship to support the development of flow-based biocatalysis, which started in 2017 with Dr Reddy's as industrial partner.

B.352 In terms of expected outcomes, the team was broadly on track to spin-out a company in the next 12-18 months to begin licensing the HydRegen technology. The team was also exploring new patent applications to protect new developments arising out of the research.

B.353 Other factors that have influenced project delivery to date included the range of parallel research being conducted by the research team, some of which has supported progress made to date, with more expected in the future. The team has also engaged with existing and potential industrial partners via a range of networking events, including the NIBB networks, which is helping to ensure that the project progresses in line with industry demand (complementary to the role of the Industrial Advisory Board), and that interest in the project's developments can be communicated to potential industrial partners.

B.354 Two challenges to progress have been staffing issues and the cost of the enzymes needed for production. In terms of staffing, a technician involved in the work recently left, and has been replaced by a new PhD student who had less time to devote to the work. This issue was being managed, and was not thought to be a significant risk to the project. In terms of the cost of enzymes, the team was, at the time of the case study research, working with the CPI to scale-up the production of the enzymes required. As the enzymes used were not used commercially, they were quite expensive and not yet available in the quantities required. It was hoped that this issue would be addressed in later stages of the team's work with the CPI, and remained one of the biggest risks to commercialisation. Overall, however, the team felt that they have already 'ticked a lot of boxes' to de-risk the technology from an investment point of view, and – through their networking activities – were gaining significant interest from industry.

Effectiveness of Catalyst processes

Awareness and marketing

B.355 Following the identification of the commercial potential of the early HydRegen-related work, and the industrial relationship building and proof of concept work that followed, the technology transfer team at the University of Oxford (Oxford University Innovation) suggested that the team apply to the IB Catalyst for funding. The team was also made aware of the IB Catalyst though their departmental newsletter (which contained a section outlining relevant research funding calls, via the NIBBs) and through the Research Professional mailing list.

B.356 At the time, the team was exploring potential routes to advancing the technology, which was potentially too applied for standard academic grants, but equally too early-stage to be of interest to investors or establish a spin-out. The work was precariously positioned, with some key research challenges to overcome alongside a need for further funding to retain the experienced research staff needed to further progress and de-risk the technology.

B.357 The IB Catalyst funding was regarded as a 'perfect opportunity' for the work to progress, particularly in terms of allowing the work to continue within the University. The alternative route to advancing the HydRegen work would have been to form a spin-out and seek investment. Not only would this have meant that it would have been harder to collaborate with industrial partners openly – due to the potential for commercial sensitivities but the funding available would have likely been at a considerably smaller scale and over a shorter duration. The route would, as a consequence, have offered much more limited potential to de-risk the technology and to develop the R&D and commercial strategies in parallel (instead the focus would have been more focussed on the commercial side). In fact, it would have been quite likely that the project would not have advanced much further, if at all, without the IB Catalyst funding.

B.358 Overall, the Catalyst model was suggested to have been marketed effectively and regarded as a highly appropriate model to support important research of this nature.

Application processes

B.359 The Vincent Group team made an initial, unsuccessful application to Round 1 of the IB Catalyst. The feedback received on the initial application was regarded as high-quality and in-depth, allowing the team to significantly develop their bid across rounds (as well as from EOI to full application stage). Changes from Round 1 to Round 3 that resulted from the feedback included:

refinement to the focus of the work (from two approaches, to a focus on the most viable), and the inclusion of an industrial partner (the CPI) as a sub-contractor.

B.360 Overall, the team found the questions in the application form to be appropriate, not too onerous, and proportionate to the grant size on offer. The specific questions were thought to be useful, particularly in terms of making the team think in more detail about the commercial potential of the work, which has set a strong foundation for writing a business plan in the future. The guidance provided was regarded as helpful and of high quality.

B.361 The team did, however, find the application process challenging, and encountered multiple problems along the way for which it required some support, usually from the University's technology transfer team. The final submission process was not regarded as easy, and it was not made clear that submission had occurred, which caused some undue concern. The consultees highlighted that they were required to complete a second application (JES) form once the project was allocated to the EPSRC. This differed slightly to the initial application in the Innovate UK format, and the duplication was noted as a minor frustration.

Contracting and monitoring

B.362 As part of the project awards and contracting process, the IB Catalyst team had to make a decision as to which Research Council would fund the project. Eventually, the decision was taken to fund the project via the EPSRC (as opposed to the BBSRC). A serendipitous outcome of this decision was an uplift in doctoral funding allocated to them by the EPSRC. Doctoral funding is allocated based on a percentage of EPSRC research funding secured (which included the IB Catalyst funding), and so the Catalyst grant resulted in a substantial increase and has benefited a range of work in related areas.

B.363 More generally, the contracting process was regarded as straightforward and was mostly handled by administrative staff at the University of Oxford.

B.364 In terms of monitoring, the project was required to have six-monthly meetings. Monitoring on translation stream projects was conducted by the IB Catalyst Coordinator – an individual who was noted as highly respected in this field – which has made for high quality meetings that were not too burdensome. Due to the expertise and experience of the monitoring officer, meetings have been effective in helping the team to evaluate progress and better balance academic and commercial strategies. This was regarded as a real strength of the IB Catalyst model, and something that would not have been available from other possible funding routes (e.g. pure-academic funding, or the spinning-out of a company).

Lessons

B.365 The overall view of the consultees was that the IB Catalyst grant has enabled the project to progress at a higher speed, and with a more appropriate balance of scientific and commercial imperatives than would have been available from any other funding source. The main alternative would have been to spin-out a company, which would have been riskier, because the new approach in development was still at a relatively early stage with significant research hurdles to overcome.

B.366 As noted, a further benefit was the ability to deliver the project from the University (as opposed to as a private, commercial spin-out), which simplified interactions with industry, and allowed

the team to hire the best R&D scientists with the security of the University as employer – regarded as critical for the high-risk biotechnology sector.

B.367 Overall, had the project proceeded under a spin-out company, the team would likely be more advanced with some of the commercial aspects of the project, but they would be operating from 'a much weaker foundation'. Under the IB Catalyst the team was confident that they will eventually spin-out a much stronger company in the near future.