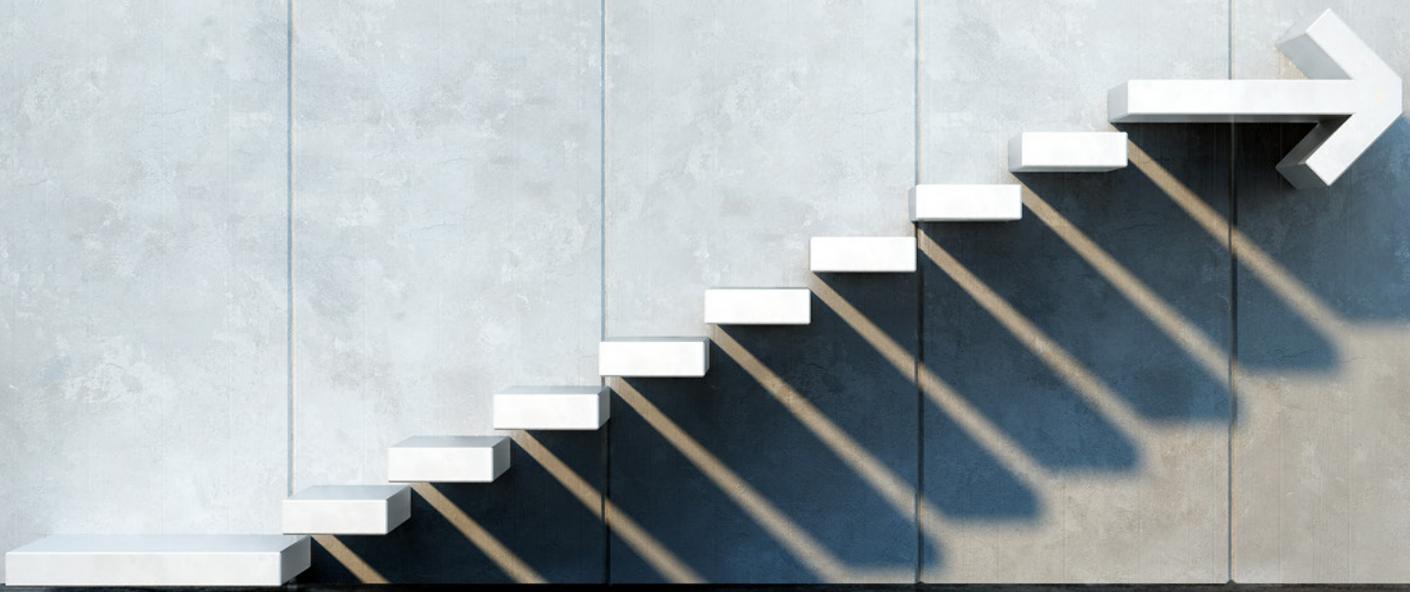


Innovate UK



Evaluation Framework

**How we assess our impact
on business and the economy**

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Contents

Introduction	4
Evaluation of innovation support	5
What is evaluation?	6
Why is evaluation important?	7
Evaluation as part of a programme cycle	8
Challenges in evaluating innovation support	10
Estimating additionality	14
Logic models	15
Approach to monitoring	18
Innovation Funding Service	22
Approach to evaluation	23
Process	24
Evaluation methods	26
Quasi-experimental methods	28
Qualitative approaches	31
Data linking	32
Evaluation plan	33
Innovate UK's structure	35
Moving towards a holistic approach to evaluation	36
Conclusion	38
References	39

Introduction

Innovate UK is committed to understanding and improving the effectiveness and efficiency of its activities. A robust, independent, and open evidence base helps us to ensure and demonstrate we are getting value for money from public funding. Evaluation is at the heart of this, providing clear evidence of the effectiveness of our processes and the impact of our activities, both on the companies we support and the wider economy.

This framework sets out our guiding principles for designing and implementing evaluations. It builds on guidance on evaluation in HM Treasury's The Magenta Book [1], guidance from the European Commission [2], the evaluation strategy of the Department for Business, Energy & Industrial Strategy (BEIS) [3], and our own experience in designing and commissioning evaluations.

This publication looks at what evaluation is and why we do it, the challenges we face in evaluating public support for innovation, how we have worked to tackle these challenges, and where there is work still to do. Evaluation is challenging, and the nature of innovation can make it particularly so. We recognise that our evaluations will never be perfect, but here we set out how we will make them as strong as practically possible.

A new framework

We also set out a new framework for monitoring the activities and outputs of projects we support, and an evaluation plan covering all of our activities. We explore how we can build on our existing evaluation activity, including this framework, to continue to improve our evaluation approach and our understanding of our impact.

We have continuously developed evaluation since our in-house team was established in 2013. Publication of this framework meets one of our goals on transparency and openness. We also wish to inform the development of evaluation of innovation support more widely.

Evaluation of innovation support

What is evaluation?

There are 3 main types of evaluation: process, impact and economic.

Process evaluations look at how a policy or programme (for clarity and simplicity, we will use the generic term programme to describe the subject of an evaluation) was delivered. They typically include a mixture of quantitative and qualitative methods used to understand the programme's financing and resourcing, perceptions of quality and effectiveness, and facts and figures on the operation of a programme.

Impact evaluations look at the difference a programme has made:

- what were the observed outcomes (such as technological development, or increased turnover)?
- how much of any observed change in outcomes can be attributed to the programme?
- how did changes vary across groups (across smaller and larger companies, or across sectors)?
- were there any unintended outcomes?
- did the programme achieve its objectives?

Economic evaluations look at whether the benefits of a programme justifies its costs. They come in two forms:

- cost-effectiveness analysis (CEA) estimates the total cost per unit of outcome achieved. In terms of Innovate UK's activities, this might consider the cost of delivering a grant – including the grant value, and the overheads associated with delivery – per new product commercialised, or per new job created
- cost-benefit analysis (CBA) places a monetary value on the outcomes. A full CBA will value as many of the costs and benefits as possible. In our case, the benefits will typically be measured through added value to the UK economy, achieved via improved business performance, or through wider economic benefits such as improved health and wellbeing, or reduced carbon emissions

“Evaluation is an objective process of understanding how a policy or other intervention was implemented, what effects it had, for whom, how and why.”

Magenta Book

All of these types of evaluation can be suitable, depending on the questions one is hoping to answer. Where Innovate UK is using new or amended processes in a programme, we would generally use a process evaluation alongside an economic cost-benefit analysis. This would show whether our processes are efficient and effective, and demonstrate whether the programme is justified in terms of benefits compared to costs.

Innovate UK is funded by the taxpayer, so we think of economic costs and benefits for the entire UK. We include costs and benefits to other parties in our evaluations. For example, when we provide a grant to a company, businesses are expected to provide match-funding. This cost to those businesses should be included in the total economic costs. Strictly speaking, we think of the 'opportunity cost' to businesses: the cost of providing the match funding is the value of the opportunity foregone in doing so. This can generally be considered the value of the next-best thing the business could have done with that funding.

Why is evaluation important?

An understanding of how programmes function – both in terms of effectiveness in delivering outputs, and the eventual impacts of those outputs – is essential to inform strategic decision-making and the allocation of resources in any organisation. Without an understanding of what is working well, and what is working less well, it is not possible to systematically, continuously improve. And without rigorous evaluation, it is not possible to fully understand what is working well.

For public sector bodies, such as Innovate UK, there is an important additional need to demonstrate the impact of public funding and to help justify and understand ongoing or future initiatives. Evaluations are a demonstration of accountability.

Well-designed evaluations can help confirm or revise our understanding of business needs around innovation, and how we can best meet those needs through targeted support. Over time, as we build the evidence base, we can better design our activities to ensure maximum return from public funding.

“Measurement is the first step that leads to control and eventually to improvement. If you can’t measure something, you can’t understand it. If you can’t understand it, you can’t control it. If you can’t control it, you can’t improve it.”

H. James Harrington, author and business process expert

Evaluation as part of a programme cycle

A broad policy cycle known as ROAMEF is used across the UK government. It charts how policies are developed, appraised, evaluated, and then fed back into policy design.

ROAMEF stands for:

- **rationale** – setting out the rationale for government action in any particular area
- **objectives** – defining the objectives a policy or programme aims to achieve
- **appraisal** – assessing the best ways of delivering a policy or programme, and estimating the costs and benefits
- **monitoring** – continuously checking progress of the policy in delivering the stated objectives
- **evaluation** – assessing the effectiveness and impact of the policy to see whether the anticipated benefits have occurred
- **feedback** – ensuring learning from the policy is fed back into its implementation and into the design of other policies or programmes

Figure 1, below, sets out this cycle, although it is important to note that in reality it is not a smooth, linear process, but rather an iterative one, with each stage potentially informing the others. Evaluation can inform all stages of this cycle, from understanding the rationale of any particular programme, to appraising the likely costs and benefits, defining the monitoring framework, and feeding back findings into programme design.

Later sections of this report – ‘Approach to monitoring’ and ‘Approach to evaluation’ – set out how Innovate UK approaches the implementation of evaluation in order to ensure robust, reliable evidence.

First, we go through some of the overarching considerations and challenges when designing an evaluation of an innovation support programme, and provide some examples of how we have sought to overcome these issues.

Choosing a proportionate evaluation

Rigorous evaluation can be resource-intensive, so it is important to consider the proportionality of any activity. Typically, the more novel, expensive, or high-profile a programme is, the more resource should be made available for evaluation. Likewise, where there is significant risk or uncertainty around the effectiveness or impact of a programme, a more intensive evaluation could be justified.

The evaluation strategy of the UK Space Agency includes a guide to choosing proportionate evaluation, setting out considerations of budget and profile against risk and uncertainty, outlined in Figure 2 opposite.

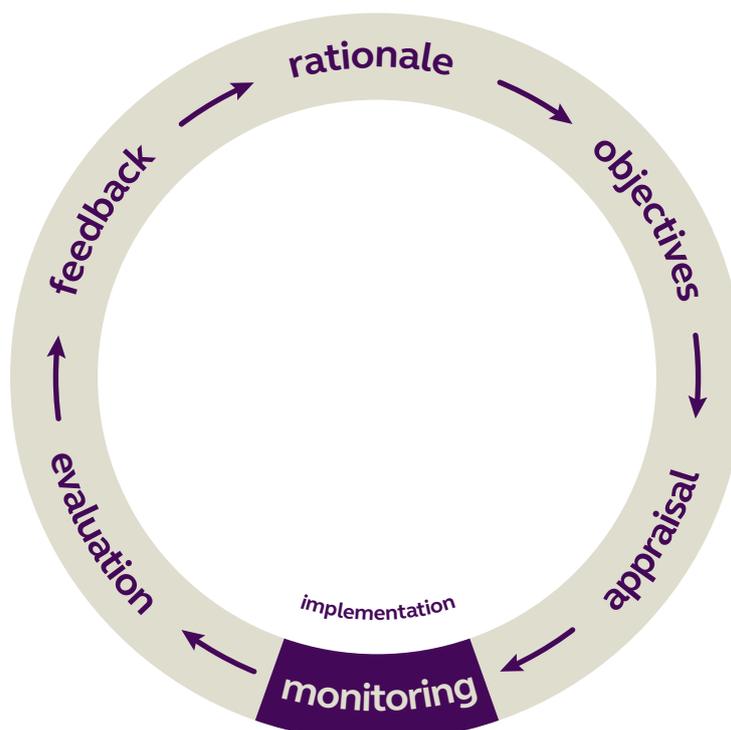


Figure 1:
The ROAMEF policy cycle

Source:
HM Treasury's Green Book – Appraisal and Evaluation in Central Government

Budget* and profile	High	Large project with significant budget and/or high profile with media and public interest and potentially high impact	Level 2	Level 3	Level 3
	Medium	Medium-sized programme with moderate budget and/or some media and public interest expected to have a sizeable impact	Level 2	Level 2	Level 3
	Low	Small budget and/or limited public or media interest with relatively low impact	Level 1	Level 2	Level 2
<p>* Budget thresholds LOW <£1m MEDIUM £1-10m HIGH £10m+</p>			Straight-foward low risk programme with low uncertainty around the outcomes	Programme not especially complex or risky but some uncertainty around outcomes	Complex programme design and/or significant risk and uncertainty around programme outcomes
			Low	Medium	High
			Risk and uncertainty		

Level 1: light touch, internal evaluation recommended including before/after monitoring

Level 2: consider commissioning externally with appropriate budget allocation

Level 3: detailed, externally commissioned evaluation with budget of 1-5% of total programme recommended

Figure 2:
 Choosing proportionate evaluation

Source:
 UK Space Agency

Challenges in evaluating innovation support

Measuring the impact of innovation support is notoriously difficult. Innovation can create improvements in business performance, but this generally happens over long timeframes, and there is a high level of uncertainty about when and where those benefits will manifest. Valuable knowledge created with Innovate UK's support can spill over to customers, the supply chain and competitors, making these impacts difficult to identify and measure.

Data paucity

This is exacerbated by a relative data paucity, a widely varied set of beneficiary companies that can frequently and rapidly evolve, a highly skewed distribution of impacts, and a lack of readily available data on companies' research and development activities and outputs. Where impacts are observed, it can be difficult to prove that it was Innovate UK's activities that led to those impacts.

In this section, we go through some of the most common challenges we face when designing and implementing evaluations of innovation support policies. We use a classification developed by Abdullah Gok, of the Manchester Institute of Innovation Research [4].

Innovation support affects a relatively small sample of the business population. It is unlike other areas of government policy, such as education and employment, where programmes affect millions and there are well-defined ways of measuring outcomes. There is no standard for collecting data or measuring results. Low sample sizes reduce the statistical power of any analysis.

Solution: evaluating our Smart programme

Smart was an open funding programme that offered research and development funding to small and medium-sized companies working in all markets and sectors. Our evaluation of the programme, published in 2015, covered a two-year cohort of Smart applicants from April 2011. There were responses from 293 successful applicants and 189 companies that applied unsuccessfully. Whilst these figures were sufficient to conduct analysis at a headline level, the power of the analysis quickly decreased when looking at the three different types of Smart award (proof of market, proof of concept, development of prototype), or by region, or company size. This limited the amount of detail and insight it was able to provide.

We have begun tracking cohorts in real time from the beginning of projects to overcome issues around sample size. This enhances the quality of data and encourages participation in the evaluation through regular contact. Where surveys take place 2 or 3 years apart, we contact participants in between to ensure up-to-date contact details are on file. Where necessary, we use longer time periods to increase the overall sample size, and we combine our data with data gathered from third-party sources without the need for surveys.

Heterogeneity

Heterogeneity, or diversity, amongst businesses can be problematic for many standard evaluation methods where that diversity cannot be controlled for. Companies differ greatly by size, region, sector, structure, and so on, and we have relatively limited data on them. Vast datasets can provide controls for a child's entire school history, but we are limited to relatively crude controls for business data such as age, size, and sector of the business.

The statistical models that underpin many evaluation methods – where sufficient controls for differences cannot be included – make an assumption that all units of observation (companies, in this case) are similar.

Innovation programmes are targeted at particular types of businesses. We also need to understand whether those companies that did apply and receive support were those that could benefit most.

Low observability

The primary output of innovation support is knowledge. Whilst this knowledge is often embedded in some form of innovation, which can lead to observable impacts through new products, services, and processes, it is also embedded in the minds of the people who worked on those projects. This knowledge cannot easily be observed or tracked.

It moves with people and is often applied elsewhere, in other projects, perhaps in other companies and industries. Typically, these spillover impacts to other beneficiaries are impossible to predict and difficult to track, observe, and measure in a cost-effective way.

Solution: tracking spillover impacts

In our Smart evaluation we are using repeated observations over time to learn about spillover impacts.

In the first survey, we asked Smart beneficiaries whether they thought any of their customers, suppliers, competitors, or others had benefited from their involvement with the project. Where they did, we asked what form those benefits took, and used the responses to build a classification of spillover impacts.

In the second wave of the survey, we asked another cohort which of those types of spillover they think may have occurred, and requested contact details of those affected so we could follow up. In practice, we faced difficulties in contacting the indirect beneficiaries, and the analysis was limited to a qualitative and non-representative discussion of types of spillover impacts. We will learn from and build on this approach in future evaluations. A report on this approach will be published in 2018.

Fluidity

Companies are fluid. They change frequently and unpredictably. This could be through introducing new products or processes, entering new markets, or more fundamentally, through mergers and acquisitions.

Solution: monitoring companies' change

We have been using external data, from Companies House and other databases, to gain a better understanding of changes in company ownership and exit strategies. This will provide us with a clearer picture of how the companies we support may change over time, and help us to understand whether grant support has any impact on company structures.

We are considering the use of advanced analytical techniques to dynamically analyse internet data for product launch activity, widening the extent to which we can monitor impacts without being reliant on company surveys.

Long-tailed effects

Statistical models often assume a standard 'normal' distribution of observations around a mean. However, the impacts of innovation tend to be highly skewed towards a small number of very successful projects, with a long tail of low or no-impact projects.

As with heterogeneity, this profile of returns can undermine the statistical models being used. There is an important implication: most evaluation methods seek to calculate the 'average treatment effect', essentially the mean impact of a programme on a participant. Where impacts are highly skewed, this can be misleading. In cases where the high-impact subjects are missed by the evaluation, impacts could be under-reported. Impacts could be over-reported where they are included.

Duration and lagged effects

Innovation support often takes place over a number of years. Specific supported projects may last up to 3 years or, in the case of the Catapults, programmes may be designed to have an impact over a longer period. The impacts of the innovation can occur later than the period of the supported project, as further development or commercialisation work is needed. Once they do materialise, they can last a number of years.

In the initial years following public support, it can appear that returns are low or non-existent. Indeed, research has shown that companies that are innovating (rather than those that have innovated) are less productive than those that are not, as they are investing resources into innovation before realising any revenue or efficiencies from the project [5].

Solution: evaluating over a long time

Our evaluations are designed to span a wide time frame, from the start of projects to several years beyond their formal end. In our ongoing evaluation of the Sustainable Agriculture and Food Innovation Platform, we looked at projects that started as far back as 2010 with the intention of conducting surveys in 2016 and 2018 to evaluate the programme's impacts.

At the point of the 2016 survey, only 28% of projects had completed, and around half of all respondents said they expected to commercialise innovations resulting from the projects over the following three years. Based on this, we have extended the evaluation to 2020, a full 10 years after the first competition.

Further issues arise in such long-term evaluations, including people moving on and memories fading. Long-term evaluation is best designed early on, to ensure data is collected as things happen, and that expectations for data collection and reporting are set early in the process.

Attribution of impacts

Innovate UK is part of a complex science and innovation system. There are many organisations at national and sub-national levels providing a variety of support that companies may interact with before, during, and after Innovate UK support. Indeed, companies may be involved in many types of Innovate UK support at the same time. Identifying the contribution of any single programme with observed performance improvements is difficult. The support of any single programme is often necessary for outcomes to be realised, but not sufficient in itself.

Attribution can also be an issue around past or ongoing private sector investment in innovation or skills. If the data cannot account for all of this – which it typically cannot do to a sufficient degree – then attribution of impacts becomes more complicated.

We have taken some steps towards controlling for the wider policy environment, using surveys to ask about other public support received, and data on other programmes and past innovation activity. However, the full complexity of the environment cannot be captured and controlled for through these techniques alone.

Solution: using data from other sources

Greater use of data from outside organisations would allow for a more complete picture of businesses that receive multiple forms of support. For example, we have in the past used such data to look at companies that have received support from British Business Bank and Innovate UK programmes. Nesta have been compiling data from local enterprise partnerships and growth hubs to build a picture of local support. The inclusion of more programme data could allow a more complete, robust analysis of the impact of multiple interventions for a single company.

Endogeneity

Endogeneity occurs in econometric models where a variable being used to explain an outcome – for example innovation support being used to explain business performance – has a correlation with other variables that also affect the outcome but are not captured in the model. In our example, this could be a company's ambition. Ambition could affect a company's likelihood of applying for innovation support, and could also affect that company's performance [6]. If ambition is not controlled for in the model, the results will be biased and either under or over-stated.

For innovation, there are several factors that could lead to an endogeneity problem, not least due to an ambiguous cause-and-effect relationship between innovation and performance. Indeed, some research demonstrates that the observable characteristics – such as the age, size, or sector – of a business only explain a small part of innovation and growth, and unobservable characteristics play an important role [7].

Strategic behaviour

Economics is, at its heart, a study of reaction to incentives. Economic evaluation must be wary of strategic behaviour in response to the incentives that government programmes create. Companies can be expected to react strategically to innovation support, changing behaviours in order to increase the likelihood of receiving support. These behaviour changes may not last beyond the timeframe necessary to receive support, and so longer-term behaviours – such as lasting changes to investment in innovation – must be accounted for in evaluation.

Tackling these challenges

All this makes traditional evaluation methods less readily applicable. Innovate UK is committed to being an innovator in this area. We have been working over the last 2 years to overcome these challenges and design and implement evaluations using the most robust available techniques to better capture the impact we have.

Throughout this report, we have set out some of our approaches to the challenges we face, but these do not solve everything. Some innovation programmes will continue to be difficult, or impossible, to evaluate robustly in a quantitative manner.

It is important to recognise clearly and openly the limitations that any evaluation will have, whilst striving to ensure the most robust approach possible is implemented. In some cases, this will mean relying on more qualitative methods to complement potentially flawed quantitative analysis. Our evaluations will always seek to set out challenges, our actions to mitigate them, and where limitations remain.

Estimating additionality

Impacts seen in an evaluation should be measured against a baseline of what would have happened had the intervention not occurred. Gross impacts need to be adjusted to discount for what would have happened anyway – the ‘deadweight’. For example, a grant is provided to a company that was going to invest fully in the project regardless. All government policies are likely to carry some deadweight.

In reality, it is not a question of whether something is simply additional or not. Partial additionality will be common. An outcome might have occurred in the absence of a programme, but it would have been achieved over a longer time period, or perhaps at a different level of quality. Evaluations should enable partial additionality to be captured and, where possible, quantified.

The location of outcomes and impacts is a further consideration, especially if local effects are a programme objective. If a programme aims to encourage investment in a particular region, for example, the evaluation might consider whether impacts are additional to that region, rather than the whole country (although any negative impacts on other regions should also be measured).

A common approach to assessing additionality is to define a ‘control group’ of companies that do not receive ‘treatment’ – a counterfactual – and to compare the outcomes of the treatment group and control group to understand additional impact. Different approaches to defining a control group are explored in later sections, but the challenges to evaluation set out above do make the construction of a credible counterfactual extremely difficult, if not impossible, for some types of innovation programme.

Wider effects

Beyond deadweight, and beyond what it is possible to infer from a counterfactual, there are wider effects to consider in an evaluation. These include:

- **displacement:** where positive outcomes of a programme are offset by negative outcomes elsewhere. For example, where an Innovate UK grant leads to a company increasing their market share due to their commercialisation of an innovative new product, other companies see their market share reduced
- **substitution:** where the effects of a programme are realised at the expense of other activities. For example, where a grant leads to a company investing in one R&D project at the expense of an alternative R&D project, which could also have had productive outcomes
- **leakage:** where the programme’s benefits ‘leak’ to those outside the target group. For Innovate UK, this would be where some or all of a programme’s benefits accrue to overseas companies
- **knowledge diffusion:** where beneficiaries of a programme develop new knowledge and then move on and apply it to projects not associated with the programme. These spillover benefits are generally found to be large – often larger than the direct benefits of innovation support [6]

Evaluations should also consider whether a programme has led to any unintended or unforeseen consequences.

Example: estimating deadweight

We have estimated the extent of deadweight in our programmes by using control groups. Deadweight is not a black-and-white issue, and headline numbers need to be treated with some caution.

Our evaluation of Smart (2015) found that 60% of high-quality projects that did not receive an award did continue, suggesting reasonably high levels of deadweight. However, of those 60%, some 90% continued at a slower pace, or with a reduced scope, suggesting there would have been some additionality to those projects if they had been funded.

In our evaluations of both Smart and SBRI (Small Business Research Initiative), deadweight was found to be lower the further the innovation project was from market. This fits with expectations. As innovations move closer to market, the risks decrease and the likelihood of raising funding – whether from internal or external sources – increases. This is not to say that all government efforts should be focused further from market. Additionality is still found to be high in closer-to-market programmes, where many risks and uncertainties remain.

Logic models

A logic model is a graphic that sets out a programme's expected path. It shows the relationships between each step. They provide a framework for understanding how best to monitor and evaluate a programme. Figure 3 below provides a simple logic model for an R&D grant programme.

This simplified logic model demonstrates what data needs to be captured through monitoring and evaluation. Instead of just focusing on the end game – economic growth – which may take years to materialise, and could occur outside the direct scope of the programme, the logic model shows the expected shorter term outputs and outcomes.

So, a monitoring and evaluation framework should look at:

- **inputs:** the resources required to achieve the programme objectives. Here we would be looking at the grant funding and the overhead costs of delivering the programme
- **activities:** what that funding delivers. Here we would be looking at the number of R&D projects funded, most likely broken down by company and project characteristics
- **outputs:** the direct result of the activity, observable by the end of the activity. Here we would most likely be looking at technological progress, or increased knowledge
- **outcomes:** the changes or benefits that result, generally to the direct beneficiaries of the programme. Here we would be looking for increased sales or other forms of enhanced business performance resulting from the innovation
- **impacts:** the final, wider changes that result from the programme. Here we would be looking at the economic growth resulting from increased business innovation

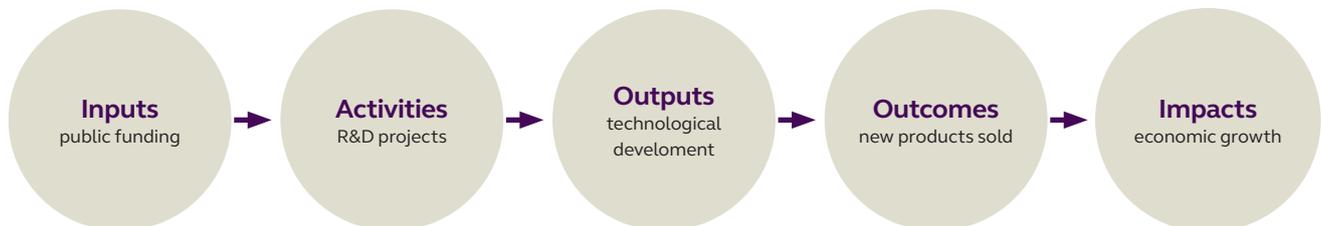


Figure 3:
Simplified logic model for
an R&D grant programme

First step in evaluation

Figure 4 below shows a more complex logic model taken from one of our ongoing evaluations.

Having a logic model for the programme helps ensure that any evaluation measures things that are expected to occur, whilst allowing for the capture of unexpected impacts. It reduces the risk that spurious outcomes or impacts will be sought. For example,

programmes that seek to increase productivity are less likely to lead to large increases in employment. Indeed, the opposite could be the case.

A logic model is the first step for every evaluation or impact analysis conducted for an Innovate UK programme. In the rest of this publication, we will use the terminology of the logic model to describe which aspect of a programme we are considering.

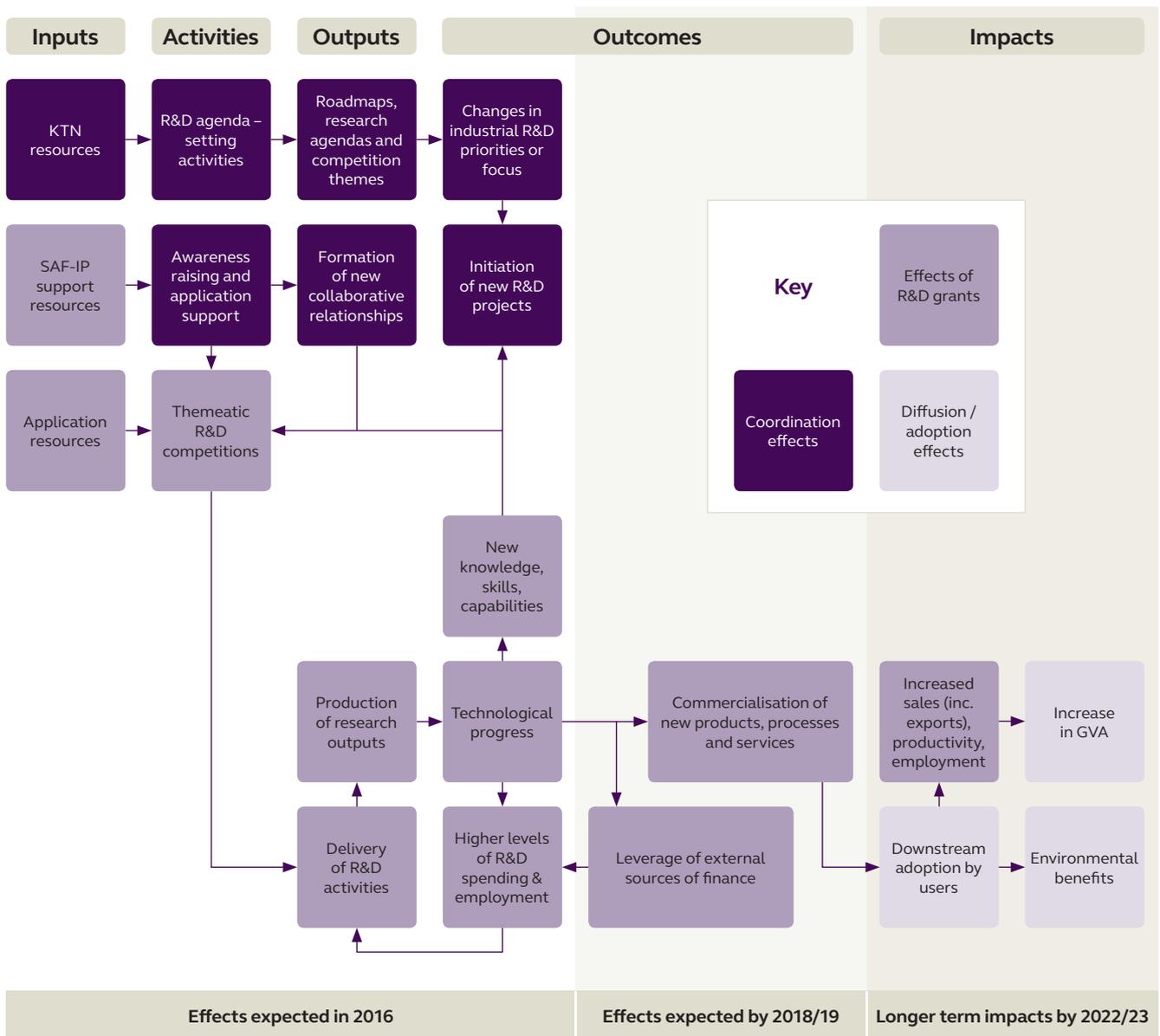


Figure 4: Logic model for our strategic investments in sustainable agriculture and food

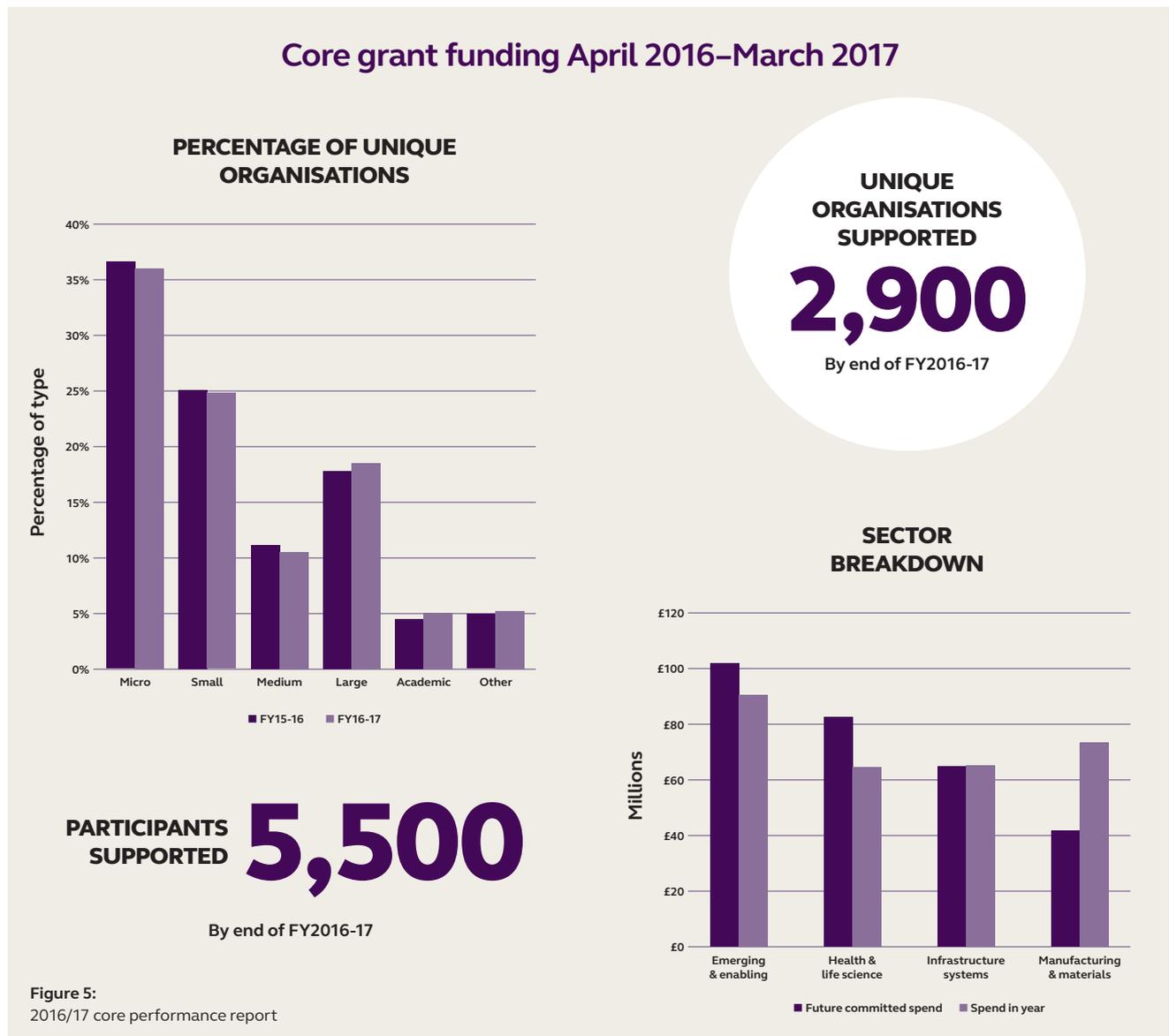
Approach to monitoring

Approach to monitoring

In 2017, Innovate UK published the first of our new performance reports, built from our transparency data – a monthly publication covering the details of each grant we have provided or managed since 2004 [9]. The 2016/17 report is set out in figure 5. The reports present an overview of our existing monitoring data, at an Innovate UK level, setting out clearly and transparently the types of organisations our funding has gone to, where those companies are, the industry match funding, and some details of the number of active projects and competitions.

“Monitoring seeks to check progress against planned targets and can be defined as the formal reporting and evidencing that spend and outputs are successfully delivered and milestones met.”

Magenta Book



SPEND IN YEAR

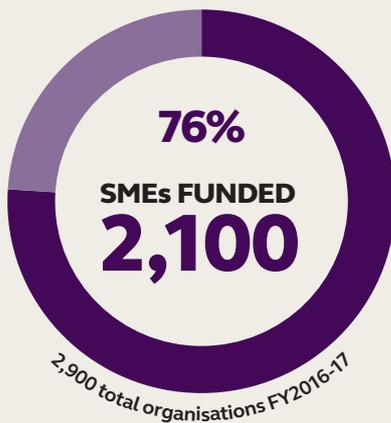
£294M

Total spend on projects in FY2016-17

FUTURE COMMITTED SPEND

£292M

Projects started in FY2016-17

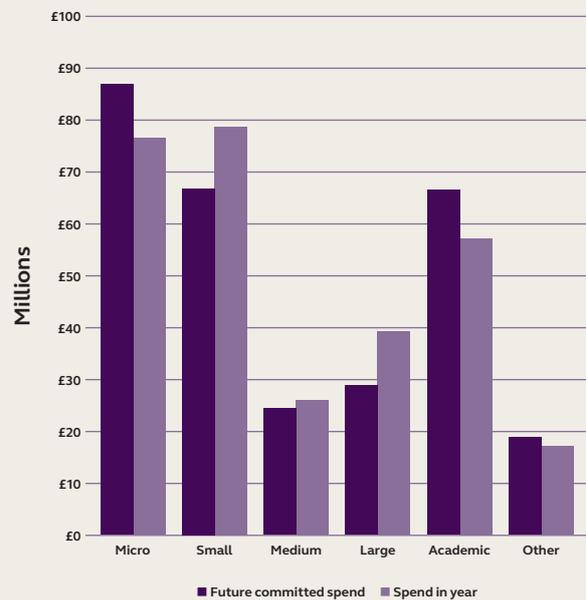


CROSS SECTOR SMEs

230

Number of SMEs operating in more than 1 sector in FY2016-17

ORGANISATIONAL BREAKDOWN



NUMBER OF PROJECTS COMPLETED

1,100

Projects completed in FY2016-17

NUMBER OF LIVE PROJECTS
2,400

At end of FY2016-17

£116K
AVERAGE SPEND ON CURRENT PROJECTS

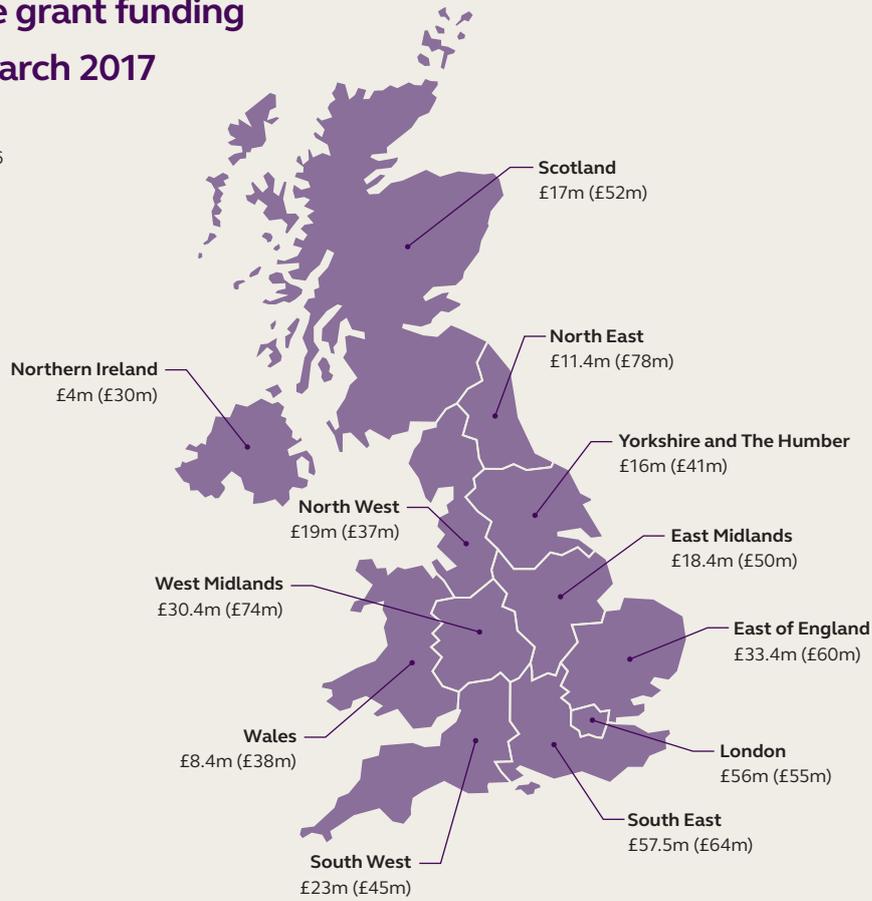
£95K
AVERAGE COMMIT FOR NEW PROJECTS

Median grant amounts in FY2016-17

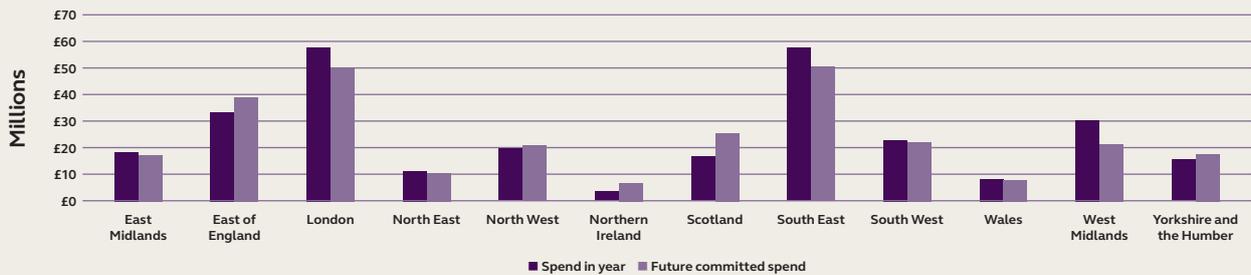
Regional core grant funding

April 2016–March 2017

Figures in brackets:
Per business October 2016



SPEND AND COMMITMENT BY REGION



SPEND IN YEAR BREAKDOWN

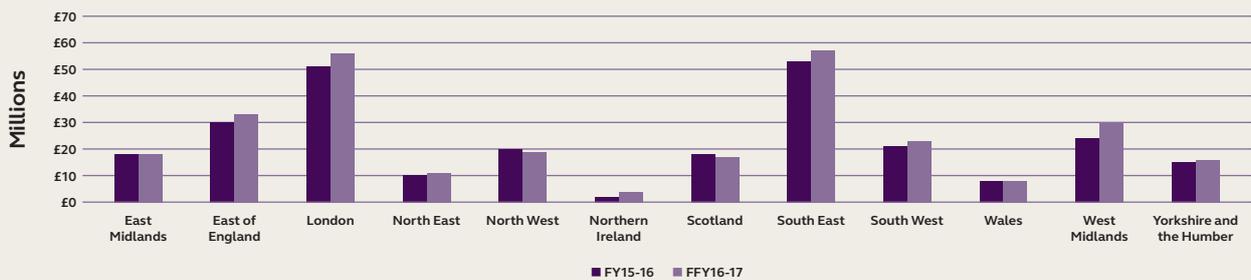


Figure 5 continued:
2016/17 core performance report

Data types

The report covers 3 main data types:

- the number and headline characteristics of companies receiving grants
- the amount of funding provided
- the number and nature of grants provided

Data we collect but are unable to publish due to commercial sensitivity gives similar detail on unsuccessful applicants to our programmes.

Summarising transparency data

These performance reports aim to summarise our transparency data on a regular basis. They provide timely, accessible information that can be used to manage our programmes and communicate to the public what we are doing. Currently, these reports capture our funding and activities. In 2018 we are introducing new monitoring systems to capture project output data consistently across all of our projects, and supplement this with data on the expected outcomes and impacts of those projects. This includes data covering:

- collaboration activities
- improved or gained skills
- technological progress
- new products, services, or processes commercialised or implemented
- expected cost savings, licensing revenues, or turnover
- employment impacts

This data will, for the first time, enable Innovate UK to monitor the complete path for each project, from inputs and activities, through to outputs and expected impacts. This will allow for more complete performance reporting in 2018, and more sophisticated management of our activities. The first data from this new system is being collected, and it is expected that there will be sufficient data to incorporate into our performance reports from 2018, improving the evidence for decision-making.

Monitoring data can also be a valuable input to evaluations. Our administrative data on projects and project participants are vital for evaluations, but they do not on their own provide robust evidence of impact. Data on companies we have supported and what the projects have achieved provide an overview of what our funding is enabling. Critically, they do not demonstrate what would have happened in the absence of our funding. For that, we require the more sophisticated data collection and analysis that evaluation provides.

Innovation Funding Service

Innovate UK introduced a new online grant application system in 2017, the Innovation Funding Service (IFS). This is an end-to-end, customer-focused and easily accessible online grants application and processing service. IFS is designed to provide access to all of Innovate UK's funding mechanisms through a single, intuitive service and a faster, clearer application process. It also provides timely, validated, accessible data and business intelligence, enabling timely, robust analysis of programmes' monitoring data.

Approach to evaluation

Innovate UK follows best practice on evaluation, embedding evaluation activity into the design and delivery of programmes. This section sets out our processes and guiding principles around the design and implementation of evaluation, the range of methods we could use in evaluating our programmes, and our aspirations for continuously improving.

Process

Evaluations should be built into a programme's design, and programme design should reflect the needs of a robust evaluation. Innovate UK's project authorisation forms will include explicit consideration of evaluation from 2018 – would the programme be covered by any existing evaluation? If not, is a new evaluation required?

The decision to have a new evaluation is based on:

- the importance of the programme in terms of cost and strategy
- whether there is any recent, robust impact evidence available
- whether the programme is novel, either in its processes and delivery mechanisms, or in what it is trying to achieve
- whether the programme has a high public or political profile

New evaluations

Where a new evaluation is required, our in-house evaluation experts will work with the programme team to go through a series of steps to help define the needs and approach of the evaluation. These steps are in line with the processes set out in The Magenta Book:

- define a high-level logic model for the programme, setting out objectives and intended outcomes
- consider whether any adjustments to the programme's design or implementation could enhance the potential for robust evaluation. For example, consider whether a pilot phase or phased roll-out might be possible
- define the audience, or audiences, for the evaluation. These could include: internal audiences, for strategic decision-making; other public organisations, to justify the programme expenditure; or the public, including businesses who might benefit from innovation support
- identify the objectives of the evaluation and the research questions to be answered. Consideration is given to what the programme lead, Innovate UK, BEIS, or other stakeholders will need to know about the programme and its impacts, and the evaluation's scope will be defined
- identify the appropriate evaluation approach(es). Consideration will be given to whether a process evaluation is required alongside an impact or economic evaluation. The likely level of robustness will be assessed, based on the programme design. The precise evaluation method is not defined at this stage, although likely methods will be identified
- define the monitoring framework. Consideration is given to what data is required to answer the evaluation's research questions and, in particular, whether the existing monitoring system is sufficient for this. Where it is not, potential data sources will be identified
- define the governance around the evaluation. To ensure subjective oversight, Innovate UK's central economics and performance team lead on all evaluations of Innovate UK programmes, and a steering group for each evaluation is formed, involving representatives from the programme and from BEIS analytical teams. Other appropriate stakeholders are considered for the steering group as necessary. A budget is defined based on the scale and profile of the programme and the complexity of the evaluation

Independent research

The evaluation is then conducted. In most cases, we commission external, independent researchers to conduct evaluations on our behalf, overseen by the evaluation steering group. This is partly due to the sheer volume of work that evaluations entail and, more importantly, to enhance the credibility of the evaluation findings. Independent researchers are more likely to provide a subjective evaluation of the programme's impacts, and business engaged in the evaluation are provided with a degree of separation from Innovate UK, enabling them to respond openly and honestly. Where evaluation work is conducted in-house, any surveys will be commissioned from independent companies to allow for open, honest responses from potential respondents.

We involve the programme team in the evaluation from the beginning to help ensure that the evaluation results are fed back into the programme's design and implementation, and that any implications for the wider organisation are considered. The final evaluation report will be published to ensure transparency. Where recommendations are made for process improvements, these will be considered by the steering group and an action plan will be drawn up.

We work with the BEIS independent peer review group for evaluation at appropriate points in this process, inviting feedback and suggestions to improve our methods.

This process from programme inception to evaluation feedback ensures that our evaluation framework and plan cover all key activity and provide robust evidence on the effectiveness of our processes and impact of our programmes.

Evaluation methods

There are a wide range of quantitative and qualitative evaluation methods for measuring the impact of a programme. Any single method will rarely be sufficient to capture the full impact of any programme, and so evaluations of Innovate UK programmes almost always bring together multiple methods in order to provide a more complete picture of impact.

We have outlined several challenges we face when evaluating innovation support, from small sample sizes and unobservable outcomes, to long lags to impact and a diverse, changing business population. These challenges, combined with a programme's design and characteristics, will be an important determinant of which evaluation methods are most suitable, feasible, and robust for any one programme.

An important part of selecting the right method is capturing a good 'counterfactual' – an estimate of what would have happened in the absence of a programme.

We aspire to be world leaders in the evaluation of innovation support, and this means we need to innovate in how we evaluate. We will always look to try new methods and analytical techniques, expanding the use of the most rigorous techniques, and using new tools such as web scraping and social media analysis. But at the core of each evaluation, we will first ensure that we are doing the basics right, measuring what can be measured through tried, tested, and peer-reviewed techniques, and innovating on these foundations.

In this section, we go through evaluation methods we are most likely to use, and set out examples of those we have already used.

Randomised controlled trials

Randomised controlled trials (RCTs) are often regarded as the gold standard of control-group evaluation in medicine. The primary benefit is that cause of impact can be derived due to the randomised nature. Treatment is allocated to a sub-group of the eligible population selected on a randomised basis, whilst the remainder of the population do not receive the treatment. Following 'treatment' – it could be the receipt of a grant for an innovation project – the outcomes in both groups are observed and, assuming the trial has been run correctly, the difference observed between the two groups is caused by the intervention and not some other factor.

Why is this the case? With a large enough sample size, the characteristics (observable and unobservable) that could affect the outcomes of interest will be balanced across the two groups. For example, some businesses might be more motivated than others. This can be hard to observe and control for in an evaluation. By randomly selecting businesses in the 2 groups, the distribution of motivation levels in large enough samples will be equal. In other words, allocations of support have been determined by chance and not correlated with motivation. In this way, the randomisation controls for all other factors that might affect the outcome of interest (say, turnover), and the observed difference in that outcome can confidently be ascribed to the programme.

RCTs designed and delivered correctly are a powerful evaluation tool. However, it is not always feasible to use an RCT. Most Innovate UK programmes are designed to allocate support to projects on the basis of excellence. This is not a random process. Whilst it may be feasible to make it random for the purposes of evaluation, we could run the risk of not evaluating the programme as it is designed to be delivered. There are also legal and ethical considerations.

The advantages of an RCT make it the most powerful evaluation method where feasible. However, transferring it from a laboratory environment to a complex system such as innovation risks invalidating the entire experiment.

Innovate UK recognises that RCTs represent the most robust method of measuring the causal impact of our programmes, and we commit to consider them for all areas of our activity. However, we also recognise that they can be difficult to implement, particularly at a programme impact level. The box opposite sets out how we are working with partners to identify the opportunities to run RCTs, and to design programmes and processes to enable us to run them.

Randomised control trial of Innovation Vouchers

Innovation Vouchers were introduced in 2012 and provided SMEs from all sectors with financial support of up to £5,000 to fund the services of experts from academia, research and technology organisations, or the private sector in support of an innovative project.

The programme was set up to operate as an RCT, with vouchers being allocated to eligible applicants on a randomised basis. A light-touch application process reduced the burden on applicants, and a lottery system combined with an eligibility check was used to make the awards.

Innovate UK is working with Nesta's Innovation Growth Lab and researchers at the Max Planck Institute to design and implement an RCT of the programme. The evaluation focuses on three rounds of Innovation Vouchers, allocated in 2014 and 2015.

To ensure the control group of companies not allocated a voucher is comparable to the treatment group, all applications went through an eligibility check. A survey was then designed to consider the impact of the programme on collaboration with external partners, innovation activities, innovation outputs and business performance. We are currently embarking on the second and final round of surveys for the RCT, and will report findings later in 2018.

The Innovation Growth Lab (IGL)

The IGL was formed in 2014 and is a global collaboration that aims to enable, support, undertake and disseminate high-impact research that uses randomised trials to improve the design of programmes and institutions. Innovate UK is a founding partner of IGL. We work with them and other partners to improve our understanding of how we can implement more rigorous evaluations, including designing specific RCTs around some of our activities. We will be launching more RCTs in the coming months and years.

Quasi-experimental methods

Where randomised evaluations are not feasible, quasi-experimental approaches tend to be the next most robust option. In quasi-experimental approaches, random allocation to treatment is not possible, and some control, or decision-making criteria, around allocation is instead taken. For Innovate UK, this control would be the assessment process of applications for funding, through which projects are funded on the basis of excellence.

Whilst allocation is not random, quasi-experimental methods use analytical approaches to estimate a counterfactual or identify a comparison group to provide a robust measurement of impact. The primary concern with quasi-experimental approaches is that there may be systematic differences between the control and treatment groups, which could undermine the ability to determine any causal link between treatment and observed outcomes. The design of the control group is critical to the success of such methods.

Where applications to Innovate UK for support are typically ranked according to excellence, the most likely source of a suitable control group is unsuccessful applicants to the same programme. This approach carries some pros and cons. On the plus side, unsuccessful applicants are more likely to share similar characteristics with successful applicants than the general business population. They have demonstrated:

- an awareness of public support, which could be correlated with performance
- an innovative approach, which is known to be correlated with performance
- a project at a similar level of innovation, which could correlate with performance (innovative businesses with a less or more advanced project might have different lags to performance outcomes)
- the company has an innovation project in a similar technical or sectoral area, which might be expected to have similar expected returns to the successful applicants
- the company is likely to have similar levels of motivation and ambition to the successful applicants

Overcoming selection bias

Using unsuccessful applicants as a control group helps overcome the selection bias that can be associated with quasi-experimental methods.

However, there are also potential disadvantages to using unsuccessful applicants as a control group. Most notably, by definition, unsuccessful applicants are conducting innovation projects judged to be of a lower quality than successful applicants. This could be for several reasons, all of which might have implications for the validity of the control group. These could include:

- the project is less likely to have significant returns, meaning the control group would be expected to perform less well than the treatment group
- the project is either too early or too late in the innovation journey to be suitable for grant funding. This means the control group would have a different returns profile to the treatment group
- the application could be rejected because it is likely to go ahead without public funding, meaning the control group would be more likely to proceed without treatment

In order to overcome these issues, control group design should focus on projects deemed to be high-quality and fundable, but for which funding was not available. This would increase the observed and unobserved similarities between the treatment and control groups, enhancing the validity of the control group. Innovate UK tends to receive more high-quality applications than it has funding available, providing a suitable pool from which to draw a control group.

Regression discontinuity design

There are several quasi-experimental approaches that can be used, depending on the specific circumstances. At the most robust end of the scale, regression discontinuity design (RDD) uses a threshold or cut-off between the control and treatment group to analyse the difference in outcomes resulting from the programme at the margins of the 2 groups. This can be used in Innovate UK programmes where there is a particular quality threshold (for example, an assessment score of 70%). It uses a presumed randomness in allocation either side of that threshold to proxy a random allocation process.

RDD approaches require a clear threshold between the 2 groups, and a sufficient sample size around the margin, meaning it cannot always be used in evaluation. The box on page 30 sets out how this approach was used in defining a control group for the evaluation of the Biomedical Catalyst.

Difference-in-difference analysis

An alternative approach is difference-in-difference analysis (DiD). Once an appropriate control group has been defined, measurements of the outcomes of interest are taken before and after the programme. The primary assumption behind the approach is that any unobservable differences between the treatment and control groups are constant over time, and so any observed difference in outcomes following treatment compared to the baseline measurement can be assumed to be caused by the programme. Figure 6 sets out the approach graphically.

There are a number of ways to help ensure the treatment and control group are as similar as possible. As previously set out, one approach is to select the control group from high-quality, unfunded applicants. Another common approach is to use a matching technique, such as propensity score matching. This is a statistical technique that estimates the probability that any business will receive treatment based on observable characteristics. These probabilities, known as propensity scores, are then used to match businesses in the treatment and control groups, so each group contains businesses with a similar set of propensity scores. The intention is to remove the effect of those observable characteristics from any analysis of outcomes.

There are numerous matching techniques available, and a case-by-case analysis of which is the most appropriate should be conducted.

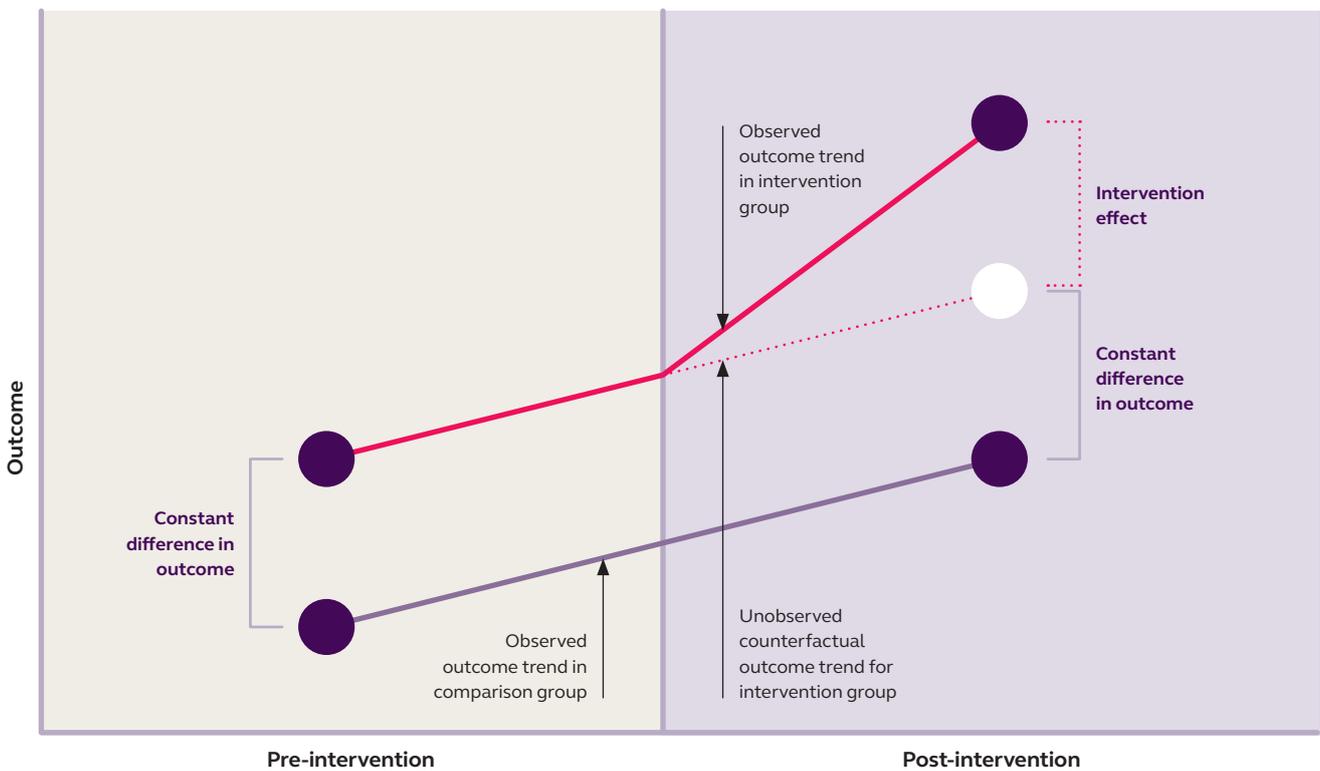


Figure 6:
difference-in-difference analysis

Source:
Columbia University Mailman
School of Public Health

Highly programme specific

Whilst these approaches, when implemented properly, can provide robust evidence of impact, there are challenges with implementing and learning from them. All quasi-experimental methods, like RCTs, can be highly programme specific. In other words, their findings cannot often easily be generalised to help inform alternative programme designs or alternative programmes.

A number of the challenges highlighted earlier also cause issues for these methods. We design our evaluations with

these challenges in mind, seeking to yield the largest possible sample size, selecting a control group that controls for self-selection bias, and complementing quasi-experimental methods with more qualitative analysis.

A more complete overview of the range of quasi-experimental approaches and potential control groups can be found in The Magenta Book.

Regression discontinuity design – our evaluation of the Biomedical Catalyst

Our ongoing evaluation of the Biomedical Catalyst, co-funded by the Medical Research Council, uses the application appraisal method to implement a regression discontinuity design (RDD). Applications to the Catalyst are scored, either by independent technical assessors or by a panel of experts. A quality threshold is defined in each round. Projects that score below this threshold are considered not suitable for funding.

The first step for the evaluation was to determine whether there was a clear difference in score between applicants receiving a grant above and below the threshold. The results, displayed in the chart below, demonstrate this was clearly the case. As expected, no applications that scored below the threshold received a grant.

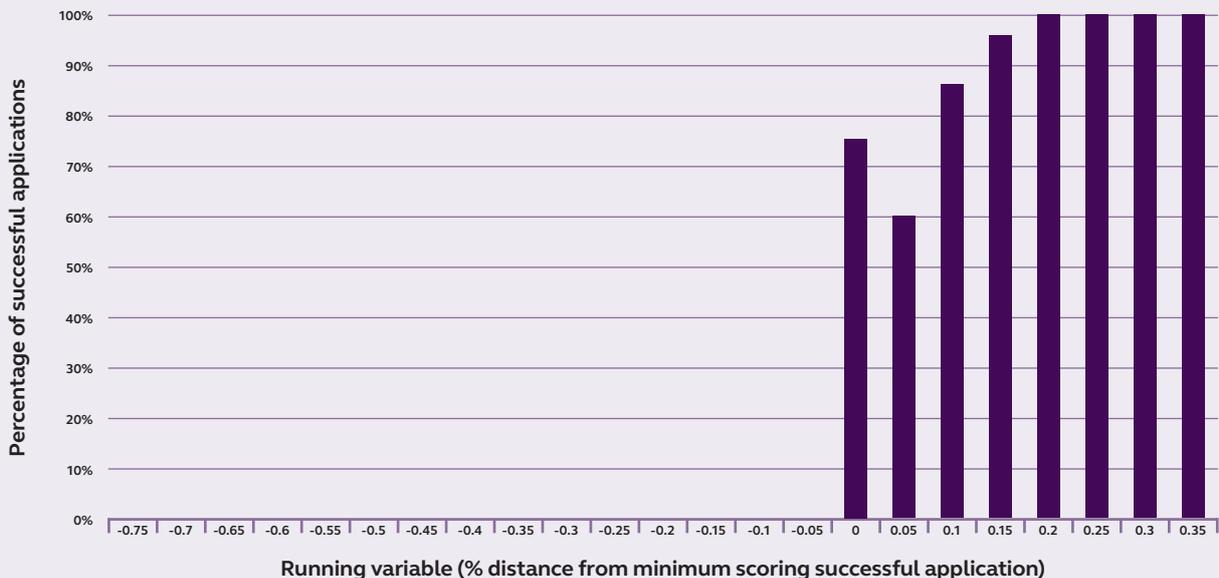
It is reasonable to assume that randomness in the score just above and just below the line means the observed and unobserved characteristics of the applicants will be close to identical at this point. In other words, the quality of the applications is likely to be very similar. By measuring the impact at this point, we are able to garner a more robust counterfactual.

Despite this, the RDD method still brought many complications. We were only able to measure the impact of the programme at the margin. If companies that scored well above the quality threshold were impacted differently, this approach would not provide that evidence. A technique known as ‘fuzzy RDD’ would provide the average impact for all participants, but our sample size was insufficient to use this.

Conducted alongside complementary approaches, including propensity score matching, the evaluation used a range of methods to estimate impact. This meant we could verify our findings across a range of different methods and build confidence in the results.

A full description of the approaches used, the issues faced, and the actions taken to overcome them can be found in annex D of the interim evaluation report (Innovate UK 2017) [10].

Source:
Ipsos MORI (2015)



Qualitative approaches

Evaluations will generally require qualitative approaches to be used alongside the more quantitative approaches such as RCTs and quasi-experimental designs. Innovate UK's qualitative evaluations are most likely to be case studies and in-depth interviews with programme stakeholders and beneficiaries. The use of qualitative methods alongside quantitative analysis helps demonstrate why observed impacts are happening; they tell the story behind what is happening through the logic model.

Qualitative approaches are particularly important where programmes are complex, where there are many forms of impact, or where some aspects of the logic model are difficult to quantify. They can also be used to understand more about which factors may have supported or hindered innovation and whether any adjustments to the programme could help bring about better outcomes. Qualitative approaches can help us to design programmes to enhance impact.

Contribution analysis

Contribution analysis is a theory-based evaluation approach. It aims to define the links between each element of a logic model, and test and refine these theoretical links between the programme and the expected impacts. It provides a framework for analysing not just whether the programme has had an impact, but how that impact materialised and whether any particular element of the programme or contextual factors were crucial to the impact.

Contribution analysis is conducted through a series of progressive steps:

- set out the expected attribution of impact to be considered
- develop a theory of change, based on the programme's logic model
- gather existing evidence on the theory of change
- assemble and assess the contribution story and any challenges to it
- seek out additional evidence, including through the evaluation methods set out above
- revise and refine the contribution story

Through building the evidence around a proposed theory of change, contribution analysis can look at each link in the logic chain to build a complete picture of how a programme leads to impact. Contribution analysis can be particularly suitable for evaluations of complex programmes with many forms of impact, and brings together the evidence gathered through an evaluation using multiple forms of evidence gathering. When designing contribution analysis, it is particularly important to ensure the approach allows for the identification and measurement of unintended consequences, given the way it is built up from a designed theory of change.

Evaluating Catapults using contribution analysis

The Catapult programme is a network of technology and innovation centres that aims to bridge the gap between research findings and their development into commercial propositions. The network provides leading-edge technology and expertise, and encourages greater collaboration between research and business.

Evaluating the Catapult network was a new challenge for us, due to the complex nature of the programme. There are 7 established Catapults, working in different sectors, with different operating models, and using different activities to overcome a wide range of barriers to business-led innovation.

We needed an evaluation that provided a consistent approach to evaluating impact whilst allowing for the differing nature of each Catapult. A bespoke evaluation framework for each Catapult was developed by a group consisting of the Catapults, Innovate UK, independent researchers, and BEIS analysts.

Each centre is now being evaluated using contribution analysis, informed by a number of different analytical techniques:

- difference-in-difference analysis is being used to look at the business-level impact of working with a Catapult. Data for this is being collected both through surveys of beneficiaries and non-beneficiaries, as well as through third-party data sources
- trend analysis is being used at a sector level, to understand the impact each Catapult is having on its sector
- a large number of case studies are being developed, typically 30 for each Catapult, to gather detailed examples of how Catapults go about helping businesses. They capture a range of organisation types and activities to ensure the full breadth of the Catapults' work is covered
- in-depth interviews with key stakeholders and expert consultations are being used to complement the more quantitative analysis, to understand in more detail issues around additionality, including displacement and substitution effects

Data linking

All the above approaches to evaluation can be enhanced or complimented by combining our data with data from elsewhere. By looking at our data alongside government and third-party databases, we are able to create a broader, better verified picture of the activities and performance of businesses. This expands the range of data we have, improves its quality and reduces our reliance on self-reported data collected by surveys.

A key source of business performance data is government's Business Structure Database, released each year and containing data collected through VAT and PAYE records. This provides data on employment and turnover for any company with one or more employees, or earning over £80,000 annual turnover.

However, this dataset is not a solution to all the problems faced when looking to capture verified business performance data. For example, lags in the uploading of data and a lack of clear timestamps for data mean it can be difficult to confidently draw conclusions on cause-and-effect between a programme and business outcomes.

If we cannot be sure whether a reported upturn in employment occurred before or after a grant was received, for example, we cannot determine whether the grant might have played a role. Furthermore, there are several variables of interest not comprehensively included in this or any other database, such as R&D investment or employment of R&D professionals.

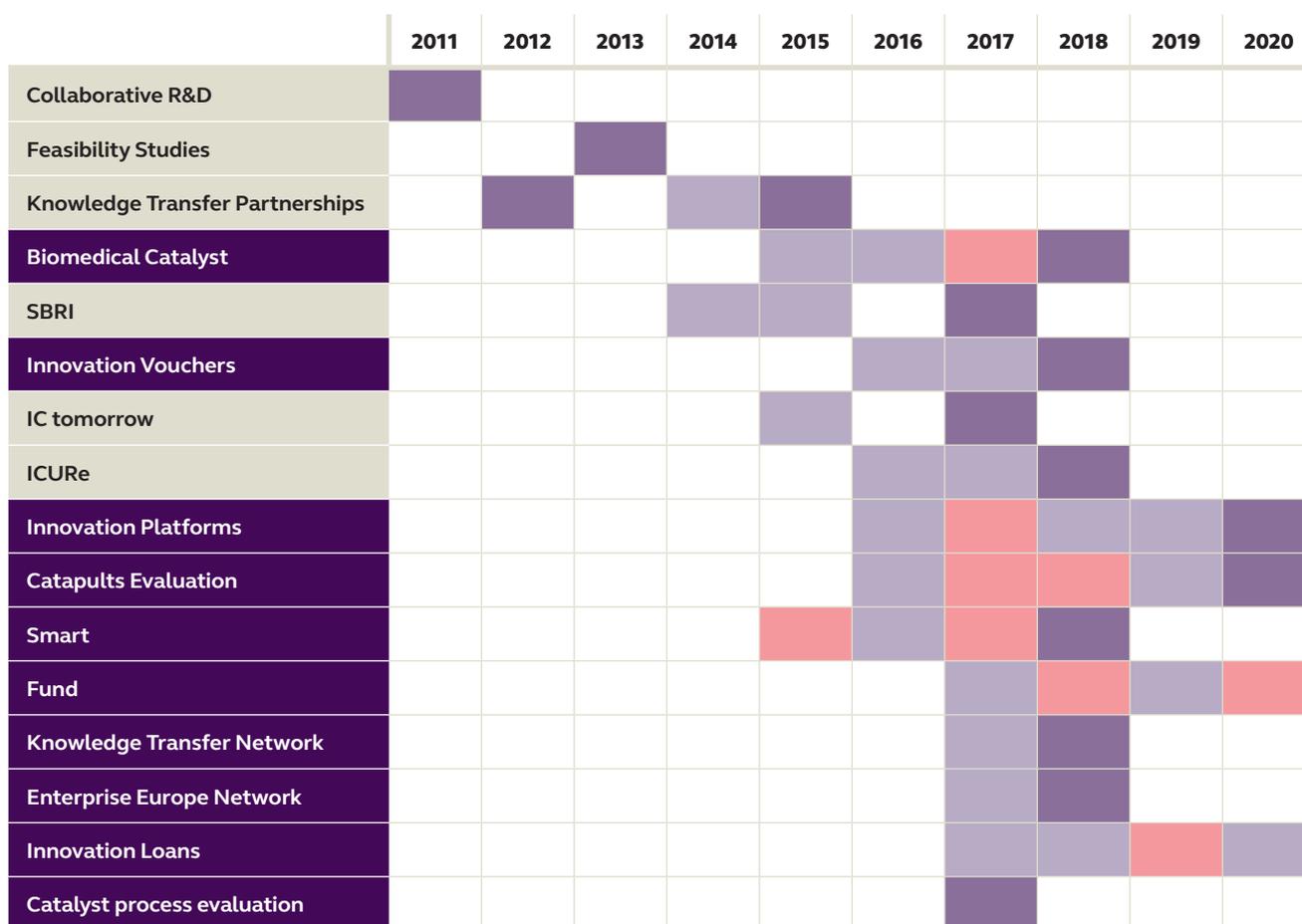
There is no single data source that should be considered, and the limitations of each dataset must be fully understood, communicated, and where possible accounted for when using data-linking as part of an evaluation. However, despite these limitations, including government or private third-party data is increasingly a core element to evaluations of innovation support.

Evaluation plan

Evaluation plan

We have launched 10 full economic evaluations and a number of smaller scale or process evaluations, covering the majority of our activities, since establishing an in-house evaluation team in 2013. We have published interim or final reports for Smart, the Biomedical Catalyst, SBRI, and Knowledge Transfer Partnerships, and will publish several more in the coming months and years. Figure 7 below sets out our existing evaluation work plan.

The notable concentration of activity in 2017 reflects the timescales involved in designing and implementing evaluations and providing enough time to allow impacts to materialise.



Key:

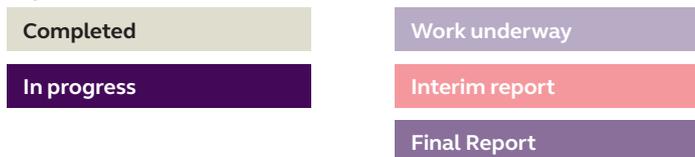


Figure 7: Innovate UK existing evaluation work plan

Innovate UK’s structure

In April 2016 Innovate UK restructured to offer businesses a single, integrated offering of all the current Innovate UK activities and services based primarily around:

- Catapults [11] and innovation centres [12]
- competitive funding for grants, contracts and, from 2017, innovation loans
- connections to all other resources available to that sector through Innovate UK’s innovation networks [13]

This simplified approach means that many of the programmes in figure 7 are no longer available, with most grant programmes, including collaborative R&D, feasibility studies, and Smart, becoming part of a single ‘funding’ offering. Where evaluations of legacy programmes are in place, these will continue, so lessons on the impact and effectiveness of those activities can help inform the design or delivery of similar mechanisms of support. Full evaluation reports will be published online, with accompanying datasets where appropriate [14].

We will deliver an evaluation plan to cover the new, simplified offering, and the continued evaluation of the Catapult network. In 2017, we launched a new evaluation of our funding activities. We are already working with partners to explore how best to evaluate our ‘connecting’ activities, and have begun with evaluations of the Knowledge Transfer Network and Enterprise Europe Network. We are also working with other funding organisations to establish a comprehensive evaluation of the Government’s new Industrial Strategy Challenge Fund.



Figure 8:
Evaluation plan for
restructured Innovate UK

Moving towards a holistic approach to evaluation

The traditional approach to evaluation in the UK, including in Innovate UK for the most part, has been to take a programme-by-programme approach. We see this in the table above, where Innovate UK's different programmes – Smart, collaborative R&D, ICURe, and so forth – each have their own evaluation. This approach has its benefits, providing evidence of the effectiveness and impact of each. However, it does not always align with Innovate UK's strategic approach, the complexity of the innovation system we support, the way companies interact with Innovate UK, or how support for business is designed.

We have sought to advance our evaluations from this programme-focused approach to a more holistic approach in line with the strategic design and delivery of innovation support.

A key example is our evaluation of 2 of our 'innovation platforms' (see figure 4 for one of the logic models from this evaluation). In these instances, we look at a strategic package of investments and activity designed to help solve a specific societal challenge. These platforms used a number of our programmes, including collaborative R&D, feasibility studies, and SBRI. Whilst each of those programmes has been evaluated separately, evaluating their use in a platform such as this allows us to determine whether the wider activities around the platforms add any additional value. The first evaluation report is due to be published in early 2018.

A simplified approach

We will continue to explore how best to evaluate innovation support policy, and the impact of Innovate UK. Our simplified approach to supporting business-led innovation allows us to take a good step towards this, with 3 main evaluations covering the vast majority of all activities. As we progress with the evaluations of funding, connecting, and the Catapults, we will seek to identify and evaluate the links between these activities. In the longer term, we will work with partners to examine the interactions between the activities of Innovate UK and other support in the UK, to build a truly holistic picture of impact.

We will present a single report in 2019 evaluating the impact of Innovate UK, combining the evidence from our programme-level evaluations with additional analysis to understand the wider impacts of innovation support on trade, competition and the economy.

Conclusion

Conclusion

We have come a long way in understanding how to evaluate our activities more robustly since establishing our in-house evaluation team in 2013. We have implemented a programme of evaluation covering almost all our activities, and continue to ensure new programmes are evaluated by the most rigorous methods practical.

This framework sets out some of the challenges we face when evaluating innovation support, and some of the solutions we have implemented to meet those challenges. We do not yet have all the solutions. We recognise that the range of challenges means fully robust evaluation of a programme's impact on the economy will not always – or perhaps even often – be possible.

However, we also recognise the importance of continuing to design and implement the most robust evaluations possible, using theory-based evaluation and mixed-methods approaches to ensure that where evaluation can be done properly, it will be done, and where the most rigorous methods are not applicable, we will implement the best that is feasible and proportionate.

We have learnt a lot over the last 4 years about evaluation of innovation support. Key lessons include:

- evaluation should be designed into programmes from the beginning – it is never too soon to start planning an evaluation
- evaluation of innovation support is difficult, with several sometimes intractable challenges. This does not mean evaluation should not be attempted – instead, ensure the most robust methods practical are applied to each element of the programme. A mixed-methods approach is usually most suitable, and we should not always expect evaluation to result in a single number that captures all impact
- data is key – know what data will be required for the evaluation, and ensure sufficient data collection processes are in place
- sample size is fundamental – design an evaluation that enables a sufficient sample size in both the treatment and control group. This may mean using a cohort from over a longer time period
- do not get too preoccupied with a single number – evaluation findings will always come with some gaps and uncertainties. The headline return-on-investment figure is important, but there will be a significant margin of error around it. The narrative and lessons around it will inform decision-making just as much, if not more
- survey data is usually required, but is also imperfect. Complement and verify this by linking your evaluation data to third-party data sources
- be innovative when evaluating – it is important to ensure robust measurement. But with this core in place, look at where you can try novel techniques, and push the boundaries of the evaluation a bit further

We strive to continuously improve our monitoring and evaluation methods and our understanding of what works, both in terms of evaluations and the programmes they are scrutinising. As these yield more robust and comprehensive understanding of the effectiveness and impact of our programmes, we commit to improving the design and delivery of those programmes based upon that understanding.

This publication aims to share what we have learned about the best means to evaluate innovation support, and to set out how we will continue to improve our processes. Innovate UK will become part of UK Research and Innovation in April 2018. We will work closely across the new organisation to ensure best practice is shared, to learn from our peers, and to build a stronger evaluation framework for all.

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Innovate UK

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