Department for
Business, Energy
& Industrial Strategy

EVALUATION OF ATI AEROSPACE R&D PROGRAMME

Process and Implementation Review

September 2017

This document is available in large print, audio and braille on request. Please email enquiries@beis.gov.uk with the version you require.

Evaluation of ATI Aerospace R&D Programme

Acknowledgements

The work in this report is the independent work of Ipsos-MORI, and any views expressed herein are not necessarily those of BEIS.

Any enquiries regarding this publication should be sent to us at enquiries@beis.gov.uk.

This publication is available for download at www.gov.uk/government/publications.

Contents

1.0 Introduction

Ipsos MORI (in association with George Barrett) was commissioned in May 2016 by the Department for Business, Energy and Industrial Strategy (BEIS) to undertake a process evaluation of the Government funded civil aerospace research and technology (R&T) funding. This funding is administered via the Aerospace Technology Institute (ATI) by BEIS and Innovate UK. This interim report set out an emerging assessment of the effectiveness and efficiency of internal processes adopted to administer ATI funding.

1.1 Process evaluation objectives

The objectives of the evaluation (as defined in the Invitation to Tender) were to:

- Generate an understanding of the efficiency and cost-effectiveness of all ATI Programme internal processes and assess this aspect of the programme's value for money.
- Gain an insight into barriers to the programme's implementation and understand the ways in which projects are looking to realise their long-term outcomes.
- Provide an informed a set of recommendations that maximise the net benefits to the taxpayer and participating companies.

The detailed research questions for the study are specified in table 1.1. below. The study has been split across two stages, the first focusing primarily on internal processes, and the second focusing on process issues associated with project delivery.

Table 1.1: Evaluation Questions

Stage One	Stage Two
What are the views of each of the stakeholders (BEIS, IUK and ATI, and applicants) for the different stages for allocating ATI funding: pre-application and marketing; targeting and prioritisation; application procedures; stages of assessment; due diligence; and contracting?	What are the motivations of firms participating in the programme? Why did they apply for funding? What is the nature of the problem that they are seeking to address? What in their view would have happened if funding of their project had not materialised?
What are the strengths and weaknesses of the process based on these views, and how effective and efficient are they?	What has been their experience in commencing the implementation of their projects? What have been some of the success factors? What have been the barriers?
What are bidders' experience of the ATI programme process in terms of the application, selection and approval process and longer terms management and monitoring of	What is the nature and extent of collaboration in the programme (horizontal or vertical, with academia and research institutions)? To what

Stage One	Stage Two
projects? Do firms consider that funding allocation is aligned to priorities in the sector? What are the costs to companies arising from the application process, including time spent and elapsed time? Are there any improvements that could be made? Is the process of selecting projects and allocating funding providing ample opportunities to companies regardless of size and composition?	extent was ATI funding responsible for stimulating this collaboration? How sustainable are these collaborations beyond the life of the project? What are some of early outputs of the programme? (number of additional R&T and design jobs created; upskilling of staff; additional R&D or capital spend; progress on technology readiness levels; types and nature of collaborations; types of projects and technologies) Have there been any unintended consequences to companies or the wider economy, beneficial or not, of the ATI programme so far?

Discussions with the client group also refined the scope of the research to focus on the delivery of Research and Technology support for UK aerospace. Late stage development activity, and Repayable Launch Investment, are beyond the scope of this evaluation. It is important to note that, except for some legacy projects, and the previous National Aerospace Technology Exploitation Programme (NATEP), all public R&T support for aerospace is directed through the ATI. For this reason, the ATI is used as a shorthand for R&T support for aerospace.

1.2 Methodology

The evaluation has involved collecting and triangulating evidence from a variety of sources including:

- **Analysis of monitoring information:** Application, appraisal and monitoring data was used to identify the organisations involved in the development of the Technology Strategy, grant recipients to explore the project assessment processes in depth, and to capture aspects of delivery, and to provide a point of reference for discussions. This included records of: all applications to the SRC process, Value for Money (VfM) assessments completed by BEIS, contracting data for 115 projects, summary records from project monitoring and the latest RAG status reports for 109 projects, and data on the defrayment of grants against expectations for 109 projects. The study team also received data relating to independent assessments of all of ATI projects.

- **Analysis of Secondary Data:** Secondary data sources such as the patent record and the Gateway to Research database was used to build up a broader picture of organisations in the UK that are active in aerospace R&T.

- **Stakeholder interviews:** Interviews were undertaken with 22 policy stakeholders including representatives from across organisations involved with the development of the ATI Technology Strategy, the allocation of

funding, due diligence, contracting and monitoring processes as well as several external industry figures. These interviews included consultations with the ATI, BEIS, Innovate UK, HM Treasury, the Aerospace, Defence, Security and Space (ADS) sector body, the Department for International Trade (DIT) and two industry experts.

- **Applicant interviews:** Interviews were undertaken with representatives of seven applicants to the ATI programme, a mix of organisations that have received multiple grants and those that had less involvement.

- **Case studies:** A total of 20 case studies were undertaken covering 15 projects and five applicants in depth drawing on a review of background documentation, monitoring reports, interviews with Monitoring Officers, project leads, collaborators and subcontractors. In total a further 52 interviews were undertaken to prepare the case studies.

1.3 Structure of this report

The structure of this report is based around the examination of major processes by chapter. In each chapter, an explanation of the process is provided initially. Subsequently, the data collected from stakeholders and applicants are presented and analysed. At the end of each chapter, a summary of the results is presented against the main process evaluation questions. Recommendations for refinement have been included throughout the report, and have been pulled out in text boxes. The structure of the report is as follows:

- Section 2 – presents an overview of the programme

- Section 3 – explores the operations of the ATI programme in supporting applications for funding prior to submission

- Section 4 – considers the processes used to allocate ATI funding

- Section 5 – covers post award processes and on-going monitoring

- Section 6 – considers the efficiency with which key processes have been managed

- Section 7 – draws on the case study research to present a mapping of the R&T programme implemented by applicants to date, and their expectations for the future

- Section 8 – explores the extent to which delivery to date reflects the original economic and strategic case for investment

- Section 9 – presents the conclusions from the evaluation.

2.0 Programme overview

This section provides an overview of the ATI programme, the processes that been employed in its administration, and provides an overview of the characteristics of the projects that have been funded to date.

2.1 Background and context

2.1.1 Objectives of ATI funding

Productivity has grown at a negligible rate across the UK economy overall in the wake of the 2007/08 financial crisis. Average labour productivity is estimated to be 18.4 percent below the level that would have been obtained if pre-crisis trends had continued[1] and what growth there has been was largely driven by the non-financial services sector. The improvement of the UK's productivity performance has been established as a key priority by successive Governments. Public support for industrial innovation in advanced manufacturing sectors has formed a consistent element of Government strategy for promoting productivity and employment growth, in the Coalition Government's Industrial Strategy, the later Productivity Plan of 2015, and in the 2017 Green Paper on Industrial Strategy[2].

The aerospace sector has received significant policy attention in these strategic frameworks, stemming from its contributions to R&T spending, employment, exports and (unlike the while UK economy) productivity growth. The sector employs 128,300 workers directly with a further 153,900 more indirectly supported and generates more than £27 billion in annual exports[3], while global demand for new passenger aircraft is expected to rise to $3.7 trillion by 2030[4], and strong growth is projected for several other sub-sectors. To exploit these opportunities, the industry will need to meet several challenges including: requirements for new air traffic systems[5], the emergence of new global competitors, and changing patterns of aviation demand, particularly for new aero-structures and propulsion technologies[6].

The Aerospace Technology Institute (ATI) was established in 2013 by the government to help the civil aerospace sector meet those challenges. The ATI is a partnership between industry and government that aims to sustain and grow the sector through targeted investments in industry led R&T projects. The programme was backed initially by £1bn of public funding (and increased by a further £950m in

[1] ONS (2017) Labour Productivity: July Sept 2016
[2] HMG (2017) Building Our Industrial Strategy: Green Paper
[3] ADS (2016) UK Aerospace Outlook, available from https://www.adsgroup.org.uk/wp-content/uploads/sites/21/2016/07/AerospaceOutlook2016-E-Res.pdf
[4] HMG (2013) Lifting Off – Implementing the Strategic Vision for UK Aerospace
[5] Note this issue faced by the sector is not an aspect that is within the scope of the ATI, and is only included here for contextual information
[6] HMG (2013) Lifting Off – Implementing the Strategic Vision for UK Aerospace

the 2015 Spending Review) with matched contributions from industry. The objectives of the ATI (as set out in the Business Case[7]) are to:

- Provide and sustain growth in the aerospace sector through proper identification and exploitation of market opportunities and the creation of UK jobs in high-technology sectors.
- Maintain R&T leadership through improving productivity and advancing aerospace technology frontiers and infrastructure in the UK.
- Co-ordinate the sector and provide support where funding opportunities are weakest, with an emphasis on strengthening funding impact.
- Develop a versatile supply chain that can offer diverse products and services that can cope with the high performance requirements of the sector.
- Forge strategic partnerships in order to bring together academia, government and industry in order to identify areas of complementarity and encourage collaboration.
- Raise the UK's profile at the international level through developing strong links with overseas sectors, institutions and funding opportunities.

2.2 Evolution of ATI funding

Since the announcement of funding for the ATI in 2013, four distinct processes have been used to allocate public funding to R&T projects:

- **Pre-ATI projects**: Total funding allocation includes support for some projects that pre-date the announcement of the ATI, that were not subject to the processes covered in this evaluation. These cover two groups:
    - **Legacy projects**: Legacy projects were agreed on a periodic basis with BEIS with monitoring and disbursement of funding delegated to Innovate UK. This activity was focused on the major primes in the sector with a broader aim to encourage increased UK activity across the supply chain. While all Legacy projects started before the ATI was announced, some have drawn on the overall ATI budget in their later years.
    - **The UK Aerodynamics Centre** was a spending commitment announced in the 2012 Budget, involving the allocation of £60m to 14 projects. This programme was a forerunner to the ATI and resources were allocated through an Innovate UK administered Collaborative R&D competition (following standard procedures).

[7] BIS (2013). Aerospace Technology Institute: Business Case.

- **Early ATI projects**: A further group of projects (classified as 'Early ATI') were approved before current ATI SRC processes were fully established. These projects and programmes emerged through liaison between applicants and BEIS. The typical model would be for a company or research institute to approach BEIS to explore opportunities to access funding for a proposed project. Once a full project proposal had been worked up following interaction with BEIS, it was shared with Innovate UK to undertake an independent assessment, in line with its standard procedures. For projects involving the commitment of public funds of £10m or more, BEIS also undertook a value for money assessment.

- **ATI Strategic Review Committee:** Since September 2015, applications for ATI funding have been largely allocated using a process that draws on the following delivery partners (explained in greater depth in Section 2.3):

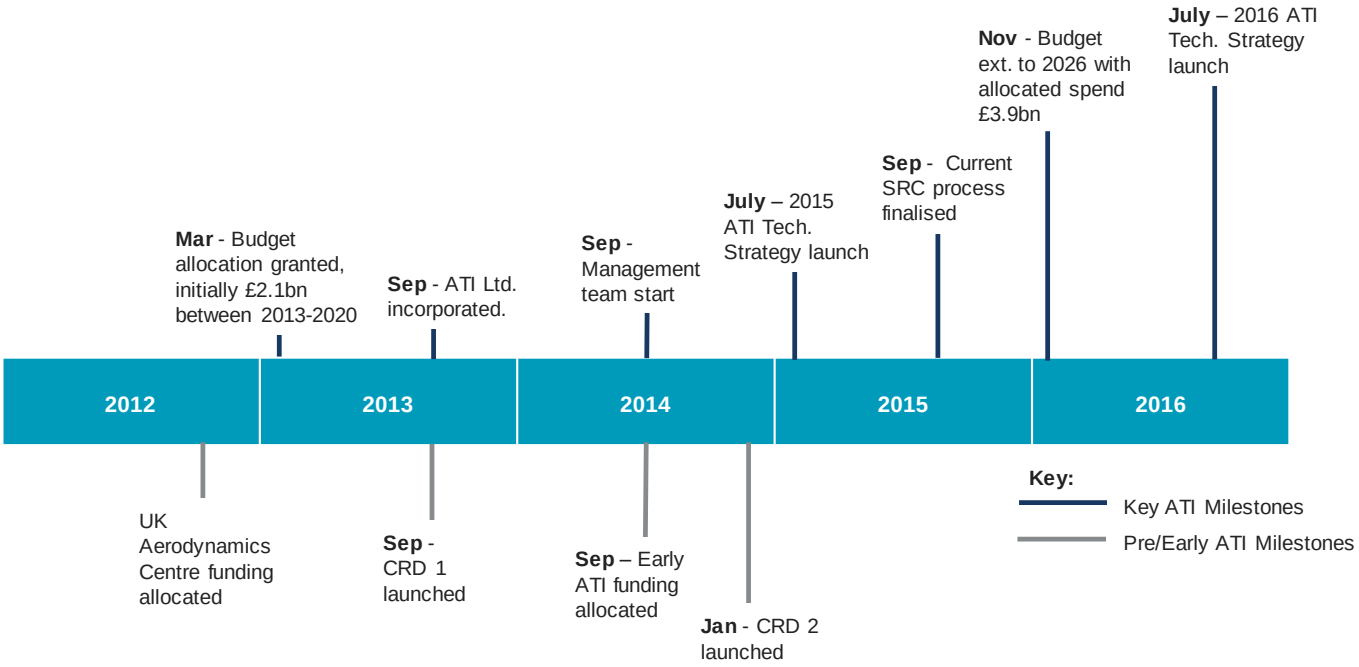
    - **Aerospace Technology Institute**: The Aerospace Technology Institute was formally established in 2014. Its role spans a range of strategic functions, including developing the UK Aerospace Technology Strategy, and stimulating industry-led R&T projects that align with this strategy and maximise the potential to deliver UK economic benefit. The ATI provides strategic oversight of the aerospace R&T pipeline and portfolio and – along with BEIS – plays a key role in a Strategic Review Committee which decides which funding proposals are taken forward for further scrutiny.

    - **BEIS** is the accountable budget holder and makes the final decision regarding which projects to fund, as well as for completing value for money (VfM) assessments of project proposals.

    - **Innovate UK** is the delivery partner for ATI R&T programme, performing independent assessments of proposals, due diligence checks, contracting and payments, and the subsequent monitoring of projects.

- **ATI Collaborative R&D competitions:** The other funding instrument available to the ATI are further Collaborative R&D Competitions (CR&D), which are managed by Innovate UK on behalf of the ATI in line with its standard processes. These competitions involve the agreement and definition of the scope of a competition. Two CR&D competitions were managed by Innovate UK on behalf of the ATI in 2013 (Aerospace Industrial Strategy: Advancing Technology Capability) and 2015 (Building UK's Leadership in Aerospace Technology).

Figure 2.1: ATI Timeline



2.3 Management of ATI funding

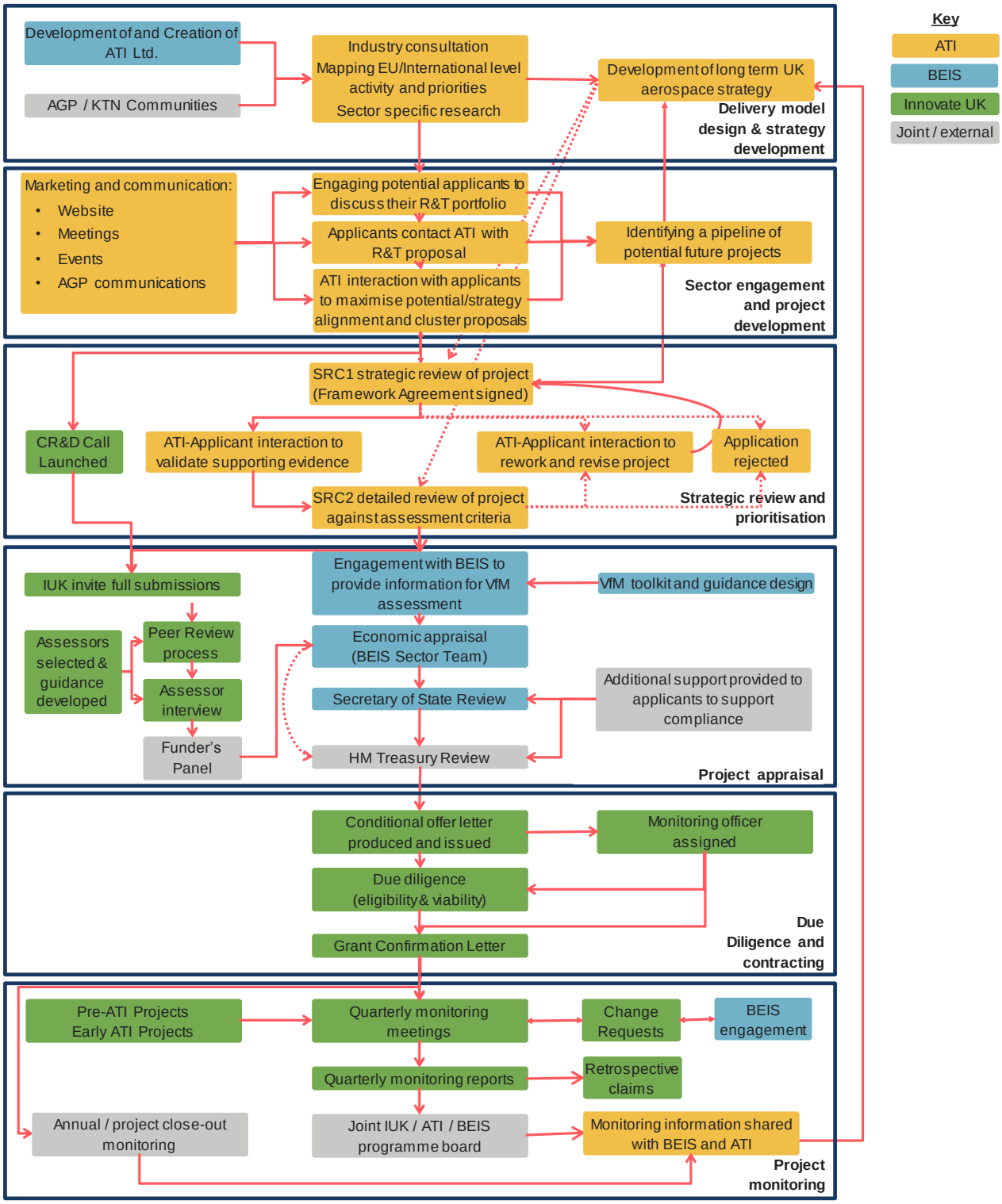
Figure 2.2 below provides a summary of the processes employed to administer ATI funding[8].

Delivery model design and strategy development

The ATI is an independent company limited by guarantee and is funded through a combination of government funds and industrial contributions (a percentage of grants awarded). Delivery against the objectives of the ATI are organised around 12 work packages that are used to plan and manage operations. To support the delivery of its objectives, the Technology Strategy for UK Aerospace was developed by the ATI in 2015, and subsequently published in partnership with BEIS, Innovate UK and the Aerospace Growth Partnership. The strategy identifies a set of technological priorities for the UK aerospace sector, considering the strengths of the industry in the UK and the anticipated challenges that will need to be addressed in the short, medium and long term. The priorities in the strategy are organised around the following three key pillars:

[8] This depiction of the processes involved was valid at the time of the research but was under review by BEIS, the ATI and Innovate UK.

Figure 2.2 Process map



- **Value Stream:** Four main product value streams were identified (aerostructures, propulsion, systems, and whole aircraft) to align with future market requirements.

- **Enabling technology and capabilities:** Five key enablers were identified including: aerodynamics, manufacturing, materials, technology infrastructure and process and tooling.

- **Timeframe**: Technologies were also classed by the timeframes over which they are expected to be developed or required (Secure - 0-5 years, Exploit – 5-10 years and Position – 15+ years).

The objectives of the Technology Strategy are to articulate a shared and industry-led understanding of the long-term direction of travel for the sector in terms of future market demand, provide a strategic framework for prioritising the allocation of public funds to R&T projects, help firms understand how their projects and innovations might connect to broader developments in the sector and help signal UK strengths internationally.

Development of the 2015 Technology Strategy involved between 15-20 consultations with key sector stakeholders, the establishment of 12 advisory groups[9] and a series of mini workshops with UK sector stakeholders spanning commercial, academic and policy spheres. This strategy was then refreshed in 2016 using a similar process. placing an emphasis on several gaps, including highlighting several near-term opportunities, early stage research opportunities and drawing out specific major cross-cutting agendas. These cross-cutting agendas comprise: high value design, the digital economy, additive manufacturing, autonomous systems and through life services. In addition, the update increased the focus on six key performance attributes to be addressed across market segments and value streams: cost, environment, fuel efficiency, operational needs and flexibility, passenger experience and safety. Lastly, the strategy identifies the new architectures, tools and methods and key technologies to be focussed on in each of the three time periods.

Sector engagement and project development

The ATI undertakes a range of activities to engage with the aerospace sector and potential applicants for public funding. The main objectives of these activities are to communicate the Technology Strategy to industry (domestically and internationally), attract relevant proposals in sufficient numbers and offer guidance to applicants to maximise the quality of the project proposals. Such activities include: engagement via the ATI website hosting the Technology Strategy, direct engagement with key companies, presence at events (e.g. Farnborough Air Show), a newsletter and the use of various professional networks.

[9] These groups have been created by the ATI that are intended to input into the development of the overall strategy including road maps, reports to government and technology reports to industry leaders in addition to representation across other cross-sectoral groups. There are currently twelve groups overall including the ATI board, a Market and Economics Group (MAEG), a Technology Advisory Group (TAG) and nine Specialist Advisory Groups (SAGs). The nine SAG cover the four primary value streams, and five primary enablers as defined in the Technology Strategy and meet quarterly. The structure of these groups are likely to change in the future as ATI priorities evolve.

The ATI also undertakes a range of 'pre-engagement' activities to increase the overall value for money of R&T funding through attracting high quality applicants, understand the complementarities between applicant projects and wider R&T agendas and minimise the administration costs for applicants applying for R&T funding. These activities include both strategic engagement which primarily involves engagement focused on gaining an understanding of potential applicants' current and planned R&T portfolio (giving insight into the range of possible future calls on the ATI budget), and project based engagement which includes discussion of potential projects with a view to supporting their development and access to funding. The latter involves: advice on suitable projects, partners or collaborators, development of projects, minimisation of wasted effort where projects may be unsuitable or need to be reshaped, support to understand the pipeline and advice to maximise economic potential of projects.

Strategic review / prioritisation & project appraisal

ATI funds are to a large degree allocated through a strategic application process with the central objectives of maximising the strategic impact and value for money associated with the portfolio of R&T projects funded. Public funds can be awarded for up to 50 percent of the total cost of a technology development or demonstration project. For capital investment up to 100 percent of the initial investment value[10], provided proposals can demonstrate sufficient commercial utilisation can be attained to reduce the public contribution to 50 percent over the lifecycle of the asset[11]. The application process involves the following key steps:

- **Stage 1 (SR1):** The first stage is primarily focused on the development of a brief outline application which is subsequently scored by ATI experts and scrutinised by the SRC. This application is intended to be formed around an initial idea/proposition that is developed, with ATI engagement, into a project outline detailing the project's business case, expected UK economic benefit, alignment with the ATI strategy and the proposed means of exploitation expected to arise from it. The SRC meets monthly to consider stage one applications, judging them to be weak, average or strong against several economic and technological criteria with the aim of evaluating the application's strategic fit and likely economic value.

- **Stage 2 (SR2):** Applications successful at SR1 then proceed to a second stage, that culminates in the submission of a full application. The ATI engages applicants at this stage to help them improve the quality of evidence underpinning their project proposals from an economic and technical perspective, and identify new potential project partners (though this type of shaping activity will generally take place prior to SR1), particularly where this can help maximise potential UK economic benefits arising from the project.

[10] Within the wider constraints set by the EU State Aid regulations, and depending on the specifics of the business case for the capital project.
[11] Again, this was valid at the time the report was prepared, although the availability of capital funding through the ATI was under review.

The full submission at the close of this stage, limited to 30 pages (or 100 pages if the request exceeds £10m), should provide a rigorous and quantified measure of the proposed project's gross economic value as well as providing evidence to support an assessment of the likely additionality of public funding. This application is assessed and scored by the ATI experts before it also reviewed by the SRC which makes the decision on whether the project should progress. From September 2016, applicants making a submission to SR2 were also given the VFM pro-forma (see below) and asked to submit the Innovate UK application form and complete the pro-forma to allow BEIS to complete an assessment of value for money before the SRC.

Box 2.1 The Strategic Review Committee (SRC)

The SRC process was introduced to allow applicants to work with the ATI to shape projects and stimulate demand. The ATI and BEIS (and more recently as an independent observer, Innovate UK) make up the SRC which is a committee installed to review, challenge, feedback and decide on whether to advance proposals to the next stage in their funding application. Membership of the committee is comprised of the ATI Chief Executive Officer, Chief Technology Officer, Chief Strategy Officer and Strategic Portfolio Manager and from BEIS, the Heads of Aerospace, Aerohub, Technology for Aerospace Marine and Defence, Sector Evaluation and Appraisal – Advanced Manufacturing, an HM Treasury representative (SR2 only), as well as several BEIS Aerospace Technology specialists, ATI experts and other subject matter experts. The committee is co-chaired between the ATI CSO and BEIS Head of Technology for Aerospace Marine and Defence. A representative from Innovate UK joins SR2 meetings as an observer.

The SRC oversees the approval of project proposals from their submission at ATI through to their submission to Innovate UK for independent assessment and to BEIS for the value for money approval processes at stage 3. The SRC makes choices on which project applications to advance based on their strategic and economic potential. An application is required to receive approval from the SRC at two separate points, SR1 and SR2, with SR1 convening once per month and SR2 in January, May and September. The study team notes that the SRC was a recent addition to the ATI strategic review process and was first held in September 2015.

- **VfM Assessment**: Evidence provided by the applicant and assumptions about the likely outcomes of the project are used to provide an assessment of the value for money associated with a project using a benefit-cost ratio defined relating the gross public expenditure involved to its anticipated external benefits (e.g. R&D spill-overs, CO2 savings, or training benefits and employment). The VfM assessment is completed by BEIS analysts, and originally was only applied to projects with a grant request more than £10m after the proposal had been approved by the SRC, in support of the HM Treasury approval process described below (with projects required to meet a minimum BCR threshold). This changed during 2016 and all SR2 applications are now required to provide some VfM information prior to submission to SR2. In addition, all projects that are recommended to proceed at SR2 are subject to a VfM assessment to confirm that the Benefit to Cost Ratio (BCR) is more than the minimum threshold agreed with HM Treasury and that the anticipated benefits are likely to offer a high level of additionality. For projects applying for a grant of more than £10 million a case paper is also prepared detailing the calculations and assumptions used (which feeds into the Ministerial and HMT approvals process).

- **Independent Assessment**: Applications proceeding past SR2 are then invited to submit their application for independent assessment (a process organised by Innovate UK). The assessment is undertaken by a panel of four or five assessors drawn from industry and academia and is intended to provide an independent judgement of the technical, commercial, and economic merits of the application. Scoring of these is undertaken in a similar manner to other Innovate UK applications using ten questions scored from one to ten generating a total score of between 10 and 100, with applications normally requiring a score of 70 to proceed. Applicants for grants more than £5 million are also required to attend an interview with independent assessors. Projects that pass the independent assessment go to the Innovate UK Funder's Panel, which ratifies the final decisions on funding. Prior to December 2016, only four projects had reached Independent Assessment were not approved at this stage.

- **Ministerial and HMT Review**: Once projects have passed both VfM and Independent Assessment, ministers in BEIS are requested to approve the funding. Following this, details of the application are shared with HM Treasury. For projects less than £10 million, that are deemed unlikely to be contentious are delegated to BEIS for a decision, with the remainder reviewed further by HMT and subject to ministerial sign-off.

Collaborative R&D project appraisal

Collaborative R&D competitions are used an alternative to the ATI 'batch' process described above and follow the standard processes used across Innovate UK CR&D calls. To date, there have been two separate ATI-branded competitions with the aim of making funding available to a range of different organisations and SMEs as well as to encourage collaboration across the sector. For CR&D calls, a specification document outlines the objectives, scope, and application process for the call before a briefing event is held. There are two stages to the application in which applicants must prove the technological and economic credentials of their projects. Applications are assessed on merit by an independent panel of experts at both assessment and interview stage, if applicants reach the final stage of the process (in line with the Independent Assessment process described above). Individual grants awarded averaged £1.3m in size (ranging from £470,000 to £3m), and were expected to last no longer than three years.

Due diligence and Contracting

Upon successful application, the due diligence and contracting phase begins with the issue of a Conditional Offer Letter following the Funder's Panel by Innovate UK. Included in the Conditional Offer Letter are:

- A number of requirements that must be fulfilled including: signature of a Collaboration Agreement, initial financial forecast, project plan, milestone register, an exploitation plan, and risk register;

- A timeline for the acceptance of the offer by the applicant – they have three months to complete the above items; and

- Project start dates, project monitoring and a set of requirements that will govern the delivery of the project.

The key aim of this process is to increase the value for money achieved from R&T funding by maximising the number of successful applications put forward by firms with a sound financial and legal health, ensuring that public support is not provided to firms that are financially unviable investment propositions. As part of this, project viability checks are conducted, as are eligibility checks to ensure the project remains in alignment with funding requirements, including both programme specific elements, and EU state aid rules. This process involves close scrutiny of project costs and overheads in particular, and applicants are typically asked to provide further details on any cost items that appear unjustified, or to justify the use of any overseas sub-contractors. Upon completion of this process a Grant Confirmation Letter is issued and the project moves in to the ongoing monitoring phase of its lifecycle.

Project monitoring

A monitoring process is implemented throughout ATI projects from the point at which the Conditional Offer Letter is sent to the applicant in order to maintain oversight of project processes. The monitoring and portfolio management arrangements are put in place once projects have been contracted, end upon project completion and are led by Innovate UK. Each project is assigned a dedicated Monitoring Officer from a pool of approximately 30 individuals working on ATI projects. It is intended that Monitoring Officers possess the relevant experience required to test and challenge information provided by from applicants and they must sign conflict of interest statements detailing any risks.

Monitoring officers meet with the project team every three months and a quarterly monitoring report is generated that outlines the progress made against six aspects: scope, time, cost, exploitation plans, risk management and project management/planning. Monitoring reports may be generated more frequently if required by Innovate UK. Scores against these aspects are numerical ranging from one to five: with one indicating a significant issue that requires attention whilst five illustrates an aspect exceeding expectations. In addition, supporting documentation is maintained via the _connect system and is required to unlock the funding claim. Monitoring ends on completion of the project with a ‘close out’ report (which includes a technical report and an independent accounts report completed by the project).

Further duties of Monitoring Officers include the provision of support in the identification of emerging issues and the processing of change requests. These may be generated for several reasons including: scope changes, risk mitigation, timing extensions, grant modifications and partner introduction/withdrawal and are managed in a way as to ensure that the amended project maintains a fit with the overall objectives of the programme. Changes more than £1m (or that are otherwise considered significant) are discussed with BEIS and some information from the monitoring process is shared with them with the intention to inform the future development of the strategy and pipeline. Changes of up to £25,000 can be signed

off by the Monitoring Office[12], and those between £25,000 and £1m can be signed off by the Innovate UK Innovation Leads.

Finally, an annual monitoring process has been introduced by BEIS and Innovate UK that monitors project level outcomes. This requires the applicant to report the number of jobs that have been created or safeguarded, additional R&D spend on projects (as well as payments to subcontractors and sources of funding) progress through Technology Readiness Levels, and additional R&T spending. The aim of this monitoring is to provide evidence on the benefits emerging from project delivery and to provide data in support of future evaluations.

2.3 Overview ATI funded projects and grant recipients

2.3.1 ATI funding commitments

As detailed in Table 2.1, by December 2016 a total of 164 projects had completed the pre-award process (i.e. had signed the Grant Confirmation Letter and had begun the process of project delivery) and a further 31 have been approved by the SRC but are yet to be contracted. In total, more than £700 million has been allocated (though this does include funding commitments for years prior to the establishment of the ATI). Remaining headroom is expected to narrow substantially as a result of projects that are currently in the process of gaining approval - £222 million of grant funding has been approved at SR2 but is not yet fully contracted and set up within Innovate UK systems, and a further £23 million has been approved at SR1 and recommended to progress to SR2 (See Table 3.2 in the next section for full details). Furthermore, significant calls on the ATI budget are expected to be submitted during 2017. Policy stakeholders reported that the annual budget of £150 million was already proving a material constraint on funding decisions for upcoming years. Since the ATI has become fully operational, the SRC process has been the dominant mechanism for allocating funds.

[12] Though it is worth noting that some individuals interviewed through this evaluation identified a materially lower approval limit

Table 2.1: ATI projects by application process

Process	Number of Projects Funded	Total Public Funding Committed	Average project size
Pre ATI – Legacy	38	£160,946,070	£4,235,423
Pre ATI – Aero Centre	14	£39,773,793	£2,840,985
Early ATI	58	£336,682,833	£5,804,876
ATI Strategic Review Committee	20	£126,249,418	£6,312,471
ATI Collaborative R&D	34	£42,835,984	£1,259,882
Total	164	£706,488,098	£4,307,854

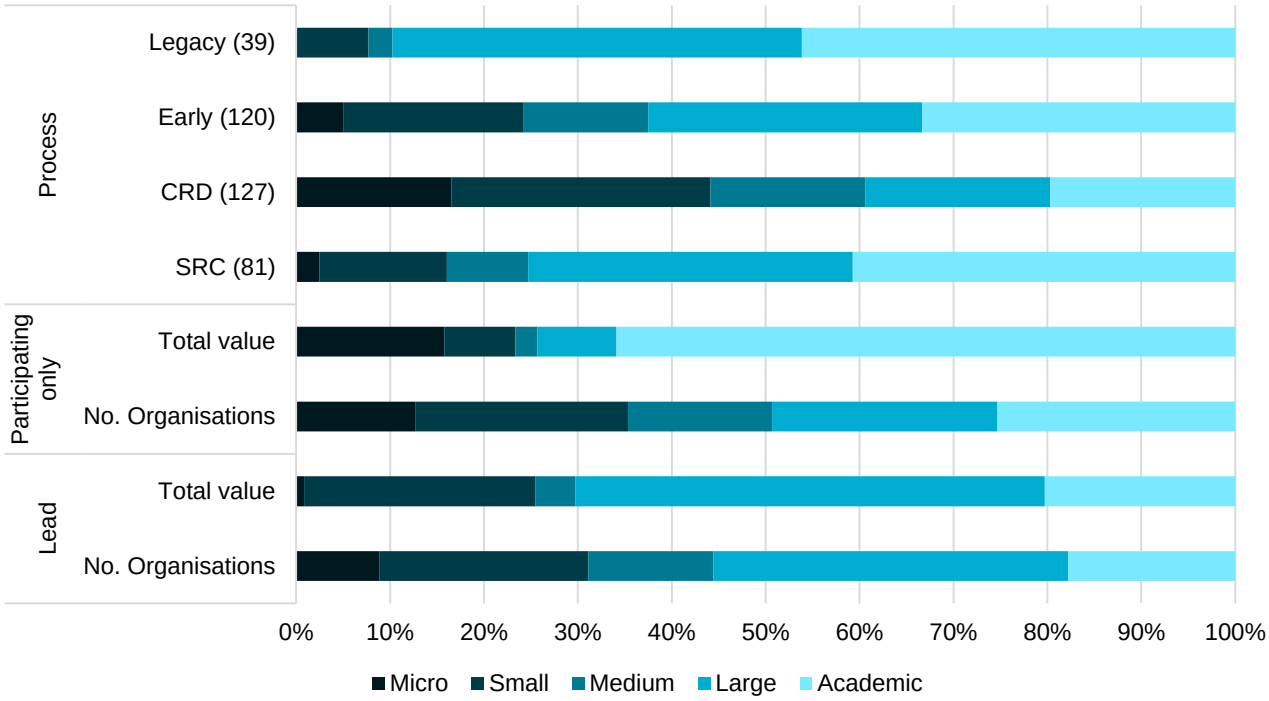
Source: ATI Management Information

2.3.2 Recipients of ATI funding

In total, 195 different organisations have received funding across all of the ATI processes outlined earlier as the lead applicant or collaborating party. Forty-five organisations were lead applicants on at least one project, and analysis of monitoring information suggests a small number of large organisations have been involved in the majority of these, with 10 organisations leading on 76 percent of ATI projects. Across the full range of ATI projects, there were on average approximately four partners per project whilst on average partners were involved in just over three individual projects each.

Figure 2.3 below shows the breakdown of firms by size and shows that large firms and academic institutions accounted for the majority of applicants in all categories, with the exception of CRD where the breakdown is relatively even across size classifications. Additionally, the figure show that large firms were more likely to have led on applications. The converse is true for academic institutions (as expected by the industry led nature of the programme). It is also evident that, for organisations not leading on any application, these institutions received a far larger relative proportion of grant compared to SMEs and large firms (though this finding may be affected by the fact that university partners can access full funding for their projects rather than seeking matched funding).

Figure 2.3 Distribution of ATI applicants by size of organisation



Source: ATI management data. Participating only relates to applicants that have only participated as project partners rather than lead applicants.

Defrayment[13] of grant

Across all projects with data available in the November 2016 Innovate UK database of funded projects, a total of £359,997,340 has been drawn down by project partners with an average of £2.2m per project[14].

Analysis of the 116 live projects in the data shows that 33 percent of projects have significantly more days elapsed as a proportion of the project length than they have drawn down in grant.[15] While this may reflect lags in recording project spend, or that projects have a non-linear spending profile (i.e. spending often increases with time), large gaps here may potentially suggest that projects are running behind, on the assumption that the planned spend profile throughout the duration of projects is uniform. Further data provided to the study team on revisions to project costs and the amount of grant shows a number of projects have at some point had revisions to either cost, grant or both cost and grant. When this data was compiled in September 2016, a total of 82 percent of the SRC, CRD and early ATI projects included in the data have at some point had their cost revised with 26 percent seeing upward

[13] Expenditure of the grant funding committed on signature of the Grant Confirmation Letter.
[14] Note that this figure is likely to understate spend since claims are made in arrears
[15] Exhibit a greater than 20 percentage point difference between % of days elapsed divided by the percentage of grant spent.

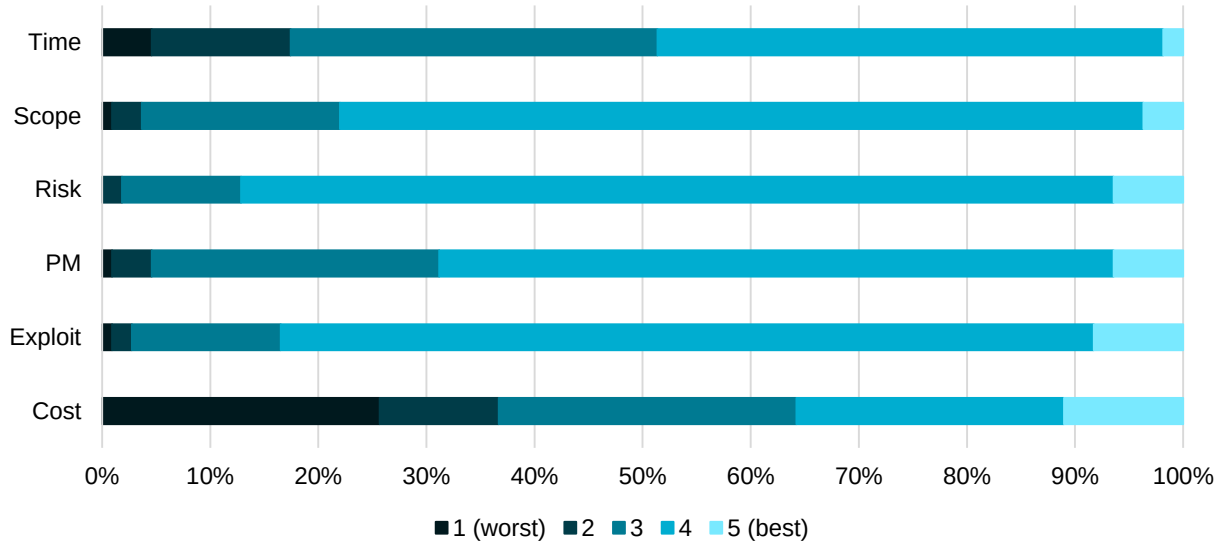
revisions and 56 percent downward revisions at some stage.[16] On average, projects costs were revised downwards by 2 percent. No ATI projects have been terminated early (though two early ATI projects were terminated during the contracting phase).

Project Performance

Monitoring reports, produced quarterly for each live project provide an assessment of the current status of the project on six key aspects: scope, time, cost, exploitation, risk management and project management. These are scored from 1 to 5 with 1 requiring urgent review to address significant issues to 5 for projects which are exceeding expectations in the accompanying category.

Analysis of the latest RAG breakdown provided by the ATI indicates a majority of projects are scored four or five on four of the six monitored factors: scope, risk, project management and exploitation. Latest status ratings on the time criterion are more varied with a larger proportion of projects scoring one; however, cost (which is assessed against planned costs, the extent to which costs incurred are commensurate with progress, and forecasts are reasonable) is shown to be the risk factor that is most varied, with the highest number of projects scoring one in addition to the highest number of projects scoring five when compared to the other factors.

Figure 2.4: RAG status of live projects as of March 2016



Source: ATI management data

Further analysis of changes to RAG scores are possible owing to the longitudinal nature of the breakdown[17] which indicates cost as being the category within which

[16] Data on revisions is available for 109 projects – this is not including any legacy projects. Two SRC projects are missing data and have therefore been excluded as has one early ATI project as a result of inconsistencies.

change is more likely to occur. A total of 72 changes in scores were observed in the data available to the study team, and a further 48 changes in the timing category. However, as noted, the net change anticipated cost from project start to March 2016 was on average downwards for each of the six categories and largest in the project management category.

2.4 Other issues for process evaluation

Two unique features of aerospace R&T projects were identified through the familiarisation phase of the research as creating potential processes issues:

- Interlocking projects – Several projects and applications are in some way linked to other projects. This includes projects that have been submitted by the same lead applicant and together feed into a larger co-ordinated programme of R&T activity, as well as applications for R&T projects that are dependent on the use of capital equipment that forms part of a separate application. These interrelationships complicate the assessment of both the technological and commercial risks and potential benefits involved with specific projects, and create a risk of double counting.

- Long time-horizons and multiple project stages – a number of applications have been received to undertake further R&T activities that follow on from previous studies and look to advance the technology further towards a market outcome. This also creates a risk of double counting if the costs and potential benefits of projects are assessed without reference to the previous project.

2.5 Summary

- The Aerospace Technology Institute (ATI) was established in 2013 by the Government. The ATI is partnership between industry and government that aims to sustain and grow the sector through targeted investments. Backed initially by £1bn of public funding (and increased by a further £950m in the 2015 Spending Review), and a commitment from industry to match government funding, the ATI supports strategic investments in UK aerospace R&T. The objectives of the ATI (as set out in the Business Case[18]) are broadly to sustain and grow the competitiveness of the aerospace industry in the UK, co-ordinate R&T in the sector (including through forming strategic relationships with industry, academia and Government), and to raise the UK's international profile in the industry. The delivery of these objectives has been supported by the development of a Technology Strategy, an industry led expression of the key technological priorities for the sector over short, medium and long term time horizons.

---

[17] This was made available to the study team for a maximum of four quarters for a total of 109 projects. This sample however did not include any SRC projects, potentially reflecting that the latest ratings available related to early 2016.
[18] BIS (2013). Aerospace Technology Institute: Business Case.

- While the ATI programme has inherited funding obligations from precursor programmes (such as the 2012 UK Aerodynamics Centre programme), the majority of public funding for aerospace R&T funding is now allocated through a Strategic Review Committee (SRC) process that was put in place in 2015, after the ATI Ltd. was formally constituted in 2013. This two-stage process involves the preparation and assessment of the strategic and economic merits of an initial outline application for funding and for those passing this first stage, a more detailed application and assessment. The ATI may engage applicants both prior to their initial submission and between the first and second stage application to improve alignment with the Technology Strategy, facilitate the formation of collaborative relationships, and identify opportunities for efficiencies were multiple applicants are intending to develop similar technology.

- Applications are scored at both stages by experts within the ATI, and decisions to progress proposals are made by the SRC whose members comprise representatives of BEIS and the ATI using the Technology Strategy as a guiding framework. Applications reaching the second stage are now subject to an ex-ante economic appraisal led by BEIS before the SRC meets to consider applications. Proposals passing the second stage are subject to an independent assessment in line with Innovate UK's standard procedures before Ministerial and (if the grant request is sufficiently large) HM Treasury approval. Other funding instruments are available to the ATI and have including Collaborative R&D competitions (open competitions administered by Innovate UK), and possible future contributions to a second wave of the National Aerospace Technology Exploitation Programme (NATEP). All projects funded through the ATI are subject to due diligence, contracting and monitoring process in line with Innovate UK standard procedures.

- While the aerospace industry took time to respond to the increased availability of funding for R&T, little difficulty is now being encountered in committing the available budget for aerospace R&T support or is anticipated over the remainder of the programme. Substantial pressures on the R&T budget are foreseen over 2017 to support major programmes of aerospace R&T, and the central future the challenge will be securing value for money from the remaining headroom in the budget. Ten applicants (typically large aerospace Primes or Tier One suppliers) account for over 60 percent of the resources that have been allocated (broadly reflecting the industrial structure of the aerospace sector). While at the time of the research, there had been little challenge in committing funds, the evidence suggests that there have been difficulties encountered in keeping the delivery of R&T work programmes on track. A non-trivial proportion (around one third) of the project portfolio have apparently defrayed grant expenditure less rapidly than originally anticipated and are deemed to be facing high risks to their timescales and costs by Innovate UK Monitoring Officers.

3.0 Aerospace Technology Institute

The ATI has been tasked with a major role in the delivery of public support for aerospace R&T through the development of a Technology Strategy, by helping to raise the profile of the funding available to attract high quality applications from a range of aerospace communities, and by engaging prospective applicants to support their applications for funding. This section explores the effectiveness of this activity.

3.1 Development of the Technology Strategy

The ATI (in partnership with the support of BEIS, Innovate UK and the Aerospace Growth Partnership) has developed a Technology Strategy to support the delivery of its strategic objectives. The strategy identifies technological priorities for the UK aerospace sector, taking account of the strengths of the industry in the UK and the anticipated engineering challenges in meeting customer requirements in the short, medium and long term. The strategy purpose is to:

- Articulate a shared and industry-led understanding of the long-term direction of travel for the sector;
- Provide a strategic framework for prioritising the allocation of public funds to R&T projects (considered in Section 4);
- Help firms understand how their projects and innovations might connect to broader developments in the sector; and,
- To help to showcase UK strengths internationally and to offer confidence about emerging areas.

3.1.1 Sector Engagement in Strategy Development

The ATI undertook a broad range of sector engagement activities to support the development of the Technology Strategy. These included a kick off workshop attended by 200 industry and policy delegates, the establishment of 12 advisory groups[19] which meet three times each year to discuss key issues covered in the strategy, and more informal and ad-hoc one-to-one discussions. The advisory groups provided a forum in which areas of the strategy were discussed, and

[19] These groups were created by the ATI to input into the development of the overall strategy including road maps, reports to government, and technology reports to industry leaders. There are twelve groups overall including the ATI board, a Market and Economics Group (MAEG), a Technology Advisory Group (TAG) and nine Specialist Advisory Groups (SAGs). The nine SAG cover the four primary value streams, and five primary enablers as defined in the Technology Strategy and meet quarterly. These structures may be realigned over time as ATI priorities evolve.

provided comments on early drafts of aspects of the strategy. The ATI took responsibility for the finalising the priorities defined in the strategy.

It has not been possible to obtain substantial volumes of data on the specific organisations that were engaged in these processes, though records of the membership of the advisory committees are available. These show the ATI has been successful in securing the engagement of a group of senior people from large aerospace organisations. These organisations are also strongly represented on advisory groups as shown in Table 3.1, providing 92 of the 190 members. There are 40 large firms in the aerospace and sector[20], and when compared to the 17 on the advisory groups, suggests a penetration rate of 43 percent (this will understate of the penetration rate given the presence of defence and space manufacturers within the denominator). One SME manufacturer is represented on the advisory groups.

Table 3.1 Membership of ATI advisory groups

Type of organisation	Number of organisations represented	Total number of advisory group members
Academic / Catapult	28	52
Large Manufacturer	17	92
SME Manufacturer	1	1
Policy Stakeholder / industry support	4	14
Airline / Operator / Infrastructure Partner	5	11
Other, including consultancy	15	20
Total	70	190

Source: ATI records. Categorisation developed by Ipsos MORI.

Large applicants to the ATI consulted as part of this research reported several ways they provided intelligence and supported the development of the Technology Strategy. Some applicants identified specific areas of influence that they had had on the strategy. Predominantly, they had provided intelligence on their own core R&D competencies and pipeline of potential future activities which had then been reflected in the strategy. Policy stakeholders reported that the purpose of intensive

[20] Based on UK business Count data taken from Nomis using the four digit SIC code for '3030: manufacture of air and spacecraft and related machinery'. This SIC code has been used as an approximation for the aerospace industry and therefore is not considered wholly accurate as it will include defence and space producers that are not in the scope for the ATI. Penetration rates are therefore likely higher than suggested by this figure.

engagement with large organisations reflected the they drove a substantial share of UK aerospace R&T, and were very well placed to contribute.

SMEs were not as engaged in the development of the strategy. While stakeholders reported a range of ways in which SMEs had been invited to participate (such as email invitations sent to membership bodies), it appears that the opportunity to do so was not been taken up as strongly by SMEs (as is clear from Table 3.1). Some stakeholders reported that this reflected the limited capacity of SMEs in the sector to engage in a foresight project, either because of limited available resources, or because they were unlikely to take a portfolio approach to R&T (focusing on one project at a time). As such, greater engagement of SMEs may not have helped define future priorities for the industries. While the ATI is increasingly engaging with SMEs, some stakeholders suggested greater engagement of Regional Aerospace Alliances could help ensure that the ATI understands the views of SMEs while enabling them to engage more effectively.

The advisory groups were reportedly oversubscribed and the research also identified a small group of individuals who felt that they had not been given sufficient opportunities to input into the development of the strategy. However, in general, the process of engaging stakeholders to develop the strategy appears to have been efficiently managed. The complexity in bringing together a sector that is not inclined to talk openly about long-term priorities was noted by stakeholders, but the use of a mix of open models of engagement (such as workshops) and 'off-line' engagement on a one-to-one basis with some organisations appears to have been a broadly appropriate model.

Looking to the future, however, some applicants questioned the value of their ongoing engagement in the refinement of the strategy. There was a sense in some cases that it was moving towards a process of 'tinkering' and diminishing returns. This view was not universal, however, with other interviewees stressing the added value of the increasingly detailed strategy outputs, and reporting a demand for further, more detailed outputs linked to the Technology Strategy such as technology roadmaps.

The strategy development process was not thought to be been highly transparent. For example, a record of the different initial priorities identified through the engagement exercise was not made publically available, or how these were refined to the final list of areas (making it difficult for some stakeholders to understand why some priorities that were suggested had not been included in the final strategy):

> *"We sat on the SAG, the process worked well, we provided input, discussed and agreed what was the next big thing and then it never made it into the strategy, it was a confusing experience" Applicant*

This perceived lack of transparency in the finalisation of the strategy together with the intensive engagement with a core of large aerospace organisations creates the perceived risk of the Technology Strategy being heavily influenced by these organisations. The possible risk is that the strategy has developed to reflect the priorities of these large organisations, potentially at the expense of alternative opportunities. However, it is important to note that the current breadth of the strategy

(discussed in detail in Section 4), limits the extent to which this may have influenced project selection.

Recommendation
#1 The ATI should consider how far it can communicate why technical priorities were chosen in the strategy ahead of others while avoiding breaking commercial confidentiality. Greater transparency could address any perception that the resource allocation process has been captured by segments of the industry and meet the sector's apparent appetite for more thought leadership.

3.1.2 Support for the Technology Strategy from the sector

Applicants and policy stakeholders consulted reported a view that the strategy had correctly identified the key priorities, particularly following the 2016 refresh. There was also a clear sense amongst most applicants and policy stakeholders consulted that they had appreciated these opportunities to input into the development of the strategy, and generally felt that their views had been heard:

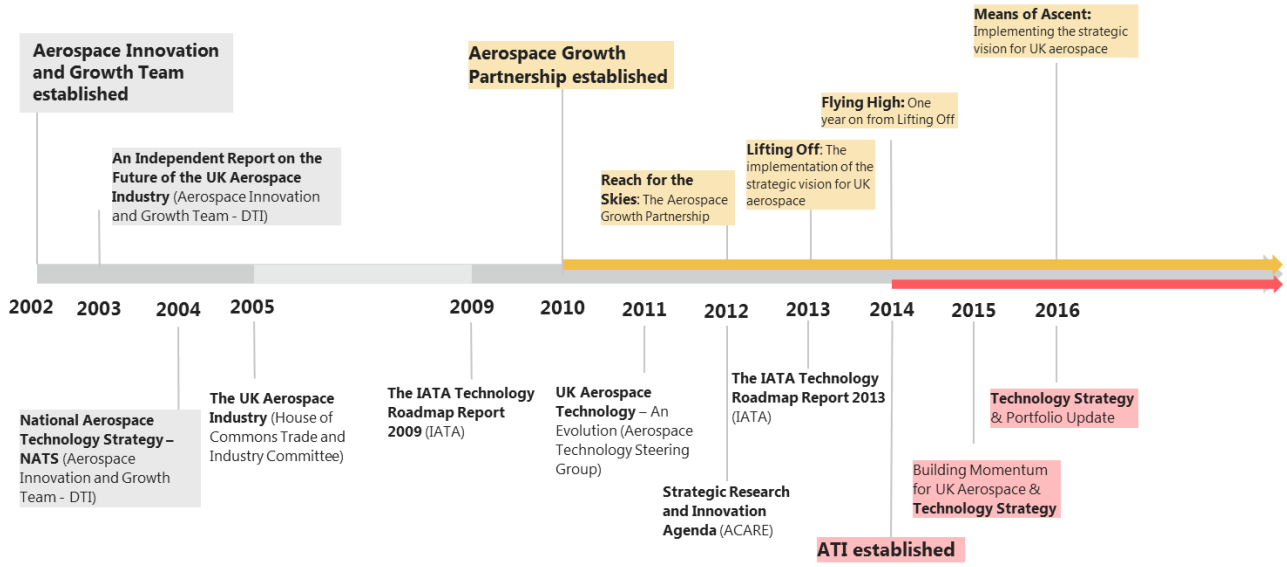
> *"I see the role of the ATI as a large filter for a pipeline of emerging ideas and see ourselves as one of the contributors to this pipeline" Applicant*

Support for the strategy amongst organisations engaged by the ATI appears to be mitigated by two key areas of concern. Firstly, a small number of applicants expressed concerns that in developing the strategy the ATI had absorbed a large volume of material and insight, and that they would now like to see this fed back to the sector in greater depth and detail. For example, the structure of the value streams used in the strategy – aerostructures, aircraft, propulsion, and smart, connected and more electric aircraft - reflects a typology of potential aerospace R&T activity rather than a detailed set of priorities. The 2016 strategy update was seen as an important step in the right direction and the gap analysis had enabled the strategy to become more specific. Nevertheless, there remains a demand from some parts of the industry for more detailed strategic outputs including white papers and roadmaps – both of which are areas that are an increasing priority for the ATI.

More widely reported was a view that the strategy had limited potential to unlock radically new opportunities for the sector as the it is largely a re-statement of established agendas. As set out in Figure 3.1 below, the ATI Technology Strategy covers an area of technology planning that had previously been the subject of extensive mapping, analysis and strategy development. There are close parallels between the priorities in the 2015 ATI strategy and a forerunner, Building Momentum for UK Aerospace, which itself built on the foundations of the four value streams and five technology and capability enablers previously established by the AGP. One stakeholder reported the view that the ATI Technology Strategy had simply built on the previous strategy that had been developed by BIS and the AGP, rather than taking the opportunity to add new value. However, another suggested this reflected a desire to use the first iteration of the strategy to help build trust between the ATI and

the sector, therefore limiting the scope for the strategy to be contentious. It is important however, to note that the evaluation did not include a programme of interviews with organisations that were not engaged with the development of the strategy, who may have a different perspective[21].

Figure 3.1 Timeline of aerospace strategy planning



3.1.3 Influence of the Technology Strategy

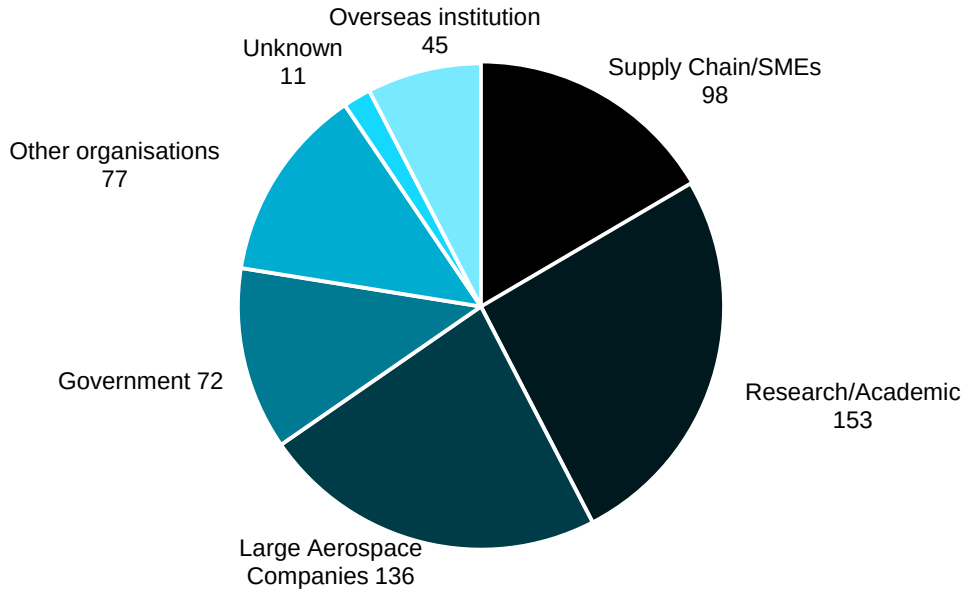
This section explores first the effectiveness with which the Technology Strategy has been communicated, and then the influence that this has had.

Effectiveness of the communication of the Technology Strategy

A broad range of activities were undertaken by the ATI to support the dissemination of the Technology Strategy including its launch in 2015 and the launch of the update at the Farnborough air show in 2016, and promotion through speaking opportunities at the Royal Society, the AGP and some Regional Aerospace Partnerships. The strategy has also been disseminated using a marketing list developed by the ATI containing several thousand members. ATI records show there was 906 downloads of the 2015 strategy and 595 downloads of the 2016 update by March 2016. Figure 3.2 below illustrates the breadth of organisations that had registered to download the 2016 strategy update.

[21] It is interesting to note that some of the applicants contacted as part of the case study research do not consider themselves to be part of the aerospace sector, but are now delivering relevant R&T.

Figure 3.2 Downloads of the 2016 Strategy Update



Source: ATI Records

All applicants and stakeholders consulted reported a high level of awareness of the strategy amongst large aerospace organisations. One stakeholder specifically reported the high frequency with which applicants reference and quote the strategy in applications. Figure 3.2 also shows that a number of supply chain partners and SMEs have downloaded the strategy (and based on the 710 SMEs registered in the aerospace and spacecraft sectors, this implies a penetration rate of 13 percent[22]). Some applicants were confident that their key supply chain partners were aware of the strategy – partly because they had notified them about its release themselves, while policy stakeholders also noted that they were now only occasionally coming across SMEs that were not aware of the strategy (typically at regional events or when SMEs are outside of the sector). Overall, it is difficult to confirm how effectively the Technology Strategy has been communicated to the sector without further evidence from organisations that have not engaged with the ATI.

Influence of the Technology Strategy on project applications

While it is possible that the Technology Strategy have brought clarity on the scope of funding, consultations with applicants suggested that it had a limited influence on their project applications. Applicants reported drawing on the strategy to influence the presentation of their projects rather than their design – the priorities of the strategy were seen by applicants as sufficiently broad to allow this (a point discussed

[22] Based on UK Business Counts obtained from NOMIS. This rate could be considered a maximum to the potential for double counting in figure 3.2 in cases where organisations download the document on multiple occasions. However, at the same time, the denominator in this calculation includes the space industry which would result in an understatement of the penetration rate.

in greater depth in Section 4). One applicant did however suggest that the reverse may be the case for organisations that were not closely engaged in the development of the strategy as they might need to refine the design of their projects to align with the strategy. Some applicants reported that the strategy, and the process of engaging to support the development of the strategy had helped them to identify new project partners, and opportunities to strengthen relationships with existing partners.

Influence of the Technology Strategy on applicants

One applicant reported that the strategy, and engagement in its development had helped them take a longer-term approach to the planning of R&T projects. It was not possible however to confirm the breadth of this, or the extent to which this was influenced by either the strategy or the availability of long term funding. A number of other applicants consulted suggested that while the strategy had not necessarily influenced their core activities, it had helped them to take a wider view of the sector, and to better understand the needs of their customers in other parts of the supply chain needed.

International influence of the Technology Strategy

Policy stakeholders were not able to directly gauge the level of international awareness of the ATI or the Technology Strategy. However, the following international engagement activities were reported:

- The Technology Strategy has been presented at several international conferences with the intention of raising the profile of the ATI;
- The strategy has been used to support discussions on potential joint projects with China and the FCO Prosperity Fund; and,
- Several applicants reported discussing the strategy with international offices internally when securing internal funding for R&T investments in the UK.

A number of stakeholders reported a belief that the strategy had helped to influence international investment by offering investors (such as Boeing or Honeywell) confidence about the strengths of the UK aerospace R&T, the government's long-term commitment to the sector, and (where international investors saw their R&T interests reflected in the strategy) increased confidence that their potential projects could access UK public support. However, it was also noted that it is difficult to differentiate the impact of the strategy in this regard from the commitment to invest close to £2 billion of public funds in this area.

3.2 Attraction of applications

This section explores the extent to which the marketing and engagement activities discussed in the previous section have maximised the value money by attracting high quality applications from across all communities of potential interest, and across the different areas identified in the Technology Strategy.

The study team have had access only to partial records of unsuccessful applications for ATI funding prior to the establishment of the SRC process[23]. The study team understand that only a small proportion of project proposals were rejected under Early-ATI processes because BEIS (at the time BIS) worked with applicants before recommending that they formally apply for funding. It is possible, however, that a number of ideas for projects were rejected at an early stage in that process, but not recorded. ATI-CRD competitions were oversubscribed, with a number pf project proposals being rejected.

The study team have received detailed records from the two-stage Strategic Assessment process. As set out in Table 3.2, these indicate that a total of 88 project applications have been made since the first SRC in September 2015[24]. In total, 51 of these projects were approved by the SRC (a success rate of around 60 percent) and recommended to proceed to Independent assessment (and a VFM assessment where appropriate) and 20 had completed all processes and are now under contract with Innovate UK. A further 37 projects have either been held, rejected or withdrawn at the SRC stage.

Table 3.2 Unique Applications to the SRC

Latest status	Number of projects	Total grant value
Under contract	20	£126,249,418
Recommended to proceed to stage 3, but not contracted	31	£221,920,557
Proceed to Stage 2 but not yet submitted stage 2 application	4	£22,511,000
Hold	9	£59,792,560
Reject and resubmit	7	£39,738,553
Reject	11	£64,336,280
Withdrawn	6	£16,615,880
Total	88	£551,164,248

Source: SRC Decision Data

[23] Panel Sheets have been received that provide a list of unsuccessful applications, but only limited details

[24] This figure includes only unique projects and therefore does not count resubmissions. For reference, 15 applications were resubmitted at SR1 and 12 at SR2. Analysis includes applications up to September 2016 SRC

3.2.1 Attracting project proposals from all communities of potential interest

Since 2015, the programme appears to have experienced little difficulty in attracting applications that meet the minimum standards of the SR1 review process. As detailed in Table 3.2 above, 55 projects with a total grant value of more than £370 million have been received and passed at least one stage of assessment since September 2015 (in addition to £380 million approved through Early ATI and CRD processes), and policy stakeholders reported that the £150 million per year funding for aerospace R&T was limiting their ability to approve further high quality applications. In addition, ATI engagement with applicants (discussed in depth in Section 3.3) has identified a pipeline of projects that applicants expect to seek support for in the future, that is thought to be substantially larger in value than the remaining available total amount of grant funding.

Analysis of secondary data identifies a number of firms and academic groups that appear to be innovation active in the aerospace sector but which have not accessed ATI funding. Analysis of patents filed since 2009 in areas identified as of most direct relevance for aerospace[25] (as set out in Table 3.1 below) showed that 74 UK based firms had applied for a total of 296 patents. While the most prolific aerospace patentees (and potentially the most innovation active) are also recipients of ATI grants, 51 of the 74 organisations filing patents had not accessed ATI funding.

Table 3.3 Patent applications and ATI funding

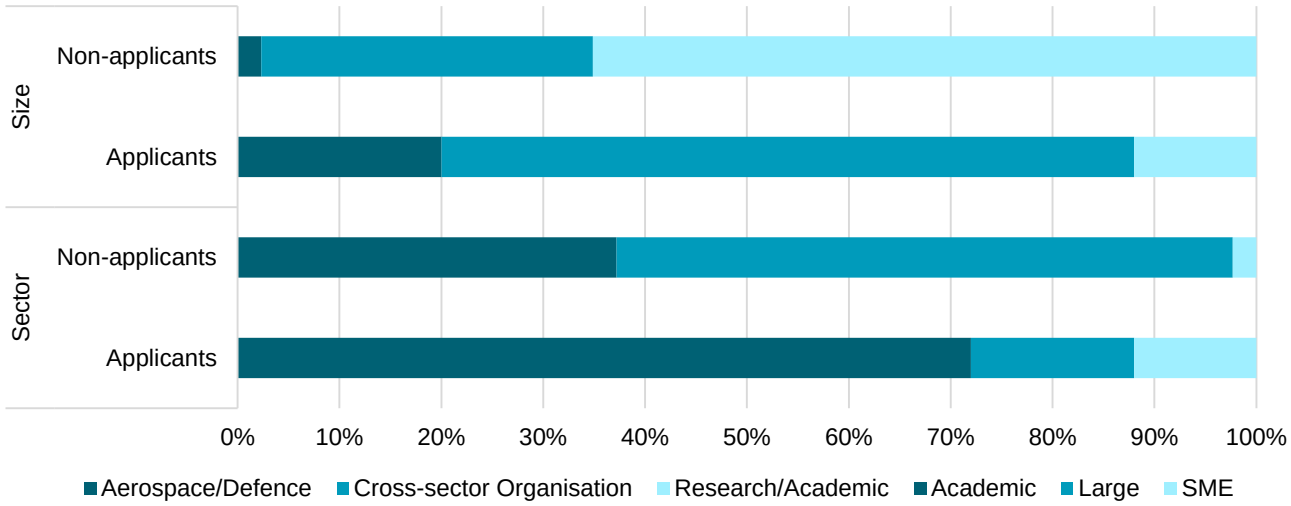
	ATI grant recipients	Non-recipients
Number of organisations filing a relevant patent	25	51
Total number of patents	217	79

Source: PATSTAT

These records show that these non-recipients are more likely to be SMEs and are more likely to be located outside of the aerospace sector than ATI applicants. Data presented in the 2016 UK Aerospace Supply Chain Study also suggests that the UK aerospace supply chain is largely formed of SMEs with 83 percent employing less than 250 employees[26]. Once academic institutions are excluded, only 64 percent of ATI applicants are classed as SMEs. This suggests that SMEs are potentially under-represented amongst applicants,[27] though more may be receiving funding through the NATEP programme and via subcontracts.

[25] IPC codes B64B, B64C, B64D and B64F
[26] BEIS (2016) UK Aerospace Supply Chain Study
[27] The relevant data from the supply chain study is based on 112 respondents from an initial sample of 884

Figure 3.3 Breakdown of relevant patentees by organisation type/size and sector orientation



Source: PATSTAT[28]

Additionally, while the ATI has received applications from a large group of SMEs, these organisations have predominantly been as project partners rather than lead applicants – of 195 projects, 137 are led by a large manufacturer, and 50 of these include one or more SMEs as project partners. This may reflect the scale of the projects funded through the SRC process and the limited ability of SMEs to match fund and co-ordinate projects of this scale. Figure 2.3 also shows that the SRC process is supporting a lower proportion of SME led projects than the Early-ATI and CRD processes. The contrast is particularly strong with the CRD process – there are a pool of 59 organisations (out of 127 participating organisations) that have only accessed ATI funding through CRD competitions, of which 80 percent were SMEs. This low level of applications from SMEs in the SRC process was reported as a concern by several stakeholders who noted a perception that the 'SRC is more for the big boys' rather than for SMEs, particularly given the weight of the process for bids which may deter applications for small amounts.

One issue identified was that the CRD tool may have been too broad an approach compared to the more strategically focused SRC process. Projects in three areas were identified as having been supported by the CRD process that either did not align with the Technology Strategy, or were otherwise thought unlikely to receive funding through the SRC process:

- Investment in UAV research has been funded through CRD calls, but was excluded from the 2015 ATI Technology Strategy based on the view that this was not a core area of opportunity for UK civil aerospace R&T.

[28] Organisation size/type for grant recipients provided by the ATI, for non-recipients this was identified on the basis of a review of organisation websites and companies house. Sector analysis for grant recipients provided by the ATI, for non-recipients this was identified on the basis of a review of organisation websites and companies house.

- Projects that are not targeting the development of a technology to directly supply a ‘prime’ such as Airbus or Rolls Royce. For example, the pursuit of a manufacturing process, or a systems project (e.g.an actuator or pump or electronic system) may have been funded under the CRD process but was thought unlikely to have been supported by the SRC process.

- CRD funding was used to support stand-alone early stage technical development projects. While some similar early stage development activities have been funded as small part SRC projects, this has only been as a small part of a broader programme of more developed R&T activity.

The breadth of projects funded is not necessarily a function of the CRD instrument. The calls for the two competitions were broadly worded, rather than focused on a specific set of objectives, problem or challenge. Acknowledging this, stakeholders noted that the competitions were launched in advance of the development of the Technology Strategy and while the ATI was in its very early stages of development and that the calls were ‘not as focused as it could have been’. As such, it is likely that the increased use of CRD competitions could have been made without diluting the alignment of projects funding with the framework set out in the strategy.

Recommendation

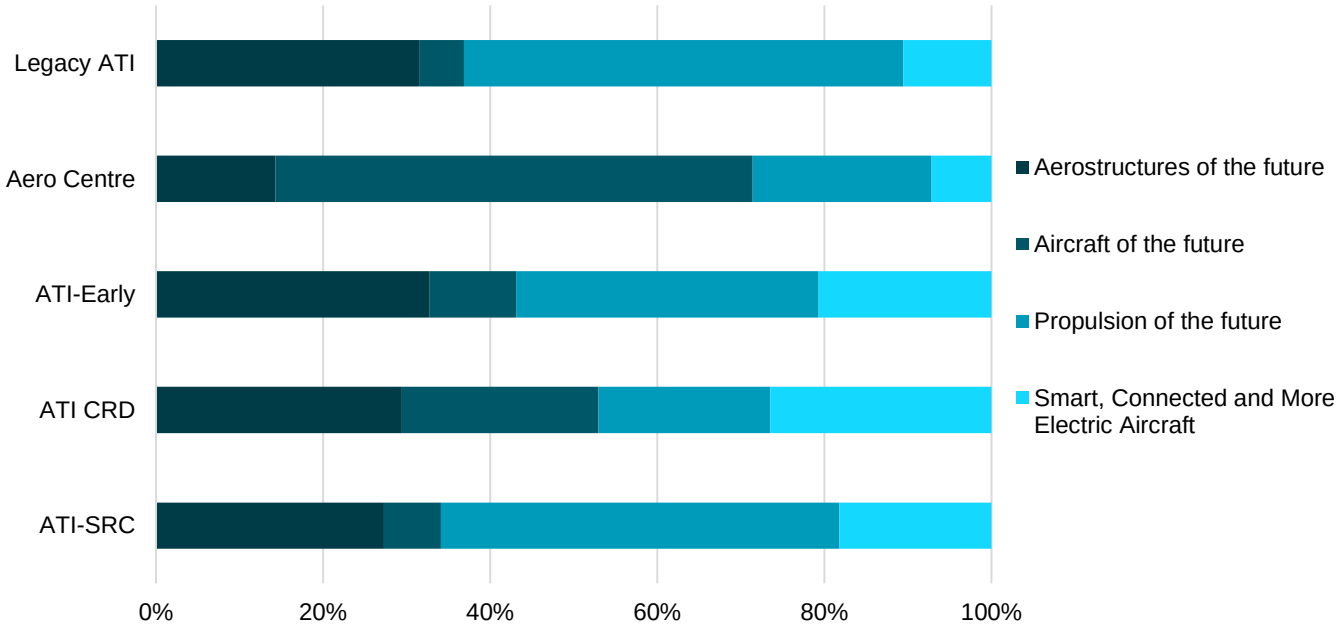
#2 The ATI should seek further opportunities to communicate the availability of funding to SMEs. The Regional Aerospace Alliances, other membership bodies, and Innovate UK (through its role delivering ATI CRD competitions, NATEP, and HITEA) could be potential conduits. The patent record or details of earlier Innovate UK grants for aerospace R&D may aid identification of further unengaged organisations.

#3 The ATI and BEIS should consider the risk that the SRC process may result in disruptive technologies with large potential returns being overlooked. The high demand for the two CR&D funding competitions from firms illustrates there may be potential in this respect. It may be possible to increase allocations through this instrument without compromising technical quality or relevance of projects funded if the principles of the Technology Strategy are embedded in the definition of the competition scope.

3.2.2 Attracting applicants across different technology areas

Figure 3.4 below details the primary value streams associated with each project across the portfolio of ATI funded projects. This highlights the prominence of support for propulsion related projects under the SRC process, when compared to the mix of projects funded under other processes. However, this focus was reported by policy stakeholders to reflect the fact that industry demand to date has been strongest in this area (resulting from the focus of major R&T programmes in the industry), rather than the ATI, ‘not harvesting sufficient projects and interest from other parts of the sector’.

Figure 3.4 Proportion of applications across Value Stream by process



Source: ATI management information. Note that full details of unsuccessful applications to processes other than SRC were not available to the study team (panel sheets provide a full list of unsuccessful applications, but offer limited detail).

3.3 Engagement with potential applicants

The ATI undertakes a range of activities with potential applicants to try to increase the overall value for money resulting from aerospace R&T funding through applicants' R&T plans, provide advisory inputs to help shape project applicants, and minimise wasted efforts by offering early signals where projects may not align closely with the Technology Strategy. This engagement ranges from regular contact with a group of the most engaged applicants, to more ad-hoc discussions with other interested parties.

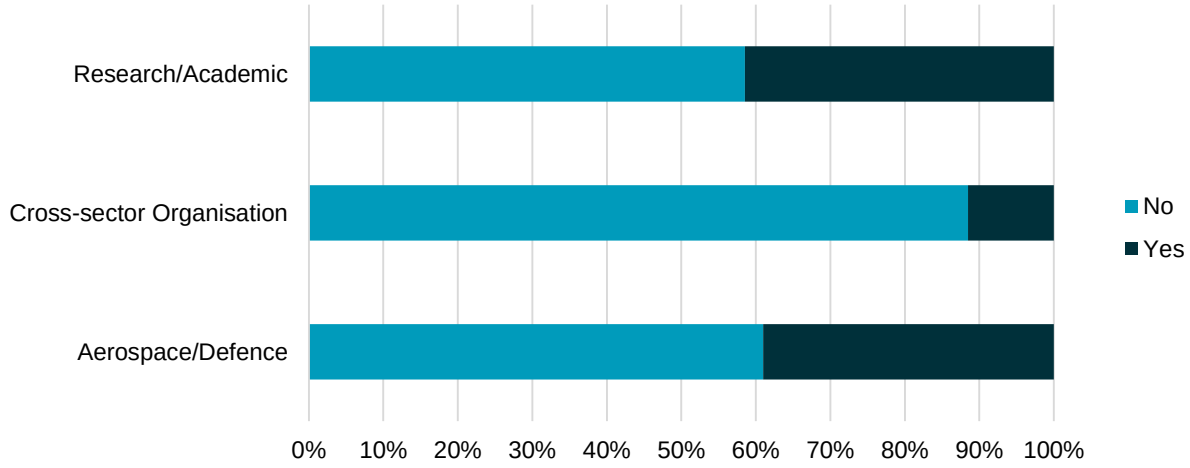
3.3.1 Strategic overview of current and future R&D programmes

ATI engagement activities appear to have built a high level of trust with many of the UK's key aerospace R&T companies which is supporting the sharing of knowledge about their pipeline of future R&T projects, and potential ATI applications. The large companies contacted through this research reported a high level of engagement and openness in discussions about their strategic priorities. Some applicants and policy stakeholders noted that such a relationship is rare within a sector that has not generally been highly open.

The establishment of a Framework Agreement appears to have helped build trust. This legal document covers aspects of confidentiality and specifies the funding mechanism for the ATI. All applicants must now sign the agreement before their

projects can be recommended for funding by the ATI, and by December 2016 the agreement had attracted 70 signatories. Several policy stakeholders stressed the importance of this document in clarifying the relationship between applicants and the ATI, and applicants noted that it had been key to unlocking their relationship with the ATI.

Figure 3.5 Proportion of partners across sector signed up to the ATI Framework



Source: ATI management information

Qualitative research identified a set of key limitations to the extent to which the ATI engagement activities can be expected to offer a strategic overview of current and future R&D projects from the sector:

- **SME engagement:** It appears that engagement activity has been focused towards larger organisations, and it is not clear that the same levels of trust and openness have been achieved with SMEs. Several large applicants reported a belief that while the ATI had effectively engaged with them, this was unlikely to be the case for their supply chain. There was a reported perception that project partners would not be comfortable having a high level of openness with the ATI and would be unsure about how much information they should share with the ATI and how to manage this interaction. A perception was also reported that primes have in the past played off smaller organisations against each other, collecting ideas from several partners, picking the best ideas, but only proceeding with one partner – potentially exacerbating issues of trust around R&T activities.

- **Information security:** An issue identified by two stakeholders related to the importance with which aerospace companies view the security of their information. As a new organisation, the ATI was not initially trusted to receive material as sensitive as an R&T proposal, and it took approximately a year before the sector was convinced that adequate IT security protocols were in place. However, stakeholders reported these issues have improved, though

there was a suggestion that the weakness of the original arrangements did have a lasting impact on trust.

- **Perceived conflict of interest:** In general, policy stakeholders were content that the ATI is free from conflicts of interest. However, some reported a perceived conflict of interest in that some in the industry see companies such as Rolls Royce, Airbus, GKN and Bombardier on the ATI board[29] and assume that this membership reflects the focus of the organisation. One stakeholder reported a 'conversation' in the sector and a belief that public funding for aerospace R&T delivered through the ATI 'is the cash for just those four'. However, consultees felt that the ATI management team have sought to dispel this perception as far as practically feasible.

3.3.2 Shaping project proposals

The ATI records information on how it has influenced the design of project proposals across the full range of projects that have applied for funding since the implementation of the SRC process (including both applications to SR1 and SR2). This is classified across the following project areas: strategic focus, market impact, economic impact, collaboration, technical focus and approach. Across the 88 separate project applications for which data is available, ATI believes it has helped to reshape 14 (16 percent). As set out in Table 3.4 below, the ATI report the strongest influence over project strategy and collaboration.

Table 3.4 ATI SRC proposal aspects reshaped as highlighted by the ATI

Area reshaped	Proportion of SRC projects	Value of reshaped projects
Strategy	10%	£58,100,241
Markets	1%	£3,800,000
Economics	3%	£16,703,915
Collaboration	8%	£45,326,461
Technical	3%	£19,491,410
Approach	6%	£44,439,000
Any	16%	£93,994,156

Source: ATI Management Data
* This is overall and therefore includes unsuccessful in addition to successful applications at both SR1 and SR2

[29] It is important to note that these companies were selected as a result of an independent study showing the most significant companies to be included on the ATI board, and the ATI also has an SME representative and several independent directors.

In addition, one systems project was identified by stakeholders as a particularly strong example of the ATI unlocking a joint working approach. In this case, the ATI was described by policy stakeholders as having brought together a large number of organisations that they had identified as pursuing a related agenda, and supported them to work collaboratively to access funding.

This perspective on the influence of the ATI on project development supported by the views of applicants who generally reported limited effects in this area. Some reported that on occasions the ATI had suggested alternative partnerships and collaborations, but this had not resulted in any changes to their plans. Another stressed that they were working as a project partner on several ATI projects with materially overlapping technological content. This suggests that there may have been missed opportunities to encourage collaborative working on related issues – though it is important to note however that there may have been strategic reasons for pursuing these activities as separate projects (such as IPR or competitive complications) and that this is a topic that the SRC does aim to scrutinise.

3.3.3 Influence over other funding in the sector

Some policy stakeholders consulted through the research reported that ATI has sought to maximise the impact of Research Council funding for aerospace through engagement with the EPSRC. This engagement includes board level representation with the EPSRC sitting on the ATI board, and senior ATI officers chairing and participating in the Strategic Advisory Team and Manufacturing Boards of the EPSRC. While this engagement will not directly influence the allocation of EPSRC grants, the ATI anticipate that they will be able to help shape EPSRC grand challenge calls for funding applications. In addition, four EPSRC grants have been made to academic researchers to deliver networking activities in partnership with the ATI around each of the four pillars of the Technology Strategy. However, it is too early to assess the impact of these activities.

3.4 Summary

- The evidence indicates that ATI have been highly effective in securing the engagement from the most technologically and economically significant organisations undertaking aerospace R&T in the UK. It is however, less clear how effectively the ATI have engaged the group of SMEs that are innovation active in aerospace R&T. This, combined with some views that the process of developing the strategy lacked transparency have led to a perception by some that the final Technology Strategy was highly influenced by these larger organisations.

- The evaluation identified a high level of support for the Technology Strategy amongst the organisations that were engaged in its development. Furthermore, the strategy is seen by some applicants and policy stakeholders as a restatement of broad existing priorities for the sector, rather than helping to identify opportunities on which further investment should be prioritised. The more detailed 2016 strategy update appears to have mitigated this issue to

some extent, but there is an appetite amongst these organisations for more detail in future iterations of the strategy and related policy documents.

- The ATI has embarked on a broad programme of activity to market and raise awareness of the strategy. There appears to be high level of awareness of the strategy amongst the organisations consulted. However, without undertaking research with organisations that are undertaking aerospace R&T, but have not engaged with the ATI it is difficult to comment on the extent to which the strategy has reflected their views.

- Overall it appears from consultations with applicants that the Technology Strategy may have only had a limited influence on the focus and design of their projects. Applicants reported drawing on the strategy to influence the presentation of their projects rather than their design. There is scope for the strategy to have helped to raise the planning horizons for organisations undertaking aerospace R&T, and it may have acted to support the attraction of new entrants to invest in the UK. However, it is difficult to confirm the relative contribution of the strategy and the allocation of long-term public funding in this regard.

- The ATI has supported the attraction of a large volume of application for public support for aerospace R&T projects, and a total of 88 applications had been received requesting grants in excess of £550 million by October 2016. However, there appears to be a broader group of organisations that are innovation active in the aerospace technologies but have not accessed funding through the SRC process – particularly comprised of SMEs and organisations with a primary focus that is outside of the aerospace sector. In comparison, the use of CRD calls appears to have accessed a broader pool of applicants.

- The ATI have built a high level of trust with many of the UK's key aerospace R&T companies and academics, supporting a broad sharing of knowledge about the pipeline of future R&T projects, and potential applications for funding. The ATI also records having helped to reshape 16 percent of projects through this engagement, in particular influencing the proposed strategy and collaboration model. However, applicants reported a lower level of influence in this area. Additionally, it is not clear that the same levels of openness, trust and sharing of ideas has been achieved with SMEs in the sector.

4.0 Resource Allocation

This section explores the effectiveness of the processes in place to allocate ATI support for R&T projects. This section covers the strategic assessment process, the Independent Assessment process, and the value for money assessments completed by BEIS.

4.1 Strategic Assessment Process

The dominant mechanism by which public funds for aerospace R&T have been allocated since the ATI was formally established as an organisation is the strategic assessment process. This process was put in place in September 2015, with objective of:

- Maximising the impact and value for money associated with the portfolio of R&T projects funded through the ATI; and,

- Maximising the efficiency of the process from the point of view of the ATI, the public sector, and the applicants involved.

Following early engagement activity (as discussed in Section 3.3) applicants must complete two stages of ATI strategic assessment processes. In the first stage, applicants prepare a brief application that is assessed by ATI experts and scrutinised by the Strategic Review Committee (SRC), as defined in the figure below. If the proposal is approved at SR1, the applicant is invited to submit a more detailed application, which is subject to additional assessment by ATI experts and scrutiny at SR2. If the project is recommended for funding by the SRC, the proposal receives a further independent assessment, before the request for grant funding is submitted for Ministerial and HM Treasury approval (if needed).

The process also involves a value for money assessment, involving an ex-ante economic appraisal of the costs and benefits associated with the proposal, led by BEIS analysts (with projects required to meet a minimum BCR to proceed to the next stage[30]). Initially, this assessment took place following the recommendations of the SRC, for those proposals with a grant request of £10m or more. The value for money assessment now takes place in advance of SR2 meetings and is undertaken for all bids.

4.1.1 Guidance and Application Process

The ATI has produced detailed guidance to help applicants understand what is required for the Strategic Assessment Process. This outlines a set of points that applicants are encouraged to consider prior to submission, such as whether a clear

[30] In borderline cases, the VFM analysis may highlight the need for further evidence from the applicant, which would entail a review of the analysis on receipt of the information.

and unambiguous business case has been explained, or if the UK economic benefit is clear. However, no guidance is offered to applicants about the form in which SR1 submissions should be made. Stakeholders noted that this openness was intended to offer flexibility to applicants. However, it appears that lack of standardisation has caused some uncertainty amongst applicants regarding the level of detail which is required.

In addition, feedback prepared by the ATI on both successful and unsuccessful submissions frequently described the need for applicants to provide more detail. In response, some applicants reported they have increased the depth and detail in SR1 submissions. Where applicants are providing more detail than is required by the ATI, there is a risk of wasted effort on the part of the applicant. There was recognition of this issue within the ATI, and it was reported that introducing an application form for SR1 to standardise the form of response at this stage is on the agenda for operational improvements moving forwards. These issues do not apply to submissions to SR2 where there is further guidance available from Innovate UK and a standard application form.

Overall, stakeholders were generally positive about the quality of evidence provided by applicants using the application forms provided for the SR2 and subsequent assessment stages in many areas. However, it is clear from the additional information requests required for the VfM assessment that these forms do not provide sufficient evidence of the expected benefits associated with project delivery. As noted below in Section 4.5 regarding Independent Assessment, the application forms that have been reviewed by the study team appear to be detailed and offer a detailed description of project aims, and its technical basis. One policy stakeholder did express some concern however that, compared to other Innovate UK schemes, the quality of evidence provided by applicants for aerospace R&T projects on aspects of project and consortium management was lower, potentially reflecting a lack of emphasis on this aspect during the early stages of the application process[31].

Recommendation

#4 The ATI should consider developing an application form for the SR1 process, and accompanying guidance that specifies in greater depth what is expected from applicants and defines what information is and is not necessary for an SR1 decision. Innovate UK should be engaged to ensure compatibility of data across systems. The form would optimally be based on a subset of questions from the Innovate UK application form produced at SR2 to minimise duplication of effort.

[31] Note that the assessment of proposed project management approaches on ATI projects is discussed in depth below

4.1.2 Scoring of SR1 and SR2 Proposals

Prior to SRC meetings, applications are reviewed and scored by ATI experts. This is intended to support project discussions during the meeting.

- At SR1, projects are scored by the ATI in terms of their Business and Economic Case, their Technological Case, their Approach, and given an overall assessment. A total of 43 SR1 assessment records have been analysed by the study team and compared to the various other scoring processes.

- At SR2, applications are scored by the ATI against their Economic Value, Economic Risk, Technological Value and Technological Risk and Additionality[32].

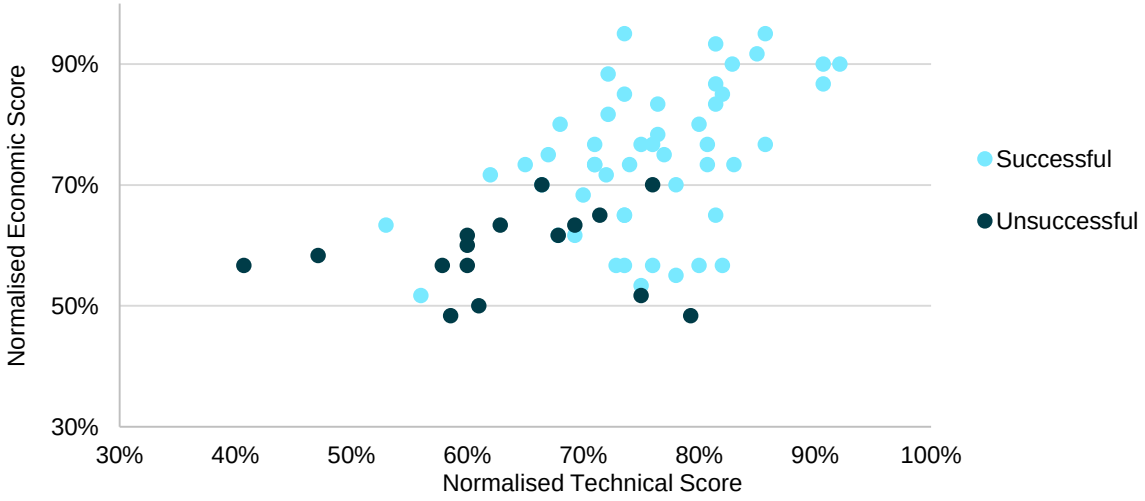
Analysis of the scores shows a strong correlation between assessment scores at SR1 and SR2. Figure 4.1 below illustrates that some poorly scoring proposals received a positive outcome at SR2, while some high scoring proposals being unsuccessful. This pattern may have been influenced by relative budget constraints at each panel meeting, raising questions as to whether the flat budget profile for ATI spending may be forcing some suboptimal trade-offs between project proposals and whether greater value for money could be attained with more flexibility.

Stakeholders reported that the assessment was designed to provide guidance to SR2 committee members, and is used in the SRC as a starting point for discussions, rather than being used to determine the final selection of projects. It should be noted that the scoring of proposals at SR2 covers similar ground, though in less detail, to the VfM assessment undertaken by BEIS analysts. Now that the VfM assessment takes place in advance of the SR2 process, parallel scoring of proposals could be viewed as redundant (though the individuals involved in these processes bring different sets of knowledge to the assessment process).

Recommendation
#5 BEIS and ATI should consider how far there is an on-going need for the ATI to qualitatively score SR2 applications on aspects relating to value for money now that VfM assessments take place in advance of SR2. There may be scope for ATI experts to feed in views into the VfM analysis, particularly around issues of additionality and technological risk.

[32] Note however that the approach to scoring of project additionality has changed over time. Our analysis is based on a normalisation of scores that pulls out the variations within the different approaches used.

Figure 4.1 Comparison of combined and normalised economic and technological scores for successful and unsuccessful applicants at SR2



Source: ATI management information.

4.1.3 Strategic Review Committee

The SRC is comprised of individuals with a mix of experience and relevant expertise, as well as individuals with a specific role to play in the process (such as advising on VfM). However, the research has identified some mixed opinions about the areas covered by the group most effectively. One stakeholder was complimentary about the ability of the SRC to interrogate the technical quality of the projects discussed while noting that scrutiny offered less depth on aspects of value for money. However, a different policy stakeholder offered the opposite perspective suggested that value for money was given greater scrutiny than aspects of technical detail.

As shown in Figure 4.1 below, the success rate at SR1 was 70 percent, and 60 percent at SR2. Several policy stakeholders reported that these success rates may be likely to decrease as the decreasing proportion of funding available will necessitate a more discriminatory approach.

Table 4.1 SRC decisions

Outcome	SR1	SR2
Proceed to next stage	64	51
Hold	3	18
Reject	5	10
Reject and Resubmit	17	1
Withdrawn	1	6
Total	90	86[33]

Source: ATI Management Information

4.1.4 Supporting alignment of ATI funding with the Technology Strategy

A core objective of the SRC process is to offer a check of the extent to which an application aligns with the priorities set out in the Technology Strategy, and ATI records show that 'Strategy' was a reason for more than half of all applications receiving a negative result at SRC, as set out in Table 4.2 below. Policy stakeholders expressed a view that this process ensured that only projects that aligned with the Technology Strategy receive funding.

Table 4.2 Reasons for Hold or Reject decisions at SRC

Reason for Hold or Reject	Count	Percentage of negative outcomes	Percentage of all decisions
Strategy	28	52%	16%
Markets	24	44%	14%
Economics	28	52%	16%
Collaboration	24	44%	14%
Technical	24	44%	14%
Approach	30	56%	17%

Source: ATI Management Information

[33] Note that 18 of these did not submit to the SR1 process because their applications were processed in advance of the SR1 system being established.

While the Technology Strategy and Strategic Assessment process represent a tool for rejecting some applications, the strategy is broad and will be difficult to use to prioritise proposals as headroom in the budget narrows substantially. As noted in Section 3, the four value streams at the heart of the strategy reflect a typology of aerospace R&T rather than a set of specific priorities, or challenges against which projects could be scored and compared against. The 2016 update has mitigated this issue to some extent through its focus on a set of more specific 'gaps' where R&T projects are required. However, some policy stakeholders reported that it remains broad, and reported a belief that the strategy had not been developed with this prioritization approach in mind:

> *"It is not a framework for prioritization"/ "not really a precise tool to select projects" / "it doesn't do this [prioritisation]" Policy Stakeholders*

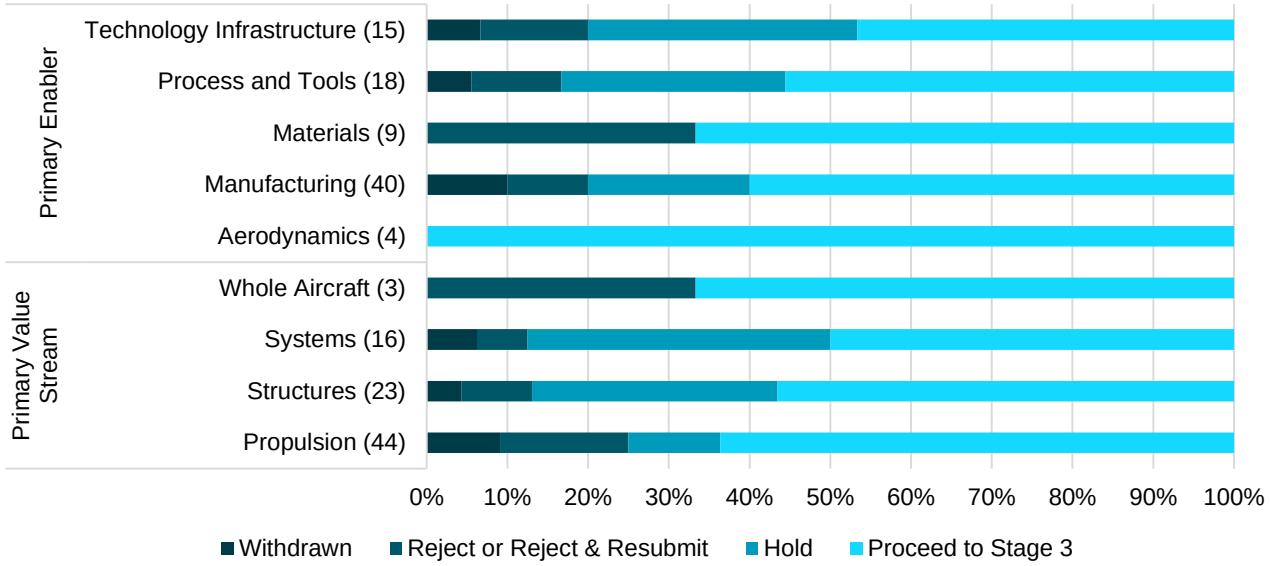
Recommendation

#6 The ATI should look for opportunities to include more specific and focused areas of interest within the next iteration of the Technology Strategy to aid the prioritisation of project proposals in the context of more acute budget constraints. However, it will be important to make clear this is not an exhaustive list of areas of UK capability, but areas where there is a desire to see a stronger set of proposals and that ATI funding remains open to good ideas not foreseen when drawing up priorities.

4.1.5 Supporting a balanced portfolio of projects

As suggested in Section 3, the projects approved by the SRC process include a strong focus on propulsion technologies. Figure 4.2 below identifies that the success rate at SR2 for applications in this area is not necessarily higher than other projects, implying that the weight of applications is the key determining factor here rather than a preference for these projects at SR2. One stakeholder suggested that the introduction of targets for specific areas of technology could support the delivery of a more balanced portfolio of projects (though this would raise the risk of forcing sub-optimal trade-offs between project proposals).

Figure 4.2 SR2 decisions across Primary Value Streams and Primary Enablers



Source: ATI management data

Recommendation

#7 ATI and BEIS should look to further clarify the relative importance of priorities identified in future iterations of the Technology Strategy. However, adopting targets for investment in specific technologies could result in a reduction in value for money from the programme if it diverts investment away from the strongest projects.

4.1.6 Independence of the process

The high level of engagement between the ATI and applicants to support the development of project proposals prior to making formal submissions to the SRC limits the extent to which the SRC assessment process can be seen independent. However, within this constraint, the process appears to be well managed to maximise its independence. Stakeholders with first-hand experience of SRC meetings were positive about the quality of discussions, particularly with regard to their technological content, and the level of professionalism.

Policy stakeholders could not identify any conflicts of interest arising from this process and no organisation consulted identified any instances where they had cause to question its integrity. This generally positive view on the independence of the SRC process may however reflect its role in resource allocation as a first check on projects, in advance of a formal Independent Assessment process. Both applicants and policy stakeholders noted that the SRC process does not need to be independent because of the role of this subsequent process (though note that this is

potentially problematic as there are also issues of possible duplication with the Independent Assessment).

4.1.7 Feedback to Applicants

Overall, the feedback provided to applicants from the SRC process appears to have been variable in quality. Some applicants described it as 'excellent' and highly constructive. Others expressed frustration that feedback from SR1 had simply asked them to strengthen, for example, technical aspects of their proposal, had been delivered late, or the messaging varied between what was provided in written form, and what was communicated over the phone. One policy stakeholders also noted that in the case of SR2 decisions to 'Hold' projects, feedback had not effectively been communicated to applicants, who still believed that they should be working with BEIS to develop a full VfM assessment of their projects. These issues have been acknowledged by ATI and BEIS and there is work underway to resolve these issues (and a 'Hold' is unlikely to be used in the future).

It appears that the feedback received by applicants following SR1 review contributes in only a limited way to strengthening project design. The feedback provided focused primarily on the quality of supporting evidence, and applicants generally had limited recall of the key messages included. Policy stakeholders that were closely involved with this process reported that engagement prior to application (discussed in Section 3) was of more material importance for shaping projects than following SR1, by which time it was thought projects were relatively 'locked down'.

Recommendation
#8 If a 'Hold' was to be used in the future (there are no plans to do so), ATI should specify the conditions under which these applications would be recommended to proceed to VfM Assessment and Independent Assessment.

4.2 BEIS VfM Assessment

The objective of the BEIS VFM assessment is to provide a detailed assessment of the extent to which government aerospace R&T funding generates value for money for the taxpayer and the exchequer. The assessment is based on supplementary information and evidence provided by applicants and any assumptions around the likely outcomes and benefits of a project. This section focuses primarily on the perspectives on this process offered by applicants and policy stakeholders.

4.2.1 VfM framework

A VfM framework has been developed by BEIS analysts to support an understanding of the accumulation of economic benefits over time whilst discounting for deadweight losses, displacement and possible project risks. Applicants are contacted to provide an array of estimates on expected economic outcomes including: R&T expenditure, sales forecasts, jobs created, training, TRL progression, risks and wider benefits.

This information is then populated into a spreadsheet that provides an indication of expected VfM. BEIS analysts then conduct a series of analyses to verify and test the benefit-to-cost ratio derived from the model, and to confirm that this meets the minimum threshold of 2. For projects with a grant ask of more than £10m the outputs from the VfM process feed into a full Green Book assessment to support review by the Secretary of State, and HM Treasury.

Treatment of private benefits

The value for money methodology excludes consideration of all costs that will be incurred by the firms delivering the projects forming the focus of their ATI applications, and the benefits that may accrue in the form of subsequent profits. This is a departure from the standard convention of cost-benefit analysis to consider all costs and benefits regardless to whom they accrue - and focuses decision making on how far the level of additional external benefits are justified by the gross public spending involved (i.e. a narrower focus on the net present value of public benefits). External benefits in the form of additional consumer surplus associated with the consumption of the products, components or systems under development are also excluded. The rationale for this decision for this reflects a desire to focus on the public benefits associated with projects and the difficulties in establishing how far profits and second order benefits can be attributed to individuals residing in the UK).

The exclusion of considerations of the benefits that would accrue to the applicant could be excluding important information that may inform the appraisal of additionality and/or the selection of the optimal instrument to support the project. Putting aside issues of international mobility, if a project is expected to yield a positive internal rate of return then it would imply that the applicant will still have an incentive to pursue the project without public funding. In these cases, the applicant may not be able to proceed with the project by raising the necessary external finance - and the optimal funding instrument may be a loan rather than a grant (unless there is a significant threat that the project would be otherwise taken forward overseas)[34].

While applicants may not always prepare IRR analysis for early stage R&T programmes, it may be possible derive such an analysis from the projections prepared by applicants and asking for additional items of information. This will provide information to refine the current assessment of additionality as well as help guide discussions regarding the optimal funding instrument (and, again, greater use of alternative funding options may be helpful given the reducing headroom in the ATI budget). However, it is important to note that in some instances this approach may be difficult to operationalise.

Costs

The VfM appraisal treats the present value of gross public expenditure associated with the project as the cost of the intervention (covering the requested ATI grant amount and other sources of public expenditure). It has been drawn to our attention

[34] It is acknowledged that it there may be constraints in departing from grant funding instruments given the basis on which the business case for ATI has been approved.

that a number of ATI applications are phased (i.e. further grants are requested at a later stage for follow on development work). The VfM analysis does not always (with the exception of interrelated project applications discussed below) quantitatively account for the possibility of future public sector spending on the projects or the need for future follow-on public funding for projects in order to deliver the projected benefits from exploitation[35].

Recommendation

#9 BEIS should ensure that the VfM assessment factors in all possible future calls on public funding (either to support R&T or to support follow-on exploitation of IP) to the extent that this is practicable.

Wider Benefits and Additionality

The appraisal also involves an assessment of the benefits associated with CO2 reductions that may be realised as a consequence of adopting the technology under development (e.g. fuel savings arising from weight reductions). These benefits are monetised on the basis of the carbon valuation methodology set out in supplementary Green Book guidance developed by the then Department for Energy and Climate Change. Analysis of VfM assessments shows that CO2 emissions savings were sometimes significant in determining the BCR outcome from the VfM assessment[36].

In the context of wider benefits, estimates are based on a single deadweight figure that reflects the estimated likelihood of a project proceeding in the absence of support. However, in cases where the do-nothing scenario is expected to result in a project moving abroad, it is possible that the environmental outcomes associated with a project would still be realised regardless of where the R&T activity takes place (or indeed could arise from the R&T activity of competing producers). Similarly, knowledge could spill over to UK suppliers from projects that are ultimately delivered abroad (though potentially less easily). This creates a case for a more sophisticated more differentiation in deadweight considerations when looking at economic as opposed to broader benefits (such as R&T or CO2 savings).

Recommendation

#10 BEIS should undertake separate assessments of deadweight regarding the future economic benefits of the project (which will be linked to the likelihood the project proceeds in the UK) and the environmental benefits (which will be linked to the likelihood the project proceeds at all and whether technologies with comparable

[35] Note however that this is an aspect of that can be explored in greater depth through case study research.
[36] It is important to note on resource projects carbon savings were responsible for approximately half of all benefits, but that these carbon savings are not considered for capital projects.

Recommendation

properties may be developed by competing producers within the UK or overseas).

Interdependencies Between Projects

Some challenges have been encountered in the VfM assessment process due to the interdependencies between individual projects highlighted in Section 2. However, consultations with applicants and policy stakeholders have confirmed several areas of significant technically and economically significant interdependencies, which mean that the benefits and risks can only be considered with respect to the entire work programme:

- Issues of interdependencies between projects arise on some large programmes of work as a result of State Aid requirements - projects exceeding €20m would require additional scrutiny from the EC, thus introducing timescale and feasibility risks. However, assessing elements of the work programme in isolation may result in the double counting of benefits across appraisals and only a partial understanding of system wide issues involved (i.e. costs and benefits should be considered at the level of the overall R&T programme rather than discrete elements of these programmes).

- Where case officers are aware of the presence of closely related current or potential future applications then the approach now being taken is to undertake a VfM (and full Green Book assessment) of the overall programme, and to use this as a framework for consideration of individual applications. This is an appropriate approach in cases where the relationship between projects is clear (and especially where projects will involve a common group of partners), but does rely on applicants (and the ATI) effectively flagging these interactions to case officers.

- Another issue arises around the assessment of capital projects. Policy stakeholders reported that in a number of instances the delivery of proposed R&T projects was contingent on funding for specific capital infrastructure items also being approved. The relationships between these projects were not identified at an early stage and were not considered later within the VfM assessment.

Recommendations

#11 BEIS and ATI should consider whether it may be feasible to strengthen processes through which interdependent projects are identified at the ex-ante appraisal stage, and establish how far it may be possible to appraise these projects as a group rather than as discrete project proposals. This should include explicit acknowledgement of the dependencies between capital and R&T project proposals. Information on interdependencies should be circulated amongst the full range of

Recommendations
individuals involved in the assessment of applications.

4.2.2 Support provided to applicants

The VfM assessment requires additional highly specific inputs from applicants that are not necessarily submitted within their application form[37]. Separate guidance has been produced by BEIS to support the collection of this information. However, there appears to be a mixed level of awareness of this amongst applicants (likely because applicants were not asked for this information for all bids prior to September 2016). In contrast, the support from case officers was seen unanimously by applicants as of high quality and clear once direct communication was established.

Several applicants reported that they had found engagement with BEIS an effective way to resolve initial confusions about these requests. However, it appears that in other cases more could be done to support and improve the relationship with applicants. Some applicants did not appreciate that the VfM process would be required for their projects. For others, it appears that the timelines involved with the review had caused dissatisfaction. There may be scope for additional communication to clarify the operation of this process (including where delays may be occurring in other aspects of the process, such as HMT approval):

> "VfM is a nightmare, that comes out of the blue, you submit it and wait for months and months, comes back with requests from this and that partner and then back to the black hole, it is very frustrating[38]" Applicant

In addition, some applicants demonstrated that they did not understand the VfM approach or why it is required (though this is desirable given the possible scope to game the assessment process)[39]. A small number of applicants reported a material objection to the VfM approach, suggesting again that further communications and engagement with applicants might help to explain its the role:

> "VfM assessment goes against principles of building a strategic value chain as process innovation will often reduce the number of jobs needed for a manufacturing process" Applicant

For some projects, it appears that applicants have experienced material challenges in forecasting the likely benefits emerging from the delivery of their R&T projects. For

[37] The findings in this section pre-date the introduction of a VFM assessment prior to SR2 and may no longer be valid.
[38] Note that this is likely linked to aspects of the wider appraisal and approval process as described in Section 4.4.
[39] It should be noted that the records suggest that £617m in grants were awarded without scrutiny of the economic case through the VFM analysis (excluding legacy projects).

some applicants, sales volumes can be highly 'lumpy' – applicants reported that a product developed for a prime (e.g. Airbus) would have a market that can be predicted to some extent, but orders from a global customer (e.g. Boeing) could double or triple that market overnight with the likelihood of these sales not being something that could be readily quantified in advance. This was not a universal view, however, suggesting that some applicants may be better equipped than others to engage successfully with VfM processes.

Recommendations

#12 BEIS, ATI and Innovate UK should consider whether it may possible to adapt application forms to better gather the evidence needed to underpin the VfM assessment at the application stage (which may reduce the level of engagement required from applicants in the process).

#13 Existing guidance relating to the application process should be consolidated to give applicants a comprehensive guide to engaging with the R&T support process (from the application process through to monitoring).

4.2.3 Validation of Claims Made in Applications

The VfM process is reliant on claims made by applicants about their projects. This creates a risk as in some circumstances applicants may have an incentive to respond in a way that would favourably influence their application. For example, applicants may be tempted to overstate how ground-breaking a technology they are researching is if they are aware that this would encourage a case officer to apply a lower deadweight estimate. The long-term nature of R&T projects, and the challenges discussed in Section 5 regarding how far applicants can be held to account for their future exploitation of technology developed, make these issues particularly acute.

Case officers take several steps to mitigate this risk. Where possible the VfM approach has been developed based on empirical evidence which allows estimates of effects to be grounded within a credible range. An example of this is the use of a BEIS commissioned review of the aerospace supply chain in the UK[40] to gauge the likely level of R&D spill-overs based on the known depth of the UK supply chain of the applicant. In-depth discussions between applicants and case officers are frequently used to probe issues such as the plausibility of another location being used for a particular R&T project, and how corporate R&T decisions are taken by a global operator. However, there is a risk that BEIS has limited capacity to draw on internal technical expertise in the aerospace sector to validate the technical claims

[40] See 'UK Aerospace Supply Chain Study,' July 2016, Department for Business, Innovation and Skills. Available at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/536903/bis-16-310-aerospace-supply-chain-study.pdf.

made by applicants (and there may be advantages if the technical judgements made in the Independent Assessment could feed into the VfM appraisal).

Another area in which potential improvements might be found would be in terms of creating a feedback loop between the on-going monitoring of projects and the judgements made through the VfM assessment. For example, if there were applicants that appeared to be struggling to deliver their R&T work programmes due to issues with internal organisation, or exhibited tendencies to exploit intellectual property overseas following project completion, these aspects could potentially be factored into the appraisal of future applications.

Recommendation

#14 BEIS, ATI and Innovate UK should consider options for changing the phasing of the VfM process to better support scrutiny of the technical claims made by applicants (including the judgements made by the Independent Assessors). Closure of feedback loops from monitoring into the appraisal process could be beneficial in enabling case officers to reach an informed judgement of the future risks to the anticipated benefits associated with applications.

4.2.4 Recent refinements to the process

Until September 2016, the assessment of value for money was only applied to projects applying for a grant exceeding of £10 million. However, only a small proportion of applications exceeded this threshold and few proposals received detailed scrutiny of their underlying economic case. Reflecting these concerns, since September 2016 all projects have been required to complete a VfM costing model to confirm that their BCR meets the required minimum threshold, with projects in excess of £10 million requiring additional scrutiny in the form of an accompanying case paper to support HM Treasury approval. This increased use of VfM assessment also appears to be creating additional resource constraints for case officers.

Analysis of BEIS assessments of first stage VfM submissions to the September SR2 shows that of the eight projects recommended to progress to the next stage, four had been assessed by BEIS to be 'Red = Weak bid, the overall benefits do not justify the costs' (though these were largely capital projects, which were subject to issues identified above with the treatment of interdependencies between projects). Of the eight projects identified as having the potential to pass VfM assessment, four were either held or rejected at SRC. It is important to note however that the introduction of the new approach coincided with funding pressures ahead of the Autumn Statement, and records from the meeting identify a set of strategic and technical considerations that drove the determination of outcomes. Nevertheless, these changes represent an important refinement and potential strengthening of the VfM process.

Recommendations

#15 BEIS and the ATI should learn from the introduction of the process to complete

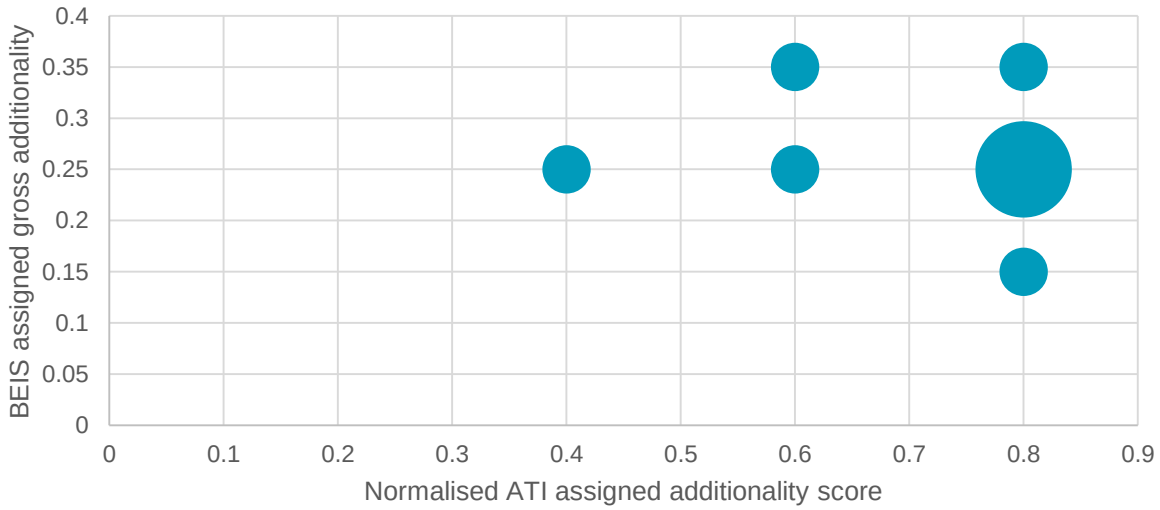
Recommendations

initial VfM assessments ahead of the SR2 meeting, to ensure results are explicitly considered and used to make decisions and recommendations alongside technical and strategic considerations.

4.2.5 Alignment with earlier assessment processes

Figure 4.3 below presents a comparison of the gross additionality score from the VfM process for projects receiving a full VFM assessment and their additionality score at SR2. There appears to be limited correlation between these scores (highlighting the importance of scrutinising the economic case for intervention in detail).

Figure 4.3 Comparison of gross additionality assessment VfM and additionality score in SR2



Source: ATI management information and BEIS VfM records.

4.3 Ministerial and HMT review

Once projects have passed VfM and Independent Assessment they are shared with BEIS ministers and then HMT for review. This process is intended to provide a further check on the quality of projects and aspects of value for money. The key issues explored around this process related to the timescales for its delivery, and are explored in Section 6.

4.4 Independent Assessment

Applicants that pass the SR2 assessment are invited to submit their application to Innovate UK for an assessment by a panel of four or five independent assessors (drawn from industry and academia). This stage of the process is intended to act as a safeguard against the risk of 'capture' of BEIS and ATI by the aerospace industry[41], providing an independent judgement of the technical, commercial, and economic merits of the application (and a quality check against the wider range of sectors that Innovate UK supports). This assessment mechanism is also used to allocate resources as part of the Collaborative R&D Competitions.

Assessors are allocated to proposals from a pool of approximately 25-30. The assessment follows the 'ten questions' framework often applied in the assessment of applications to other Innovate UK administered programmes. Proposals are given a score of 1 to 10 against ten criteria, resulting in an overall score of between 10 and 100. Project proposals will normally only proceed if they receive a minimum score of 70. Projects proposals with a grant ask of £5m or more are also required to attend an interview with the panel of assessors through which further scrutiny is given (and scores are given against three criteria using a blind voting system). Projects that pass the independent assessment go to the Innovate UK Funder's Panel, which makes the final decisions on funding.

4.4.1 Independent Assessment scores

The bullet points below identify the key points emerging from analysis of analysis of independent ATI scores:

- **Independent assessor scores are consistent across groups**: Over the four groups of projects (legacy, Early-ATI, CRD, SRC), variation in average scores awarded to projects as part of the Independent Assessment process is relatively low, with average scores ranging between 77 and 78. In addition to this, the average scores awarded across different questions remain very similar (within one percentage point) across these groups.

- **Lower scores for risk involved in the project and the risk management strategy:** Scores for Q7, "What are the risks (technical, commercial and

[41] The risk that the ATI acts to allocate public resources to maximise the private benefits accruing to aerospace producers, rather than to maximise overall social welfare.

environmental) to project success? What is the project's risk management strategy?", were on average lower than on other questions across most ATI groups with Q9 "What is the financial commitment required for the project?" also scoring less highly than other questions. Conversely projects tended to score higher for Q8: "Does the consortium have the right skills and experience and access to facilities to deliver the intended benefits?" and Q1: "What is the business opportunity that this project addresses?".

- **Consistent spread in scores**: The average spread in individual assessor scores given to projects on each question was low, consistently remaining within 2 to 3 points (total score of 10 per person). The spread in total scores across assessors showed some variation (on average 19 points) but this was consistent over groups of applications.

4.4.2 Robustness of Independent Assessment processes

The available evaluation evidence suggested that stakeholders had a high level of confidence about the quality of this assessment process:

- **Process design:** all stakeholders who commented on this process suggested the process was effective reaching an independent view of proposed projects – and was seen by some applicants as the point where technical issues are scrutinised in the greatest depth. Several noted that the process has been refined and improved, and that incremental changes (such as the design of the applicant interview) had improved the suitability of the process for large aerospace R&T projects. However, one policy stakeholder did note that some of the larger projects were approaching 'the edge of the envelope', an upper threshold, beyond which a more bespoke approach to assessment would be suitable.

- **Information provided:** The information received by assessors that has been reviewed by the study team appears to be detailed and offer a detailed description of the project aims and its technical basis. Stakeholders confirmed this view. However, it was reported by some policy stakeholders that, compared to some other Innovate UK funding schemes, the they felt the attention given by applicants to aspects of project management in their submissions was weaker for projects that have come through the Strategic Assessment process – the quality of this information is explored further in Figure 4.4 below, and the extent to which project plans were sufficiently detailed at the point of application is explored through the case study research in Section 7.

- **Suitability of assessors:** The pool of assessors was reported by policy stakeholders to be strong. Innovate UK have a pool of approximately 25 to 30 individuals to review Aerospace R&T proposals with experience in the aerospace sector, engines, advanced manufacturing techniques, or materials. A number of steps are taken to maintain the quality and independence of this group: Innovate UK consider assessor's current and previous employment to

minimise potential conflicts of interest and the scores given by individual assessors are tracked to identify any frequently giving outlying scores. Assessors are also required to sign a non-disclosure agreement and declare conflicts of interest for each project they assess, and are not provided with the judgements made by the SRC or ATI. Policy stakeholders reported that their ability to build the pool of assessors enables them to avoid potential conflicts of interest, without compromising on the experience of assessors. Applicants reported that the feedback received on written submissions and discussions at interview demonstrated that assessors generally had sufficient technical knowledge to understand and engage with the application. However, the programme appears to be characterised by a high level of networking between applicants, and there was a suggestion from some applicants that this pool given that 'they all know each other'.

Interdependencies between projects also appear to create inefficiencies in the independent assessment process. Project assessors are employed to review a project in isolation, so even in instances where an application might make it clear that the project would only proceed if another application (such as a capital grant) is successful, then there is limited scope to explore this interaction. One policy stakeholder with knowledge in this area suggested that assessors might even be inclined to treat the uncertainty created by an interrelated project as an additional project risk considering the possible possibility that contingent projects are not funded (another issue caused by the artificial disintegration of integrated projects).

Recommendation

#16 Guidance to applicants should be updated to stress the importance of applicants fully explaining in their application the relationships between their projects and other R&T activities, and to discuss the risks created by these. This is an aspect that the SRC could be expected to review in depth and to feed any comments here to independent assessors.

Additional analysis of Independent Assessment scores was used to explore the extent to which assessors successfully identified weaknesses and risks in project proposals that might hold up delivery. Assessors are asked to provide feedback in two areas that relate directly to risk management and project management when scoring:

- Q5: What technical approach will be adopted and how will the project be managed?

- Q7: What are the risks (technical, commercial and environmental) to project success? What is the project's risk management strategy?

There, however appears to be no clear correlation (as show in Figure 4.4 below) between scoring for these questions and a broad measure of project financial

performance – the difference between the proportion of forecast project time elapsed, and the proportion of the overall grant drawn down[42]. This represents a challenge because, as discussed in Section 7, a number of projects had both loosely defined objectives and suffered material delays at their inception stages while these broad objectives were pinned down. While average assessor scores do not appear to have identified issues with these projects, it is noteworthy that in some cases individual assessors flagged concerns in this area as part of the feedback in response to either Q5 or Q7. The need to make the most of this feedback is discussed below in the context of closing the feedback loop between Independent Assessment and later project stages.

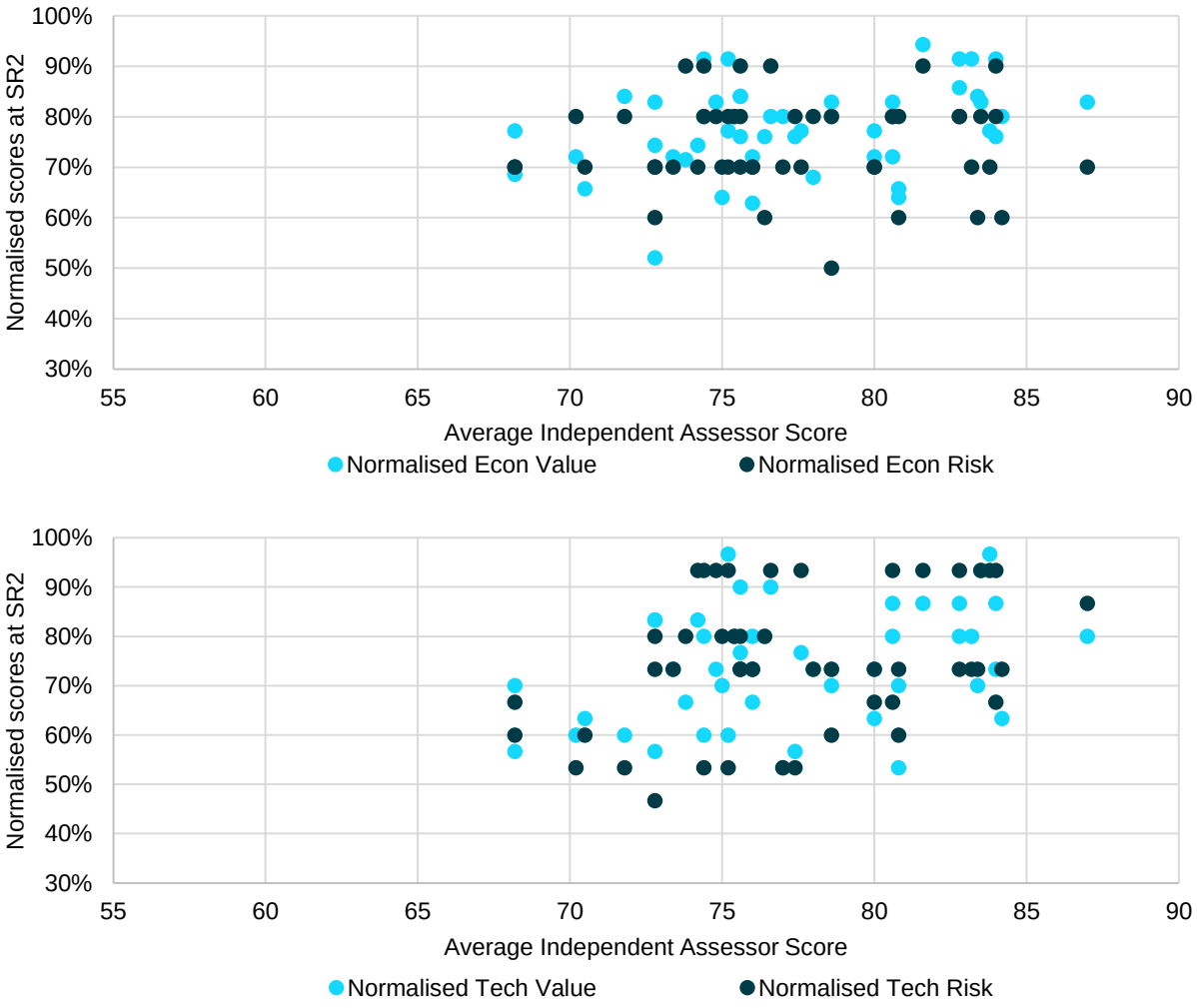
Figure 4.4 Comparison of average score on Q5 and Q7 (right) and financial performance

Source: ATI Independent Assessment panel sheets and Monitoring Information

As illustrated in Figure 4.5 below, a positive relationship between scores at SR2 for economic and technological value and IA scores is evident from the data. However, the association is fairly weak, suggesting that independent scrutiny of the technical case adds value to the overall appraisal process. Higher scores from the independent assessment are also correlated with higher technological risk scores, but there is no obvious correlation between economic value scores and IA scores. The relationship between these two assessment processes is discussed in greater depth in Section 7.

[42] It is important to note that while this is not as precise measure of project performance as variance against plans, when comparing across the portfolio this metric does appear to identify projects which are performing less strongly. Data accurate as of September 2016.

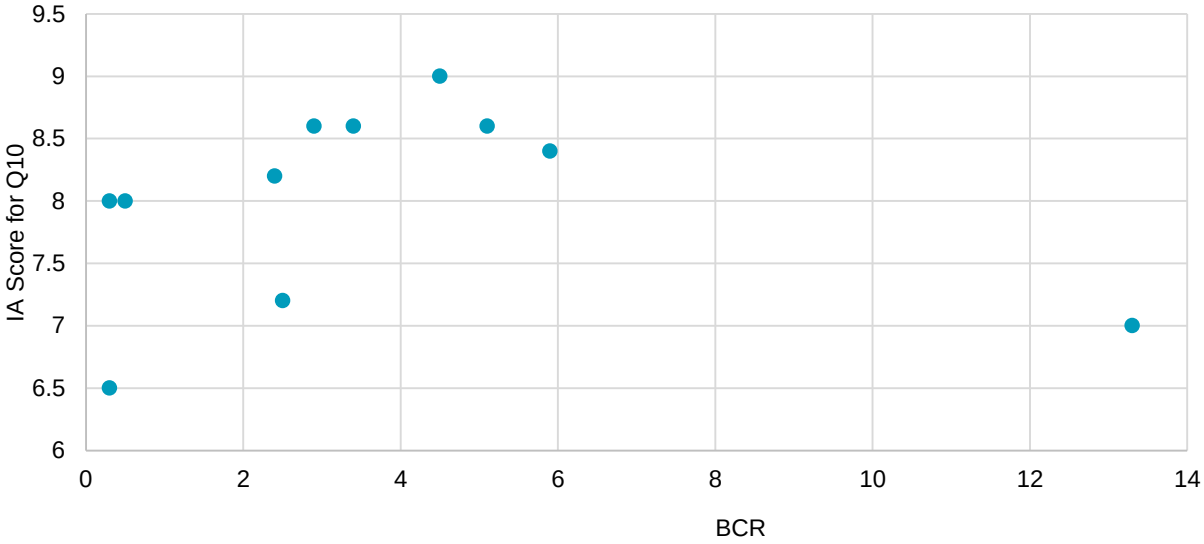
Figure 4.5 comparison of SR2 value and risk scores and average Independent Assessment scores



Source: ATI data and Independent Assessment Panel Sheets

There is a broad alignment between the BCR allocated by BEIS in the VfM and the scoring of the project by Independent Assessors against Q10 ‘How does the financial support from the Technology Strategy Board and its funding collaborators add value?”. As illustrated in figure 4.6 below, this relationship is apparent once the outlier is excluded.

Figure 4.6 Comparison of VfM BCR and Independent Assessment Score on Q10 (How does the financial support from the Technology Strategy Board and its funding collaborators add value?")



Source: BEIS VfMs and Independent Assessment Panel Sheets

4.4.3 Funders panel

Once projects have been assessed the scores and feedback provided by assessors is considered at a meeting known as a Funders Panel. This is an internal Innovate UK process. Policy stakeholders with knowledge of this process reported that its primary value added is as a quality assurance check on the internal Innovate UK process and to provide a forum through which it is possible to check that that all procedures have been followed correctly before sending recommendations to BEIS that a project receives funding.

4.5 Project selection against the annual budget constraint

ATI grant funding is constrained to £150 million per annum. From consultations with policy stakeholders it appears that this ceiling and the limited room to flex budgets between years creates challenges for project selection because commitments in the short term already broadly equate to this amount. This creates a potential trade-off for the programme between supporting the highest quality of projects possible, and the need to ensure an even spending profile.

4.6 Summary

Strategic Assessment

- The ATI has produced detailed guidance to help applicants understand what is required in order to secure a recommendation for funding from the Strategic Assessment process. However, no guidance is provided to applicants about the form in which SR1 submissions should be made. It appears that this has caused some uncertainty amongst applicants regarding the level of detail that is required at this stage. There is a risk of wasted time on the part of the applicant as they provide more detail than is required for the assessment.

- Prior to SRC meetings, applications are reviewed and scored by the ATI experts in order to support project discussions during the meeting. Now that the VfM assessment is initiated in advance of the SR2 process, aspects of the parallel scoring of proposals could potentially be seen as redundant where there is duplication.

- The SRC process appears to effectively offer a check to identify and reject projects that do not align with the priorities set out in the Technology Strategy, the strategy is broad and it will be difficult to use to prioritise proposals as headroom in the budget narrows substantially. The portfolio of projects supported to date does not fully cover the different priorities of the strategy (though this is likely related to demand, with little variation in success rates across technology areas).

- The engagement between the ATI and applicants to support the development of proposals prior to formal submissions limits the extent to which the SRC assessment process is fully uninfluenced by this stage (creating a risk that there may be an interest that some projects are approved even if they fail key hurdles, such as VFM). However, within this material constraint, the process appears to have been well managed to maximise its independence.

- The feedback provided to applicants from the SRC process appears to have been variable in quality, and in particular when SR2 have recommended that projects are placed on ‘hold’ this has not always been effectively communicated to applicants.

BEIS VfM Assessment

- All proposals now receive a form of VfM assessment which relates the gross public expenditure on the project to the external benefits associated with the project. The framework is largely fit for purpose and its application is enhanced by using empirical evidence gathered by BEIS on the depth of the UK supply chains to help gauge the strength of R&D spill-overs. Further attention to the treatment of the possibility that future follow-on public funding for projects will be required to deliver the projected benefits and the use of separate deadweight estimates for economic and environmental impacts could improve the resolution of estimated BCRs. The first stage VfM process

is in its infancy, but represents an important opportunity to feed in considerations of value for money earlier in the project assessment processes.

- There appears to be a mixed level of awareness of the VfM process amongst applicants (partly due to the fact that few applicants were exposed to this process prior to September 2016). While the support from case officers was seen unanimously by applicants as of high quality and clear once direct communication was established, more could be done to support and improve the relationship with applicants in this area. Some applicants did not appreciate that the VfM process would be required for their projects. For others it appears that the timelines involved with the review had caused dissatisfaction.

- While case officers take a number of important steps to mitigate this, the VfM process is heavily reliant on the claims made by applicants, and there is a risk that BEIS has limited capacity to draw on internal technical expertise in the aerospace sector to validate the technical claims made by applicants.

Independent Assessment

- This assessment approach is viewed as an effective tool for reaching an independent view of proposed projects, though the scale of some projects may be approaching an upper threshold, beyond which a more bespoke approach might be suitable.

  The information received by assessors appears to offer a detailed description of project aims, and its technical basis, though details provided on project management may be less strong than for other Innovate UK programmes. Assessors were reported to be suitable. However, a key limitation in the design of the process is the extent to which it can accommodate the interdependencies between projects that are a feature of the aerospace R&T portfolio.

Alignment between assessment stages

- Overall, there is some consistency between the different scoring processes in terms of their overall assessment of projects. There is alignment between the SR1 and SR2 scores. There is also a correlation between the BCR calculated by BEIS and the added value score calculated by Independent Assessors.

- However, it is important to note that the analysis found several specific measures that were not correlated where this would have been expected. The correlation between the scoring calculated by Innovate UK in advance of SR2 meetings is weakly correlated with average assessment scores, and the BEIS assigned assessment of gross additionality does not appear to be closely linked to the ATI additionality score. As such, it does appear the Independent Assessment and the assessment of VFM add important additional information to the scrutiny process.

5.0 Due Diligence, Contracting and Monitoring

This section examines the effectiveness of the processes underpinning the delivery of the ATI Programme after the Funder's Panel. This scope of this section includes the due diligence, contracting, and monitoring processes.

5.1 Due diligence

5.1.1 Overview

After the independent assessment, VfM and ministerial review have been completed, a Conditional Offer Letter is produced and issued to each successful applicant. This initiates a set of processes that are designed to identify any unacceptable risks before contracts are signed (ultimately aiming to maximise value for money by protecting the public sector from ex-ante and ex-post contracting risks):

- Project viability – checks to confirm the viability of applicants and collaborators to deliver the projects that they have proposed. These primarily focus on an assessment of their financial standing and their ability to fund the matched contributions).

- Eligibility – checks to confirm that all elements of a project align with funding requirements, including both programme specific elements and EU state aid rules. A key focus of this work is on verifying that any costs to be counted as part of the project are directly related to its delivery and have been reasonably priced (to avoid the risk that the applicant may seek to increase the level of subsidy beyond that required to deliver the project).

- Scrutiny of subcontractors – the due diligence process also involves detailed scrutiny of proposed use of overseas subcontractors to validate that an equivalent supplier could not be obtained within the UK (to avoid the risk that the project does not involve unnecessary diversion of public subsidies to overseas locations).

Applicants had relatively limited knowledge of this aspect of the application and approvals process. Project-specific discussions with applicants, as well as interviews with Monitoring Officers undertaken as part of second stage of this evaluation, offered a further opportunity to scrutinise the due diligence, contracting and monitoring processes.

5.1.2 Probing likely project performance and risks to value for money

Policy stakeholders with knowledge of the due diligence processes reported a generally high level of confidence with their performance, suggested that they effectively protected the public sector from risks in three areas:

- **Probing the viability of smaller companies:** A financial assessment of companies involved in the collaboration includes a requirement to demonstrate how they will fund their contributions to the delivery of the project. Smaller companies are required to provide appropriate evidence (e.g. documentation showing that the bank has issued a loan facility to cover the costs involved) to demonstrate their viability.

- **Minimising the leakage of project spending overseas** – policy stakeholders reported extensive scrutiny of cases where the lead applicant is proposing to use an overseas supplier to provide services that could otherwise be provided in the UK. In such cases, Innovate UK reported that they would challenge the applicant to justify the use of the subcontractor and refuse to issue a Grant Confirmation Letter unless a replacement was found or a valid justification was provided. Scrutiny is also given to the ownership structure of firms, to verify that firms are registered in the UK (rather than being a branch of a company headquartered overseas). For the ATI, particular issues have arisen where large multinational firms have used overseas subsidiaries extensively to provide discrete inputs to projects, and have been challenged on this both by the independent assessors and due diligence officers. This was in turn said to have resulted in the concentration of expenditure in the UK in subsequent locations. Applicants interviewed as part of the case study research did not however, report changing partners as a result of this process.

- **Identifying ineligible costs** – A range of checks are made on expenditure to ensure it is compliant with State Aid rules and that all spending is directly related to the costs incurred by participants. This involves an assessment of the cost of both labour and capital inputs to the project (e.g. checks on the costs of specific capital items or materials) and probing applicants where cost information is seen to be insufficiently detailed. This process does not necessarily involve suggesting to the applicant that they could deliver the project more economically with a different procurement or delivery strategy but key budget items (including labour hours) need to be justified (and the due diligence officer may ask the Innovation Lead for opinion). An example was given where the project might include testing of particular technology in Germany or the USA: some travel costs and accommodation would be justifiable in such a scenario, although if the applicant proposed to visit the foreign site too many times then Innovate UK would challenge this. Through this process, Innovate UK identifies ineligible expenditures which are removed. One element of this process that has changed over the duration of ATI is that greater scrutiny is given to charging of overheads; initially there was a possibility of agreeing an overhead rate as a percentage of labour

costs. Applicants are now required to set out a value for the overhead costs associated with the projects[43].

However, analysis of the broad performance of the ATI portfolio identifies some suggestions that due diligence processes are not identifying a group of project delivery risks (i.e. threats to timescales and risks). While no projects have been aborted for technical reasons or due to the financial failure of applicants, it was noted by policy stakeholders that at the time of the research, a small number of projects were currently under review due to their poor performance (and we understand some may have been subsequently aborted). Analysis of the latest RAG reports (see Section 2), indicates that while the portfolio of projects is performing strongly in a number of areas, a large proportion of the portfolio is classified by a negative risk rating with regard to costs – 26 percent of projects received a 'red' RAG rating at their last assessment.

Case study research suggested that in a number projects, some large elements remained unspecified after project confirmation. In one case this included a large open budget for procurement activity. In a limited number of other cases (as discussed in greater depth in Section 7), the project was confirmed despite significant details of the work programme and intended milestones remaining vague. For example, one lead applicant suggested that they had been given too much flexibility in the early stages of the project because milestones were no more specific than 'write a report'. It is important to note, that applicants on these projects also frequently noted that due diligence checks with Innovate UK had been extensive. Monitoring Officers are also closely involved with the development and sign-off of Level 2 plans which provide additional detail on what will be delivered throughout a project. This process does not appear to have been effective in resolving these issues in all instances, as Monitoring Officers reported a need balance detailed planning against the need to start the project based on the prior approval of the project at Independent Assessment.

The scope of due diligence extends to the capabilities of the applicant to deliver the proposed of programme work at the speed envisaged in the form of a resource and capability report (including commitments to deliver parallel programmes of work). The evidence raises some questions regarding the effectiveness of these processes (in light of the drift in the portfolio and evidence emerging from case studies that some ATI funded projects have been 'crowded out' by parallel programmes of R&T at higher TRL levels). In a small number of case studies, the availability of staff to work on the project (either from within the firm, or the availability of suitably qualified staff in the wider labour market) was identified as a key issue holding back project progress. In some cases, this was a risk that could have been identified prior to project confirmation.

[43] As part of Stage Two research the study team have conducted interviews with a small number of Monitoring Officers. These have reported a difficulty in separating sub-contractor and procurement costs within budgets – many of the costs approved follow closely to the original application. If this issue is confirmed to be widespread through further case study research then this would raise a question around the effectiveness of due diligence processes in scrutinising costs.

Additionally, no technical due diligence is completed as part of the process, raising a risk that the technical claims of the applicant remain unvalidated following the scrutiny of the Independent Assessors. It was reported that this is an area where Innovate UK are currently looking to refine the process, and to provide Finance and Monitoring Officers with comments and feedback from Independent Assessors. Monitoring Officers reported positive change in this area in that they are now able to request further information from assessment stages, but do not yet receive this information automatically.

5.2 Contracting

The Conditional Offer Letter initiates the contracting processes which are used to protect the public sector from unacceptable post-award risks. This letter specifies a set of detailed requirements that applicants must comply with, and applicants are required to sign this document to access funding. Applicants are given a three-month window (which can be extended if required) to put in place a Collaboration Agreement between partners fixing the intended relationship between project partners with particular regard to the management of intellectual property, and to sign the Grant Confirmation Letter.

5.2.1 Protections against the risk of project failure

Policy stakeholders involved with this process confirmed that these arrangements provide the relevant officers with the authority to terminate projects in the event of the emergence of adverse technical results or excessively slow project delivery (though this would only be used as a last result). In general, however, policy stakeholders reported that such approaches are rarely used by Monitoring Officers to manage poor performance, relying instead on a more collaborative approach to identify solutions. Policy stakeholders reported a belief that the fear that poor performance on one project would prevent the applicant from accessing other Innovate UK grants was a key motivating factor in such discussions – a perspective confirmed by more than one of the case study lead applicants. It is important to note however that no ATI projects have been terminated during delivery, despite the presence of delivery issues identified in the previous section.

A key issue for contracting, however, relates to the ability of existing contractual arrangements to adequately reflect inter-dependencies between projects and other external factors or changes. In addition, the portfolio includes a set of R&T projects that intend to make use of infrastructure that is also funded as part of an ATI capital project. However, projects in isolation are treated in isolation. There would be no legal basis to terminate, for example, an infrastructure project if the demand for this was materially reduced because early testing on a related R&T project proved unsuccessful and the scheme was abandoned through mutual agreement. Equally, there is no provision in contracts to terminate funding as a result of other technological advances that might supersede that project, or make the outcomes that they are targeting redundant. It is important to note however that the two policy stakeholders who commented on this issue had conflicting perspectives on the extent to which monitoring arrangements would terminate a project should this arise (this is discussed further in Section 5.3).

Recommendation
#17 There is a case for contracting arrangements to include provisions for BEIS or Innovate UK to change or terminate R&T projects based on the performance or viability of a discrete set of interrelated projects. Intelligence on anticipated project interdependencies could be identified from within application forms, from discussions at SR2, and from VfM assessments (or indeed, directly from the ATI).

5.2.2 Resolving transactional frictions inhibiting collaboration

A key element of the contracting processes involves applicants working to agree the terms for their joint working – covering both funding allocations and the management of intellectual property rights across the consortium. While Innovate UK do provide a suggested template for this agreement (which some case study applicants in particular found to be very helpful for bringing their consortium together), applicants are free to use the approach they feel best suits their needs. Applicants and policy stakeholders confirmed they applicants predominantly undertake this process independently, with Innovate UK only receiving the final agreement. Applicants reported a high level of satisfaction with how this process operates. However, policy stakeholders and applicants did identify the long timelines that can be involved with agreeing this (discussed in depth in Section 6).

5.2.3 Retention of project benefits within the UK

Contracting arrangements appear to be limited in the extent to which they can be expected to prevent leakage of project benefits (i.e. those associated with exploitation) overseas. On inception, project participants are required to develop a plan for how the results of the project can be expected to be exploited in the form of an Exploitation Plan. In signing the Conditional Offer Letter, applicants commit to taking reasonable steps to exploit the results of the project as specified in the final exploitation plan, or by other means acceptable to both the participants and Innovate UK. However, several policy stakeholders reported a concern that there is no credible mechanism for detecting where IP developed through R&T projects is exploited outside of the UK[44], or for the clawback of grants in the event that IP is exploited outside of the UK. One policy stakeholder went as far as to report that contractual provisions here are 'never enforced' (despite provisions that would enable clawback in such scenarios).

Applicants that had a first-hand experience of this process reported that the contracting process from Innovate UK appears to be very light touch, with applicants working independently to agree their own consortium agreement with their project partners and then seeking sign off from Innovate UK officers. While Innovate UK

[44] While BEIS have recently introduced an outcomes monitoring approach, as discussed in Section 5.2, this approach is not equivalent to an auditing arrangement in so far as it relies on applicant self-reporting.

provided a standardised Collaboration Agreement, most primes consulted indicated they used their own contractual arrangements. The implication is that current contract arrangements are not necessarily pushing applicants to the limit of what they would accept, as might be the case for a private sector investor.

There is a case for tightening contracting arrangements relating to the realisation of project benefits. As some policy stakeholders suggested that the protections against overseas exploitation of IP following project completion were less strong than, some international comparators, and in particular the German system of public support for R&D. This would require changes to tighten the clauses used in either the Conditional Offer Letter or in the Grant Confirmation letter.

While several policy stakeholders echoed this and noted that more could be done to introduce additional contractual requirements on applicants, a set of important potential challenges were also reported that would complicate implementation. Any attempts to link funding for aerospace R&T activities to the location of future manufacturing activities may be in breach of EU state aid regulations, and could be seen as representing a subsidy to manufacturing in breach of World Trade Organisation rules. It would also be important to explore the extent to which some form of agreement at the overall applicant level covering participation in the whole programme would be valid (where there are substantial issues regarding interdependencies between projects).

Recommendations

#18 BEIS, ATI and Innovate UK should consider the feasibility of making further use of provisions in contracts to insulate the public sector from the risk that IP developed through the ATI is exploited overseas (e.g. penalising grant beneficiaries that do so).

#19 These efforts can only be policed if it is possible to monitor the post-completion outcomes associated with ATI funded projects. This could draw on the provision in contracts to undertake further monitoring for a period of five years after project completion.

#20 Should recommendation #18 prove incompatible with EU State Aid regulations and/or WTO rules and it not be possible to achieve grant claw-back, consideration could be given to alternative means of achieving the same objective. One possibility would be to penalise applicants in future application rounds where their post-completion commitment to R&T and production has proven weak, through adjustments to leakage parameters in the VfM appraisal.

5.2.4 Contracting the ATI contribution

Some lead applicants noted that they had originally contracted with Innovate UK for their project, and then at a later date been asked to amend the agreement to include a 2.5 percent contribution towards the ATI. Applicants in some cases reported that this requirement had come as a surprise. Policy stakeholders reported that all large

aerospace manufacturers were made aware of this contribution at the point when ATI funding was agreed, suggesting that the issue may have been one of internal communication within these large organisations. However, there is scope for project participants who were not part of the aerospace sector when the funding was announced, to have been unaware of the requirement for the contribution before their projects started. In one such case in particular, the late imposition of this contribution created a relationship challenge for the partnership as the contribution had not been included in the original project budgets, and project participants were unwilling to see this commitment cascaded down. While the presentation of this contribution appears to now be clearer to applicants and is included in the latest version of the guidance to applicants[45], the importance of transparency and continuity over such arrangements is an important lesson from the implementation of the programme.

5.3 Monitoring

5.3.1 Quarterly monitoring

Quarterly monitoring arrangements aim to manage and mitigate the risks to which the public sector is exposed through the delivery of the programme. The primary process for this is a quarterly project review by a Monitoring Officer. These processes target the risks by verifying that projects are being delivered as planned, and ensuring that that public resources are not wasted on projects that are unlikely to meet their objectives (or are diverted to other activities). As noted, Monitoring Officers meet with lead project participants to receive an update on delivery, and report on project performance in six areas: scope, time, cost, exploitation plans, risk management and project management/planning. In addition, BEIS have recently introduced a programme of annual monitoring to track the emergence of project outcomes.

Capturing technological progress and emerging project risks

Evidence collected within the evaluation indicates that Monitoring Officers working on ATI projects have a high level of technical knowledge and are likely to be able to capture the extent to which projects are making technical progress, and the emergence of technical issues. Monitoring Officers appear to be offered sufficient time to scrutinise project delivery. Policy stakeholders with oversight of other Innovate UK schemes were able to make comparisons, pointed to the higher funding available for monitoring of ATI schemes than other Innovate UK collaborative R&D programmes. They explained that following feedback from applicants about the value brought by engagement with Monitoring Officers, provision was made to increase the time spent on each project from 1.5 to 2.5 days per quarter on a case by case basis reflecting the complexity of the projects, and the number of partners involved[46]. In

[45] Innovate UK (2017) ATI Strategic R&D Projects: Guidance for applicants, available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/589410/GFA_ATI_v2.07.pdf

[46] It is worth noting at this point that initial discussions with some Monitoring Officers as part of Stage Two case study research have suggested that in some cases planed outputs may be too vaguely

the majority of case studies, the time available for this activity was not seen as a key issue.

Current monitoring arrangements are however potentially limited in the extent to which they accurately capture emerging project risks from two perspectives:

- Some stakeholders suggested that as independent contractors, MOs may be at greater risk of 'capture' by applicants than Innovate UK employees would be, potentially limiting the extent to which risks are tracked. This is not an issue that the evaluation has been able to explore further, though all Monitoring Officers consulted as part of the case study research demonstrated a breadth of experience and knowledge that might help to minimise this risk.

- A specific shortcoming of the process pointed out by the stakeholders was that it cannot cope with interdependencies between specific projects. However, one applicant stated that when a Monitoring Officer is responsible for a number of projects in one area, it is possible for him or her to make the teams aware of which stage their respective projects are at. This would not represent a robust approach to mitigating this risk, and the case study research did not identify any instances where Monitoring Officers had been able to play this role.

Managing the response to emerging issues

Monitoring data identifies a small number of projects that have held a 'red' RAG rating on at least one area for four consecutive quarters. This is a potential area for concern as it implies that effective mitigating action has not been taken. However, as shown in Table 5.1 below, it appears that most projects have tended to respond rapidly to a poor rating – the majority of projects with a 'red' RAG rating have recovered after one or two periods (projects held a 'red' rating for only 1.6 periods on average). It is not however, possible to confirm the role of the monitoring activities here.

---

defined to support the sufficiently precise definition of milestones to allow effective monitoring. This is a point to be explored further through Stage Two research.

Table 5.1 Evolution of RAG ratings

Measure	Count	% of projects
Number of projects currently 'red' on any measure	31	28%
Number of projects rated 'red' at any stage on any measure	53	49%
Average number of consecutive periods red rating have persisted	1.6	n/a

Source: ATI management information. Note that RAG data has only been provided to the study team for a total of 109 projects, and no records for legacy projects have been available.

Stakeholders who observed the process expressed a high level of confidence that MO's have the flexibility to recommend withdrawal of funding in the event of technological failures or the realisation of other risks (e.g. the launch of a competing technology rendering the product under development obsolete); however, evidence from monitoring information indicates that this has not been used to date. Case study research has also confirmed that monitoring processes give applicants a large degree of freedom and time to correct issues themselves, rather than embarking on an escalation process. For example, one case study project was seen by the Monitoring Officer as performing very poorly for a full 12 months from inception without an escalation of the issue, and the changes implemented after 12 months were only partially motivated by the poor monitoring score, alongside other internal changes at the applicant.

5.3.2 Change Requests

The monitoring of projects allows applicants to make change requests (material changes to the terms of the Grant Confirmation Letter) which might cover changes in the scope of projects, virement of budget between partners, changes in collaborating parties, or changes in the overall grant request. While it is important to offer applicants flexibility to ensure that the outcomes from projects are optimised, safeguards are also needed to avoid the risk that the applicant uses the change request process to divert resources to alternative activities that may be less risky or have lower potential to result in the desired technological and economic impacts. The evaluation revealed a range of evidence on this point:

- **'Day one change requests'**: Stakeholders consulted reported an issue encountered with change request processes triggered in the first days following the signature of the Grant Offer Letter. This included changes the profile of subcontractors to include greater use of overseas suppliers. It was suggested that in some cases, the long period of time between the application submission and project start date might be used to justify a change in the mix of partners. There was also a concern that the applicants could be using the handover between the finance and contracts team and the monitoring team as an opportunity to divert resources overseas. Innovate UK has introduced additional safeguards to prevent this happening.

- **Authorisation limits** – the limits for the maximum change that Monitoring Officers can make between different project budgets represents a very small percentage of the overall grant in the case of ATI projects (and this may be generating unnecessary levels of change requests requiring the approval of innovation leads, and absorbing unnecessary resources).

- **Appraisal of change requests -** It is intended that major changes to ATI projects and changes to any budgets in excess of £1m should be discussed with the Department before being agreed with project participants. As discussed in Section 7, major changes in scope have been made on several case study projects. However, it was not clear from consultations with stakeholders that the BEIS Sector Evaluation and Appraisal team are being consulted when material changes on projects are made, and in no instance have any changes resulted in a re-visiting of the VfM assessments. On one case study project the lead applicant reported that an earlier change request had resulted in a 'softening' of the milestones for their work, and the removal of TRL targets for specific work packages. While this could not be confirmed in the monitoring information available to the study team, this emphasises the importance of checks on the change request process.

- **Time taken to approve requests –** Several applicants expressed concerns about the time required to approve requests for changes on projects. In one instance, it was reported that a requested switch from a current to a capital budget had taken 12 months to approve, causing material project delays. It is not however, possible to confirm the extent of this issue from monitoring forms.

Recommendations

#21 BEIS and Innovate UK should consider putting in place processes to reappraise change requests where the underlying economic or strategic case for the funding the project may be significantly changed (i.e. where there is a substantial change to the basis for public sector support). The establishment of this feedback loop would work to limit the risk that the applicants seek to divert R&T funding to activities that do not produce the anticipated economic benefits.

5.3.3 Annual / post completion monitoring of outcomes

BEIS and Innovate UK have recently put in place an additional annual monitoring process that aims to capture and track the outcomes emerging from projects. Applicants have been asked to complete an on-line survey covering the following areas:

- Number of newly created and safeguarded jobs, in R&T and production, including average salary and NVQ level

- Additional R&D spend on projects and payments to subcontractors, and the sources of this funding
- Details of any fuel or weight savings achieved
- Progression of projects with regards to TRLs

Returns of these monitoring reports to date has been limited and so it is too early to judge the effectiveness of this process (though as the analysis in section 7 shows, it provides useful evidence on the outcomes associated with projects). Only a small number of applicants consulted reported knowledge of this process. Those that were aware reported some concern that this process was not integrated with the quarterly monitoring and not directly supported by Monitoring Officers. It was suggested by one applicant with a large number of ATI projects that it might be more appropriate to manage such returns at the level of individual applicants rather than the project level. In addition, one applicant reported concern that this in requesting data technological progress, the monitoring approach was looking for information that the applicant had not previously tracked, potentially reducing the accuracy of this evidence[47].

Outcomes monitoring forms for 20 projects were shared with the study team for analysis. The results of this have fed into the discussion of project progress in Section 7. However, it is important to note that in several instances partners have filled out the forms differently to each other – this may relate to the different outcomes experienced by partners, but in some cases the gap is several orders of magnitude, potentially suggesting a misunderstanding of the units being reported on[48].

Recommendations

#22 BEIS and Innovate UK should continue the annual monitoring process to enable the outcomes of the projects funded to be metricated (and relative to the size of the grant awards, it is considered a low-burden process[49]). It is also suggested that this process is integrated more clearly with existing quarterly monitoring arrangements, and is continued beyond the lifetime of the grant to enable tracking of exploitation outcomes.

#23 There may be benefits in managing the longer term monitoring process at a portfolio level (given the likelihood that the individuals involved may leave the relevant organisations).

[47] It is worth noting that where monitoring is asking for information that has not previously been tracked, this monitoring may build up new measures that will be of value for future evaluations.
[48] For our analysis a common sense approach has been applied in such situations.
[49] For example, the Regional Growth Fund required an annual report validating the spending and the jobs created or safeguarded, produced by an independent accountant.

5.3.4 Delivering intelligence to support the operation of the ATI

Initially information on the performance of the ATI portfolio or individual projects was not made available to the ATI. Policy stakeholders reported that it was not possible to share information with the ATI because this was not provided for in the contracts between applicants and Innovate UK. However, it was reported that the introduction of the Framework Agreement (discussed in Section 3), together with activity from the ATI to demonstrate the security of its IT systems[50] has meant that ATI are now able to access data on most projects (which is aiding the delivery of the programme).

All policy stakeholders with knowledge in this area confirmed that adequate information is now being shared to support the effective management of the ATI budget – it was reported by more than one policy stakeholder that this aspect is now a key focus of both ATI board meetings and SR2 discussions. Policy stakeholders with knowledge of these process also reported a high level of confidence that the ATI is now receiving sufficient information on the performance of currently contracted projects to support the future prioritisation of resources. However, it was not apparent that this information is currently feeding into Independent Assessment, due diligence or contracting activities.

5.4 Summary

- Due diligence processes appear to effectively scrutinise projects to detect issues with project viability confirm that costs are eligible in a broadly effective manner (though early consultations with Monitoring Officers point to the possibility of residual issues in this area). However, currently it is a concern that no checks made on the validity of claims made in VfM process. The process does not currently handle issues created by interrelated projects or involve any due diligence on technical or commercial issues associated with the project. There is currently a missed opportunity to feed in intelligence gained from project selection into this process.

- Contracting arrangements are led by applicants and do not appear to currently effectively commit applicants to follow on investments in the UK. However, there are material challenges in tightening this aspect of the process.

- Monitoring arrangements appear to effectively capture the broad technological progress of their projects and emerging risks. However, a key weakness is the extent to which these arrangements can handle interdependencies between different projects.

- Change request processes may also benefit from further scrutiny, in particular on the high volume of ‘day one change requests’, the appropriate level of authorisation limits and processes for appraising requests. Processes for

[50] Again, the consistent use of secure systems is an aspect that can be probed through discussions with Monitoring Officers.

approving changes to projects however appear to be sub-optimal in so far as the limits to the flexibility that Monitoring Officers can offer are very low, and processes have not been put in place to revisit VfM if changes are made to the design of a project.

- Despite initial teething issues, it now appears that information from project monitoring is now feeding back to support the management of the ATI budget, and to provide intelligence to help with the prioritisation of funding allocation.

6.0 Efficiency Analysis

This section explores the efficiency with which key process are currently managed to minimise duplication of effort, the time required for a project to be confirmed, and the costs incurred by both applicants and the public sector.

6.1 Duplication

The evidence presented throughout this section highlights some overlap between the aspects considered at different assessment stages. Table 6.1 below details the core focus of each assessment stage.

Table 6.1 Focus of different appraisal stages

Assessment stage	Strategic fit	Value for money	Technical quality	Project management
Strategic Assessment – SR1 (ATI)	Core focus of process – detailed consideration	Limited consideration as part of an assessment of the business and economic case	Detailed scrutiny of the technological case and approach	N/A
Strategic Assessment – SR2 (ATI)	Core focus of process – detailed consideration	Aspects of VfM considered under the economic value, and now more specifically covered following the introduction of the first stage VfM process	Detailed consideration of the technological value of a project and its technical risks	Some consideration of management issues and technical approach
Independent Assessment (Innovate UK)	Considered as part of Innovate UK's 'ten questions', but not seen as a core element of the process by those managing the process	Additionality is considered as part of Innovate UK's 'ten questions', but is investigated in less depth than in the BEIS review	Core focus of process – detailed consideration	Detailed consideration
Full VfM review (BEIS)	N/A	Core focus of process – detailed consideration	N/A	N/A

Reflecting these overlaps between processes, and the evidence presented throughout this section, the following conclusions can be drawn about the relative value added by each assessment stage:

- SR1 provides an initial gateway assessment of the potential of projects across all areas of project quality, and can offer an in-depth assessment of the extent to which projects fit with the broad objectives and scope of the Technology Strategy that is not readily performed outside of the strategic assessment processes. However, the extent to which the process can be used to contribute to the prioritisation of projects is limited by the extent to which the Technology Strategy is sufficiently detailed and precise to support an effective comparison of projects.

- SR2 offers an opportunity to review projects in the round and to manage and prioritise the selection of competing high quality applications for limited public aerospace R&T budgets. It is also a forum in which it is possible to consider the interrelationships between different projects. However, reflecting the risks of capture or perceived conflict of interest discussed in the previous section, it would not be appropriate for this process to determine resource allocation in isolation. In addition, the timing of this process before Independent Assessment and full VfM analysis means that decisions are made in the absence of all possible evidence on project quality and anticipated benefits.

- The independent assessment considers technical quality and the extent to which applicants have considered how a project will be managed and delivered practically. However, in the case of the ATI, other processes are better suited to assessing the strategic fit of projects, for offering detailed scrutiny of additionality and value for money, and for considering the potential significance of interrelationships between different projects.

- The current VfM framework represents a comprehensive assessment of the potential additionality and of economic efficiency of public expenditure on projects.

Recommendation

#24 Duplication and delays in the assessment of applications could be minimised if project selection processes were reorganised along the following lines:

- SR1 – can be used as a key gateway for applicants to check the strategic fit of their application, and for applicants to receive formal feedback on any additional material that they might need to submit.
- Applicants would then finalise their proposals in a similar way to currently. However, in advance of the final Strategic Review meeting the proposal would be subject to both the VfM assessment and the Independent Assessment (removing delays between SR2 and the Funder's Panel while retaining the independence of the technical appraisal).
- The scope of the Independent Assessment could also be limited to technical and project management issues (given the focus of the VfM analysis on the economic case, and the SR1 focus on the strategic case). BEIS, Innovate UK and ATI could also consider whether separate scoring of the technological and economic value of applications by the ATI is needed at this stage (or whether the ATI market and economic assessment could feed in some way to the VfM assessment and the preparation of case papers).
- Applications passing independent assessment and the VfM assessment would then be shared for SR2 review where the role of the committee would be to check that the project has not materially shifted away from its scope at SR1, and to prioritise competing calls on the funding available. Preservation of the independence of the process would require that only proposals passing the independent assessment are considered by the SR2 panel (so the judgements could not be overturned).
- If required, ministerial sign-off could follow SR2 – or could feed into HMT and BEIS representation at the meeting following a twin track approach. Consideration of how the Funder's Panel might feed into to this process would also be needed.

6.2 Timescales

The study team have explored the extent to which the timings for all processes are both appropriate and realistic, as well as the overall timescales associated with the resource allocation process.

6.2.1 Overview

The following information on timescales associated with each process has been assembled for the evaluation:

- Pre-ATI projects – the study team have received materially less movement information on these projects in general, and have not received any data on the timing of the approval processes for these projects. It is important to note that this represents a minor issue for the process evaluation as these were approved through a previous system.

- Independent Assessment, VfM and Ministerial sign off – While dates for Funders Panel meeting have been received the study team have not received any timing data relating to VfM or Ministerial sign-off processes. While consultations with policy stakeholders have provided some perspectives about the typical timings for these processes, they cannot be mapped precisely.

- Conditional Offer Letters were obtained for 85 of 195 projects and include the date that this was issued[51]

- Collaboration Agreements were obtained for 129 of 195 projects allowing analysis of dates.

- Grant Confirmation Letter – have been provided for 90 of 195 projects allowing analysis of dates.

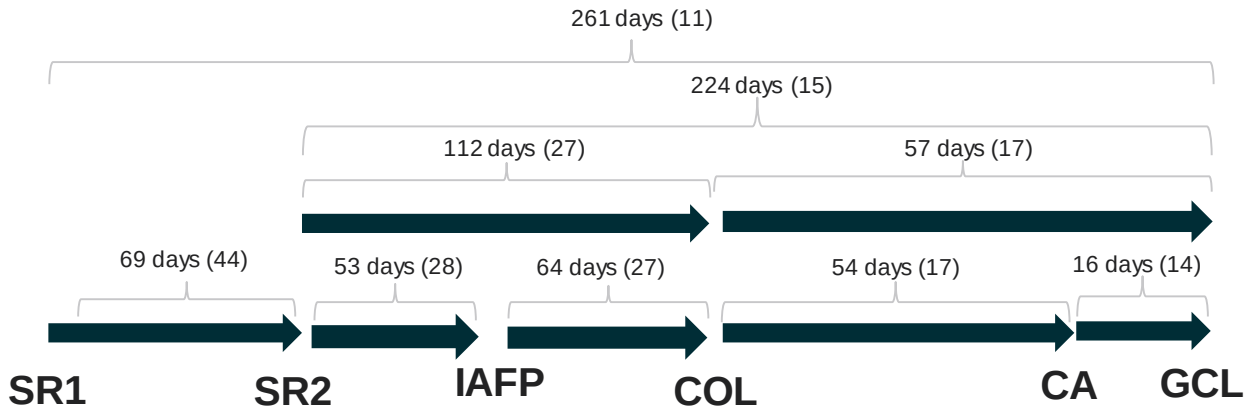
Figure 6.1 below presents a summary of the timings for the processes that can be precisely mapped from the available data. It is important however to note the varying sample sizes used in this analysis (included in brackets in the figure). This analysis shows that recent applicants that have gone through the SRC process from SR1 through to grant confirmation this has taken an average of 261 days or nearly nine months (between 238 and 335 days). This is likely to be materially longer than that experienced by applicants to Early ATI and CRD processes. This timeline was generally viewed by both policy stakeholders and applicants as excessively long. Several of applicants consulted provided examples where delays in project approval had detrimentally affected projects, mainly because the most suitable engineers had been allocated to other R&T projects due to the uncertainty about the start date for projects. It was also suggested by one applicant that this long timeline meant that during the time it took to achieve project approval complementary research might have identified new technologies for the project to look at, and some partners may have dropped out. Describing this as a 'shift in the baseline' it was suggested that this has complicated the contracting and due diligence processes.

Reflecting on this timeline, some applicants and policy stakeholders raised concerns that approval processes were taking increasingly long as the programme has developed. Figure 6.1 illustrates that applications made under the SRC process appear to have progressed from Conditional Offer Letter to grant confirmation more rapidly than was the case for applications through the Early-ATI or CRD processes. The average time taken to proceed from Conditional Offer Letter to Grant Confirmation Letter for applicants to the Early-ATI and CRD processes was on

[51] This has been calculated based on extracting from these letters the dates that they were issued.

average of 135 days (with a high of 365 and low of 17) compared to the 57 days taken by applicants to the SRC process (with a high of 108 and low of 17).

Figure 6.1 Timing for project approval



Key:

SR1 - SR1 decision date
SR2 - SR2 decision date
COL - Conditional offer letter first issued
CA - Collaboration agreement signed
GCL - Grant confirmation letter issued
IAFP - Independent assessor funders panel ratification

Note: Numbers in brackets indicate the number of records available. Averages do not sum in all cases due to missing data.

Source: ATI contracting data[52]

6.2.2 Strategic Assessment

The addition of the two stage Strategic Assessment process before projects proceed to Independent Assessment and VfM extends the time required for project selection. Several applicants reported a concern that the inclusion of this process represented a set of 'additional hoops to jump through', and some stakeholders also expressed concern that the process had excessively extended the time required for project selection. While the windows for the ATI to review applications are reasonable given the volume and detail of information received, the quickest possible passage from

[52] Note that timing records have been extracted based on a review of the dates included in letters and contracts, rather than a record of when these were received by participants, so should be treated as indicative only.

SR1 submission to receiving notification of a recommendation to proceed to Independent Assessment is approximately twelve weeks:

- SR1 meetings are held monthly, and submissions are required two weeks in advance. Feedback is released to applicants five days later (applicants noted that this feedback was generally provided on time). With funding pressures, there may be efficiency gains in reducing the frequency of SR1s (though as suggested below, a key advantage of the ATI relative to international comparators is the frequency with which proposals can be considered).

- SR2 meetings are held three times a year, and submissions are required four weeks in advance. Submissions are not accepted from projects that have been recommended to proceed at SRC1 meetings the previous month (applicants targeting a SR2 submission date are required to submit their SR1 proposal at least two months previously). Again, feedback is released to applicants five days after the SR2 meeting.

In practice, applicants that have not been required to revise and re-submit their applications at any point appear to have tended to pass through the SRC process at a rate that is close to this theoretical maximum. Using information taken from the SRC decision sheets, projects that were successful (including resubmissions) at SR1 took on average 69 days to go from a successful SR1 decision to submit and receive a decision at SR2. This result is skewed by a group of applications from one applicant that were submitted in July 2016 that were held back until October 2016 (122 days) for approval at SR2. In almost all cases where a project received the go ahead to proceed to stage 2, it was subsequently submitted for review at SR2 for the next session with the variation in the time between SR1 and SR2 decisions therefore accounted for by the time between sessions.

The process has been designed to support the development of a project from a rough outline at SR1 stage to a fully developed proposal at SR2. However, the close alignment of applicants to this theoretically most rapid passage implies that some applications may be sufficiently developed to submit a full application at SR2 before the current processes would allow. There is a risk that the infrequency of SR2 meetings (three per year) creates a potential additional delay for projects. Applicants reported concerns that if they just missed an SR2 submission date they would have to wait four months for the next opportunity. This infrequency also appears to be creating bottlenecks and workflow issues for the processes that follow. It is important to note however that in two instances the ATI has introduced an exceptional additional SR2 meeting to respond to this first issue. This analysis would support this change; however, it is not possible to identify the significance of the potential associated gain in speed.

Recommendation
#25 An increase in the frequency of SR2 meetings (subject to demand) could be introduced on a trial basis to explore the extent to which this can accelerate the Strategic Assessment process. A key question for this trial would be to assess whether having fewer projects to review in a batch limited the extent to which reviewers could assess the relative merits of applications.

6.2.3 Independent Assessment, BEIS VfM assessment and ministerial review

As noted above, the study team have been able to access records relating to timelines for the Independent Assessment, but not other assessment and selection processes. On average, for the 28 projects for which records were available, projects took 53 days to progress from SR2 to having completed Independent Assessment and Funders Panel. These projects took on average a further 64 days to progress to the issuing of a Conditional Offer Letter (covering VfM assessment and ministerial review). Together, these project selection processes have taken an average of 112 days, suggesting that this is the longest single stage of the process. There is a high level of variance however here with the quickest project taking 88 days, and the slowest 227, however there appears to be a pattern with 12 projects taking 105 days (15 weeks) and most of the remainder taking considerably longer.

Evidence from stakeholder consultations can however help to break this timeline down further:

- It appears to be highly unlikely that Independent Assessment frequently delays project progress, as both applicants and policy stakeholders reported this to be a highly efficient process. Following an SRC recommendation that a project proceed to the next stage applicants are given a deadline of three weeks to submit to Innovate UK. It was reported by a policy stakeholder with knowledge of the process that, once this submission has been made, Independent Assessment consistently took between five and a half and six weeks, with the COL following ‘a couple of weeks’ later.

- In contrast, stakeholders could not be specific about the timeline for the VfM assessment and ministerial review process, and there are a number of reasons to think this strand of assessment is likely to be a primary driver of any delay.

- As discussed above in Section 4, the VfM process can require multiple iterations between applicants and BEIS and was perceived by some applicants to be highly time-consuming. The quality of early application drafts and missing evidence created a need for this iterative process. However, it

was reported that the VFM analysis was generally turned around within 4 weeks.

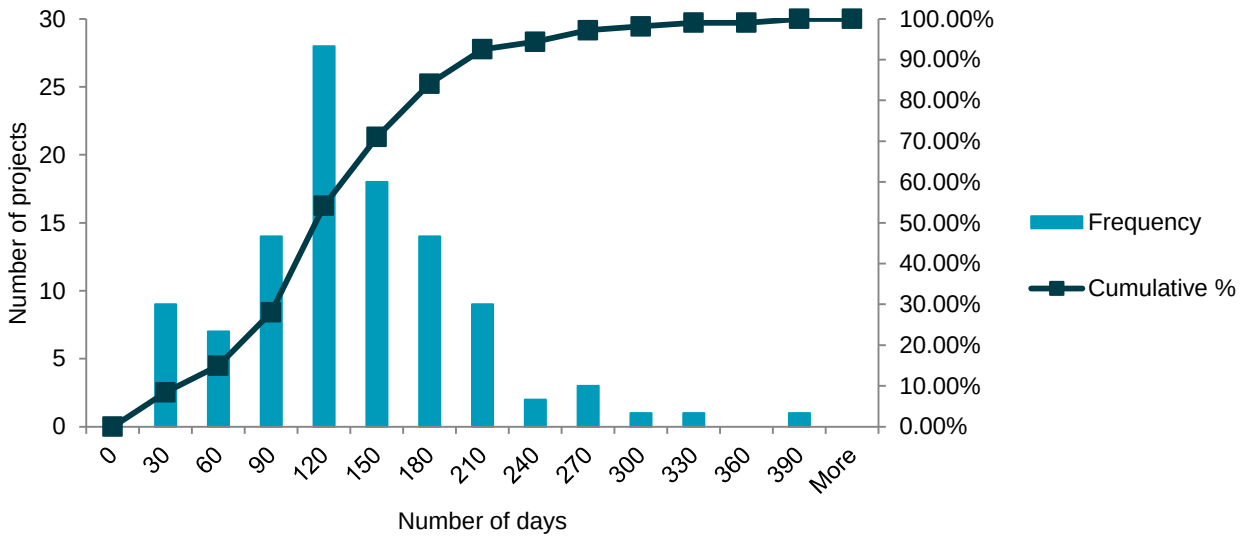
- The process of ministerial review appears to create a number of delays, partly because it was reported by policy stakeholders that Ministers had used the approval of ATI projects in order to make potentially unrelated additional requests for investment in the UK from applicants. Stakeholders also reported an example of a batch of projects where applicants had been notified of a successful outcome from this process, but subsequently approvals were re-opened by the new ministerial team causing additional uncertainty. Policy stakeholders were able to offer no solutions for the delays caused by these political issues.

- One policy stakeholder suggested that HM Treasury review typically took two to three weeks, depending on whether further ministerial approval was required, so long as this was occurring outside of a busy period such as the run-up to a Spending Round or Autumn Statement. There was however an external perception that the timetable for this review process was considerably longer than this.

6.2.4 Due diligence and contracting

Due diligence and contracting process are initiated by the Conditional Offer Letter, and the Grant Offer Letter confirms the end of this process. Drawing on these, management records suggest that this process has taken an average of 122 days. However, as illustrated in Figure 6.2 below, the time taken by this process has been highly variable. Policy stakeholders have suggested that this variability reflects peaks and troughs in the volumes of projects being processed by Innovate UK.

Figure 6.2 Distribution of days elapsed between issue of COL and GCL signed



Source: ATI management records

Due diligence

Policy stakeholders with knowledge of these processes reported that the key hold-ups in due diligence processes were created by applicants' inability to provide relevant information in a timely manner. These stakeholders reported a belief that Innovate UK could in principle undertake the required checks in only a handful of days, but that delays were caused by:

- **Frequent material gaps in submissions** – **Details of project costs:** Applicants provide variable levels of detail on project costs in their application forms which means that in those cases where little detail is provided (the example was given of a £2.5m budget row for 'materials') the due diligence officer will need to request further information from the applicant to proceed. The applicant may take time to respond (e.g. one month), and only provide a part of what is needed (resulting in further delays). The consultee suggested that this was often a personal issue (with the quality of submissions from one organisation varying greatly depending on the member of staff that prepared the application).

- **Slow responses** – Policy stakeholders reported a mixed set of views on how constructively applicants responded to any challenges at the due diligence stage. These ranged from a belief that applicants typically engage very positively in this process and generally already have the information that is being requested from them to a view that applicants were in some instances highly vague when prompted for further project details, including the breakdown of a multi-million-pound cost item and were often slow to respond to queries, delaying the process further. One policy stakeholder suggested

that these slow responses might reflect the desire of applicants to target a particular project start date; however, this is an aspect that it has not been possible to confirm.

- **Ability of some organisations to respond to requests** – It was also suggested by one policy stakeholder that SMEs were often ill prepared to provide evidence that they had the resources available when they submit applications, and several iterations are needed before they can provide the necessary information. In addition to a timing challenge, it is important to note that, if partners are unable to produce this evidence, there is a risk that projects could fail to proceed, resulting in unnecessary expenditures of resources.

Contracting

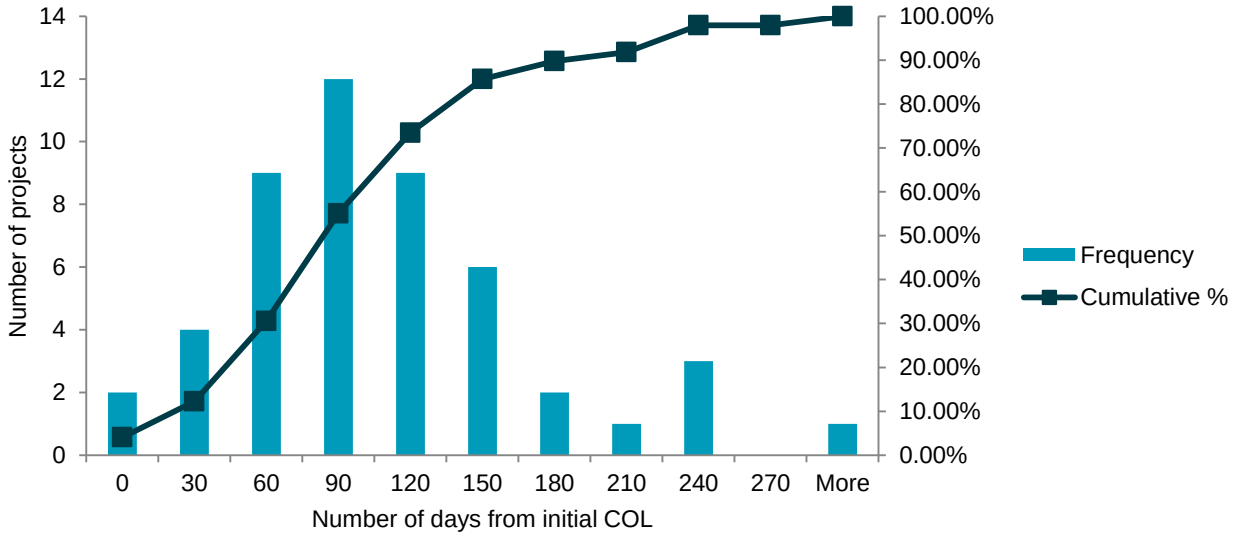
Overall, it appears that contracting processes are more likely to cause a delay to project confirmation than completing due diligence requests. It appears that agreeing Collaboration Agreements between consortium partners is responsible for the majority of delays during by contracting. The additional time required to complete the end-to-end process of contracting with Innovate UK appears to be modest. As illustrated in Figure 6.1 above, the Grant Confirmation Letter is issued on average only 16 days after all partners have signed the Collaboration Agreement with the time ranging from 2 to 63 days, suggesting that this may often be the factor delaying project confirmation.

There appears to have been large variations in the length of time taken to agree the Collaboration Agreement. In two instances management records indicate the Collaboration Agreement was signed before a Conditional Offer Letter was issued, but on average the remainder were signed 54 days after. While the management data available shows that 15 of 17 were agreed within the three-month initial timeframe set out in the Conditional Offer Letter, some have taken materially longer, and in one case the Collaboration Agreement appears to have taken eight months to agree.

Applicants reported that the time taken to agree a Collaboration Agreement might reflect the number of partners, and whether these were experienced in working together previously. Applicants reported that agreeing the terms for the sharing of background and new IP generated through the projects were often the key issues delaying the signing of Collaboration Agreements. A key tension identified by applicants was the balance between the need to protect knowledge and academic partners' interest generating publications from their work. In one instance, a material delay was caused due to the complication of agreeing an internal IP relationship between two sister companies that were participating in a project.

As noted above, the Collaboration Agreement process was reported by applicants to be driven by themselves, with limited inputs from Innovate UK. with applicants working independently to agree their own consortium agreement with their project partners and then confirmation from Innovate UK officers that this is in place before the Grant Confirmation Letter can be issued.

Figure 6.3 Time taken to achieve a signed CA



Source: ATI management information

Recommendation

#26 Project confirmation would be quicker if applicants were required to agree the terms of their collaboration before submitting proposals. ATI, BEIS and Innovate UK should consider making more use of the three-month obligation to complete these processes set out in the Conditional Offer letter (i.e. 'use it or lose it') in order to accelerate and reduce the uncertainty around this aspect of the process. Stakeholders noted that action to enforcing the three-month limit is already being taken.

6.3 Costs

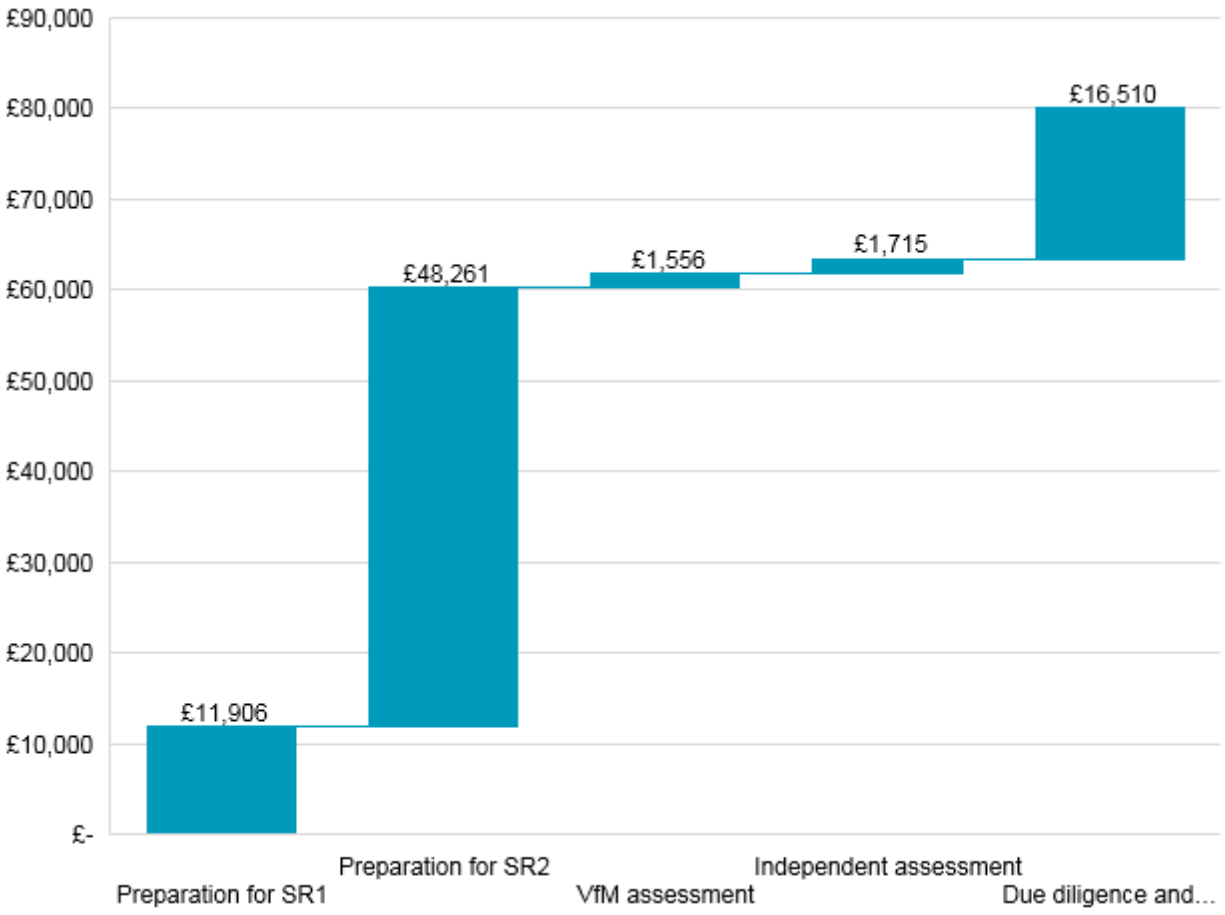
This section focuses on the costs incurred by both applicants and public sector organisations that support these grants for aerospace R&T.

6.3.1 Applicant costs

Interviews with applicants were used to gathered a range of estimates of the costs incurred by applicants and their perspectives on the extent to which these were considered to proportionate. Reflecting the small sample sizes here Table A1 (included as an annex) presents both individual views and a summary of the costs reported. Few case study applicants were readily able to provide detailed estimates, instead offering more qualitative indicators, and the findings may be subject to some bias. It is also important to note that these costs are based on staff time and salary and employment costs, and no estimate of overheads has been calculated. Staff time has been valued using the total R&D expenditure on salaries and wages and

the number of R&D employees in the aerospace sector gives an average employment cost per worker of £57,800, equating to £31.75 per hour assuming a 35-hour week.[53] Applying this cost of time to the estimates in the table produces Figure 6.4 below. It is important to note that this information is based on a limited number of responses, a more detailed discussion of this evidence is included in the Annex at the end of this document.

Figure 6.4 Indicative costs to applicants



Source: ATI applicant interviews. Note that 'preparation of proposals to SR2' may include time required to further scope and specify the R&T project in additional to articulating it for the funding application.

From the figure, application preparation in advance of SR1 and SR2 are shown to be the most time consuming of the processes involved in SRC applications, with a high

[53] ONS (2016). BERD: Business enterprise research and development, UK: 2015. While it is likely that these time estimates included some more junior administrative support, this cost per worker broadly aligns with the level of seniority of staff identified by applicants as involved with pulling together applications.

proportion of costs also incurred through the course of due diligence and contracting. Because the application is locked down at SR2 stage, the estimate of time to SR2 includes preparing the proposal for both SR2 and Independent assessment, but not time required to prepare for assessor interview. In addition, it is likely that this figure includes some time to further specify the R&T project, which might help to actually advance the project.

The costs of engaging in monitoring arrangements per annum are estimated to be in the region of £28,000 using the same method and would imply a lifetime cost of just under £64,000 applying the average length of all ATI projects.[54] In addition, the indicative cost of engaging in the development of the Technology Strategy was £1,400 (per annum), and with other engagement activities of £8,000 per annum.

A total indicative cost of just over £82,000 (excluding monitoring costs) is implied by the estimates rising to £93,000 if estimates of time taken to approve a framework agreement is included. Total lifetime costs, including monitoring costs described above and excluding costs in agreeing a framework contract, are on average estimated at just under £146,000.

The case studies provided additional views on the efficiency of monitoring processes. Monitoring Officers have significant flexibility in terms of the approach they take, and this was seen as creating a varying level of need for input from applicants. Perspectives ranged from some who saw the engagement as constructive and collecting similar evidence to what was required for internal project management, to applicants who saw monitoring on some of their projects as very time-consuming and burdensome. Some applicants suggested that the process could be made more consistent between projects and could potentially be streamlined.

6.3.2 ATI

Following guidance from the ATI, and drawing on the 2016-17 Business and Delivery Plan the study team have apportioned elements of the organisation's overall £5 million per annum budget (which is jointly funded by central government and industry contributions) to the processes discussed through this report. This analysis found that approximately half of this budget is spent on activities that are related to these processes[55].

[54] Information reported for monitoring costs could be considered open to interpretation and clarification may need to be sought as to whether the figures provided relate to quarterly costs or annual. For the above, costs reported as related to activities taking place quarterly have been assumed as quarterly and costs relating to annual monitoring as annual.
[55] The remainder of the budget is spent on general operations and international engagement.

6.3.3 Public sector costs

The study team have received only limited details[56] of the costs incurred by public sector organisations' engagement in these processes and agreed with the project steering group that this was not a priority area for the evaluation.

6.3.4 Overview of costs and potential for efficiency savings

- The development of the technology strategy has been a highly time-consuming process to date for both the ATI and applicants alike. It appears that the organisations that were investing the most time in these activities were also those reporting achieving the greatest influence over the strategy. It is important therefore that the opportunities from this document are maximised through further engagement with a broader range of potential applicants.

- The per application costs incurred by applicants prior to project confirmation are very substantial, with one applicant reporting a lead applicant cost per application higher than of £140,000, though it is important to note that this represents a small proportion of the average project size. While this evaluation has not recommended the removal of any key processes, the implementation of the recommendations above could help to reduce this burden to some extent. Changes such as the development of clearer guidance for SR1 could play a role here.

- As set out in Section 4, there are material overlaps and duplications between different project selection stages. The implementation of the recommendations set out there with regard to potentially streamlining this process could act to reduce the public sector costs. However, without further information on current costs, it is not possible to estimate the potential scale of these savings.

6.4 Comparison with international schemes

A small number of applicants were able to offer comparisons between the ATI and other international models for accessing funding for aerospace R&T. These views have been reported below, but it is important to note the sample size was limited, and that these views have not been validated or tested against other evidence sources.

6.4.1 Comparison of ATI Technology Strategy to ACARE

Several applicants consulted had extensive experience with international schemes for setting aerospace R&D agendas and providing financial support for innovation activities. From this experience the following comparisons were reported:

[56] To date, only information on the costs incurred at HMT for review and broad draft costings for Independent Assessment have been provided to date (though we are awaiting confirmation of these).

- The ATI technology strategy development was less resource intensive / burdensome compared to its European equivalent, the Advisory Council for Aviation Research and innovation in Europe (ACARE).

- The ATI is more approachable as an organisation than its international peers and is more willing to hold meetings with all significant players in the industry – for example, on the European level the only direct engagement is through participation in the advisory groups of ACARE, the European Technology Platform with focus on aerospace research.

- However, the UK national policy effort is seen as less transparent in the way that the long list of technological priorities was reduced to a specific strategy and the ATI was has chosen to be more selective about who can obtain the final documents compared to those from competitor locations.

6.4.2 Comparison of ATI funding to national and European R&D programmes

Applicants were also able to draw detailed comparisons with the national R&D programmes in Spain, France and Germany and to the European Framework Programme for Research and Technological Development and its successor programme Horizon 2020. Applicants reported that:

- ATI guidance to applicants is less than clear that for European Programmes but applying to the European initiatives a more administratively burdensome undertaking, considering the requirements to build consortia with partners from two or more EU countries and the specificity of the administrative documentation to be submitted within the application process.

- In EU programmes the timeframes for submitting applications are clearly stated and adhered to, while in case of ATI there were often gaps in calendar and changes to deadlines took place. In terms of timescales, the EU application process for approval of projects was from applicants' view quicker than ATI.

- The scale of funding in the UK is larger and more concentrated than in many international comparators, one applicant stating that funding in the UK was 200% larger than in Spain and 100% larger than in France or Germany, and also noted that the US system is much more complex due to state to state differences. However, funding by ATI tends to be concentrated on a smaller number of applicants – with a more concentrated ecosystem and less scattered landscape being supported. Comparator programmes were seen as favouring nationally headquartered companies to a greater extent than is the case for UK support for Aerospace R&T.

- Level of project costs covered differs – ATI funding provides for only 47.5% of a project[57], while the EU supports 60%[58]. The latter is focused on pre-competitive research and technological development to generate new knowledge, which is further away from the market than the nationally funded research under ATI.

- National aerospace funding in France, Germany and Spain is organised through calls which tend to be more 'drip fed', resulting in more uncertainty compared to the UK. The long-term budget of the ATI is an important element for raising support for the UK R&T profile. In countries where this funding is lower, the companies instead focus more on European opportunities.

ATI monitoring processes are seen as 'heavier in comparison to the EU projects', especially the programme EU JTI Clean Sky[59]. A more specific point was made by one applicant that the change request for scope of a project is easier to obtain in the EU scheme but the claims process is much more burdensome.

6.5 Summary

- Project assessment processes include material overlaps between the aspects considered at different assessment stages, creating a case for the re-ordering of activities in order to ensure that these processes can more effectively build on and inform each other. In particular:

    - Strategic fit is considered at SR1, SR2, and to some extent through the Independent Assessment process.

    - Aspects of Value for Money are considered (qualitatively) as part of the assessment of the business and economic case at SR1, in depth at SR2, additionality is explored through Independent Assessment (qualitatively), and is a core focus of the VfM review (which produces a quantitative assessment of costs and benefits).

    - The technical quality of proposes is also given detailed scrutiny at SR1, SR2 and at Independent Assessment.

- Current project confirmation processes are associated with very long timescales – for the 11 projects where full records are available it has taken an average of nearly nine months to move from the first stage (SR1 assessment) to project confirmation (Grant Confirmation Letter). The majority

[57] ATI funding is allocated based on a 50:50 match between industry and grant funding, minus a 2.5% industrial contribution
[58] The study team have not been able to confirm the level of industry contribution associated with the Clean Sky programme, and therefore this figure may be slightly lower.
[59] http://www.cleansky.eu/ is a Joint Technology Initiative programme where a group of companies and research organisations had direct funding and administered individual projects with a goal of reducing environmental impact of aircrafts.

of this time appears to have been taken up with project selection processes, rather than contracting and due diligence:

  - SR1 to SR2 – an average of 261 days from a sample of 11 projects.
  - SR2 to Conditional Offer Letter – an average of 224 days from a sample of 15 projects.
  - Conditional Offer Letter to Collaboration Agreement – An average of 54 days from a sample of 17 projects.
  - Collaboration Agreement to Grant Confirmation Letter – an average of 16 days from a sample of 14 projects.

- Applicants reported incurring a high level of costs in engaging with these processes. A total indicative cost for a lead applicant of taking a project through from SR2 to Grant Confirmation letter of £82,000 was reported by applicants. The costliest process appears to be the time taken to prepare an application for SR2 submission (£48,000). This is in addition to the annual costs of engaging with the development of the Technology Strategy (£1,400), the annual cost of engaging with the ATI's pipeline development work (£8,200), and the annual costs of project monitoring requirements (£28,000). It is important to note that these calculations are based on a small sample of organisations that were able to provide precise estimates.

- Data provided by the ATI indicates that the organisation spend an annual sum in the order for £2.75 million engaging with the processes, half of which is funded by the public sector, and half from industry contributions. Limited details are available however on the extent of the costs incurred by other public sector organisations in supporting aerospace R&T funding.

  Applicants have mixed views on the extent to which UK arrangements compare favourably to those of key international competitors. The scale and long term nature of UK arrangements was noted as a key advantage by some applicants. In contrast the timelines for approvals in the UK were viewed unfavourably by some. However, further triangulation of this evidence would be required to identify key features of international schemes that could strengthen UK arrangements, and to build more concrete recommendations from international comparisons.

7.0 Implementation

This section of the report is based on an in-depth analysis of 15 project level and 5 applicant level case studies to offer an overview of the delivery of ATI projects to date and expectations for the future. The analysis drew on an extensive desk research, reviewing evidence from application forms (in some cases SR1 and SR2 level proposals), feedback from the assessors, VfM forms and evidence provided in the quarterly monitoring reports. Primary research within the case studies involved on-site visits, interviews of project managers from lead partners and collaborators and interviews with monitoring officers (MOs).

This case study evidence has been complemented by analysis of outcomes monitoring data provided to the study team for 20 projects – 17 annual monitoring returns which have provided quantitative evidence for this section and three close out forms which have been analysed qualitatively. As noted in Section 5, the study team identified some instances where the data reported in these forms gave counterintuitive or inconsistent results, potentially relating to a misunderstanding of the guidance. This data has been cleaned by the study team who have removed likely erroneous returns, such as increasing TRL levels. This provides evidence on employment and TRL progress, in particular.

7.1 Overview of ATI projects

7.1.1 ATI project objectives

The table in the appendix illustrates the variety in ATI project case studies in terms of technologies and processes targeted (across product design, process design and manufacturing). In general, there was a high level of alignment with the overall aims of the ATI as set out in Section 2 of this report. Most projects targeted design process improvements, and tended to focus on gaining or retaining a competitive advantage and improving the exportability of products. A smaller number of projects explored manufacturing processes with a view to improving the productivity of UK aerospace manufacturing activities.

The case studies suggested ‘Legacy’ and ‘Early ATI’ projects had much broader aims, which were in some cases described by Monitoring Officers and lead partners as ‘vague’ which inhibited the extent to which an assessment could be made as to whether those objectives had been met. Examples of this include a project that aimed at “improving efficiency of all future engines” or a project which aimed to “test and develop a range of additive manufacturing processes to the point at which they can be demonstrated as a viable direct production method for advanced aerospace components”. From our limited sample of 15 projects it appears evident that CRD projects and projects that had gone through the SRC process were more likely to have specific aims included in the proposal from the outset.

Recommendation

Recommendation
#27 There should be a focus on ensuring that project objectives are precise and clear to improve outcomes. It is positive that more recently approved case study projects appear to have more specific objectives than those approved earlier. This is an aspect that could be potentially covered by requesting Independent Assessors or the ATI flag areas to be addressed by applicants as part of the development of Level 2 Plans with monitoring officers, prior to project kick-off meetings.

7.1.2 Interrelationships between ATI projects and other R&T activities

Large companies involved in ATI have substantial R&T departments with portfolios of projects funded through EU RTD programmes, national R&D programmes in the UK, US, Germany, France and others and internally funded projects. This means that projects funded under ATI tend to have their roots in previous R&T activity and often feed into follow on projects. In some cases, R&T activities are being undertaken in parallel and feed findings to other projects. For example, one project developing and testing a component system followed on from another Legacy ATI project, and fed findings into project another SRC project which was specifically looking at application of a novel component system but with a different gearing ratio. The prominence of interrelationships underscore the importance of the recommendations discussed above relating to appraisal, assessment and project section.

7.1.3 Origins of ATI projects

Origins of ATI projects identified by the case studies ranged from those driven by specific strategies such as UK Aerodynamics Centre strategy (legacy projects), those based on previous projects (RGF, EPSRC, EU FP6, Innovate UK and ATI), new academic ideas and even one project where the origin was an IP purchased by from a foreign company. Examples included:

- In response to funding strategy – One applicant reported that they had developed their project in response to the funding stream and the published strategy of the UK Aerodynamics Centre.

- Projects in which the lead partner bought foreign IP – initial development was led by the foreign division of the lead partner and then commercialised by a specialised component manufacturer. To avoid being a captive of the supply chain in this core technology the company pursued an R&T project within the Early ATI programme to re-shore the technology into the UK.

- A project originating from a new idea of the academic partner – a team of academic researchers originally developed it as a smaller, more limited internal project for the OEM to which their academic institution is aligned. This was then developed into a full ATI project. This evidence raised questions about the extent of the additionality involved.

- A project originating from a new idea of the lead partner – a team of engineers held an internal brainstorming session about advances that could be made in existing propulsion units to make small incremental gains in efficiency and emissions.

- A project originating in a former publicly funded R&D activity – the work from two EU funded projects (FP6 ANASTASIA and FP7 SANDRA) resulted in concepts that required further technological development under Early ATI funding.

7.1.4 Alignment of projects with key features of the ATI programme

This section explores the extent to which the ATI projects align with key features of the ATI programme, providing a high-level assessment of areas of focus, the extent to which projects targeted technologies in the desired levels of development (codified by technology readiness levels or TRLs) and collaboration patterns.

Areas of focus

ATI projects reviewed in the case studies had objectives that were generally well-aligned with technologies specified in the Technology Strategy. This is perhaps unsurprising given findings that the applicants consulted indicated that they felt they were able to feed and influence the strategy documents. Only one of the fifteen projects - with a focus on developing communications for Remotely Piloted Aircraft Systems - was said to be on the periphery of the Technology Strategy by the project lead consulted.

Baseline Level of Technical Development

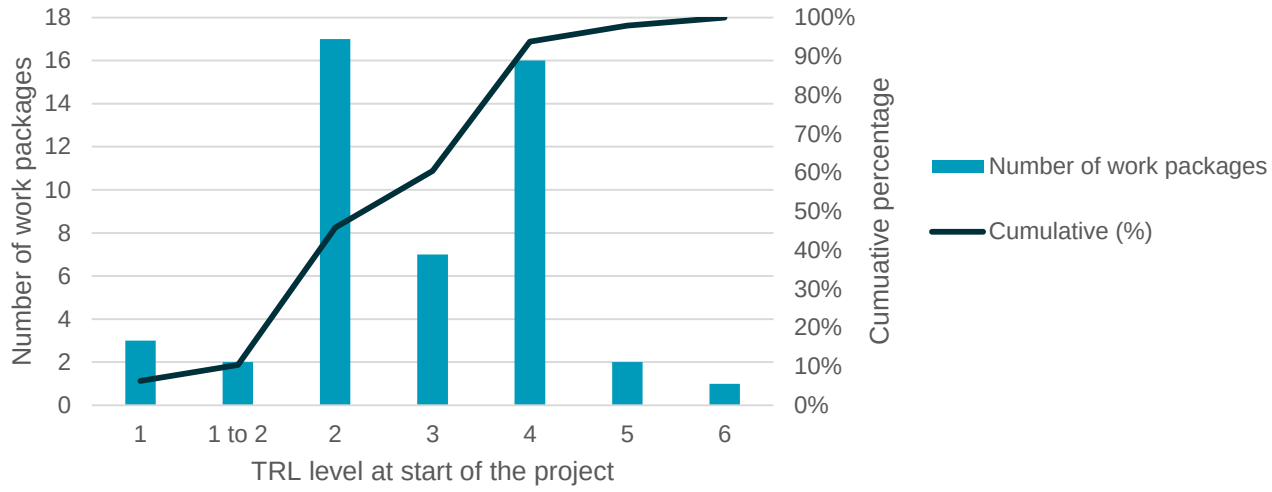
None of the application forms associated with projects reviewed explicitly indicated that the teams would pursue technologies developed to lower level than TRL4. However, the case studies research suggested that certain elements of projects were closer to conceptual research rather than technologies being validated in a laboratory environment. Conversations with project teams and monitoring officers revealed that due to the breadth of some of the projects there were often multiple technologies being pursued, some within the TRL levels targeted by the ATI (TRL4-6) and some more conceptual technologies which were not proven beyond an academic study exploring a potential benefit.

More than a third of case studies involved an area of technology which was described to be by the applicant at TRL1 or TRL2 at the start of the project. The remaining projects targeted technologies that were on average in TRL3 or TRL4 at the time of the application. None were reported to be overall at TRL5 or higher at the outset. However, in general, applicants aimed to bring technologies to TRL4-6 in line with the programme's objectives.

This pattern was been replicated in the annual monitoring data. Annual monitoring forms provide information reported by project participants on the baseline TRLs for a total of 49 individual work packages. These suggest that the average baseline TRL was 2.9. As is clear in Figure 7.1 below, a large proportion of applicants are reporting a baseline TRL lower than the core TRL4-6 focus of ATI funding. It is possible

however, that those filling in the forms have misinterpreted these, and provided a baseline relating to when they started working on a project, rather than when ATI funding was confirmed.

Figure 7.1 Reported TRL/MCRL at project start



Source: ATI annual monitoring returns

Recommendation

#28 BEIS, the ATI and Innovate UK should consider including further guidance to all individuals involved in the assessment and monitoring of ATI projects to ensure a closer focus on activities at TRL4-6, or consider clarifying the focus of the programme.

Collaboration

ATI projects involved a wide range of collaboration patterns (from a single lead partner delivery model, through to projects drawing on specific research and development capacities of firms, RTOs and academic institutions, and vertical supply chain collaborations). These collaborations varied in terms of their history – in some, partners reported a long history of having worked together on R&T projects, for others collaborations had been materially deepened through the ATI project (partners often knew each other, but had not worked together on R&T previously) and in a small number of cases the partnerships were totally new and had been formed entirely to pursue the project in question. Within the fifteen case studies there was no example of a horizontal collaboration – an explanation provided by more than one applicant was that this was because there are only single large UK manufacturers in key product areas, though there may be examples of such collaborations in other parts of the portfolio.

7.2 Outputs and results observable to date

This section explores the extent to which case studies indicate the realisation of outputs and results at this stage. This is focused upon the R&T activity implemented within these projects but extends some of the assessments to consider progress towards the commercialisation of technologies. We have used standard TRLs as a measure of progress. Our analysis also reflects the assessment within the 20 project close out forms that were received within the monitoring information from ATI. Of the 20 returns only three provided an assessment of TRLs. The average TRL progress reported was 2.3 TRLs since project starts over the 5 work packages identified.

7.2.1 Overview of R&T activities undertaken to date

Projects funded through the ATI typically involved a wide range of activities. During early phases of their development, applicants set up (often cross-organisational) teams of engineers to work on individual work packages and in some cases conducted paper based studies exploring what has been done on the topic by their respective organisations, and whether there was a possibility to translate any technology from a related engineering sectors. Later stages of projects tended to involve design and manufacture of components or demonstrators and culminated in tests in laboratory or relevant environments. Some of the tests had to be performed in unique facilities in Europe. Only a small proportion of projects were finished at the time of the review and all required more time than anticipated in the level 2 project plans.

The majority were still delivering but experienced either minor or more substantial delays. Delays were generally caused by a variety of problems during the start-up phase of the project (mainly difficulties securing the resources needed to deliver the project, the discovery that the anticipated resources or knowledge was not available as expected, or time absorbed by pinning down project objectives more precisely where these were originally vaguely defined). Longer delays term were sometimes outside the control of the consortium - such as a failure in tests which required major re-design of components, but in some cases difficulties caused by resourcing created longer term challenges in delivery. In one case the project timeline changed from two years to four years, as a major commercial opportunity that was described was missed during the delivery and led to a refocusing of the project of the next available product platform. Applicants were typically confident that delays would be recovered.

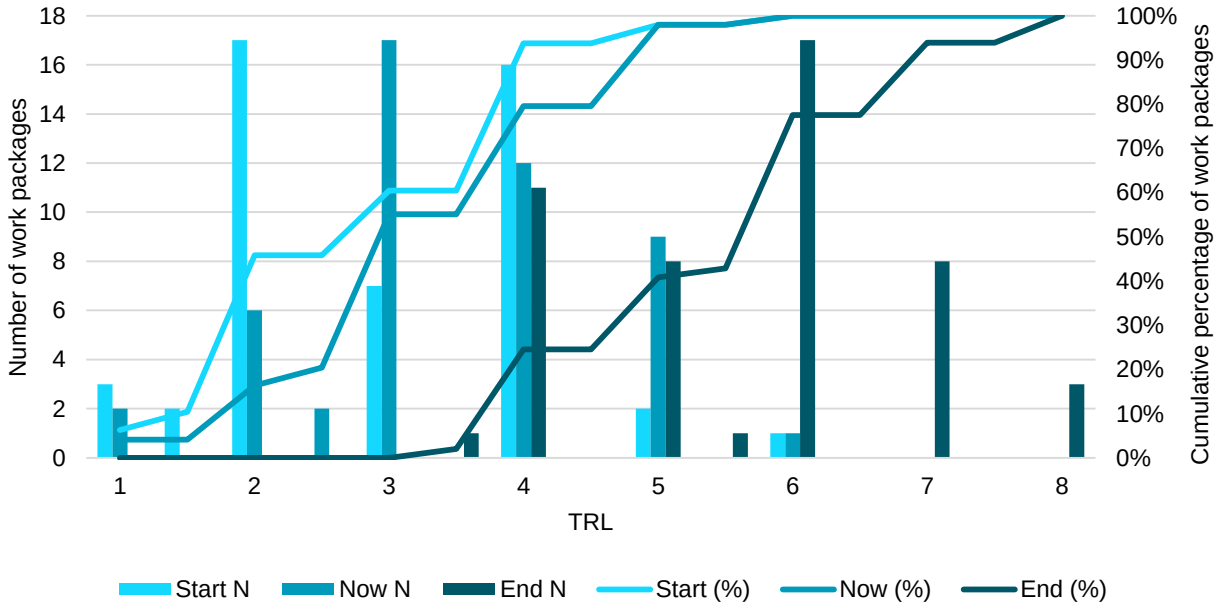
The case studies did not show any substantial changes in terms of the overall aims of the projects (though this was partly to be expected as these aims were sometimes very broad). Some of the projects had increased the scope of what they were seeking to achieve. Examples include three projects, one of which added an additional test with a view to applying the manufacturing technique not only to the future next generation component but also the current one and adding a whole new work package exploring integration of systems to enable higher fuel efficiency.

7.2.2 Progress against key outcomes

Progress Towards Commercialisation

Monitoring data suggests that in aggregate, progress towards commercialisation of technologies, projects have progressed – most of have shown progress in TRLs but progress in relation to MCRLs is to this point limited (as illustrated in the figure below). On average, projects had progress by an average of 0.6 TRL levels per work package by the end of 2015/16 to an average TRL level of 3.4. As suggested in the figure below, in general, significant further progress is required to reach the TRL levels targeted by the end of the project.

Figure 7.2 Number of Work Packages by starting, current, and target TRL level



Source: Annual monitoring returns

The case studies generally confirmed this picture, and in many cases, a progression to higher TRL levels would not occur until the results of key tests were available (and in many cases these tests had not yet been completed). A summary of the progress made by applicants is provided in Table 7.1 below.

Table 7.1 Progress towards commercialisation of technologies

Average TRL change in a project[60] and weight of evidence	Example of tech development
No Change (e.g. started and remained at TRL 4) Projects that either started at a relatively higher TRL or those at early stages of development. (3 case studies fit this criteria)	Example 1: One project that experienced a minimal TRL change, started and remained at TRL 4 (with some tests still to be run). Project lead reported that there was an expectation to progress to TRL5 when the design would be frozen for tests after April 2017. Example 2: Different elements of the research started in the range TRLs 1 -5 with the aim to reach TRLs 4-7. The plan is to demonstrate the developed system on a prototype for dynamic testing. The project is working with two potential shape sensor technologies, one of which is relatively mature and one more experimental. If successful it is expected to lead to a follow-on project based upon further testing but, as of now, no TRL change has realised been realised.
TRL increased by 1 (e.g. started at TRL 3 and at the time of the review was at TRL4) Projects that are in their early stages of development or those that are trying to progress a number of technologies in parallel to meet one project objective. (3 case studies fit this criteria)	Example 1: The project is only in its first year of delivery but the team have delivered trade studies, some based on external (competitor) analysis but some also on assessing internal projects and methods. These studies generally look at alternative solutions to solve a problem with some basic stress models. They range from conceptual work (Early TRLs) but as such only one of the subcomponents has received a formal review of its TRLs. Example 2: Up to the first quarter of 2017, the project had completed design (part of WP1) and manufacture (WP3 in full) and run a number of tests, including investigations and analysis of early designs. This demonstrated the move from TRL4 to TRL5 but, as the full scale test in the relevant environment had not yet been achieved, not TRL6.
TRL increased by 2 (e.g. started at TRL 3 and at the time of the review was at TRL5) Projects starting in lower TRLs than 4 realising material progress (2 case studies fit this criteria)	Example 1: A project consisting of a complex programme with 10 work packages. Predominantly these were at TRL3-4 at the point of application, and all were targeting TRL6 by the end of the project. The majority of these work packages were at the point of the review at TLR5 with a small proportion at TRL6, but two have been aborted. Overall, it is estimated that the project is about two-thirds of its way to achieving the overall technological objectives. Example 2: A project with progress against objectives that has been materially slower than anticipated. Progress is however significant as the starting point was only at theoretical / conceptual thinking.
TRL increased by 3 (e.g. started at TRL 3 and at the time of the review was at TRL6) Projects taking concepts	Example 1: While TRL progress with designs was cited to be important by the project lead, developing an understanding of what designs do not work and why was said to have been just as crucial: TRL development from 2 to at least 5 as a result of the project, with a view to reach TRL6 at the project's close. Example 2: The project focused on the development of

[60] One of the project level case studies is excluded from the analysis as the MO and lead applicant were unable to estimate TRL progress. The lead applicant only indicated current and expect TRLs.

Average TRL change in a project[60] and weight of evidence	Example of tech development
in TRL2 and TRL3 to TRL6 and further along MCRLs. (4 case studies fit this criteria)	aerodynamic technologies related to the design of advanced components. TRL progression from TRL3 to TRL5/6 and MCRL change from 5-6 had been achieved. Apart from the main design achievements, a set of diagnostic testing and validation tools had been developed as part of the project. These have subsequently been used in other projects.
TRL increased by 5 (e.g. started at TRL 1 and at the time of the review was at TRL6) One project from concept to TRL6.	Example 1: The project had made significant progress in the majority of its work packages, some of which were proven to work and some confirmed that the technology was not able to improve efficiency. Two major successes in technology development have subsequently been incorporated into manufacturing processes and product development. Two technologies progressed from concept to TRL6 within the project and then internally further into production

Source: Case Study Analysis

Application of research to date

As the analysis of TRL and project progress suggests, in-depth case studies have at this point showed only limited progress with respect to commercialisation – this is not surprising given the timelines involved and the dynamics of the aerospace industry. The principal example of a product that has been commercialised is an enhanced system unit fitted to specific upgrades (a software product has also been brought to market but its development was not the major focus of the ATI project). The system progressed to TRL6 with ATI funding and has since been developed into a product through two internally funded projects. This technology consists of a patented novel design which was proven through the ATI project, and delivered 'a huge performance benefit' while extending the life of a high value component.

Many projects involved the development of modelling tools that allow the design stages to be completed more rapidly or will reduce the number of tests required to achieve the same or higher level of rigour and evidence (in many cases OEMs and Tier 1s in the supply chain). An example of such technology is a software package developed by an academic partner in one of the ATI projects which is being adopted by an OEM and is promising to halve the time taken to test of design decisions.

Additional investment

Seven case study projects examined had secured follow on funding. Four of these secured follow-on funding from the ATI (with project values ranging from £14m to £19m). One project was said to have secured follow on funding from the €4bn Clean SKY II programme but the project lead could not report the exact size of the project. Other sources of funding included VC investment totalling £530k. Four projects secured follow-on funding from internal sources.

Collaboration

Collaboration outcomes varied materially between case studies. In a number of cases, collaborations had been formed between organisations that had not previously worked together on R&T activities. In at least two case studies, a supplier of a large structures worked for the first time with the OEM in an R&T capacity which was a welcome opportunity. In one of these cases the UK component supplier was steered by the ATI to replace a long standing relationship with an overseas sub-component supplier with a UK one. The new UK partner brought along a relevant academic and increased the breadth of the novel collaboration. In a small number of cases a wholly new collaboration had been formed to pursue the project.

In general, the collaborative relationships formed to deliver ATI projects appeared to have been largely formed from within existing networks. On one occasion a known partner introduced another 'new' partner to the consortium. In this instance, while the lead partner personnel did have previous experience working with the academic partner and the academic spinoff, they had not worked with them whilst at the lead partner organisation. However, an analysis of project needs by the lead partner identified them as suitable. A representative of the academic spinoff suggested the inclusion of an engineering design specialist partner firm after working with them on a relevant study; the organisations have had a professional working relationship since 2009; the lead partner would not have worked with the specialist without the funding opportunity provide by ATI. However, there was one noteworthy exception to this where a new consortium had formed across a range of organisations in different sectors, pursuing different types of technology.

In a final group of case study projects all partners had previously collaborated on R&T activities, and in several cases were currently working together on multiple projects funded through a variety of sources. In such examples, there is limited scope for ATI funding to have strengthened these collaborations.

R&T jobs

Applicants generally identified significant teams working on case study projects, noting that these were generally in line with expectations at the point of application. Within the applicant interviews only a half of lead applicants felt they could estimate the exact number of jobs safeguarded and or created. It is important to note that, as discussed above, case study projects were at different stages of development. However, these jobs are focused towards high skill levels. When broken down into skill level, an average of 2.6 jobs per R&T project that are typically created and/or safeguarded are mostly at NVQ Level 5. This equates to 59 percent of all R&T jobs created/safeguarded. Design jobs are typically of level four (88 percent) whilst manufacturing jobs, the largest proportion created or safeguarded, are of NVQ Level 2 (51 percent).

Table 7.2 Average number of jobs created and/or safeguarded by NVQ level

Level	R&D jobs	Design jobs	Manufacturing jobs
Level 5	43.6	2.5	-
Level 4	24.2	23.1	9.2
Level 3	2.7	-	8.3
Level 2	2.4	-	15
Level 1	0.7	0.8	1
Total	73.6	26.4	29.5
Average per project	4.3	1.55	1.74

Source: ATI annual and close out monitoring returns. Note: for reference the average grant size for the case studies was £5.9m, which is larger than the overall average project size of £4.3m presented in Table 2.1 above

Training outcomes

Extensive opportunities for on-the-job experience and development were identified by applicants. In one case an applicant reported that project delivery had helped to build up technical competencies to the point that they had been able to secure commercial contracts in this area. Formal training was however, not a core focus for most of the case study projects. Three case studies involved formal training related to an implementation of a new software for design and analysis. Only two annual reporting forms highlighted any training of staff with a total of 12 employees from two organisations trained to NVQ Level 4, two to level 5 and one to level 3.

Training outcomes were in particular emphasised by academic project participants, who identified the importance of short placement of university staff in industry. In addition to the knowledge transfer from academia to industry it was reported that these projects resulted in a broader set of development outcomes including pushing of engineers towards new and more innovative or critical ways of working.

> "We need to do more of innovative work, spending time being creative and not just working to specification, something that large aerospace is not well designed to do, everything is set up to design and manufacture extremely robust components to withstand much more than needed. Being creative takes time and has uncertainty and risk involved." Applicant interview

Knowledge spill over outcomes

Applicants could not identify examples of knowledge spill overs occurring beyond their consortia to date. As discussed in Section 8, it may be that applicants are not well placed to make such judgements.

In contrast, ATI projects involving collaborative working (either in the form of formal collaboration or the sub-contracting of research tasks) was reported to have resulted in a high level of knowledge sharing between the organisations involved. One example of this was the sharing of data from a failed test by a Tier 1 supplier with a team or academic researchers who were employed by a formal subcontractor in a project. This sharing resulted in predictive models that can be used by the Tier 1 in future designs to avoid extensive testing. The academic partner valued the opportunity to work with industrial level data in commercial confidence which allowed application of fundamental research in real applications and was said to have a real effect on work satisfaction by their post docs and PhDs involved.

7.3 Project expectations for the future

7.3.1 Overview

Projects examined the case studies revealed a variety of levels of expectations from project teams in relation to their expected progress within the life of the project and beyond. Projects fell broadly into three categories, depending largely on the technical performance of the project:

- **Expectations in line with the application:** The position found most commonly among the reviewed projects was that the expectations of achieving specific goals and outcomes had not changed since the submission of the application. Examples of this kind of view were expressed in TRL levels anticipated to achieve or expected timelines of future products into which the project outcomes would feed into.

- **Increased expectations:** For a small number of projects, expectations were higher than at the outset of the project. As noted in the previous section, approximately half of case study projects had at the time of this research already secured follow on funding for the technological development that was undertaken under the ATI projects and their expectations of the future were wholly related to these follow on activities. These were in general expected to progress the technologies further from TRLs. An example of such instance was where the ATI project allowed the applicant to progress a technology from TRL3 to TRL5 and was expected to further progress it within an EU Clean SKY project to TRL6.

- **Reduced expectations:** Instances where a part of a project pursued promising technologies or concepts involving high levels of uncertainty and in which after initial testing the pursuits were abandoned and therefore there was no expectation of technical or commercial outcomes at all. An example of this kind of project is one where a number of different technologies were being pursued to achieve the same objective and one ended up not being suitable for the application after specific investigations (this included choices of materials or specific designs of sub-components).

7.3.2 Anticipated outcomes

Expected technical outcomes

As illustrated in Figure 7.2 above, annual monitoring returns indicated that applicants are expecting significant further technological progress to be achieved within the life of their projects. On average, applicants are expecting to reach an average TRL of 5.6. This represents a significant advance on the current average position of 3.4. In general terms, the case study evidence reflected this high level of ambition regarding the technological progress that will be achieved within the remaining case study time. Many applicants and Monitoring Officers consulted indicated that they were still expecting to achieve the levels of technological development set out in their applications.

Expected commercial outcomes

Broadly, expectations of the commercial outcomes are in line with those at the point of application (except where the ATI project failed to de-risk a technology as expected). Commercialisation expectations are broadly in line with technological risks – engineers tended to suggest that if the expected technological benefits were validated within the projects they would find their way into products. As suggested in the applicant level summaries of implemented R&T, these innovations tend to be long term except for some specific existing manufacturing techniques or minor incremental product design improvements.

Case study applicants were generally highly confident about the technologies that they were pursuing being used in a changed product or a design or manufacturing process. However, as discussed above, case studies include a large number of projects that are part of broader interrelated R&D programmes, many of which are targeting a related or common objective. In cases such as this it is very difficult to associate a specific individual project with a particular commercial outcome.

In all case studies there was an expectation that the project will lead the design or manufacture of a new set of components or systems. But sales are in most cases are highly dependent on not only developing something that their customers require, but also doing this within the timeframe of their customers' product life cycles. For example, in one case the lead applicant was targeting a material improvement in the performance of an aerospace system, but did not have an indication from their potential customers about when the OEM might introduce a new model.

Some applicants do however, have a higher level of control over the timeframes for the adoption of their technologies. In case such as this, applicants were able to offer more precise details of the commercial opportunities that they are targeting. A good example of the this is a set of four projects led by one applicant, three of which are expected to feed all directly into a new specific product planned to be tested in-flight in 2020/2021 and go into production 2025. The fourth project was also hoped to feed into this product however there was less certainty surrounding this development as it concerns a wholly new capability for UK business.

Follow on investment

The next steps for projects following completion of the ATI grant varied. In a small number of instances projects have resulted in technologies that are already being either implemented or used in manufacturing processes. In one example, learnings on the project had already been used to introduce a new manufacturing tool in different industrial settings. In another example, a new design had been developed after an internal follow up project introduced within a larger upgrade to an existing technology. A large number of projects have already secured a mix of private and public sector funding to take their projects forwards, as noted in Section 7.4. Applicants for these projects had not wanted to speculate about the need of further funding beyond what they had secured. The third group of projects was characterised by a high level of uncertainty regarding the availability of follow on investment, with applicants either applying for further funding already or waiting for an outcome of an application.

A general opinion held among ATI participants was that once projects reached TRL6, they could be expected to secure private sector investment either internally or from their customers. This was seen as a major stage-gate when bidding for OEMs collaborative R&T projects tends to be secured.

Collaboration

Overall, applicants believed that the delivery of ATI projects would continue to strengthen their relationships with other project partners - the collaboration was said to allow suppliers to understand the needs of their customers better and were therefore expected an increase in sales in the long run. These types of benefit were reported also by applicants leading single partner projects as sub-contractors tended to provide substantial pieces of work such as contract research. We have spoken to a small number of subcontractors delivering services on the projects who indicated current and expected benefits including better position for delivery of contract research to the lead partners beyond the existing projects. These expectations for future collaboration were even more explicit in case studies with larger consortia. In one example of a vertical supply chain integration, the consortium consisted of a large Tier 1 company, a supplier of additive manufacturing technology, a software supplier and an academic partner and the lead company indicated that realised and expected collaboration benefits exemplified in the quote below.

> ”the delivery of the project has supported a very strong partnership with the software partner in particular”… “This relationship has already gone beyond the scope of the project”… [the collaboration on the project] “has influenced our other work, and we expect to work together on a number of other projects”… “The delivery has also led to closer links with [the academic partner] where we now sponsor a number of PhDs and engineering graduates”. Applicant interview

R&T jobs

From the three project close out forms analysed, two showed a forecast of jobs growth as a result of their ATI projects. One of these indicated a specific increase in design jobs from 2021/2022 of on average 88 while the close out forms for the other project showed more than 3,000 design jobs safeguarded from 2023/24 onwards in

addition to over 2,000 manufacturing jobs safeguarded from 2028/29 on. For this latter project the total number of jobs safeguarded peaks at five and a half thousand in 2028/29.[61]

ATI projects included in the case studies in which the applicants could make the estimate with some confidence indicated on average an expectation to result in 23 R&T jobs created, however the clarity in timeframes over which this would be achieved was low.

Training

Applicants involved in the projects reviewed within the case studies were unable to provide details about the scale of expected training outcomes from their projects in the future. In two cases there were however highly specific expectations. In one a training manual was being developed relating to specific software developed within projects. In another the academic partners indicated how new research methods and data emerging from the project could influence the curricula of engineering courses.

Scope for knowledge spill overs

Case studies provided limited evidence on the scope for knowledge spill overs to arise beyond the consortiums being funded to undertake the research. In many cases applicants suggested that the knowledge arising from their projects would likely either be retained within their consortium, or might be of limited relevance externally. In only a limited number of cases applicants did identify the potential for spill overs to arise in the future (for example through data sharing systems, or the application of technology from one aerospace sub-sector to another). The case studies did not however, involve consultations with potential end beneficiaries of new knowledge generated on R&T projects, so this lack of evidence is perhaps unsurprising. It may also be too early to make predictions about the likely scope or nature of knowledge spill overs before projects have completed.

7.3.3 Key risks and uncertainties

Most project participants and Monitoring Officers identified a set of technical and commercial risks that might frustrate the realisation of these outcomes. Only one lead applicant indicated that there were no real risks involved in the project but, conceded that they were still encountering technical challenges.

Technical risks reported included the component passing a specific test at which performance of the component would be measured, the reliability of a sensor in real environment and the ability of manufacturing tools to produce components at scale to a desired specification. The primary commercial risk reported by project partners related to the uncertainty of being able to convince the customer about benefits of the new manufacturing process in relation to quality improvements in order to secure

[61] The study team have not validated these figures with the applicant and it is possible that the figures presented aggregate jobs created or safeguarded over multiple ATI projects and/or other funded programmes.

orders. In some cases, a more fundamental risk relating to the existence of a market for the new product was reported.

The majority view was that once these risks were overcome, the technologies would influence product design and relevant manufacturing processes. While these risks were to some extent in the control of the applicants, the commercial uncertainties such as product life cycles of their customers were outside their influence. The aerospace sector is also characterised by large 'lumpy' contracts throughout the supply chain which result in big wins or losses, which were seen by applicants as both increasing commercialisation risks and making them more difficult to commercialise. Nevertheless, there was a high overall level of confidence that these outcomes would materialise over the longer term, but with higher uncertainty with regard to specific timeframes.

7.4 Summary

In summary, the following key findings have emerged from our mapping of R&T activities through case studies:

- The importance of the interactions between ATI projects and applicants' broader programmes of R&T and other projects was immediately apparent. The implications of these relationships have been discussed in depth throughout this report.

- There appears to be no single typical origin for an ATI project with the case study projects originating from academia as well as commercial needs, from prior publicly funded projects, from purchases of IP from abroad, as well as in response to the ATI strategy.

- Overall the ATI projects reviewed within the case studies had objectives that related to and were generally well aligned with the technologies specified in the ATI strategy. However, a large volume of activity appears to be focusing on technologies that are at an earlier stage of technological development than the core focus of the programme on TRL4-6.

- In the round, projects appear to be making generally good progress towards the commercialisation of the technologies involved, though there are some noteworthy exceptions where progress has been less rapid than anticipated.

- The case studies did not reveal any substantial changes in the overall aims of the projects. In cases where change had occurred this was generally within what were initially very broad objectives.

In the majority of cases projects expect to make significant further technological progress (in the region of an additional two TRL stages). However, the realisation of commercial outcomes from projects is, in a number of cases, highly dependent on the extent to the technology concerned can be de-risked ahead of a key customer purchase decision point.

8.0 Strength of Rationale

This section provides an assessment of the strength of the rationale for public funding of ATI projects. This section draws largely on the case study evidence, which investigated how far the key market failures and other barriers underpinning the strategic and economic case for ATI funding were constraining the delivery of the projects examined (i.e. distance from market, scale of R&T investment required, international mobility, co-ordination challenges and knowledge spill-overs).

8.1 Distance from Market

The most frequently reported rationale for public funding reported by applicants was that ATI grants enabled applicants to pursue projects that were either a long way from market or characterised by high levels of risk and uncertainty. This aligns with the idea that part of the rationale underpinning the ATI funding is that some firms find it difficult to invest in cycles that span the time horizons associated with market opportunities in aerospace:

- **Long time-horizons** – In some cases, applicants suggested that they were able to progress towards commercialisation at a rate of one TRL per year (implying a nine to ten year product development cycle). However, it was clear that in several instances the projects studied were part of much longer development cycles. In one case, returns were not expected to accrue for 15-20 years and will depend on substantial further R&T investment.

- **Remaining technological risks** – as discussed in Section 7 above, a number of projects are operating in areas characterised by early TRL levels and high levels of technical uncertainty. From the case studies, a small number of R&T strands have yielded negative results and been aborted (though no overall programme of research had been) and in many of cases it remains too early to tell if the research direction will be successful. Several smaller applicants reported that in aerospace manufacturing it is difficult for them to obtain internal funding for projects that are not either at TRL6 (or include a majority of components that have not achieved this step). It is reasonable to expect this issue to exacerbate the time horizon issue discussed above.

- **Uncertain returns** – Applicants identified a further range of systemic sources of uncertainty that reportedly exacerbated these issues. One applicant in particular stressed an uncertainty relating to the scale of the specific market that they were targeting. A more common issue reported was the challenge of predicting the likely ROI from R&T investments, particularly because of the 'lumpy' nature of sales opportunities, which are tied to the development of new platforms by aerospace primes. In addition, a set of project delivery risks (such as the risk of crashing and breaking expensive components and systems) and regulatory risks relating to uncertainty about the future evolution of specific regulatory frameworks were also reported by applicants. It is important to note that these issues are not necessarily evidence of a market

failure (and raises questions as to which it is realistic to expect the public sector to be able to assess the likely return on its intervention against these points through an additionality case).

Despite the frequency with which the distance from market was identified as a rationale for requiring ATI funding, limited supporting evidence was offered by applicants to explain why the scale of the opportunities associated with their proposed projects was not sufficient to compensate for the inherent risks involved. In the majority of cases, the distance from market was presented as a secondary limiting factor to explain why public investment was required for the project to proceed. These other factors are discussed through the rest of this section.

8.2 Scale of R&T investment required

8.2.1 Overview

A key element of the rationale for ATI funding reflects the challenge of supplying enough investment to enable the co-ordination and implementation of improved technology standards where each component is often derived from a larger number of sub-components, developed independently in some instances. For some of the largest aerospace manufacturers, this consideration was strongly reflected in discussions of their portfolio of ATI grants. These organisations described the need for large scale funding to support their programmes of R&T activity that reach beyond what they could fund internally from the margins on their ongoing manufacturing activity, or leverage externally based on these margins. In this respect, the case study evidence suggested that the ATI funding is in some cases being treated as a supplement to the resources available across the applicant's portfolio of R&T projects.

The importance of this effect was apparent when probing the rationale for public funding of individual case study projects that are led by some of the larger ATI grant recipients. In some instances, it appears highly likely that the project would have proceeded in the absence of public support. Some projects appear to be so critical to the core business model of the lead applicant that it is highly unlikely that they would not have been able to access internal funding to take these forward (e.g. projects linked to ensuring existing technologies meet future environmental standards). In other cases, it appears that the applicant had already committed to pursue a particular research avenue (such as through the purchase of a specific intellectual property right) prior to the application for grant support being made. Judged in isolation, it would be difficult to conclude that the funding had unlocked this R&T activity – a perspective that some applicants confirmed directly to the study team. However, discussing with applicants it was felt that, rather than unlocking a single 'marginal project' that would otherwise not proceed without support, ATI funding was increasing the overall scale of their UK R&T activities.

This consideration has important implications for ATI processes as the implication is that public funding is unlocking a set of alternative projects to those receiving scrutiny through selection, contracting and monitoring processes. This would support the case for monitoring of outcomes at the level of the applicant, and for focusing VfM assessment at the programme level (as discussed in Section 4, this

programme-level approach has been piloted by BEIS in a number of instances). There is scope, however, based on this logic, for grant funding to unlock projects that are not necessarily part of the programme being funded, making realistic ex-ante and ex-post assessments more challenging to achieve in practice.

Recommendation
#29 There is a need for project selection processes to probe the role of proposed projects in the strategic context of applicants' other R&T activities. This is required to understand instances where projects would have been likely to proceed without ATI funding, but where this has helped to unlock other R&T projects. This could most effectively be handled at project review to more fully understand what activities are being unlocked by ATI funding, and should be complemented with additional applicant level monitoring.

For a second set of case studies, a lower level funding constraint has created a case for support. ATI funding has helped to sustain the scale of their R&T activities in the face of limited internal resources (and highly leveraged balance sheets). Two case study organisations in particular reported that financial issues were limiting the extent to which any non-fee-earning activities, such as R&T, were progressing at all, but that ATI grant funding had helped them to sustain a small core of R&T work.

8.2.2 Rate of progress

Applicants reported a view that receiving ATI funding had helped them to progress their projects more rapidly than would otherwise have been the case. In several cases, it was thought that the ATI funding had allowed applicants to pursue multiple technical objectives in parallel – such as pursuing multiple work packages, and alternative technical approaches to a specific problem at the same time.

Where this accelerated technological development has the potential to support the realisation of commercial outcomes, it can help to de-risk the broader programme of investment. In addition, applicants explained how accelerating delivery has the potential to drive a step change in return on investment where it helps to de-risk a technology sufficiently that it is selected by prime manufactures ahead of that from competitors.

8.2.3 Scope

For applicants reporting that grant funding was required to overcome challenges of limited funding availability, a common suggestion was that, as well as delivering over a longer timeframe, they would have reduced the overall ambition of their projects in the absence of grant funding, or in one case that they would have focused their R&T investment in a completely different area. For projects that involve a portfolio of different R&T initiatives, applicants could identify how this list could have been scaled back. Other applicants suggested that they might have pursued more modest technological goals (such as a smaller weight reduction from a particular system) or

not pursued a specific capability for a technology under development. It is important to note that in some cases where applicants suggested that they would have scaled back the project in the absence of support, it was less immediately apparent how this could have been achieved without compromising the core project objectives.

8.3 Threat of undertaking R&T activity abroad

A key justification for public support for the ATI reflected concerns that without grant funding an increasing share of key aerospace R&T work will be completed overseas, eroding the UK's competitive advantage in the design, manufacture, maintenance and repair of aircraft and engines. This concern was used to justify the need for public funding in several of the case study projects led by multi-national firms, particularly where the projects involved the development of an entirely new platform or capability. In some instances, this support was seen as an inevitable part of the funding landscape and a regular requirement of the operation of aerospace businesses. In some cases, there was significant internal competitions to develop new capabilities, with public funding reported to be required to prevent the capability being developed overseas (for example, where an overseas site was reported to be further ahead). One applicant gave several examples of rejected project applications made to the ATI that were ultimately taken forward with subsidies from another EU Government. However, such arguments were rarely made where the project involved incremental improvements to an existing product.

8.4 Co-ordination challenges

Part of the rationale articulated by policy stakeholders related to the challenges of bringing together different project partners to pursue a common objective. In a small number of cases, ATI grant funding was reported to have been instrumental here, in pulling together a consortium to pursue a project. In one case, the availability of the grant had helped to pull together a diverse group of engineers and systems specialists from different sectors who had not worked together on R&D before. Each partner has a very distinct interest in the project, and once the project completes, does not necessarily anticipate working together to support the commercialisation of the IP generated. The potential draw of grant funding was reported to have brought this consortium together. In another case, the neutral ground created by the set of Collaboration Agreements required to be completed by participants was seen as helping the applicants to overcome a complex IPR sharing issue – something they felt they would not have been able to solve without a 'safe framework to collaborate', directly created by working with the ATI and Innovate UK. This was indicated to be especially useful when large companies and SMEs were seeking to collaborate. In cases, such as these, applicants suggested that the project had been 'on their radar' for some time, but they would not have been able to bring the group together required to deliver it without the opportunity of the grant.

In addition to these specific collaborative projects that appear to have been unlocked by the nature of grant funding, other case study projects may have been strengthened by the availability of grant funding. A key theme across several case studies was that receiving ATI grant funding had allowed applicants to justify working with a broader range of project partners than they would otherwise have. Several case studies reported that they would not have been able to justify funding other

organisations to work with them on these specific R&T projects, but that accessing ATI grants had provided enough incentive for commercial partners to provide match funding to form collaborations. The ability to fully fund academic partners was also seen as greatly helping to unlock collaboration. Through encouraging increased collaboration, several applicants reported that ATI funding had helped to:

- Strengthen the quality of their R&T activity – supporting a more robust approach to either testing or modelling.
- Provide access to specific technologies and knowhow that were either unique or world leading.
- Offer an external, and sometimes broader perspective on their work – in one case, an academic partner was playing a role close to that of consultancy service, offering advice on how the lead applicant's performance could be improved.

8.5 Knowledge spill overs

Looking across public programmes support for R&D, a common rationale for intervention is a perceived need to compensate for the fact that an individual firm may not be able to capture the full benefits of any new knowledge generated. The claim is that businesses cannot perfectly protect and exploit this new knowledge as it will 'spill over' to other organisations, and therefore they will underinvest in R&D compared to what would be socially optimal. In reviewing a number of value for money assessments of ATI projects provided, the need to compensate for this issue appears to have been central to the case for business support. Analysis of the 16 VfM Lite summaries provided to the study team from the September 2016 SR2 indicates that knowledge spill overs were expected to represent 30 percent of the total quantified benefits emerging from these projects. It is therefore a surprising finding that, as discussed in Section 7, knowledge spill overs do not appear to be a key feature of the emerging or expected outcomes from the projects explored as case studies.

It is important to note however a key limitation to the methodology here. The research has only consulted individuals who are directly involved with projects. These individuals might not be well placed to anticipate what the wider benefits and potential learning points from their projects might be for individuals outside of their organisation. It may also be too early to consider this outcome. As with many areas of R&D, it is fundamentally difficult to predict the application of knowledge and intellectual property before it has been created – a factor that underpins the market failure associated with R&D investment.

8.6 Summary

Overall, there appears to be a close alignment between the objectives of ATI identified by policy stakeholders and the case for support for individual case study projects:

- The overall distance from market of the projects, and the total scale of funding required appear to have been the most important factors for understanding how ATI grant funding may have helped to unlock aerospace R&T activity in the UK. The threat that activity would have gone forwards, but outside the UK, and co-ordination challenges are also apparent on individual ATI projects.

- Particularly amongst larger applicants, there appear to be instances where ATI funding has been used to supplement their R&T budgets, rather than to deliver specific projects. Where the central case for ATI funding relates to the need to unlock a larger volume of funding than the applicant would otherwise have had access to, there is potential that at the margin this has unlocked a different set of activities to those that were assessed and are being monitored.

- The importance of knowledge spill overs appears to play a less prominent role in justifying public support for the case study projects than VfM assessments would suggest. However, it is important to note that this might reflect the mix of individuals consulted, or the fact that in many cases the knowledge has not yet been generated.

9.0 Conclusions

This section sets out conclusions from the process evaluation of the Aerospace Technology Institute and makes (summary) recommendations[62] for potential enhancements to delivery processes for discussion with the Evaluation Steering Group.

9.1 Performance of the ATI Programme

After a slow start, the ATI programme has apparently faced little in the way of challenges in committing the available resources to support R&T projects (and indeed, the primary challenge moving forwards is likely to be prioritising future applications for funding rather than generating sufficient demand). The dominant mechanism through which these funds have been allocated since September 2015 (the Strategic Review Committee process) has resulted in resource commitments becoming more focused on supporting the R&T activities of large aerospace R&D producers.

Projects that have been funded through the SRC process typically have well defined objectives that align closely with the objectives of the ATI programme. Some issues have been encountered in delivery, with around a third of the portfolio deemed to be facing significant risks with respect to timescales or costs (with the ability of applicants to commit internal resources to projects a key factor in delays). While there have not been major changes in expectations regarding the commercial potential of the projects that have received funding, though projects are generally at their early stages with key tests to de-risk technologies yet to take place. It was only possible to identify nascent exploitation outcomes in the case studies.

9.2 Strategy development and industry engagement

The ATI appears to have been effective in engaging the most economically and technologically significant organisations in the aerospace sector (across industry and academia) in the process of setting a Technology Strategy to guide its activities. High engagement with traditional aerospace supply chains may also help explain the ease with which R&T funding has apparently been allocated.

While feedback from those engaged by the ATI was largely positive, operational improvements have been identified that could potentially be found as the organisation matures. Some applicants suggested a lack of transparency in the process by which the long list of technological priorities is reduced to the shortlist presented in the strategy left them unclear how the final set of priorities were determined. Additionally, stakeholders felt the ATI could do more to process the insights generated by the strategy development and feed it back to the sector in the

[62] Recommendations in the conclusions section retain numbering from sections 2-8 of the full technical report and in some cases do not follow natural order

form of thought leadership (e.g. technology road maps). The Technology Strategy is also designed to support the resource allocation process. While it has been used to reject some applications, the strategy is viewed as broad and it may be difficult to use to prioritise proposals as headroom in the budget narrows.

The evidence also suggests that the ATI has been less focused to date in engaging SMEs inside or outside of traditional aerospace players in this process. There is little SME participation in the Advisory Groups that lead the definition of technical priorities (though this may reflect challenges faced by SMEs in engaging in this type of forum), and few applications have been received by SME led consortia. This may not be problematic in the context of the wider objective to safeguard the future competitiveness of the aerospace industry, in that most of the future commercial opportunities for SMEs will be linked to the development programmes of key Primes and Tier One suppliers. However, it is also possible that disruptive and high potential projects are being overlooked by the dominant funding mechanisms, and it may be beneficial to consider whether there is any case for making more funds available through CR&D competitions to support this type of project.

The ATI also aims to support the development of new and stronger collaborations between UK based organisations, including SMEs. Their records report that the ATI has acted to have reshaped collaborations in eight percent of applications reviewed by the SRC. This was not confirmed through applicant interviews, and case studies of projects tended suggest that patterns of collaboration tended to be partnerships of organisations with a long history of working together.

Recommendations

#1 The ATI should consider how far it can communicate why technical priorities were chosen in the strategy ahead of others while avoiding breaking commercial confidentiality. Greater transparency could address any perception that the resource allocation process has been captured by segments of the industry and meet the sector's apparent appetite for more thought leadership.

#2 The ATI should seek further opportunities to communicate the availability of funding to SMEs. The Regional Aerospace Alliances, other membership bodies, and Innovate UK (through its role delivering ATI CRD competitions, NATEP, and HITEA) could be potential conduits. The patent record or details of earlier Innovate UK grants for aerospace R&D may aid identification of further unengaged organisations.

#3 The ATI and BEIS should consider the risk that the SRC process may result in disruptive technologies with large potential returns being overlooked. The high demand for the two CR&D funding competitions from firms illustrates there may be potential in this respect. It may be possible to increase allocations through this instrument without compromising technical quality or relevance of projects funded if the principles of the Technology Strategy are embedded in the definition of the competition scope.

#6 The ATI should look for opportunities to include more specific and focused areas of interest within the next iteration of the Technology Strategy to aid the prioritisation

Recommendations

of project proposals in the context of more acute budget constraints. However, it will be important to make clear this is not an exhaustive list of areas of UK capability, but areas where there is a desire to see a stronger set of proposals and that ATI funding remains open to good ideas not foreseen when drawing up priorities.

#7 ATI and BEIS should look to further clarify the relative importance of priorities identified in future iterations of the Technology Strategy. However, adopting targets for investment in specific technologies could result in a reduction in value for money from the programme if it diverts investment away from the strongest projects.

9.3 Application process

The process of applying for funds through the SRC process was considered appropriate, involving efforts that were deemed by applicants to be proportionate in relation to the level of funds involved. In general, policy stakeholders regarded the application process as generating sufficiently detailed information to support the allocation of funds. Verbal guidance provided both by the ATI and BEIS in support of the application process and later VfM assessment was thought by applicants to be of high quality. However, the evidence gathered through the evaluation suggests that there may be some opportunities to refine the application process to improve its simplicity and effectiveness.

The application process also involves a pre-engagement process with the ATI in which it seeks to influence the shape of project proposals to improve their alignment with the Technology Strategy and maximise benefits to the UK economy. Though management information suggests that the ATI has influenced the development of around 15 percent of project proposals in some form, evidence gathered from applicants is less conclusive in this respect. The strength of ATI influence in shaping project proposals was explored in more depth as part of the case studies, but only a modest effect was reported by a sub-group of applicants who had been through the SRC process to date.

Recommendations

#4 The ATI should consider developing an application form for the SR1 process, and accompanying guidance that specifies in greater depth what is expected from applicants and defines what information is and is not necessary for an SR1 decision. Innovate UK should be engaged to ensure compatibility of data across systems. The form would optimally be based on a subset of questions from the Innovate UK application form produced at SR2 to minimise duplication of effort.

#12 BEIS, ATI and Innovate UK should consider whether it may possible to adapt application forms to better gather the evidence needed to underpin the VfM assessment at the application stage (which may reduce the level of engagement

Recommendations

required from applicants in the process).

#13 Existing guidance relating to the application process should be consolidated to give applicants a comprehensive guide to engaging with the R&T support process (from the application process through to monitoring).

9.4 Appraisal, assessment and project selection

The SRC process involves up to four assessments of the strategic, economic, technological, and managerial merits of project proposals (as part of a two stage application process). These comprise:

- **SRC:** The Strategic Review Committee (made up representatives of the ATI and BEIS) provides an assessment of the strategic and economic case for public funding and makes recommendations on which projects should proceed to Independent Assessment[63]. Observers of the meetings suggested that discussions at the SRC were well informed and gave detailed scrutiny to important aspects of project proposals (likely supported by the information that ATI has been able to gather regarding the wider R&T agenda of key industrial applicants). However, it should be noted that approval rates at the SRC have been higher than 60 percent[64], raising questions as to how far greater prioritisation of proposals at this stage could have improved the value for money associated with the project portfolio. All projects are now required to undergo a VFM assessment ahead of the SRC, and not all proposals pass the minimum thresholds required for HMT approval[65]. Additionally, there was also a view put forward by some that the quality of the project management plans prepared by applicants is weaker than those typically developed by applicants to Innovate UK CR&D competitions[66]. This was not a core focus of discussions at the SRC, though given the elevated level of delivery risk observed in the project portfolio, greater scrutiny to this element in discriminating between proposals may be helpful.

- **VFM:** All proposals now receive a form of VfM assessment which relates the gross public expenditure on the project to the external benefits associated

[63] Note that Innovate UK and HMT join SRC meetings as observers
[64] Of the 88 unique applications to the SRC process, 55 were recommended to proceed to the next stage at their most recent assessment. Though it is important to note that the success rate was generally lower at more recent SRC meetings.
[65] Note that in the first batch of pre-SRC VfM assessments the only applications to fail at this point were capital projects.
[66] While benchmarks for Independent Assessment scores are not available across the Innovate UK portfolio, scores for the risks involved in the project and its risk management strategy were lower on ATI projects than other questions.

with the project. The framework is largely fit for purpose and its application is enhanced by using empirical evidence gathered by BEIS on the depth of the UK supply chains to help gauge the strength of R&D spill-overs. However, many projects funded through the ATI involve follow-on applications for funding, and there are questions about how far enough information on this is feeding into the VfM assessment.

- **Independent assessment:** An Independent Assessment of applications administered by Innovate UK takes place following decisions made at SR2. The process is highly regarded by applicants as a thorough technical review of project proposals, and by policy stakeholders as contributing an important independent step to the resource allocation process. Scores given in the Independent Assessment were not predictive of the likelihood that a project may encounter delivery issues, though assessors often had identified the relevant issues in their narrative comments.

Recommendations

#5 BEIS and ATI should consider how far there is an on-going need for the ATI to qualitatively score SR2 applications on aspects relating to value for money now that VfM assessments take place in advance of SR2. There may be scope for ATI experts to feed in views into the VfM analysis, particularly around issues of additionality and technological risk.

#8 If a 'Hold' was to be used in the future (there are no plans to do so), ATI should specify the conditions under which these applications would be recommended to proceed to VfM Assessment and Independent Assessment

#9 BEIS should ensure that the VfM assessment factors in all possible future calls on public funding (either to support R&T or to support follow-on exploitation of IP) to the extent that this is practicable.

#10 BEIS should undertake separate assessments of deadweight regarding the future economic benefits of the project (which will be linked to the likelihood the project proceeds in the UK) and the environmental benefits (which will be linked to the likelihood the project proceeds at all and whether technologies with comparable properties may be developed by competing producers within the UK or overseas).

#15 BEIS and the ATI should learn from the introduction of the process to complete initial VFM assessments ahead of the SR2 meeting, to ensure results are explicitly considered and used to make decisions and recommendations alongside technical and strategic considerations.

9.5 Protections for the public sector

The value for money associated with ATI will be maximised to the degree that the IP developed through the programme is ultimately exploited within the UK. This forms a core focus of the VfM analysis which often involves a judgement as to the likelihood that R&T and production capacities would be lost overseas. Due diligence processes are also thought to be effective in maximising the share of the R&T spending associated with projects delivered within the UK, and safeguards have been in place to prevent applicants circumventing these checks by requesting contract variations at an early stage of the project delivery process. As such, processes are thought to be broadly effective in retaining short term R&T spending within the UK.

However, the anticipated exploitation benefits associated with project proposals will typically arise after projects have come to an end and the contractual framework within which projects are delivered offers the public sector little protection against the risk that the intellectual property developed through the programme is eventually exploited overseas. There may be opportunities to strengthen protections either formally or less directly through the establishment of feedback loops between the monitoring of projects and the appraisal process. However, the absence of post-completion monitoring of the outcomes associated with projects funded also means that delivery processes do not generate the information needed to police the post-completion behaviour of applicants, enforce supplementary conditions, or impose penalties. Filling this gap in information should be seen as a priority and may be most straightforward to manage at a portfolio or applicant level.

More difficult to assess is how effectively the due diligence process is scrutinising the detail of project costs (helping to minimise public exposure to the risk that applicants seek to use R&T funding to subsidise unrelated activity). Policy stakeholders suggested that many applicants prepare initial project plans and costs that incorporate large budget unexplained rows, and part of the focus of Innovate UK financial due diligence is on scrutinising these costs and establishing how far they might be considered reasonable. However, consultations with Monitoring Officers as part of the case studies have suggested that unexplained budget rows can persist (with applicants refusing further discussion or to engage in scrutiny on the basis that the costs involved have been ‘agreed’ with Innovate UK). The study team did not receive records from due diligence as part of the evaluation so cannot comment on the extent to which these items were probed and confirmed as part of that process. Monitoring Officers also reported that the rigour with which Innovate UK are implementing post award processes has moved recently in a positive direction.

Recommendation

#18 BEIS, ATI and Innovate UK should consider the feasibility of making further use of provisions in contracts to insulate the public sector from the risk that IP developed through the ATI is exploited overseas (e.g. penalising grant beneficiaries that do so).

#19 These efforts can only be policed if it is possible to monitor the post-completion outcomes associated with ATI funded projects. This could draw on the provision in contracts to undertake further monitoring for a period of five years after project completion.

Recommendation

#20 Should recommendation #18 prove incompatible with EU State Aid regulations and/or WTO rules and it not be possible to achieve grant claw-back, consideration could be given to alternative means of achieving the same objective. One possibility would be to penalise applicants in future application rounds where their post-completion commitment to R&T and production has proven weak, through adjustments to leakage parameters in the VfM appraisal.

#22 BEIS and Innovate UK should continue the annual monitoring process to enable the outcomes of the projects funded to be metricated (and relative to the size of the grant awards, it is considered a low-burden process[67]). It is also suggested that this process is integrated more clearly with existing quarterly monitoring arrangements, and is continued beyond the lifetime of the grant to enable tracking of exploitation outcomes.

9.6 Interdependencies between projects

Many of the projects supported by the ATI programme form part of wider programmes of R&T. While the ATI's engagement has enabled the SRC to develop a strategic understanding of applicants' wider R&T agendas and where support may bring or retain capabilities in the UK, the treatment of projects as discrete work programmes in formal appraisal processes and in monitoring are creating some challenges outside the SRC process. It has been necessary in the past to undertake separate VfM assessments of parallel projects that may ultimately produce the same benefits or projects that are in practice part of a single portfolio and intended to contribute towards a common objective. The risk is that independent assessments and monitoring activities are being completed without an understanding of the breadth of external technical risks that may affect the outcomes of a project. BEIS has recently undertaken a VfM analysis at a programme level combing several current and expected applications, and such a portfolio approach could bring broader benefits to the delivery process.

Recommendations

#11 BEIS and ATI should consider whether it may be feasible to strengthen processes through which interdependent projects are identified at the ex-ante appraisal stage, and establish how far it may be possible to appraise these projects as a group rather than as discrete project proposals. This should include explicit acknowledgement of the dependencies between capital and R&T project proposals. Information on interdependencies should be circulated amongst the full range of

[67] For example, the Regional Growth Fund required an annual report validating the spending and the jobs created or safeguarded, produced by an independent accountant.

Recommendations

individuals involved in the assessment of applications.

#16 Guidance to applicants should be updated to stress the importance of applicants fully explaining in their application the relationships between their projects and other R&T activities, and to discuss the risks created by these. This is an aspect that the SRC could be expected to review in depth and to feed any comments here to independent assessors.

#17 There is a case for contracting arrangements to include provisions for BEIS or Innovate UK to change or terminate R&T projects based on the performance or viability of a discrete set of interrelated projects. Intelligence on anticipated project interdependencies could be identified from within application forms, from discussions at SR2, and from VfM assessments (or indeed, directly from the ATI).

#23 There may be benefits in managing the longer term monitoring process at a portfolio level (given the likelihood that the individuals involved may leave the relevant organisations).

9.7 Closure of feedback loops

The effectiveness of several processes could potentially be enhanced if it were possible to establish a number of feedback loops that have been identified as potentially absent in the evaluation:

- **Technical judgements in the VFM appraisal:** The assessment of technical risks in the VFM appraisal could be enhanced if there is any way for the latter to build on the judgements of the Independent Assessors in addition to those of the ATI technologists. This would require a remodelling of the sequence of the appraisal process.

- **Handover of information to Monitoring Officers:** At present, monitoring officers only receive information regarding the issues and risks identified through the SRC, VfM, Independent Assessment, or Due Diligence processes when this is specifically requested. Further formalising this feedback loop and better informing MOs has the potential to improve the effectiveness of the monitoring process.

- **Reappraisal of change requests:** At present, there are limited processes in place for the reappraisal of project proposals should there be significant change requests that materially alter the scope of the project (and which could potentially change the costs and benefits associated with its delivery). Project change request processes are in place for BEIS to refer significant changes to the ATI. Given the scope for moral hazard issues arising following the signature of the Grant Confirmation Letter, it is advised that the VfM

assessments are revisited in the event of any major rescoping proposed by applicants. There may be a need to clarify what is considered a significant change.

- **Feedback of monitoring into appraisal:** As suggested above, information capturing the feedback given to projects from Independent Assessment, the progress and results of funded projects could potentially be fed back into the VFM assessment process to improve estimates of key parameters influencing the analysis. This evidence could also be used to support and inform SRC decisions.

Recommendations

#14 BEIS, ATI and Innovate UK should consider options for changing the phasing of the VfM process to better support scrutiny of the technical claims made by applicants (including the judgements made by the Independent Assessors). Closure of feedback loops from monitoring into the appraisal process could be beneficial in enabling case officers to reach an informed judgement of the future risks to the anticipated benefits associated with applications.

#21 BEIS and Innovate UK should consider putting in place processes to reappraise change requests where the underlying economic or strategic case for the funding the project may be significantly changed (i.e. where there is a substantial change to the basis for public sector support). The establishment of this feedback loop would work to limit the risk that the applicants seek to divert R&T funding to activities that do not produce the anticipated economic benefits.

9.8 Efficiency

The process evaluation has also considered the overall efficiency of the resource allocation process and how far there may be opportunities to increase the speed with which resources are committed (or reduce the overall level of resources consumed). The SRC process involves a four-stage process for some applications, and several issues have been highlighted in this evaluation that could form the focus of the focus of efficiency improvements:

- **Duplication:** There is duplication in the scope of the variety of assessments that are completed at various stages of the process. For example, the ATI (in the preparation of initial scores to feed into discussions at SR2), the VfM Assessment, and the Independent Assessment all provide an assessment of the potential economic value of the applications using different frameworks. Equally, both the ATI and the Independent Assessment provide an assessment of the technical merits of project applications. Applicants have also raised questions regarding the added value of the Independent Assessment as prior to it has overturned few decisions made by the SRC. However, given the apparent perceptions that the ATI is at risk of ‘capture’

and the role of the ATI in prospecting bids, the preservation of independence in the process will likely be valuable.

- **Timescale issues:** It currently takes an average of 9 months between the submission of the SR1 application and the signature of the Grant Confirmation Letter. The biggest contributor to the time elapsed is the period between the decision of the SR2 committee and the issuance of the Conditional Offer Letter (during which the Independent Assessment, the Funder's Panel, Ministerial Approval, and if needed VfM assessment and HM Treasury approval take place). The process absorbs 3 months on average. However, the time passing between SR1 and SR2 decisions and the receipt of the Conditional Offer Letter and the submission of the Collaboration Agreement both absorb 2 months (with around 40 percent of applicants taking more than the maximum of three months allowed for this process in the terms of conditions of the Conditional Offer Letter).

- Smaller issues identified in the evaluation include processes involved for the approval of change requests (Monitoring Officers only have flexibility to sign off contract variations with a maximum value of £25k[68] – a trivial share of the overall value of a typical ATI project, which is thought to produce unnecessarily large requirements for approvals by Innovation Leads in Innovate UK). Scope was also identified to simplify the SR1 process by introducing a standard application form (as acknowledged above).

There is scope for the simplification of the assessment process for full applications by dividing up the review tasks in a way that focuses each assessment on the circle of competence of those involved. This would concentrate the judgement of the ATI on the strength of the strategic case for funding (e.g. the scale of the market opportunity), the VfM assessment on assessing the strength of the economic case, and the Independent Assessment on an assessing of the engineering merits of individual project proposals and aspects of project management. These reviews could run in parallel, and feed into a full Strategic Review meeting which would now be informed by each strand of assessment. The implementation of these simplifications would require the Independent Assessment and VfM Assessment to be brought forward ahead of SR2 meetings (with the SRC only considering those proposals passing both of these tests). This would simplify the process from the perspective of the applicant by reducing the apparent number of assessment stages and accelerate the process between the SR2 decision and the issuance of the Conditional Offer Letter.

This would come with costs, however, in that the volume of proposals considered by the Independent Assessment process and full VfM would need to increase by around 33 percent (which could be partly offset by rationalising the number of issues considered by assessors).

[68] Note that Innovate UK are using a different tool with two large ATI applicants to model future variance and to handle Project Change Requests in a different manner.

Recommendations

#24 Duplication and delays in the assessment of applications could be minimised if proposals were subject to both the VfM assessment and the Independent Assessment ahead of the SR2 meeting. The role of the committee would be to check that the project has not materially shifted away from its scope at SR1, and to prioritise competing calls on the funding available. Preserving the independence of the process would require that only proposals passing the Independent Assessment are considered by the SR2 panel (so the judgements could not be overturned). If required, ministerial sign-off could follow SR2 – or could feed into HMT and BEIS representation at the meeting following a twin track approach. Consideration of how the Funder's Panel might feed into to this process would also be needed.

#25 An increase in the frequency of SR2 meetings (subject to demand) could be introduced on a trial basis to explore the extent to which this can accelerate the Strategic Assessment process. A key question for this trial would be to assess whether having fewer projects to review in a batch limited the extent to which reviewers could assess the relative merits of applications.

#26 Project confirmation would be quicker if applicants were required to agree the terms of their collaboration before submitting proposals. ATI, BEIS and Innovate UK should consider making more use of the three-month obligation to complete these processes set out in the Conditional Offer letter (i.e. 'use it or lose it') in order to accelerate and reduce the uncertainty around this aspect of the process. Stakeholders noted that action to enforcing the three-month limit is already being taken.

9.9 Lessons from project delivery

There appears to be a high level of alignment between the overall aims of the ATI and the objectives of case study projects. The case studies suggested 'Legacy' and 'Early ATI' projects had much broader aims, which were in some cases described by Monitoring Officers and lead partners as 'vague'. From our limited sample of 15 projects it appears evident that CRD projects and projects that had gone through the SRC process were more likely to have specific aims included in the proposal from the outset.

Recommendation

#27 There should be a focus on ensuring that project objectives are precise and clear to improve outcomes. It is positive that more recently approved case study projects appear to have more specific objectives than those approved earlier. This is an aspect that could be potentially covered by requesting Independent Assessors or the ATI flag areas to be addressed by applicants as part of the development of Level 2 Plans with monitoring officers, prior to project kick-off meetings.

While there appears to be no single typical origin for an ATI project within the case studies, the interactions between ATI projects and applicants' broader programmes of R&T is a common theme. This consideration supports the recommendations for handing the interactions between different projects and external factors made throughout this report.

In both the case studies and in annual and close out monitoring returns, a large volume of activity appears to be focusing on technologies that are at an earlier stage of technological development than the core focus of the programme on TRL4-6.

Recommendation

#28 BEIS, the ATI and Innovate UK should consider including further guidance to all individuals involved in the assessment and monitoring of ATI projects to ensure a closer focus on activities at TRL4-6, or consider clarifying the focus of the programme.

Only a small proportion of projects were finished at the time of the review and all required more time than anticipated in the level 2 project plans. The majority were still delivering but experienced either minor or more substantial delays – predominantly as a result of challenges securing the resources needed for delivery or to pin down project objectives. Applicants were typically confident that delays would be recovered, but in one case a major commercial opportunity had been missed as a result of the delays.

The case studies did not reveal any substantial changes in the overall aims of the projects. In cases where change had occurred this was generally within what were initially very broad objectives. On average, project monitoring returns report progress of 0.6 TRL levels per work package by the end of 2015/16 to an average TRL level of 3.4. The commercial applications of projects have been limited to date, as have formal training outcomes. However, applicants reported success in being able to leverage in further (often public) funding into case study project areas, a range of informal training benefits, the formation of some new collaborative partnerships and knowledge sharing across consortia.

In the majority of cases projects expect to make significant further technological progress (in the region of an additional two TRL stages). However, the realisation of commercial outcomes from projects is, in a number of cases, highly dependent on the extent to the technology concerned can be de-risked ahead of a key customer purchase decision point.

There appears to be a generally close alignment between the objectives of the ATI programme identified by policy stakeholders and the case for support for individual projects:

- For case study projects, the most important factors for justifying public support appear to relate to the uncertainties created by the overall distance that

projects are from the market that prevents them from raising finance from private sources, and the large scale of funding required. The threat that projects might have progressed, but outside of the UK without support, and co-ordination challenges were also apparent on individual ATI projects.

- Particularly amongst larger applicants, there appear to be instances where ATI funding has been used to supplement their R&T budgets, rather than to deliver specific projects. Where the case for public funding rests on the idea that the scale of funding required for a project or programme exceeds what the applicant can access from private sources, there is potential that, at the margin, ATI grant funding has unlocked a different set of activities to those that were assessed and are being monitored.

Recommendation

#29 There is a need for project selection processes to probe the role of proposed projects in the strategic context of applicants' other R&T activities. This is required to understand instances where projects would have been likely to proceed without ATI funding, but where this has helped to unlock other R&T projects. This could most effectively be handled at project review to more fully understand what activities are being unlocked by ATI funding, and should be complemented with additional applicant level monitoring.

- When discussing projects with applicants, the scope for knowledge spill overs appears to be less central to the justification for public support, compared to what the VfM assessments would suggest. However, as internal stakeholders, applicants may not be well placed to comment on the scope for knowledge spill overs to occur, and in many instances it may be too early to imagine what these might be.

Annex A: Details of costs to applicants

Table A.1: Summary of costs relating to engagement with and participation in ATI

Process	Summary of cost implications for applicants	Quantitative assessment of time involved
Development of the Technology Strategy	Costs varied from virtually nothing, when an applicant was invited to provide input but decided not to attend the meetings, to 50 man days a year for a large prime involved in nearly all advisory committees and driving some of the agendas. None of the applicants consulted indicated that the burden was inappropriately high, one compared it to previous DTI efforts and ACARE and stated it was less burdensome. One applicant stated it was "Worth the time, considering possibility to feed into the strategy driving large projects." However, one applicant reported that the scale of engagement with the ATI was an area that they wanted to consider further internally.	Range 0-108 man days per annum, mean of a 43.5 days per annum (Based on 5 specific estimates out of 7 applicants interviewed)
Pipeline and engagement with potential applicants	Engagement with ATI applicants ranged from smaller units of organisations being represented by 1 or 2 senior staff to representation by 10 staff within large enterprises. One applicant solely featuring as partner on projects stated that the engagement was 'limited'. Examples on time spent on engagement were: • "2 meetings prior submission attended by 3 representatives, half a day each plus phonecalls and emails" (10.5 hours per month) • "1-2 days per month, calls meetings, organising visits of ATI staff at premises, greeting partners on site" (12 hours per month) • "Maybe 9 weeks over the year of one FTE" (30 hours per month) • "40 hours per month" • "15 hours per month"	Range between 1 and 10 staff engaging with ATI, mean of 6 employees (Based on 6 specific estimates out of 7 applicants interviewed) Time spent on engagement depended ranged from 10.5 hours per month to 40 hours per month, mean of 21.5 hours per month (Based on 5 specific estimates out of 7 applicants interviewed – standardised to hours per month) Two companies that had put a framework agreement into place spent 200 and 500 hours on this respectively.

Process	Summary of cost implications for applicants	Quantitative assessment of time involved
Strategic assessment process	Time spent on SR1 prep by lead partners ranged from a minimum of 50 hours incl. assessment and updating of the versions and a maximum of 1000 hours. As a partner, SR1 and SR2 submission takes a maximum of 5 days, SR2 specifically takes 3-4 people holding meetings and phone calls for a few months. Time spent on SR2 ranged from 225 hours to 3,360 hours. One applicant could not indicate a specific timeframe but specified an internal budget of £100k for the large ATI proposal, which has been spent in full, equalling to 1.5FTE a year for 18 months, seen as a reasonable cost for a £15m project Resubmission of a SR2 took between 50 and 1,000 hours and associated costs excluding time and legal costs for SR1 and 2 could cost as much as £210k (another applicant indicating £47.5k) Most applicants found the cost of complying with the costs of SRC process to be acceptable; reporting that success rates have been high and the projects were sizeable, making it easy to justify the investment up to this point.	SR1 Range between 50 and 1000 hours, mean of 375 hours. (Based on 4 specific estimates out of 7 applicants interviewed) SR2 Range between 225 and 3,360 hours, mean 1,520 hours (Based on 4 specific estimates out of 7 applicants interviewed)
VfM assessment	Partner applicants do not even see the VfM but for a lead it is very intensive. One applicant found it difficult to estimate but stated it was an intensive process. The VfM time efforts ranged from 25 hours over a one-month window to complete to 120 hours An issue was reported by one policy stakeholder was that some applicants that had received 'hold' decisions at SR2 were unclear whether they should be preparing their applications for VfM assessment. This may have resulted in applicants incurring unnecessary additional costs by preparing VfM estimates where projects are unlikely to proceed.	Range between 25 and 120 hours, mean 49 hours (Based on 3 specific estimates out of 7 applicants interviewed) One applicant added that they spent additional £5,000 on this process
CRD Competitions	Only two applicants provided estimates of the time spent on a CRD applications, one 35 hours and the other 700 hours (estimated the costs of this time at £2,600 and £4,200 respectively)	The two companies that provided estimates stated 35 and 700 hours respectively for preparing a CRD application
Independent assessment	Time spent on the independent assessment took between 8 hours and 100 hours. Time spent preparing for assessor interview ranged between 20 hours and 40 hours Time required to attending assessor interviews ranged between 15 hours and 40 hours. The costs associated with this time were specified by two applicants, one £2650 and the other £10k Most applicants considered this to be a highly efficient	The two companies that provided estimates stated 8 and 100 hours respectively, spent on an independent assessment

Process	Summary of cost implications for applicants	Quantitative assessment of time involved
	process	
Due diligence and contracting	Time required to respond to due diligence requests: Applicants indicated this was a highly variable and project specific element, most stating it took hours or days rather than weeks with an exception of one applicant whose experience was expending weeks over 10 months. Only one applicant gave an indication on time consumed on contracting, stating it took as much as 520 hours. The costs of this time were £32k.	Only one specific estimate provided, indicating 520 hours spent on due diligence and contracting
Monitoring	Completing quarterly monitoring and claims reports: of those who could estimate, one applicant stated monitoring takes about 20 hours and another applicant stated 160 hours . Time required to engage with Monitoring Officers: of those who could estimate, one applicant stated monitoring takes about 30 hours and another applicant stated 40 hours. Time required agreeing project changes: Of those who could estimate, one applicant stated monitoring takes about 12 hours and another applicant stated 130 hours. Time required to engage in annual or project close out monitoring requirements: Of those who could estimate, one applicant stated monitoring takes about 30 hours and another applicant stated 160 hours. Only one applicant estimated costs of this time, stating it was £7,000. Time to engage here generally seen as appropriate. There was a general sense of satisfaction from applicants with the process for identifying risks and mitigating these. Respondents indicated that the six categories and the five-point scale of rating allows for enough flexibility to cope with the breadth of projects. Those with personal experience were broadly content with monitoring arrangements described above and commended on the flexibility of the system through which they feed back whether the project is on track or what challenges had arisen. “The monitoring arrangements allow us to track project progress as the format is open enough to adapt to project specificities” Applicant	Estimates provided by the two companies for quarterly monitoring activity costs were 62 and 330 hours respectively. Estimates for annual monitoring activity costs were 30 and 160 hours respectively[69]. Combined, this equates to 278 hours and 1480 hours per annum

Annex B: Overview of R&T implemented to date

[69] There is a risk that this higher figure might have included all annual / project close out monitoring activities across all of the applicants projects and is subject to further confirmation.

Tables B.1 and B.2 below provide an overview of the R&T implemented to date on case study projects and by the five case study applicants.

Table B.1 Mapping the R&T programme implemented in case study projects

Case	Overview of R&T implemented
1	The project aims to develop accurate and robust measurement technologies for precise real-time measurement of dynamic deformation of an aircraft component using novel fibre optic based measurement technologies with the intention to overcome the disadvantages of existing methods. At the time of the research the project was in its early stages and has focused on interface requirements and has been theory and laboratory based, essentially involving the testing of the relatively mature technology and development work on the emerging alternative (lower TRL than 3). Some delays have been experienced because of issues in accessing and sharing data from a sister company of the lead partner.
2	The aim was to create a more productive and efficient early design process, creating a capability to deploy new technologies on novel configurations more quickly and with greater confidence, with the eventual aim of creating a step change in product performance and cost. The elements of the project were at different TRL levels at the outset, some (e.g. the design process explored by the academic partner) was at TRL 2 and others at 4/5. By the end of the project, the core design process elements were at least TRL 4, though 'more securely' so. One of the specific design tools was indicated to be at TRL 6 and has resulted in a marketable product. According to its Monitoring Officer, the project delivered its major intended outputs closely in line with what was planned, albeit with inevitable detailed mismatches within some elements – insisting strictly on regularities is generally agreed to be unrealistic. The emphases changed somewhat as a result of emerging results and the evolving priorities of partners. The lead partner argued that it did more than anticipated at the outset, with enhancement to deliverables as a result of the learning which was acquired. It has provided important advances in predictive capability, tools and management for data processing and links and data sharing with the supply chain. Importantly too, it has helped to: - Create a pragmatic engineering capability - Bring together tools and processes to an extent which would likely be surprising to those not involved in the project - Eliminate what would otherwise have likely been duplication of effort through improved knowledge and data management - Develop a pool of technological expertise - Build working relationships, taking issues of 'ego' out of joint working and creating a pool of people sharing innovative ideas and approaches.
3	The aim of the project was to carry out a programme of research and associated validation testing to further develop design methodologies for commercial aircraft wings. It is intended to address issues associated with aerodynamic performance and the use of additive manufacturing technologies. The project was at the time of the review still in its early stages, only around 6 months of substantive work having been undertaken and outputs at this stage are limited.

Case	Overview of R&T implemented
4	The project aimed to build upon the four themes of: Conceptual Definition, Design and Integration, Demonstration/Validation and Learning, feeding to a wing development research programme. The key output of this project was always expected to be new aircraft concepts. Some of the designs explored have produced exciting results and are now being considered for incorporation in a number of follow up projects. The only tangible output which was reported in the documentation is the “exhibition of mock-up at Farnborough Airshow”, with ongoing engagement with stakeholder groups through workshop activity. Further to this, discussions with participants indicated that 5 demonstrators have been created and that some 60 patents have been registered. The project academic partner indicated that currently the majority of commercial passenger planes have a similar design, based on long-held assumptions but to achieve 90% reduction in NOx - set out in the ACARE goals - there will have to be a major rethink of aircraft design. Product development cycle is currently at least 10 years and the models developed here should contribute to reducing the early stages of deciding which novel design to go for by approximately halving the development time. In overall terms it is expected that the project will “overdeliver”, demonstrating an agile engineering process to improve the capacity to provide airlines with products meeting their specifications. This will aid competitiveness, enabling design changes to be made more quickly, facilitating product customisation.
5	The overall objectives of the project relate to the miniaturisation, testing and development of the communications technology for use on Remotely Piloted Aircraft Systems (RPAS). The technology concerned has been in use for military RPAS but the project’s focus on a civil application for cargo was novel. Delivery in the first year of the project has focused on the specification of the project – establishing what were the user requirements and undertaking a systems design phase that involved testing of different components of the system. This has involved a small number of ‘field trials’ however overall R&D outcomes to date have been limited.
6	The core objective of the project was to test and develop a range of additive manufacturing processes to the point at which they can be demonstrated as a viable direct production method for advanced aerospace components. Overall delivery to date appears to have focused on the testing and refinement of manufacturing processes and the refinement of components across a broad range of initiatives. These were bundled under 10 work packages, pursuing a number of different additive manufacturing process innovations, covering: - Testing and refining additive manufacturing machinery and laser powder bed technologies - Piloting the manufacture of a set of aerospace components through additive manufacturing - A set of software and modelling projects to support the use of this technology in an aerospace environment - Developing new tools for conventional aerospace manufacture that are made using additive manufacturing processes A small number of work packages have been aborted. This reflected a strategic decision to move away from polymer (plastic) approaches to

Case	Overview of R&T implemented
	additive manufacturing, and a decision to reduce the software simulation aspects of the study.
7	This project aims to advance the existing knowledge regarding the impact behaviour of environmentally (temperature, humidity) preconditioned fibre reinforced polymer matrix composites and develop a set of integrated experimental and numerical tools for designing components and structures capable of withstanding the necessary loadings. The key objective is to advance the existing integrated experimental and modelling methodology for assessment and quantification of the response of environmentally preconditioned composite materials to impact loading and thus to validate predictive modelling, which could be readily employed in the design of the next generation of a key component of a large civil aircraft system. At the time of the review finalisation of the component for testing was three months late compared to the original project plan. A variety of tests are being undertaken or planned, some within another ATI project. Initial tests are being done at the site of the academic partner which has a test rig from the lead partner for testing single subcomponents (WP1). An RTO partner is manufacturing longer sub-components in WP2 which introduced new manufacturing challenges such as having to expose carbon fibre longer than its 'shelf life', having an effect on absorption of moisture. The tooling has been ordered but not delivered – this is expected to be finalised towards the end of 2017. These changes relate mainly to reducing the time and cost of production of sub-components. Currently, it takes 40 hours to produce the one unit but producing the complex profiles by use of additive layer manufacturing techniques potentially offers major savings.
8	The aim of the project was to improve the efficiency of future components in which the lead applicant worked together with three academic partners. The project consisted of ten distinct work packages (initially nine WPs but the scope was extended to consider one more technology contributing to the achievement of the aim). The work packages ranged from small improvements to sub-components (example in WP1) to broader system integration (WPs 9 and 10 respectively). As a large four-year project finishing in early 2017, there is a large body of evidence on the R&T implemented. The project made significant progress in the majority of its work packages, some of which were proven to work and some confirmed that the technology was not able to improve efficiency. There were two major successes in technology development that have subsequently been incorporated into manufacturing processes and product development. Work undertaken under WP9 had resulted in a novel system which has proven its worth and made it into upgrade refit packages (within the project it progressed to TRL6). This technology consists of a patented novel design. The new feature is very simple in its design and has resulted in two internal projects running alongside the ATI project and leading to an enhanced product. The improved design is delivering in the words of the lead applicant 'a huge performance benefit…' in efficiency while extending the life of a high value component The second technology which was successfully developed within the project was systems integration of design, performance analysis and lifecycle tools within WP10. This technology influences products on the market today despite initially not being included within the specification of the project. It enabled the bringing together of different software systems used in research and design and product development teams. Previously each team would have a suite of tools used for design and testing of components. These tools included specific software tools focusing on early

Case	Overview of R&T implemented
	design, product lifecycle development, etc. Within the project the team brought all these tools together in one toolset package which allows designers within the Tier 1 manufacturer to zoom in and out of the detail of specific components and systems. This process innovation has a clear benefit in standardisation of processes, reducing the time spent on design dramatically from 6 months to about 40 days. Within this project, there were R&T successes in the form of negative proof of the ideas pursued. One example was WP8. This consisted of an investigation in different types of component. This included exploring technologies used commonly in defence applications but the conclusion from research was that these were not yet suitable for civil applications which require long maintenance cycles. By proving that this technology is not yet suitable in early design stages, the team has potentially saved substantial resources An unintended outcome of this part of the project was a discovery of a UK supplier of a key component that was previously imported.
9	This project aims to acquire the capability to design and manufacture a specific component required to improve performance. This project aims to significantly enhance the performance, reliability and cost of producing this part for a competitive future product (ACARE goals) & emerging legislation. The key objective of the project is to onshore the technology. Initial completed R&T consisted of producing 'replicas' of existing designs and finding suppliers capable of manufacturing some of the part's sub-components. This required building a materials database that lists properties of joints using different metals. This database is now available for use by other staff at the Tier 1. The project achieved production of an equivalent part to the one available abroad in the UK and demonstrated that it can achieve similar performance in a laboratory environment. Within the project, the team identified 30 suppliers, all of which were UK-based. The UK-manufactured part is booked in to be tested on a rig in Germany which is able to imitate specific conditions later in 2017.
10	The project had two key objectives (1) to create the design and tooling for the next generation of composite components required for future large systems, and (2) to develop a complete system with sub-system validation in a relevant environment and develop the understanding of the route to certification for the component. The scope of the study changed with an aim to demonstrate the integrity of the component using representative methods. There was also a major change to the delivery of the project in the form of a shift in the timeframe from 2015 to 2017. Up to the first quarter of 2017, the project had completed design (part of WP1) and manufacture of sub-components (WP3 in full) and run a number of tests, including investigations and analysis of early designs. The project also investigated the strength of the 'Fast Make' sub-component design. The project team successfully completed manufacture of several samples and three different types for test. Some manufacturing processes resulted in wrinkles in composite structure which resulted in investigation of various strategies. Following these analyses, a residual stress analysis was undertaken. Under WP1 the project team undertook tests of the resilience of various sizes of component and safety performance. One of the early tests however resulted in failure of the component, leading to major damage. This required redesign of the whole system with a need for further tests to be 'parked'. The newly designed component has so far undergone only early tests by the academic subcontractor but these suggest it does not

Case	Overview of R&T implemented
	share the issues of the earlier design. WP4 moved from full tooling development to setting out main features and roadmaps for composite components production. This included identifying detailed features discovered by an academic partner. Much of this work involved identification of the most suitable practices for manufacturing a specific part of the component with the aim to bring the cost down while keeping to the necessary tolerances and performance specification. These sub-components are currently very expensive to produce. Within WP3, the team developed the method and generated foreground knowledge about interaction of specific factors (moisture, temperature etc.) and tested them on smaller components on the site of the lead partner with results fed back into models that can predict failure. The model run by an academic partner requires a high computing power and its use has currently been limited but it will be extended to the full component level. Running the modelling along with the analysis of the observations of the test where the component failed, proved the accuracy of the model to predict when and where the failure would occur. This is seen as a particular success of the project that could in the future save time and financial resources through similar tests.
11	The project objective is to improve the efficiency of a specific aircraft component saving its weight by 20% and increasing the interval length between overhauls by 66%. The project is only in its first year of delivery but the team has delivered trade studies, some based on external (competitor) analysis but some also on assessing internal projects and methods applied. These studies generally look at alternative solutions to solve a problem, alternative designs, materials, running some basic stress models. They range from conceptual work, including sky thinking, other designs, using new approaches from other sectors (automotive, oil and gas etc.) A member of the project lead's supply chain and an academic partner have been working together using some background IP to investigate the performance characteristics of sub-components. The academic partner has undertaken sub-component modelling and stress analysis. Another business partner was proactive in manufacturing a component for later testing and modifying a test rig. An RTO involved in the project is managing trials of features with concepts. The academic partner was said to have just settled in and set up analysis to perform at a later stage and the second academic partner is reviewing sub-components and designing a test rig. Another RTO has already performed some analysis on their newly developed prototypes which will feed to the project team members for broader comparison of performance. The team has raised 8 patents on the back of the project which were in the pipeline before but have been put forward since July 2016 in order to protect main areas of development. Two of these relate to the design of individual components. One relates to a specific shape that will result in weight saving and the other assembly process in manufacturing. Specific highlights of R&T delivered to date include a detailed review of existing reports from previous projects and trade studies resulting in identification of weight savings of 16.5 percent to 20 percent. While this progress was described by the project lead as 'good', the identification needs to be completed in year one of the study. The main result of this collaborative working is that the design is looked at in a holistic way by the producers of individual sub-systems and components who had historically worked on development of their products separately.

Case	Overview of R&T implemented
12	The project focused on the development of aerodynamic technologies related to the design of advanced airplane components. The whole planned component design TRL progression from TRL3 to TRL5/6 and MCRL change MRCL 5-6 has been achieved. Apart from the main design achievements, a set of diagnostic testing and validation tools developed as part of the project were reported to have been used in other projects at the time of interview by the lead. These tools are now able to be used in any piece of work delivered by the lead.
13	Overall, the aim of the study was to help improve the productivity of UK aerospace manufacturing processes, to support the re-shoring and to ultimately grow UK employment in aerospace manufacturing. Progress against objectives has been materially slower than anticipated. While the pace of change has picked up dramatically recently, the Monitoring Officer reported that only a small proportion of the project has been delivered to date. The project lead reported a move towards robotics and other digitised tools and the MO confirmed a step change in its attitude and investment in such technologies. These included delivering a 'DES visualisation' and factory planning tool and casting technologies for specific components. There is material scope for the introduction of the process innovations being researched through the project (such as a new method for joining materials, or the use of projector technology to give work order instructions to engineers) to generate cost savings and quality improvements for the lead applicant.
14	The project aimed to develop the techniques and technologies required to develop an integrated system using software defined technology for the next generation of civil aircraft. This would replace the current system of isolated systems. This has been a technically challenging project which has delivered against its objectives (exceeding them in some areas). The specific areas of technology developed were specific subcomponents of the system. A comprehensive automatic testing environment was developed for cost effective testing and certification of a future system. The major achievement was the development of an integrated system which required building new software architecture. The project partners had to work very collaboratively for this challenge to be overcome. These issues had been overcome through a strong consortium and clear technology areas. An exploitation plan was provided to Innovate UK which details specific job creation achievements that were both expected and had been realised. Further development is being undertaken under an ATI follow up project.
15	The project aimed to create safer, quieter, more-reliable sub-component designs containing electronics suitable for extreme environments. While TRL progress with designs was cited to be important by the project lead, developing an understanding of what designs do not work and why was said to have been just as crucial in informing decision making. A number of examples were given to illustrate this: Component type: Significant development work in analysis of concept designs resulted in the transition away from a sub-component type that was proposed but has never been used. Sensing technologies: While not a specific part of the component's design, the project looked at the use of sensors to identify component position and performance. Analysis indicated that position sensors were not reading the same location for components due to component bending.

Case	Overview of R&T implemented
	TRL development moved from 2 to at least 5 as a result of the project, with a view to reaching TRL6 at its close. The academic partner's analysis indicate that this technology may be even be able to meet military aircraft specifications.

Table B.2 Mapping the R&T programme implemented by applicants Overview of project progress

Applicant	Overview of R&T implemented
1	This applicant had substantial involvement in the ATI both as a lead and a project partner. Staff within the R&T department of the company had extensive experience of the SRC process and stated that typically their applications progressed through the two stages at the 'standard' three months but in a small number of projects these were held up by the comprehensive spending review. As a manufacturer of aerospace components, a large proportion of applicant's ATI projects are feeding into the development of a key new product with a launch expected in the next 8-10 years. The next generation of their core product will represent a 'step change' leading to a substantial reduction in emissions of the aircraft introducing a number of innovations new to the company and some new to the sector. They also have some more specific projects leading to smaller incremental improvements of existing products with time horizon of less than 5 years to entering production. Finally, they have a set of projects focusing of manufacturing existing and future products. There are specific technologies funded by the ATI that had been deployed by the applicant which are mainly manufacturing and design related. The main benefits from ATI projects are however expected to come through in the form or helping to secure a large order from one of the applicant's customers. All projects reviewed were highly aligned with the ATI technology strategy and the company has a clear internal strategy for what types of projects are being pursued and implemented through ATI, Innovate UK projects and the EU and other national aerospace R&T funding programmes.
2	The applicant has a number of lead and partner participations especially in the early stage of the ATI's development. Staff had a limited experience of the SRC process. Monitoring information shows consistently high performance of projects led by the applicant with a much lower level of variance in projects within which it had a collaborator role. The organisation was involved in developing advanced manufacturing techniques and was predominantly active in the role of a collaborator but also leading on innovation in manufacturing techniques for the benefit of whole sector. The key activities implemented within ATI projects related to the development of infrastructure to grow capability in additive manufacturing, some of these are very near production ready in large Tier 1 partners. Partnering benefits were in the form of strengthened relationships and knowledge transfer from the organisation to participating SMEs in particular. The applicant fed predominantly to the ATI strategy with a focus in their area of expertise in which it had a strong representation. The chief technologist and individual engineers and technology managers have been involved at different levels of feeding to the technology strategy. The strategy was found not to drive the applicant but to be aligned well with their priorities and provide better insight into what the sector requires.
3	The applicant led and participated only in a small number of ATI projects. However, the applicant recognised the importance of the role of the projects within their portfolio, especially due to their higher relative size compared to other R&T activities. Their main R&T activities related to systems integration and working with suppliers of sub-components to demonstrate a proof of concept. While there were no specific commercial organisational level results realised at the time, R&T implemented has led to securing another ATI

Applicant	Overview of R&T implemented
	project that was hoped to move the technology along the development continuum and ultimately resulting in a clear competitive advantage. As a provider business in a number of sectors including aerospace, the applicant fed into the advanced systems technology strategy and informed the development of some other parts such as infrastructure and engines. ATI strategy had a clear effect on what they do, highlighting options and technologies to pursue. The funding behind the ATI strategy gives the company certainty and a clear approach to technological progress. The support from ATI has attracted the attention of the applicant's foreign headquarters and resulted in a strong commitment to co-invest internal funding.
4	The applicant led only a small number of projects, most of which went through the SRC process, but also had some engagement with CRD activities. The key R&T activities undertaken by the applicant involved advancing specific component technology likely to result in scaling up the production of the component in the UK compared to own foreign manufacturing plants. The outcome at the applicant level is the ability for the UK part of the company to compete globally with other parts of the group that are also involved in developing this specific technology. Possible outcomes detailed by the applicant representatives related to on shoring jobs from abroad, improved economic performance of the UK part of the business, and increasing global market share in specific components. Funding provided by ATI project grants was identified to be a key element in achieving these benefits. Work undertaken under the ATI implemented ATI activities aligned well with the strategy - and with ACARE goals.
5	The applicant has a number of ATI projects, the majority of which were from the Early ATI and Legacy part of the programme. The R&T activity being performed to date consisted of running specific engineering tests and exploring innovative concepts in design and manufacture but the projects led by the applicant have delivered only limited outcomes to date. The projects have clearly supported R&T jobs – though the uncertainties about the additionality of the projects concerned mean that it is impossible to be confident that the jobs involved are new or would otherwise have been lost – and they have helped to support the acquisition of a number of PhDs (though we are told that these are no longer eligible for support). The key outputs of the projects reviewed relate to the development of knowledge and techniques, some but not all of which are reflected in increases in TRL levels (although it is understood other projects are concerned with MRLs). There have also been some benefits in terms of the development of new collaborations. The applicant was extensively involved in feeding into the ATI Technology Strategy through strategic advisory groups and hence their projects were all closely aligned to the strategy. The applicant indicated to have a substantial influence on the development of the document, in particular to ensure it included a sufficient dimension from their position within the supply chain. Similarly, to the other largest of applicants, there was a belief that the influence was one-directional from the applicant to ATI rather than vice versa.

This publication available from www.gov.uk/bis

Contacts us if you have any enquiries about this publication, including requests for alternative formats, at:

Department for Business, Energy and Industrial Strategy
1 Victoria Street
London SW1H 0ET
Tel: 020 7215 5000

Email: enquiries@bis.gsi.gov.uk