FUTURE FLIGHT CHALLENGE

Interim impact and process evaluation

19 APRIL 2023

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1.1   The Future Flight Challenge

The future flight sector, as defined by the Future Flight Challenge (FFC), includes organisations which are developing, commercialising, producing and supporting the deployment of technologies or services related to unmanned aerial systems (UAS), advanced air mobility (AAM) or regional electric conventional aircraft. The sector also incorporates the digital and physical infrastructure, systems of systems and regulatory frameworks that are necessary for the coherent development and operation of the sector.

The UK has the potential to achieve a substantial share of this rapidly growing global market, leveraging existing competitive advantages with respect to regulation, design engineering, and digital and physical infrastructure.

However, a range of market failures and institutional barriers could prevent the UK from gaining an advantage. These include underinvestment in research and development (R&D) by the private sector, regulatory barriers, airspace integration challenges, coordination barriers, infrastructure barriers, supply chain disruptions, and challenges associated with the post-Brexit economy.

The FFC is a £300 million programme, which includes £125 million committed by the public sector as part of the Industrial Strategy Challenge Fund (ISCF) and a minimum of a further £175 million of industry funding. This programme helps to position the UK strategically to develop and commercialise technologies.

The Challenge provides grant funding to industry consortia seeking to address these problems, along with a range of supporting activities, to converge and align industry, facilitate knowledge exchange, support the development of regulatory frameworks, produce reports and provide strategic input to government policy.

The Challenge is running from 2019 to 2024 in three phases: a Discovery Phase from 2019 to 2020; a Development Phase from 2020 to 2022; and a Demonstration Phase from 2022 to 2024. The phases are closely linked, preparing consortia to undertake effective, collaborative R&D, allowing the FFC to adapt later competitions in response to technological change and lessons learned, and reducing the risk of allocating large grants to unsuccessful projects.

1.2   The impact evaluation themes

The theory of change set out in the evaluation framework report describes the narrative of how the FFC is expected to transform inputs and activities into outputs, outcomes and impacts. The evaluation framework translated this theory of change into 11 evaluation themes that should be used to evaluate the impact of the FFC.

Some of the evaluation themes include shorter-term outcomes of the FFC (i.e. themes that are likely to have material and measurable outcomes by 2022). We analyse early findings in these themes in greater depth in this report:

1. Has the technological readiness of future flight technologies been progressed as a result of FFC?
2. Has the FFC increased collaboration within the future flight sector, and between the sector and other stakeholders?
3. Has the CAA [Civil Aviation Authority] developed a set of robust regulatory frameworks to support the future flight sector?
4. Has the FFC increased investment and R&D in future flight technologies?
5. Has the FFC helped to shape a coherent government policy that supports the development and operation of future flight technologies in the UK?

A second set of evaluation themes focus on medium- and long-term effects, where the impact of the FFC is expected to be measurable from 2024 onwards. We adopt a light-touch monitoring approach to summarising preliminary evidence in these areas:

6. Has the FFC helped to improve public attitudes to future flight technologies?
7. Has the FFC helped to build the skills needed to support future flight technologies?
9. Has the FFC helped to encourage a diverse future flight sector?[1]

A third set of evaluation themes focus on longer-term outcomes and impacts, and at this stage it is too early to assess these areas. These themes are not analysed in this report:

8. Has the FFC accelerated the formation of economic clusters developing and producing future flight technologies in the UK?
10. Has the FFC accelerated the deployment of future flight technologies in the UK, leading to economic and social benefits?
11. Has the FFC increased the contribution of aviation and aerospace sectors to the UK economy?

All evaluation themes will be assessed in the final impact evaluation in 2024.

1.3   The interim impact evaluation key messages

This report sets out interim impact evidence of the FFC and compares it to the baseline evidence collected at the end of 2020. The interim impact evidence draws on five sources of evidence: primary data from surveys of future flight sector organisations (197 responses), stakeholder interviews (9 organisations), short workshop sessions with 13 individuals from different organisations in FFC consortia, a FFC portfolio review conducted by Frazer-Nash Consultancy, and FFC monitoring data.

The survey and stakeholder evidence indicate that the FFC has positively impacted the sector through accelerating different types of collaboration, especially multidisciplinary, multi-sector and cross-

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[1] The theme numbering reflects the ordering in the baseline evaluation report. We include monitoring of Theme 9 but not Theme 8 in this report.

government collaboration. Industry stakeholders we interviewed generally highlighted how the FFC has played a coordinating role that has brought new focus and direction to the sector, through links to both government and industry. These have contributed to a number of positive short-term outcomes. Key points are:

- The Development Phase rules required cross-organisation collaboration within consortia. Both the survey and interview evidence indicate that the Development Phase had a positive effect on technology readiness, and industry stakeholders interviewed emphasised that the technology advancement occurred in areas that require interdisciplinary expertise (e.g. digital modelling, avionics and airspace management technologies), which typically complement core technology development.

- Consortia stakeholders reported in interviews that the FFC was widely seen as a signal of sustained government interest in future flight, which is an important enabler for private investment, particularly among companies whose main focus is not future flight. Multiple industry stakeholders felt that functions of the FFC would continue to be needed post 2024 in order to support UK competitiveness.

- The FFC reports that it is on track to achieve its matched funding targets and additional co-investment targets. Survey evidence suggests that the FFC has had a positive impact on private investment.

- Government stakeholders reported that the FFC was valuable as a link with industry, allowing them to gather industry information and coordinate industry participation faster and more comprehensively than would otherwise have been possible. Industry stakeholders also reported that this communication channel was valuable in communicating a sense of urgency to government. These activities have contributed to the creation of the ministerially chaired Future of Flight Industry Group (FFIG).

- Most Demonstration Phase consortia stakeholders interviewed valued the advice from the FFC on navigating CAA processes, permits and approvals. Most stakeholders agreed that it had been challenging for future flight companies to understand how to best operate under the current regulatory frameworks, and to work efficiently and effectively with the CAA.

There are early warning signs that views on barriers to sector development have deteriorated since baseline, and that the UK may be falling behind international competitors. These views are not necessarily related to the FFC, and they appear to apply to the wider sector landscape.

Some of the specific evidence gathered suggests that:

- Regulation is perceived to be a risk and there have been delays in introducing new regulatory frameworks relative to the timelines that the FFC initially envisioned. There is an increasing perception that the UK is slipping behind international competitors in terms of electric vertical take-off and landing (eVTOL) regulation.

- Views on funding opportunities have become more negative; based on expert input, this may relate to macro trends and events (e.g. COVID-19 pandemic effects or uncertain access to EU research funding).

■ There was also the perception among survey respondents that government policy has lagged behind other countries and skills are increasingly seen as a barrier, which may be due to sector growth and demand for more specialised and new skills.

■ Development Phase consortia stakeholders who had attempted flight demonstrations reported that CAA processes and capacity were a very significant barrier to achieving objectives within timelines. Achieving CAA flight demonstration approval (especially for beyond visual line of sight (BVLOS)) within FFC timelines was identified as a material risk to achieving Demonstration Phase objectives.

We provide more detail and some of the key supporting evidence for this narrative summary below.

Theme 1 - Has the technological readiness of future flight technologies been progressed as a result of FFC?

Survey findings suggest that **competition consortia that were funded in the Development Phase have increased their technological readiness**. Among survey respondents in Development Phase consortia, the proportion of projects with a technology readiness level (TRL) of 1 or 2 was 27% at the start of the phase and 8% at the end of the phase; for TRL 3 or 4, the proportion fell from 48% to 20%; for TRL 5 or 6, the proportion increased from 20% to 39%; for TRL 7, the proportion increased from 5% to 31%; and one project reported achieving a TRL of 8 or 9. Stakeholders agreed that the FFC had played a major role in accelerating the technology readiness of the future flight sector in the UK, particularly in technologies that were already somewhat more advanced (e.g. BVLOS and eVTOLs).

The FFC also aimed to **accelerate technological development in the wider future flight sector**. Thirty percent of survey respondents reported that the FFC had accelerated technological development significantly, compared with only 13% at baseline. Ninety-three percent of those who responded to the interim evaluation survey felt that the FFC had had at least some accelerating impact on technological development. Government stakeholders and industry experts emphasised that the FFC had played an important role in bringing together key organisations to collaboratively address complex systems issues to enable the development and deployment of new technologies.

Industry expert stakeholders noted that the UK had the potential to utilise its favourable geography and population density for the development of future flight technologies, particularly AAM use cases. However, stakeholders highlighted two main uncertainties that affect the future advancement of future flight technologies:

1. The development of the underlying digital and physical infrastructure to support the introduction of new classes of electric or autonomous air vehicles; and

2. CAA capacity constraints that affect the ease of conducting trials and demonstrations and entering an in-service phase.

Stakeholders widely felt that CAA capacity constraints **slowed the pace of conducting demonstrations**, which was a barrier to Development Phase projects that planned flight demonstrations in achieving project objectives. A majority of survey respondents (57%) felt that the CAA approval process for demonstrations was currently inefficient, although this was a decrease from

67% at baseline. It is worth noting that this is not necessarily a case of an inefficient process but reflects that the CAA has limited and stretched resources, as it is building capacity following the UK's exit from the EU and the European Union Aviation Safety Agency (EASA). This is apparent in cases where a demonstration involves a new type of technology (often the case for future flight technology), as there is usually limited availability of suitably qualified and experienced personnel to evaluate applications for demonstration. Most stakeholders interviewed were concerned that these barriers would affect the Demonstration Phase currently underway.

Theme 2 - Has the FFC increased collaboration within the future flight sector, and between the sector and other stakeholders?

The survey and qualitative evidence indicate that the FFC has led to **collaboration at a scale that would not have occurred otherwise** and has contributed to the joint delivery of future flight technologies and services that otherwise would have been developed in isolated workstreams. Eighty-three percent of survey respondents felt that the FFC had increased collaboration in the sector to an extent, including 40% who felt it had done so significantly. The Challenge's role in encouraging collaborations, providing funding and holding events was seen as key in supporting collaboration. Qualitative evidence suggests that the effects of the FFC on collaboration were largely due to eligibility criteria for consortia (requiring cross-organisation collaboration) and the perceived benefit of securing dedicated CAA engagement for FFC consortia, which was otherwise hard to come by.

The **competition brought together diverse organisations** including end-users, commercial airlines, academia, government agencies, local authorities, operators and companies of different sizes and ages. The Demonstration Phase consortia included more end-users and large companies relative to the Development Phase. This was likely due to competition rules and the different aims of these phases. Stakeholders emphasised that the **FFC provided a useful impetus to engage large companies in future flight projects**, because these companies were less accustomed than future flight start-ups to working on development projects whose medium-term impacts were subject to high levels of uncertainty.

Surveyed consortia reported that **the FFC took an active role in supporting the formation of competition consortia**, most frequently through the Discovery Workshop, introductions and FFC events. Respondents highlighted the importance of bringing organisations together where there was no pre-existing working relationship. Sixty percent of consortium members said that **the FFC had been very influential in forming their consortium**, with a higher influence for those involved with non-future flight technologies and electric, hybrid-electric or hydrogen regional aircraft. Stakeholders reported that it was important that the FFC provided a formal framework within which organisations had to collaborate and which existed outside their usual commercial or academic circles.

Consortia stakeholders indicated that **the FFC bridged a communication gap between the industry and the government**, especially with the Department for Transport (DfT), (former) Department for Business Energy and Industrial Strategy (BEIS) and the CAA, by acting as a main contact point and intermediary. Consortia particularly valued receiving FFC advice on navigating CAA processes, permits and approvals and communicating a sense of urgency to government to develop the policy and regulatory frameworks needed to support the international competitiveness of the UK.

This second point aligned with views from government stakeholders, who valued the ability of the FFC to quickly gather and distil information from many and varied industry stakeholders.

Theme 3 - Has the CAA developed a set of robust regulatory frameworks to support the future flight sector?

Views among survey respondents about the impact of the FFC on the efficiency of the CAA approval process were somewhat positive, with half believing it had increased efficiency, one in ten feeling it had decreased efficiency, and the remaining 40% believing it had had no impact. Regulatory and industry expert stakeholders emphasised that companies needed experience with CAA processes in order to successfully plan trials and demonstrations, and that it was important for the sector to further develop companies with mature approaches to regulatory affairs. These stakeholders felt that it had been useful to build working experience between future flight companies and the CAA over the course of the Development Phase. Overall, the evidence indicates that there have been recent improvements in how respondents work with the CAA,[2] but it is too early to assess the impacts on Demonstration Phase outcomes.

Stakeholders agreed that **the FFC was contributing to the development of regulatory frameworks that support the future flight sector in the UK** by bringing together industry and regulatory expertise. Stakeholders thought the FFC had **accelerated the development and publication of some pieces of regulation and guidance** as part of CAA engagement with competition winners (e.g. publication of guidance for remotely piloted aircraft system (RPAS) operators carrying dangerous goods). In other cases, regulatory frameworks appeared to be taking longer than expected (e.g. for drones, AAM and regional hybrid aircraft), with stakeholders highlighting CAA capacity constraints and the intrinsic difficulty of such frameworks where there were many use cases being key factors.

There is some evidence that perceptions of the UK's relative performance in terms of regulation has declined. Fifty-seven percent of survey respondents viewed regulation to be a barrier to the progression of future flight technologies, compared with 42% at baseline. Forty percent of respondents viewed UK performance in regulating future flight technologies to be behind most other countries, compared with only 17% at baseline. A possible explanation for this is that, as future flight organisations continue to progress towards market entry, significant interaction with the regulator is required to support development and demonstration of technology. In this circumstance, the role of the CAA is to ensure safe testing of future air vehicles in order to build evidence of both safe practice and technologies to inform future regulation. This process will enable safe and secure operations of future air vehicles, but it is often perceived as a barrier to the pace of industry. With new technologies, the regulators will likely lag behind industry as they work to develop appropriate and safe regulation, which initially may constrain innovators. We have no evidence of whether other national aviation authorities are in a similarly challenging or different position, and this may be a useful area to explore in the final evaluation.

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[2] This report includes evidence collected during 2022. Although we heard anecdotal evidence of more recent developments at the CAA, we cannot evidence these yet and will assess them in the final evaluation report in 2024.

Theme 4 - Has the FFC increased investment and R&D in future flight technologies?

The survey evidence indicates that **the sector view of UK funding and investment is generally positive**. Two-thirds of respondents felt that UK private sector investment was an enabler to technological progression (29% felt it was a barrier). Similar responses were found for public investment (68% enabler, 27% barrier, 5% no impact).

However, **responses suggest that perceptions have declined over time and relative to other countries since baseline**. At baseline, 80% of respondents reported that private funding was an enabler, and in the interim survey 67% reported that private funding was an enabler. Similarly, at baseline only 24% of respondents said the UK was behind most countries in terms of private investment; this increased to 36% in the interim evaluation. The results indicate similar trends in views on public investment, which is categorised by successful milestones and technical progress. One assumption could be that other barriers in the UK have led to the perception that investment in the UK will slow technological progress. Similar to the views shared in Theme 3 above, regulation can be seen to limit technology advancement with regards to enabling technologies into service, and therefore the impact of investment in the UK when compared to other countries may be viewed as 'less impactful'. Based on expert input, possible contributing factors may include concerns about recent UK economic performance, UK access to EU funding and the ability of UK funding to keep pace with European funding opportunities in the sector.

Views of the FFC's impact on funding and investment were positive. Seventy-one percent of survey respondents thought that the FFC had had a positive impact on the ease of securing investment, and 24% thought it had had a large positive impact. There is anecdotal evidence that, for companies that typically do not work in future flight, the FFC has contributed to incremental future flight R&D spending due to the competition match funding requirements.

Theme 5 - Has the FFC helped to shape a coherent government policy that supports the development and operation of future flight technologies in the UK?

DfT published the government's strategic framework for the aviation sector in 2022.[3] The FFC (under the remit of BEIS) contributed substantially to its future flight content. As part of this framework, there is **a commitment to developing a UAS and AAM sector to be led by a ministerially chaired joint government/industry body, the Future of Flight Industry Group** (FFIG). Government stakeholders found that the FFC had accelerated the process of determining the structure of the FFIG and had an instrumental role in bringing together key government and industry organisations, which was expected to lead to faster cross-government policy development than would have otherwise occurred. The master plan for the FFIG activity is under construction jointly by the DfT, FFC and the CAA.

The **FFC continues to remain involved in many of the policy-level activities** which are described in the ten-point plan within the strategy document. These include influencing BEIS (now the Department for Science, Innovation and Technology (DSIT)) and Innovate UK representation on the

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[3] DfT (2022) Flightpath to the future

Jet Zero Council, and the FFC Challenge Director sitting on both the Zero Emissions Flight Delivery Group for Regulation and the ministerially chaired FFIG.

Other areas where the FFC has supported and informed government policy are:

■ **Future Flight Vision and Roadmap August 2021**. This publication by the FFC outlines the vision for the future aviation system of 2030 and has so far been influential in the early thinking within the FFIG.

■ **Aviation Council**. A new initiative under the 'Flightpath to the Future' strategy which brings together attendees from across the whole of aviation as well as key cross-government and devolved administration representatives.

■ **Future Aviation Industry Working Group on Airspace Integration (FAIWG-AI)**. The FAIWG-AI was formed jointly by the FFC, Connected Places Catapult, CAA and DfT. It includes industry stakeholders who have worked collaboratively to deliver recommendations and propose actions required by the CAA, DfT and wider industry to enable an integrated airspace that will act as a catalyst to the integration of future flight technologies. It published a strategic plan in early 2023.

■ **Drones Industry Action Group (DIAG)**. The FFC is a member of the DIAG and has contributed to the group's Ambition Statement for the drone sector, which was jointly published by the DIAG and government.

■ **ADS Advanced Air Mobility (AAM) Market Group**. Contributions by the FFC have led to such documents as the ADS AAM Annual Market Outlook, providing an underpinning baseline for government and companies to inform business cases for investment across the sector.

Industry stakeholders agreed that policy certainty was important for attracting investment, particularly for investment in stationary assets (e.g. manufacturing, infrastructure). But the expected benefits of policy were more likely to be visible over a longer period of time in comparison to other evaluation criteria.

Theme 6 - Has the FFC helped to improve public attitudes to future flight technologies?

The FFC has focused some of its social science research activities on understanding and influencing public acceptance for future flight technologies. So far this has included appointing a team of academics, articulating social science priorities, gathering evidence on public attitudes using a deliberative methodology and publishing findings. Funding will be allocated through up to seven project grants[4] of up to £150,000, to understand topics around user design, innovation, governance and impacts on users. The projects begin in April 2023. The FFC is also funding two policy fellowships, starting in April 2023, to conduct research projects on the public value of potential policies and services to inform DfT/DSIT initiatives. These initiatives seek to apply social science methods and expertise developed largely for non-aerospace applications, and thereby aim to develop a new interdisciplinary area of research among international future flight programmes. At this stage, it is too early to assess the outcomes of these initiatives.

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[4] FFC social science grants and policy fellowships are awarded to UK-based researchers eligible for Economic and Social Research Council (ESRC) funding.

Among survey respondents, 39% regarded public perceptions as an enabler and 41% as a barrier. There is little evidence of overall changes in perceptions between the baseline and interim surveys. The survey views were broadly consistent with the FFC's findings from the public in the *Mini Public Dialogue.* Participants recognised that the technologies had potential benefits, including jobs and sustainability benefits, but were concerned about personal safety and undue risk of harm, security and cybersecurity, collisions, intrusion and privacy, affordability, risk of 'greenwashing', and environmental and noise pollution disbenefits.

Theme 7 - Has the FFC helped to build the skills needed to support future flight technologies?

On balance, survey respondents had **more positive than negative views on UK workforce skills**, with 55% of respondents regarding skills as an enabler and 40% as a barrier. However, **views were less positive than the baseline**, where a net 47% of respondents regarded skills as an enabler. This trend is potentially due to recent growth in the sector, such that demand for skills has broadened and increased faster than supply. It may also be linked to the broader labour supply issues relating to the lack of UK engineering capacity, COVID-19 impacts on workforce productivity and civil aviation, alongside increased demand across multiple industries including defence. In addition, it is currently more difficult for companies to hire skilled workers from outside of the UK owing to multiple factors including Brexit.

The FFC has allocated £632,000 to a competition to develop upskilling initiatives that tackle immediate skills gaps in the UK aviation industry. The outputs will be aimed at different educational audiences and projects will be carried out in 2023. The FFC is currently developing a toolkit to 'upskill local authorities' to help them understand their potential role in the development of future flight technologies. There is anecdotal evidence from a number of FFC-funded consortia that they expect skills development to be a medium-term outcome of their project. At this stage, it is too early to assess the outcomes of these initiatives.

Theme 9 - Has the FFC helped to encourage a diverse future flight sector?

The FFC aims to support diversity in the future flight sector, including the diversity of the workforce and the diversity of types of UK companies in the sector. The FFC competition's focus on collaboration between different types of organisations, particularly collaboration with end-users, local authorities, aviation companies and other organisations that are not specialised in future flight, supports their diversity objective. A free-to-users programme to provide mentorship to female participants in the Challenge was recently launched with the University of the West of England. Overall, FFC initiatives have had limited focus on diversity to date, but this theme was not a core focus of the FFC.

1.4   Process evaluation themes

The purpose of the process evaluation is to identify the factors that have helped or hindered the effectiveness of the Challenge while providing actionable feedback to allow the FFC to refine processes in real time and/or to feed into future initiatives. Key insights and recommendations are summarised below for each of the process evaluation themes.

The process evaluation was organised around **four broad process evaluation themes**:

3. The management and governance of the FFC
4. The structure and delivery of the FFC competitions
5. The design and implementation of engagement activities
6. The delivery and outcome monitoring process

Within each theme, we developed a set of process evaluation questions to be explored and success indicators, and we identified data sources or methodologies to answer the questions. Our approach highlighted the use of surveys, industry workshops and delivery group workshops as common approaches to evidence-gathering across all themes, with relevant accounting and other monitoring data being used for a minority of themes. In some cases, the evaluation questions are specifically about the processes around the FFC; in others, they speak to how process appears to relate to impacts.

1.5 The process evaluation key messages

This report sets out process evaluation findings, drawing on three sources of evidence: primary data from a survey of organisations that have engaged with the FFC (197 responses), workshops with 18 individuals from different organisations in FFC consortia and FFC delivery leads, and FFC monitoring data.

The management and governance of the FFC

While the governance structure of the Challenge is similar to other ISCF programmes, delivery leads felt that **more time or resource should be allocated to the process of setting up projects** as they considered them to be insufficient as they stood, leading to delays in the funds being granted to project teams. According to the Challenge, the complexity/breadth of FFC projects compared to other UK Research and Innovation (UKRI) funded activity as well as delays caused by COVID-19 are likely to be factors in this. While the process of granting funding to competition winners is meant to take 90 days from the point at which winners are notified as being successful, the lack of resource available to set up projects is resulting in this process taking up to twice as long. Industry workshop participants noted this could lead to uncertainties for consortium members given the lead times involved. Therefore, we recommend allocating additional resource to the process of setting up projects as suggested by delivery leads to ensure that applicants are not put off from applying to future competitions.

In terms of budget management, there has been an underspend at Phase Two, mostly due to COVID-19 affecting projects. Nonetheless, the Challenge is planning to reinvest the underspent amount at Phase Three and still expects to fully utilise the budget by the end of the Challenge period. There was agreement among delivery leads that governance processes could make using the Challenge's funding difficult, as it could take around three months to procure new activities or research. We recommend **that the process of repurposing underspent funding to new activities is**

streamlined where possible while maintaining necessary levels of due diligence, to ensure that the Challenge is able to effectively invest in activities that will help it deliver on its impacts.

In risk management, the process of identifying risks at a Challenge level and reviewing these quarterly with the Programme Board was seen to be working well as it allowed the Challenge to take action in a timely manner. Nonetheless, when it came to project risks, delivery leads explained that there was no current way to look at risks across the portfolio of projects funded by the Challenge and these could only be looked at on a project-by-project basis. It was felt that **a more holistic approach of looking at critical project risks across all projects would allow the team to identify common risks, which would help inform the Challenge's internal risk register**.

Additionally, some issues were identified in relation to due diligence affecting a small minority of projects. **The due diligence process could be further strengthened by drawing on learnings from these specific cases.**

The structure and delivery of the FFC competitions

Views of the application process were generally positive, with around seven in ten survey respondents agreeing that there was clear guidance about the focus of the Challenge and that the application process was clear and easy to understand. Nonetheless, industry workshop participants identified some areas for improvement in relation to the application process. Smaller organisations and those with no prior experience of applying for government funding wanted additional support to prepare applications. We therefore recommend that **the Challenge routinely publicises the support that the Knowledge Transfer Network (KTN) provides to applicants around bids**.

While the majority of survey respondents considered that the Discovery Phase supported the formation of consortia , workshop participants who were not involved with the Challenge at this phase felt there should be **events similar to the Discovery Workshop prior to future rounds of competitions in order to support the formation of consortia**.

The majority of survey respondents saw the structure of competitions as positive, although with a substantial minority of respondents who felt that it did not support the transition from Phase Two to Phase Three. The overlap between phases was seen to be a barrier in some instances for those working on delivering Phase Two projects while writing Phase Three bids. While we understand that COVID-19 caused delays and led to Phase 2 being extended by six months, we **recommend that for future initiatives sufficient time is allocated to ensure that existing consortia are able to both continue their project activities and prepare applications for new rounds of competitions**.

Views of the Future Flight Roadmap and Vision were nuanced. While a majority of those surveyed felt they helped with setting up and carrying out projects, unsuccessful applicants raised some concerns about aspects of the vision. This suggests that the Challenge could make **further efforts to address these concerns through engagement with unsuccessful applicants to ensure wider buy-in**.

The design and implementation of engagement activities

Results from the contact survey show that participants viewed most of the Challenge communications as informative, with events being regarded the most highly. In spite of this, survey evidence suggests that **improvements could be made to KTN introductions and newsletters and social media communications,** which were seen as less informative. Industry workshop participants would like **communications around events to be timelier and for communications about future events to be sent to relevant project contacts rather than finance contacts** where these differ.

Nonetheless, the programme was considered successful in having encouraged collaboration between different types of organisations, with around seven in ten survey participants agreeing that the Challenge was structured in a way that facilitated collaboration between future flight sector organisations as well as across different sectors. Industry workshop participants attributed this to the structure of competitions, which allows different levels of funding to different types of organisations and requirements for Challenge eligibility (such as the need to include small and medium-sized enterprises (SMEs) in consortia at Phase Two Strand One). Delivery leads also attributed this success to the work of the KTN in developing a future flight network of contacts to publicise competitions. We recommend that **the Challenge's structure of competitions in terms of levels of funding and KTN engagement activities are kept for upcoming rounds of competitions as well as for future initiatives in order to ensure that collaboration among different types of organisations is encouraged**.

Despite the Challenge's success in reaching target competition participants, there was a feeling among industry workshop participants that engagement with wider stakeholders outside of competitions could improve. Building connections with the CAA early on was considered a priority. For future initiatives, we recommend that **engagement with stakeholders, where there are high dependencies such as regulation, is undertaken early on in the programme** in order to avoid uncertainty around the possibility of deploying the funded innovation.

In terms of alignment with other UK government initiatives, evidence from the delivery group workshop suggests that, while alignment with initiatives related to transport and aviation is well established, there is less clarity about alignment with Net Zero (although some stakeholders valued the more informal discussion around environmental benefit at this stage). Given the importance of this policy objective as a route to buy-in with some stakeholders, we suggest that there is **additional focus on the potential impacts in future initiatives**.

The delivery and outcome monitoring process

Delivery leads explained that this Challenge had made a point of developing a thorough benefits map which enabled tracking outcomes at a Challenge level. This map includes the intended outcomes of all funded projects and activities and is reviewed regularly, which allows the Challenge to intervene if an activity is having difficulty in delivering its outcomes by providing support or finding new activities that can help to achieve that outcome. We recommend that **benefits maps are developed and used in a similar way for future initiatives** to support monitoring and evaluation**.**

Additionally, delivery leads and industry workshop participants considered that the delivery monitoring process was working particularly well, with quarterly review meetings with Monitoring Officers seen as helpful for ensuring that the project was progressing according to plan and for reviewing milestones and project risks. When Monitoring Officers engaged in technical discussion with project teams, this was highly valued. Monitoring Officers were also considered to be of assistance when it came to helping project teams navigate Innovate UK processes.

However, some improvements to the monitoring process were identified by industry workshop participants and delivery leads. Most notably, the process of submitting and approving project change requests (PCRs) could be made more efficient. We recommend **quicker turnarounds for PCRs,** to avoid delays. As industry workshop participants suggested, this could be achieved by **giving Monitoring Officers greater authority for approving these requests** as they are more likely to be familiar with the project and understand the need for the request.

Finally, improvements for the actual system used for monitoring, the Innovation Funding Service (IFS), were also identified. According to workshop participants, not all project members could see financial information on this system. From the point of view of the Challenge and the Monitoring Officers, there were also different levels of access to information on projects among the Challenge team and Monitoring Officers due to different levels of permissions being granted. This could lead to details such as PCRs being missed, which caused delays. We recommend that **permissions granted to Challenge team members, Monitoring Officers and project teams on the IFS system are reviewed for all projects to ensure that relevant parties have access to the information they need and avoid difficulty in accessing information and associated project delays.**

Overall, most processes were found to be in place and followed appropriately. However, some improvements could be made, as identified in this chapter, to ensure that the Challenge's processes are as efficient as possible, which in turn will allow the Challenge to deliver on its impacts.

2   The Future Flight Challenge

2.1   The rationale for the Future Flight Challenge

The future flight sector is a small but fast-growing part of the UK economy. It consists of organisations which are developing, commercialising, producing and supporting the deployment of technologies or services related to unmanned aerial systems (UAS), advanced air mobility (AAM) or regional electric conventional aircraft. The sector also incorporates the digital and physical infrastructure, systems of systems and regulatory frameworks that are necessary for the coherent development and operation of the sector.

There is substantial investment in future flight sector research and development (R&D) in the UK and globally. With its existing competitive advantages in regulation, design engineering, and digital and physical infrastructure, the UK has the ability to become a global market leader in a rapidly growing market.

However, a range of market failures and institutional barriers could prevent the UK from gaining an advantage. These include underinvestment in R&D by the private sector, regulatory barriers, air traffic management barriers, coordination barriers and infrastructure barriers. These market failures motivated the design of the Future Flight Challenge (FFC) intervention. Other challenges associated with supply chain disruptions, the war in Ukraine and the post-Brexit economy could also affect sector development.

2.2   The structure and objectives of the Future Flight Challenge

The FFC is a £300 million investment programme, which includes £125 million committed by the public sector as part of the Industrial Strategy Challenge Fund (ISCF), and a further £175 million of industry funding. The Challenge is supporting the development and commercialisation of technologies that could address mobility and congestion problems faced by an increasingly urban and ageing population and reduce the carbon footprint of the global aviation sector.

The FFC's business case identified four objectives for the FFC: increased business investment and additional R&D; safeguarding the UK aerospace advantage; delivering a reduction in aviation emissions; and realising economic benefits from mobility.

The Challenge provides grants to projects undertaken by industry consortia which address these problems. It also organises a range of supporting activities to facilitate knowledge exchange, support the development of regulatory frameworks, produce reports and provide strategic input to government policy.

The Challenge consists of three phases: a Discovery Phase from 2019 to 2020, a Development Phase from 2020 to 2022 and a Demonstration Phase from 2022 to 2024. The phases are closely linked.

2.3   Theory of change

The theory of change describes how the FFC is expected to transform inputs and activities into outputs, outcomes and impacts. The theory, summarised below, was developed collaboratively with the FFC as part of the wider evaluation framework report. We summarise the theory here as it was used to develop the set of evaluation metrics that are measured in this report, and therefore provides important context. More detail is available in the evaluation framework.

There are five categories of **input** to the FFC programme: funding from UK Research and Innovation (UKRI) and industry; staff time from the FFC, supporting agencies and industry; strategic plans and roadmaps from the transport sector and broader ISCF; FFC businesses cases, plans and institutional arrangements; and the existing R&D capacity, skills and supply chain in the UK.

Collectively, these inputs drive five categories of **outputs and activities**: three phases of competitions; knowledge exchange activities supported by the KTN; the development of a new regulatory framework supported by the CAA; strategic input to government policy making; and a range of reports, frameworks and supporting research. These are summarised in Section 4.

These in turn drive four categories of **immediate outcomes**: increased readiness of future flight technologies; improved collaboration within and between relevant sectors; the adoption of a new regulatory framework; and increased investment and R&D in the future flight sector. In many cases, these overlap with the five high-level objectives of the ISCF as a whole: increased UK business investment in R&D and improved R&D capability and capacity (ISCF1); increased interdisciplinary research (ISCF2); increased business-academic engagement on innovation (ISCF3); increased collaboration between younger, smaller companies and larger, more established companies up the value chain (ISCF4); and increased overseas investment in R&D in the UK (ISCF5).

FFC activities and outputs also directly influence a number of **future flight sector enablers** that sit outside the immediate Challenge. These include: coherent government policy; supporting infrastructure; skills and supply chains; social desirability; and demand for future flight technologies.[5]

These outcomes and enablers are all necessary conditions for the establishment of a competitive future flight sector in the UK – the primary **intermediate outcome** of the programme. They also accelerate the deployment of future flight technologies in the UK and ensure that these technologies are developed for UK-specific requirements. The ultimate **impact** of a competitive future flight sector will be to help safeguard the competitive advantage of the UK in the aviation and aerospace industries and to increase their contribution to the UK economy. The deployment of these technologies in the UK will also have **spillovers:** delivering economic and social benefits from increased mobility and reducing transport emissions.

The theory of change is summarised by the logic model in Figure 1.

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[5] Other enablers that are outside the control of the FFC include: the progress of competitors in the future flight market; related UK government interventions; and the effects of Brexit and other shocks to demand and investment.

Figure 1 FFC logic model

Inputs	Activities	Outputs	Immediate outcomes	Intermediate outcomes	Impacts
Funding	**Competition activities**	Consortia complete and report on R&D projects: mix of company types, regions and workforces	**Technology readiness**	**FFC technology clusters**	**Industrial benefits**
£125m UKRI funding, with £115m earmarked for grants and supporting agencies.	FFC conduct discovery phase competitions		Consortia advance technologies that address problem statements	Economic clusters producing FFC technologies are established in the UK: mix of company types, regions and workforces (consistent with levelling up and ED&I objectives)	Increased contribution of aviation and aerospace industries to the UK economy: including GVA, employment, exports and productivity
£175m (minimum) of industry match funding	FFC conduct development phase competitions	Consortia demonstrate technology, including multi-vehicle demonstrations at Farnborough 2024	Wider sector adv. technologies that address problem statements		
	FFC conduct demonstration phase competitions		**Collaboration**		
Staff time			Improved collaboration between industry and: regulators; govt; end-users; academia (ISFC3)		
FFC staff time	**Knowledge exchange activities**	Competition participants strengthen links with each other	Improved links between small and large companies (ISCF4)	↓	↓ Indirect impacts
Supporting agency staff time	FFC/KTN facilitate networking events for competition participants and winners	Competition winners form and strengthen links with other companies and stakeholders	Improved links between UK and international companies		
Industry and stakeholder staff time	FFC facilitate networking opportunities for the future flight sector, adjacent sectors and other stakeholders	Wider sector, including supply chain companies, better informed of FFC opportunities	**Regulatory adoption**	**Technology deployment**	**Socio-economic benefits**
			UK industry accelerates adoption of regulatory framework	Accelerated deployment of FFC technology in the UK: including transport modal switching and new-aviation services	Economic benefits from increased mobility/connectivity for passengers and freight (e.g. agglomeration benefits)
Institutional inputs	KTN facilitate knowledge exchange with sector: seminars, newsletters and social media	UK and international investors more informed of FFC opportunities	Other jurisdictions conform to the UK regulatory framework		Social and economic benefits from new aviation services (e.g. faster organ/tissue transport)
FFC governance arrangements			**Investment and R&D**	e.g. reducing passenger/ freight transport times; conducting survey flights	Health and safety benefits from new aviation services (e.g. reduced need for manned survey flights)
FFC Business Case and Delivery Plan	**Regulation activities**	Enhanced national regulatory frameworks for manufacturers and operators of FFC technologies	Increased investment in FFC technology companies		
	FFC provides additional funding to CAA		Increased UK and overseas investment in FFC technology R&D (ISCF1/5)	**Technology specification**	
Strategic inputs	CAA expands Innovation Hub and Regulation Team		Increased interdisciplinary R&D (ISCF2)	FFC technologies developed to meet UK-specific needs: including specific use cases for new aviation services and environmental targets	**Environmental benefits**
Broader UK Government Industrial Strategy			Increased government investment in FFC technologies		Reduced aviation emissions (e.g. accelerated deployment of hybrid-electric regional aircraft)
Transport sector strategic plans and roadmaps	**Reporting activities**	Reports and research outputs published and disseminated		e.g. propulsion technologies consistent with net zero targets; focus on connectivity between islands	Reduced ground transport emissions and air pollution (e.g. modal switching from non-electric cars)
	FFC draft safety framework		**Key enablers**		
	FFC commission enabling research and reporting	Industry and stakeholders aware of research findings (e.g. public acceptance surveys)	Coherent national and local government policy addressing the development and operation of FFC technologies		
Industrial inputs	ESRC coordinate FFC-related non-tech research outputs		Increased availability of supporting infrastructure		
Existing R&D capacity in FFC sector companies and universities	**Strategic activities**	Relevant national and local policy makers informed of industry policy needs	Growth in the supply chain for FFC technology inputs	**External barriers and enablers**	
Existing skills and supply chains	FFC staff engage with industry and stakeholders to understand key policy needs and feedback on government strategy		Growth in the skills required for FFC technologies	The establishment of FFC technology clusters in other countries	
Existing demand, use cases and market information	FFC share insights with national and local policy makers, inc. conducting cross-government forums	Industry and stakeholders aware of government policy direction	Improved public acceptance of FFC technologies	Macroeconomic factors that affect the competitiveness of the UK, including exchange rates, trade barriers (including with the EU) and transport costs.	
		FFC sector roadmap published and disseminated	Increased end-user demand for FFC technologies	Global shocks to demand and investment.	

Source: Frontier Economics.   Note: ISCF numbers refer to the five ISCF high-level objectives.

3   Evaluation approach

3.1   Purpose and structure of the interim impact evaluation

The theory of change set out in the evaluation framework report describes the narrative of how the FFC is expected to transform inputs and activities into outputs, outcomes and impacts.[6] The evaluation framework translated this theory of change into 11 evaluation themes that structure the impact evaluation of the FFC.

Some of the evaluation themes include shorter-term outcomes of the FFC (i.e. themes that are likely to have material and measurable outcomes by 2022). We analyse early findings in these themes in greater depth in this report:

1. Has the technological readiness of future flight technologies been progressed as a result of FFC?
2. Has the FFC increased collaboration within the future flight sector, and between the sector and other stakeholders?
3. Has the CAA [Civil Aviation Authority] developed a set of robust regulatory frameworks to support the future flight sector?
4. Has the FFC increased investment and R&D in future flight technologies?
5. Has the FFC helped to shape a coherent government policy that supports the development and operation of future flight technologies in the UK?

A second set of evaluation themes focus on medium- and long-term effects, where the impact of the FFC is expected to be measurable from 2024 onwards. We adopt a light-touch monitoring approach to summarising preliminary evidence in these areas:

6. Has the FFC helped to improve public attitudes to future flight technologies?
7. Has the FFC helped to build the skills needed to support future flight technologies?
9. Has the FFC helped to encourage a diverse future flight sector? [7]

A third set of evaluation themes focus on longer-term outcomes and impacts, and at this stage it is too early to assess these areas. These themes are not analysed in this report:

8. Has the FFC accelerated the formation of economic clusters developing and producing future flight technologies in the UK?
10. Has the FFC accelerated the deployment of future flight technologies in the UK, leading to economic and social benefits?
11. Has the FFC increased the contribution of aviation and aerospace sectors to the UK economy?

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[6] The evaluation framework was completed in the first quarter of 2021, and the framework was updated with input from the FFC in summer 2022.

[7] The theme numbering reflects the ordering in the baseline evaluation report. We include monitoring of Theme 9 but not Theme 8 in this report.

All evaluation themes will be assessed in the final impact evaluation in 2024.

The evaluation themes were developed and refined collaboratively with FFC stakeholders and are designed to cut across the theory of change in terms of the various activities, outputs, outcomes and impacts identified. For each theme, the evaluation seeks to understand the contribution the FFC makes to driving benefits over and above those which would have happened without the Challenge being established. To facilitate this, the evaluation requires measuring the current position against a the 'baseline' position for each theme. Sitting underneath each theme are several specific metrics used to support this analysis.

Importantly, **the interim impact report represents preliminary evaluation findings.** Across many themes and metrics, data collected at later stages of the evaluation will be needed to draw more robust conclusions. Many of the full effects of the FFC on the sector will take time to be fully realised, either because the FFC activities in that area are currently in progress or because the impacts take time to fully develop. However, some of the metrics and data gathered as part of the interim impact evaluation do contain early insights into the perceived impact of the FFC to date.

For a few metrics that were added to the evaluation during the review in summer 2022 (i.e. after the baseline evaluation report), this report baselines those metrics.

3.1.1   Evidence sources for the interim impact evaluation

Four key sources of evidence are used to measure the impact of the FFC. These are:

■   A survey of future flight sector organisations;

■   Interviews with future flight sector stakeholders;

■   A portfolio review of Development and Demonstration Phase projects; and

■   FFC monitoring data.

Survey of future flight sector organisations

The survey was conducted mostly with industry and academic institutions that had engaged with the FFC by applying to FFC competitions and some organisations that began the process of applying for FFC funding but did not submit bids. There were also two respondents that were identified as being involved in the future flight sector but that had not engaged with the Challenge. Based on discussions with Challenge stakeholders and expert input from Frazer-Nash Consultancy, we understand that this sampling frame provides a good proxy for the types of companies being targeted by the FFC. Slightly different scripts were used for each of these groups.

Fieldwork took place between 27 September and 11 November 2022. An online link to the survey was sent out to contacts, followed by three email reminders to encourage participation. To maximise response rates, telephone chasing was also used to encourage participation for contacts where telephone numbers were available. The full, de-duplicated sample for the survey consisted of 1,179 individuals. A total of 197 respondents completed the latest iteration of the survey (95 by telephone

and 102 online), giving a response rate of 17%. The baseline survey was conducted between December 2020 and January 2021. Throughout the report, the results of the interim survey are compared to the baseline where possible.

Table 1 shows the response rates against the different types of engagement with the Challenge. These are shown both for the baseline survey and the interim iteration of the survey.

Table 1   Response rate by main engagement with the Challenge

	Completed interviews – interim survey	Interim survey response rates	Completed interviews – baseline survey	Baseline survey response rates
All applications accepted	57	13%	84	19%
A mix of accepted and rejected applications	39	26%	17	25%
All applications rejected	66	18%	48	24%
All applications not completed/submitted	33	14%	5	3%
Not applicants	2	50%	N/A	N/A
Total	**197**	**17%**	**154**	**17%**

By comparing baseline and interim views, we can observe trends in the sector between 2020 and 2022. We note item responses that had statistically significantly different rates in the baseline and interim surveys. In cases where a particular item response was statistically significantly more or less likely in the interim versus the baseline, this means that the sample size is large enough to statistically detect a trend over time. However, the magnitude of the change is an important indicator of material changes (in other words, a small immaterial change could be statistically significant if the sample size is large). For this reason, in our analysis and commentary, we focus on comparing magnitudes between survey items and between survey waves.

Within the survey, respondents were asked to select from a list the response that they thought best described their organisation in relation to the future flight sector. They were only able to select one response. Figure 2 shows how the individuals who completed the survey categorised their organisation in relation to the future flight sector.

The distribution of organisation types was similar between the interim and baseline surveys.[8] Those in the largest group described themselves as technology developers (31%), followed by researchers

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[8] In the following figure, and in subsequent similar figures, statistically significant differences in the response rates for particular survey responses are marked with an asterisk (*). The distribution of organisation types did not have any statistically significant differences between the baseline and interim surveys.

(19%), service providers (13%) and technology integrators (11%). For the purposes of subgroup analysis the remaining responses were combined into an overall 'other' category, consisting of the remaining 24% of respondents.
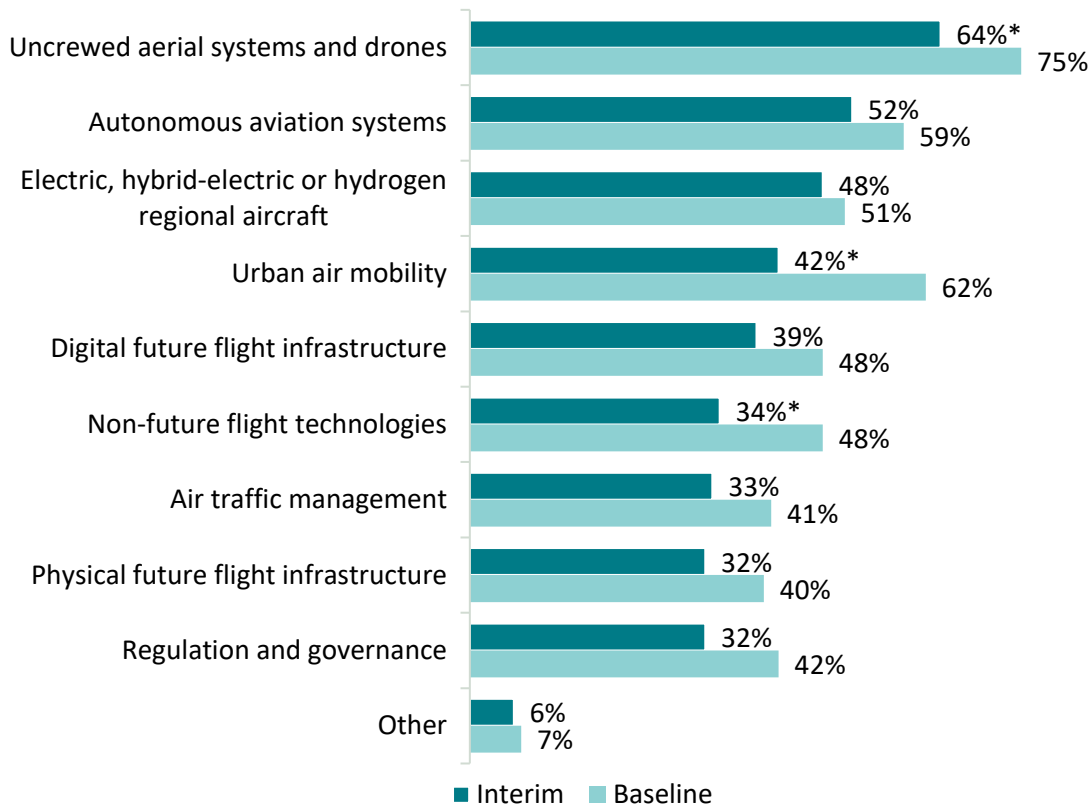
Figure 2   Involvement with the future flight sector
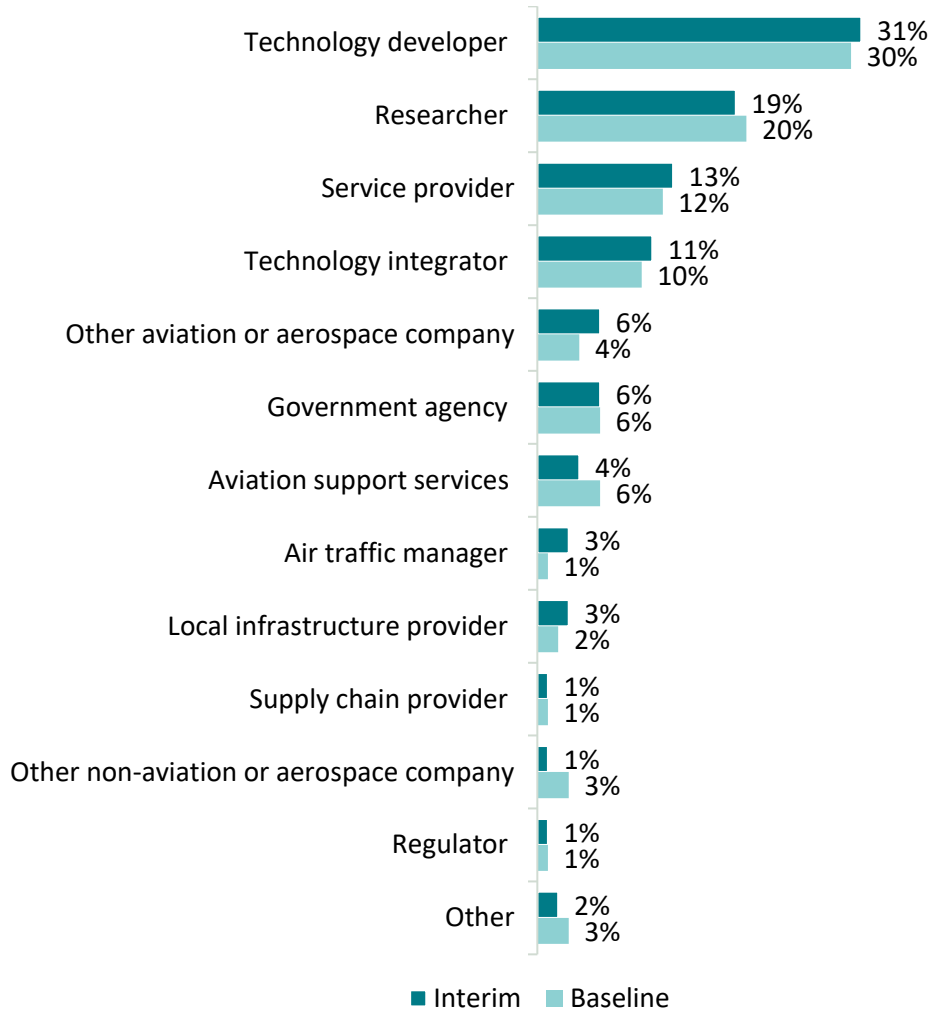
Category	Interim	Baseline
Technology developer	31%	30%
Researcher	19%	20%
Service provider	13%	12%
Technology integrator	11%	10%
Other aviation or aerospace company	6%	4%
Government agency	6%	6%
Aviation support services	4%	6%
Air traffic manager	3%	1%
Local infrastructure provider	3%	2%
Supply chain provider	1%	1%
Other non-aviation or aerospace company	1%	3%
Regulator	1%	1%
Other	2%	3%

■ Interim   ■ Baseline

Source: *Contact survey. A1. Which of the following best describes your organisation in relation to the future flight sector?*
Note: *Base: all respondents (Interim survey: 197, Baseline 154).*

Figure 3 shows the areas of design and development in which respondent organisations and research groups specialised. The most common specialisms were uncrewed aerial systems and drones (64%), autonomous aviation systems (52%), and electric, hybrid-electric or hydrogen regional aircraft (48%). In the interim survey, compared with the baseline, fewer organisations identified with each specialism, across all specialisms. The increased self-reported specialisation is consistent with the expert view that future flight organisations are increasingly working on fewer, larger contracts at a higher TRL in a narrower area. Fewer collaborations between organisations are needed by companies progressing toward commercialised technologies.

Figure 3   Areas of focus of respondent organisations and research groups

Area	Interim	Baseline
Uncrewed aerial systems and drones	64%*	75%
Autonomous aviation systems	52%	59%
Electric, hybrid-electric or hydrogen regional aircraft	48%	51%
Urban air mobility	42%*	62%
Digital future flight infrastructure	39%	48%
Non-future flight technologies	34%*	48%
Air traffic management	33%	41%
Physical future flight infrastructure	32%	40%
Regulation and governance	32%	42%
Other	6%	7%

■ Interim ■ Baseline

Source: Contact survey. A3. Which of the following areas does your organisation or research group focus on in relation to the design and development of future flight technologies?

Note: Base: valid responses, all respondents (Interim survey: 196, Baseline: 154). Figures with asterisks are statistically significant between baseline and interim at the 95% confidence level.

Respondents who had completed a competition application were asked which phase of the FFC their organisation had been involved with, taking account of all applications for funding whether they were successful or not, including any applications that were started but not submitted.

Of those who provided a response (154 respondents), two in three (66%) had been involved with the Development Phase, a similar proportion (64%) had been involved with the Demonstration Phase, and over half (55%) had been involved with the Discovery Phase. All had been involved with more than one phase. Researchers were more likely than average to have been involved at the Discovery Phase (71%), as were those who had been involved with regulation and governance (69%) and urban air mobility (66%).

Stakeholder interviews

The survey focused on understanding the magnitude of a set of expected FFC outputs and outcomes. Qualitative interviews complemented the survey by clarifying how and why these effects occurred, and by providing evidence about unexpected or unintended effects.

The categories of stakeholders in Table 2 were interviewed on impact evaluation themes. The interviews and workshops were semi-structured.

Table 2   Stakeholders interviewed

Organisation type	Organisations interviewed
UK government	Department for Transport, Civil Aviation Authority
Future flight or aerospace funding body	Future Flight Challenge, Connected Places Catapult, Nesta, ESRC
Industry	Interviews with 2 UK companies; short workshop sessions with 13 individuals who had applied to the Challenge (10 successful applicants, 3 unsuccessful applicants, all from different organisations)
International future flight funding body	NASA

Source: Frontier Economics

ANNEX B provides more detail on the topic guides used in these interviews.

Portfolio review of Development and Demonstration Phase projects

Frazer-Nash Consultancy conducted a review of the portfolio of Development and Demonstration Phase projects in autumn 2022. The objectives of this independent review were to understand the intended impacts of funded activities, assess them against FFC stated objectives, and identify alignments and gaps. This report references findings of the portfolio review where relevant for the impact evaluation themes.

Monitoring data

Internal FFC monitoring data summarised in Table 3 supplements the above evidence by documenting the activities and outputs that occurred in order to achieve outcomes. This report includes key pieces of monitoring data that the Challenge collected between 2020 and 2022.

Table 3   FFC monitoring data sources used in interim impact evaluation

Evidence	Description
Benefits surveys	The FFC collected benefits survey data from Development Phase consortia in 3 waves over 2021 and early 2022

Evidence	Description
Co-investment survey	The FFC fielded co-investment surveys of Development Phase consortia; the data we use was collected in June 2022
KTN contact and activity information	KTN activity records of introductions and events, as of August 2022

Source: Summary of FFC monitoring data

3.2   Purpose and structure of the process evaluation

Process evaluation aims to understand how an intervention was delivered and to identify the factors that helped or hindered its effectiveness.

While impact evaluation is helpful in isolating the outcomes and impacts caused by an intervention, it is less useful for explaining why these occurred or if they might have occurred differently in other circumstances. Process evaluation provides context to help evaluators understand, amongst other things:

- How the intervention was delivered and in what context;
- Who was responsible for delivering the intervention and how decisions about implementation were made;
- What parts of the interventions were most critical to delivering planned outcomes and impacts;
- What parts of the process worked well, and what parts worked less well;
- How the intervention was experienced by participants and the delivery group; and
- How it could be improved in the future.

3.2.1   Process evaluation themes

The process evaluation was organised around four broad **process evaluation themes**:

1. The management and governance of the FFC
2. The structure and delivery of the FFC competitions
3. The design and implementation of engagement activities
4. The delivery and outcome monitoring process

Within each theme, we developed a set of process evaluation questions to be explored and success indicators, and we identified data sources or methodologies to answer the questions. Our approach used a survey, industry workshops and delivery group workshops across all themes, with relevant accounting and other monitoring data being used for some themes. In some cases, the evaluation

questions were specifically about the processes around the Challenge; in others, they spoke to how processes related to impacts.

The management and governance of the FFC

This theme focuses on the overall governance and programme management, including risk management and financial accountability.

Table 4   Process evaluation questions: programme management

Evaluation question	Success indicators	Data sources
a) To what extent is the programme building on previous investments and interventions in the wider sector?	Evidence that learning from past experience has been used in delivery planning.	Delivery group workshop
b) How effective was the programme governance structure in steering the programme?	Decisions regarding the Challenge were made at the right level in a timely manner.	Delivery group workshop
c) Did the Challenge meet budgetary expectations?	The Challenge met its business case as anticipated, without unforeseen issues or additional costs.	Delivery group workshop accounting data
d) To what extent did the Challenge meet its target outputs efficiently and effectively?	Available resources were used effectively and efficiently, compared to other Challenges.	Delivery group workshop
e) How effectively has the programme identified and mitigated risks?	If risks materialise, no evidence that risk management processes could have identified and/or mitigated the risk.	Delivery group workshop
f) Did the due diligence process effectively identify projects with unacceptable levels of technical or project delivery risks (including risk of applicant's financial failure)?	If project failures occurred, no evidence that due diligence could have identified and/or mitigated the failure.	Delivery group workshop
g) How effectively did the different activities and workstreams of the programme work together and make the programme as a whole more effective as opposed to delivering individual strands?	Evidence of iterative learning and development across the workstreams.	Delivery group workshop
h) What are the unique/innovative features of the programme delivery?	N/A	Delivery group workshop

The structure and delivery of the FFC competitions

This theme focuses on the design and implementation of the competition activities, with an emphasis on how the structure of the phases and 'gates' between phases helped facilitate outcomes and impacts.

Table 5 Process evaluation questions: competitions

Evaluation question	Success indicator	Data sources
a) To what extent has the design and delivery of the programme – including the three-phase structure of competitions – enabled the programme to achieve its objectives?	Participants perceive that the development achieved has been enabled by the competitions and the structure of the competitions: they view the Challenge as a unique catalyst. They acknowledge the approach was valid.	Industry survey Industry workshops Delivery group workshop
b) To what extent did the six problem statements mature and provide effective guidance to interested parties?	Participants can identify the problem statements and continue to find them useful throughout the Challenge.	Industry workshops Delivery group workshop
c) To what extent and how did the systems of systems approach help consortia to identify problems to address?	Subsequent enterprise architecture work identified very few aspects that were not identified at the start of the Challenge.	Industry workshops Delivery group workshop
d) Did the Discovery Workshop support the formation of consortia?	Participants identified new partners at the Discovery Workshop.	Industry survey Industry workshops
e) To what extent and how has the design of the programme enabled consortia developed for Phase Two to move into Phase Three?	Evidence of consolidation among the consortia both within the Challenge and amongst those not selected for Phase Three outside the Challenge.	Industry survey Industry workshops Delivery group workshop Analysis of consortium membership
f) How were the different competitions within in each phase aligned to complement one another and add value?	Evidence that different types of companies, consortia and R&D projects formed across strands, including R&D projects that may not have been funded if strands were combined.	Delivery group workshop Analysis of consortium membership
g) In moving from Phase Two to Phase Three, was the rationale for a gate (the competition break between phases) valid?	Evidence that the gate added value either by ensuring the right participants moved forward into Phase Two or that participants excluded as a result of the gate subsequently proved not to be viable.	Delivery group workshop

The design and implementation of engagement activities

This theme focuses on how the design and implementation of the FFC supported engagement and knowledge exchange with a wide variety of organisations and on collaboration between those organisations.

Table 6   Process evaluation questions: engagement

Evaluation question	Success indicator	Data sources
a) To what extent and how did the structure and delivery of the programme encourage collaboration between types of organisations?	Intervention specifically encourages collaboration, including with academics, non-aviation sector companies, international companies and small/large companies.	Industry survey Industry workshops
b) To what extent and how has the design of the programme facilitated reaching target competition participants, and what were the consequences and implications of these successes/failures?	Evidence that the Challenge has reached and was able to engage successfully with the full range of target organisations.	Delivery group workshop
c) To what extent and how has the design of the programme facilitated engaging with wider stakeholders in the business and academic community to support the delivery of the programme?	Evidence that the Challenge has reached and was able to engage successfully with a range of wider stakeholders in addition to target competition participants.	Delivery group workshop
d) To what extent and how has the design and governance of the programme facilitated multidisciplinary working?	N/A	Industry survey Industry workshops Delivery group workshop
e) How does the programme align with or complement other government initiatives? (i.e. Future Mobility Grand Challenges, Sector Deals, 2.4% R&D expenditure objective or other initiatives)?	Organisations can demonstrate that complementary funding enabled greater innovation. Evidence of engagement between FFC and the management teams of related initiatives.	Industry survey Industry workshops Delivery group workshop

The delivery and outcome monitoring process

This theme focuses on how delivery and outcomes are monitored. Table 7 describes the evaluation questions, success indicators and data sources for this theme.

Table 7   Process evaluation questions: monitoring

Evaluation question	Success indicators	Data sources
a) How well does delivery monitoring enable the FFC to respond to delivery or performance issues promptly and effectively?	Projects progress as anticipated or have been stopped or changed early with little or no wasted time or resources.	Industry workshops Delivery group workshop
b) How well does outcome monitoring enable the FFC to understand if the programme is on track to deliver impacts?	Evidence that the Challenge management was able to identify issues early and resolve them effectively. Evidence that monitoring tracks outcomes (such as collaboration and technical progress).	Industry workshops Delivery group workshop
c) Did the benefits management approach prove sufficiently timely to enable change during the programme to ensure delivery of the objectives?	Evidence that the benefits management process enabled adjustments with the programme both at Challenge level and within consortia.	Delivery group workshop
d) How and to what extent was delivery and outcome monitoring adapted to meet changing requirements?	Evidence that the Challenge modified monitoring if it was found to be insufficient.	Delivery group workshop
e) What improvements can be made to delivery monitoring and outcome monitoring?	N/A	Delivery group workshop

3.2.2   Evidence sources for the process evaluation

We gathered and analysed five main sources of data for the process evaluation:

1. A **contact survey** of organisations that had engaged with the Challenge;
2. **A workshop** with those responsible for the delivery of the Challenge (delivery group workshop);
3. **Three workshops** with three successful consortia;
4. **A workshop** with unsuccessful applicants; and
5. **Monitoring data** collected by the Challenge.

This section provides an overview of each data source.

Contact survey

A bespoke survey was developed by BMG in collaboration with Frontier Economics, Frazer-Nash Consultancy and the FFC to explore the evaluation indicators and contextual issues highlighted in the theory of change. It contained both process and impact questions. The survey is described in Section 3.1.1 and in further detail in Annex A.

Workshops with successful consortia

Workshops are useful for collecting information from a group of stakeholders on their attitudes, perceptions and experiences in a way that allows participants to build and reflect on each other's contributions. This iterative process allows views to be validated, and it is particularly useful for exploring and testing themes identified in industry surveys.

Three workshops with successful consortia were conducted by BMG as part of the process evaluation. Successful consortia were chosen from the Development Phase, as it was completed before our fieldwork and participants could comment on their complete experience of the Phase. Organisations that were only involved with the Demonstration Phase would have only been able to comment on the first few months of that phase, and so were not included in workshops. Two of the consortia that took part in the workshops had been successful in the Development Phase only, while the third consortia had been funded for both phases. In total, ten participants from successful consortia participated in online workshops. Fieldwork for the workshops with successful consortia took place between 28 October 2022 and 13 January 2023.

The workshops were structured around the process evaluation themes and questions described in Section 3.2.1. The workshops both explored themes from the survey in further detail and gathered evidence for more qualitative indicators that were not addressed in the survey. The facilitators framed questions to focus on the processes and activities of the Challenge, rather than on the impact of these activities. The workshops were semi-structured, following a 'skeleton' topic guide that set out the topic areas to be covered. The workshops covered topics such as application process efficiency, collaboration, progression between phases, industry engagement, strategic alignment and monitoring. Please see Annex B for the topic guides used.

Workshop with unsuccessful applicants

Successful and unsuccessful consortia may have different experiences and views on the evaluation themes and, to gather balanced evidence, BMG also conducted a workshop with unsuccessful lead applicants. This workshop was held online in October 2023. Three participants attended.

As with the workshops for successful consortia, this workshop was semi-structured, following a 'skeleton' topic guide that set out the topic areas to be covered. The same themes were discussed in both the successful and unsuccessful applicant workshops and, where possible, the same questions were also used. Some adaptions were needed to make the questions relevant to unsuccessful applicants. Please see Annex B for the topic guides used.

Workshop with delivery leads

To understand the perspective of the Challenge, a workshop was conducted with a delivery group of individuals responsible for coordinating the Challenge. This workshop was conducted remotely by BMG on 11 October 2022.

In total, five delivery leads attended this workshop. These individuals were involved in a range of programme delivery activities, including procurement, competitions, project monitoring, diversity and inclusion, skills and overall programme delivery.

The workshop was semi-structured, following a 'skeleton' topic guide that set out the topic areas to be covered. Topics covered areas such as the design and delivery of the programme and different phases, governance, budgetary expectations, risk management, external engagement, strategic alignment and agility. Please see Annex B for the topic guides used.

Monitoring data

Monitoring data was used in the process evaluation to examine the composition of the consortia that bid in each competition, including which organisations were involved and whether projects had transitioned from the Development Phase to the Demonstration Phase.

This information, alongside responses to the survey and workshops, helped us to understand how consortia developed between the strands and phases of the Challenge, and how the strands and phases were aligned with one another.

In addition, management accounting data on the expenditure of the FFC was analysed to draw descriptive conclusions on whether budgeting objectives were being achieved.

4   Interim impact evaluation findings

The findings are presented by theme. In each case the following are summarised:

- **Key messages** that highlight the main interim impact evaluation findings;
- **Aims and activities** of the FFC, summarising what the FFC intended to achieve in this area and the activities it has conducted, including monitoring evidence; and
- **Evaluation evidence** summarising survey data, monitoring data and stakeholder interview evidence, on observed trends to date. For Themes 1-5, which have short-term outcomes, we also include evidence about the extent to which these developments can be attributed to FFC activity, along with barriers to and enablers for achieving the intended effects.

Before presenting evidence relating to each theme, a summary of barriers to and enablers of the development of the future flight sector was considered as context for the findings.

4.1   Barriers to and enablers of the development of the sector

The FFC interventions interact with many other factors that influence sector outcomes. Understanding barriers to and enablers of future flight development contextualises the evidence of FFC effects.

In the baseline and interim impact evaluation surveys, respondents were asked about the extent to which they perceived the following set of potential factors to be either a barrier to or an enabler of the development of the future flight sector. The baseline survey included ten potential factors and the interim survey also included four additional potential barriers/enablers: (1) geopolitical instability, (2) the size of the future flight workforce, (3) cost of inputs to production, and (4) local authority engagement. These were added based on expert input from Frazer-Nash that these four factors had become increasingly salient to sector development.

The main findings are shown below in Table 8. The factors are ordered by the rate at which respondents reported the factor to be a barrier in the interim survey.

In the interim survey, three factors were reported by the majority of respondents to be barriers to the sector: the cost of inputs to production (68%), COVID-19 (60%) and the regulation of future flight technologies (57%). For all factors surveyed at both the baseline and interim surveys, the rate at which respondents reported that the factor was a barrier increased. The largest individual increases in the rate of reporting the factor as a barrier were: supply chain (increase of 25%) and workforce skills (increase of 22%), suggesting that these issues are increasingly constraining sector development.

As organisations develop the maturity of their technologies, considerations around a serviceable solution may begin to unfold. Upscaling technology development requires the appropriate level of supply chain to support acceleration to market. The process of understanding and enabling a resilient supply chain requires forward-thinking and preparation, as the need for its definition becomes more

important as technologies progress. This may be the reason for the increase of awareness from the interim survey.

Industry, regulators and government will all need to adapt in order to support the ongoing development of the sector. A key element will be upskilling their workforces to support the growth of the new future flight sector, which may have contributed to the survey trend from baseline to interim evaluation.

The lowest increase in the rate of reporting the factor as a barrier were public perceptions of future flight technologies (increase of 3%). Although a low increase was observed, this could be due to a balance of opposing drivers. As technology approaches initial entry into service, higher percentages of the general public will begin to form their views on technology based on available data. This makes the need to provide accurate and approved information important, to ensure that a positive reception is achieved and the benefits are observed. A negative public view would be detrimental to the sector, affecting both investment and predicted economic models. This could lead to a significant barrier and, in isolation and with no opposing factors, this driver could lead to an increase in the factor's perception as a major barrier. There is, however, evidence of investment across both government and industry to better understand the perceptions of the general public at an early stage. This includes FFC Phase 3 projects hosting engagement events with the public to discuss future flight technologies and their applications as part of their wider demonstration activities. This approach helps to structure the right information relating to technologies, use cases and operations, allowing the public to fully understand the latest aviation revolution in more detail and engage with the sector so that their views are understood.

The same balance can be observed with government policy; responses may reflect both positive expectations about investment in industrial policy (see discussion in Section 4.6) and concerns that policy has the potential to halt sector development if not addressed in a timely way.

In the interim survey, there were four factors that a majority of respondents reported to be enablers for the sector: government funding or investment (68%), private sector investment (67%), workforce skills (55%) and government policy (53%). For all factors surveyed at both the baseline and interim surveys, the rate at which respondents reported that the factor was an enabler decreased. Many factors had similar decreases in the rate of reporting the factor as an enabler, but the three largest decreases were: COVID-19 (decreased by 20%), workforce skills (decreased by 20%) and supply chain (decreased by 19%). This corresponds with the increased rate at which these factors were reported as barriers.

Table 8   Barriers and enablers to the progression of the future flight sector

Factor	Barrier/Enabler	Baseline	Interim
Cost of inputs to production	Barrier	N/A	68%
	Enabler	N/A	13%
COVID-19	Barrier	49%	60%*
	Enabler	41%	21%*
Regulation of future flight technologies	Barrier	42%	57%*

	Enabler	50%	35%*
Geopolitical instability, such as the war in Ukraine	Barrier	N/A	46%
	Enabler	N/A	29%
Size of the future flight workforce	Barrier	N/A	46%
	Enabler	N/A	41%
Public perceptions of future flight technologies	Barrier	38%	41%
	Enabler	39%	39%
Supply chain	Barrier	16%	41%*
	Enabler	65%	46%*
Workforce skills	Barrier	18%	40%*
	Enabler	75%	55%*
Government policy toward future flight technologies (e.g. planning rules, environmental targets)	Barrier	28%	38%
	Enabler	63%	53%
Local authority engagement	Barrier	N/A	37%
	Enabler	N/A	44%
Pace of development of FFC technologies in other countries	Barrier	18%	34%*
	Enabler	68%	49%*
Private sector investment for the future flight sector	Barrier	15%	29%*
	Enabler	80%	67%*
Government funding or investment	Barrier	12%	27%*
	Enabler	86%	68%*

Source: *Contact survey. C5. For each of the following, please indicate whether you think they are a barrier or enabler to the progression of future flight technology in the UK.*

Note: *Base: valid responses. Figures with asterisks are statistically significant between baseline and interim at the 95% confidence level.*

4.2 Theme 1 - Has the technological readiness of future flight technologies been progressed as a result of FFC?

4.2.1 Overview

To assess this theme, we analysed the metrics summarised in Table 9**.**

Table 9   Theme 1 - evaluation metrics

Subtheme	Metric	Data source
	TRL at the start and end of engagement with the FFC	Survey data; monitoring data

Subtheme	Metric	Data source
Effect of competition participation on consortia technology readiness	Effect of competition participation on technology readiness	Stakeholder views
Effect of the Challenge on technology readiness in the wider flight sector	Extent to which FFC has accelerated the development of future flight technologies	Survey data; stakeholder views
Ease of conducting demonstrations	Efficiency of CAA approval process for conducting demonstrations	Survey data; stakeholder views
	Extent to which the CAA's demonstration approval process supports future flight innovation in 2019 vs currently	Survey data; stakeholder views

Source: Frontier Economics

Theme 1 – Key messages

■ Survey findings suggest that competition consortia that were funded in the Development Phase have increased their technological readiness.

■ Survey and qualitative evidence suggest that the FFC has accelerated technological development in the wider sector, particularly in technologies that already had a high or medium TRL (e.g. BVLOS and eVTOLs), and 'non-core' technologies

■ Industry stakeholders highlighted two key enablers of future technology progression: (1) the development of the underlying digital and physical infrastructure to support the introduction of new classes of electric or autonomous air vehicles, and (2) an increase in CAA capacity in order to facilitate conducting trials and demonstrations and entering an in-service phase. Some consortia stakeholders interviewed reported that difficulties obtaining BVLOS demonstration approval within Demonstration Phase timelines had prevented the consortium from achieving some project objectives.

4.2.2 Aims and activities

A key objective of the FFC is to accelerate the technological and commercial maturity of future flight technologies, often measured and monitored by the TRL,[9] focusing on six problem statements that the UK flight sector needs to address in delivering the economic, societal and environmental benefits of new aviation technologies.[10] The FFC aims to support technological readiness by funding competition winners and by accelerating knowledge transfer in the wider future flight sector.

In the Development and Demonstration Phases of the competition, the FFC allocated approximately £100 million to grants for 65 projects. In the Development Phase, the FFC allocated £33.5 million to 48 projects distributed in three strands. Winning consortia undertook R&D into enabling system capabilities to support the introduction of new classes of electric or autonomous air vehicles. In the Demonstration Phase, the FFC allocated £73 million to 17 projects which aimed to deliver live demonstrations in representative environments with real use cases involving UAS, AMM and electric regional aircraft. A key aim in the Demonstration Phase is to enable cross-cutting technologies that are essential to support the safe and effective operation of new classes of electric or autonomous air vehicles.

The Frazer-Nash portfolio review of Development and Demonstration Phases assessed the extent to which the project portfolio targeted the priority areas identified in the Future Flight Vision and Roadmap.[11] Overall, the review found that the portfolio strongly covered the areas of intellectual property, digital infrastructure and communications. Although a smaller number of projects addressed vertiports, energy infrastructure and future flight skills training, the review noted that these areas were likely to be progressed given qualitative assessment of the projects involved. Relatively few projects focused on air vehicle powertrain and electronic conspicuity. The review noted that electronic conspicuity is understood to be a key enabler of BVLOS operations and that this area may be a useful focus for targeted future investment. This is further supported by the recommendations of the FAIWG-AI 'Let's Get Flying' report.

Advancements in TRL are expected to contribute directly to the development of future flight clusters and accelerate the deployment of future flight technologies that meet UK-specific requirements. An important enabler for achieving these outcomes is the regulatory readiness of the sector, particularly the existence of regulatory sandboxes for competition winners to develop and test their technologies in a safe and controlled environment.

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[9] The highest level indicates a fully functioning and flight proven system in service. For descriptions, see
https://www.ukri.org/councils/stfc/guidance-for-applicants/check-if-youre-eligible-for-funding/eligibility-of-technology-readiness-levels-trl/

[10] The problem statements are: (1) Drone applications stifled by absence of physical and data infrastructure; (2) Current air traffic management systems are not scalable; (3) No clear technology, regulatory or operational integrated paths between VLOS and BVLOS, and fully autonomous air vehicle operations; (4) Need to move towards more electric flight by creating pathways between urban, sub-regional class vehicles and larger aircraft; (5) Need to develop use cases and operational frameworks to enable public engagement and market demand; (6) Lack of innovation or development environment that allows real-life demonstrations and evaluation of these problem statements
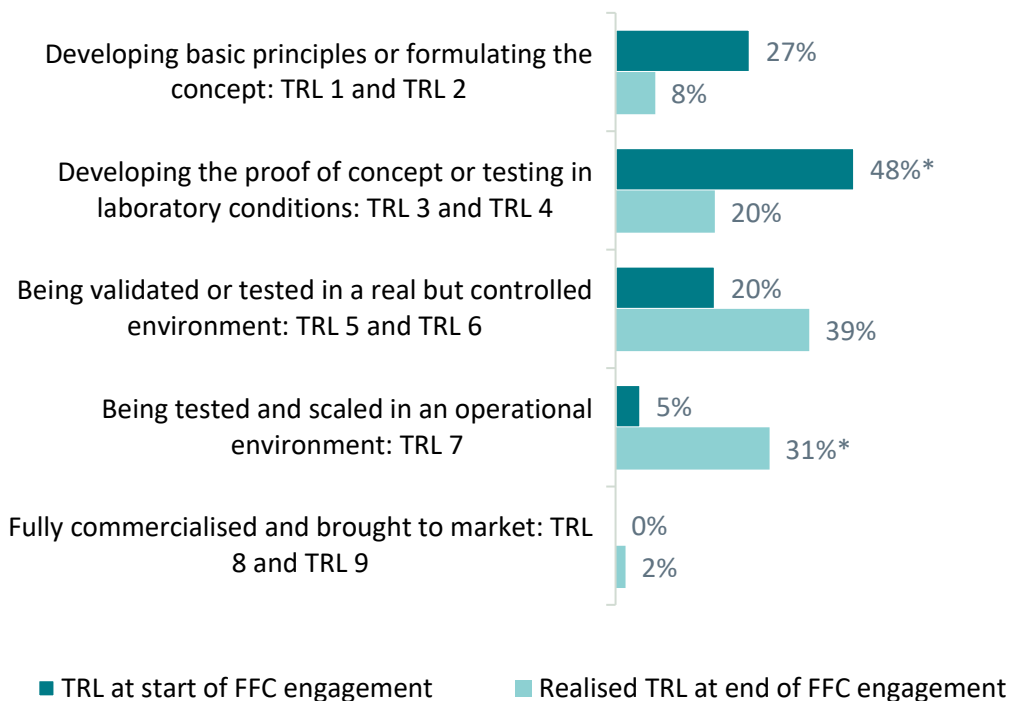
[11] https://www.ukri.org/publications/future-flight-vision-and-roadmap/

4.2.3 Evaluation evidence

Effect of competition participation on technology readiness

All respondents with a project funded by the FFC were asked for their TRL at the start of their engagement with the FFC. Respondents who took part in the Development Phase were asked about the realised TRL of their project at the end of the Development Phase, while those who took part in the Demonstration Phase were asked about the TRL they expected their projects to achieve at the end of the Phase.

Among survey respondents in Development Phase consortia, the proportion of projects with TRL of 1 or 2 was 27% at the start of the Phase and 8% at the end of the phase; for TRL 3 or 4 the proportion fell from 48% to 20%; for TRL 5 or 6 the proportion increased from 20% to 39%; for TRL 7 the proportion increased from 5% to 31%; and one project reported achieving a TRL of 8 or 9.

Figure 4 TRL at the start and end of engagement with the FFC: Development Phase

Developing basic principles or formulating the concept: TRL 1 and TRL 2	27% / 8%
Developing the proof of concept or testing in laboratory conditions: TRL 3 and TRL 4	48%* / 20%
Being validated or tested in a real but controlled environment: TRL 5 and TRL 6	20% / 39%
Being tested and scaled in an operational environment: TRL 7	5% / 31%*
Fully commercialised and brought to market: TRL 8 and TRL 9	0% / 2%

■ TRL at start of FFC engagement   ■ Realised TRL at end of FFC engagement

Source: *Contact survey. D9. At the start of your engagement with the FFC, what stage of development was the technology at in terms of Technology Readiness Level (TRL)? D10. And what stage do you expect the technology to reach at the end of period covered by the FFC funding? D13. After your engagement with the FFC, what stage of development was the technology at in terms of TRL?*

Note: *Base: valid responses, successful applicants, Development Phase (Interim survey: D9:69, D13: 51). Figures with asterisks are statistically significant between baseline and interim at the 95% confidence level.*

Figure 5 below shows a summary of TRL progression among successful applicants involved in the Development Phase, from the start of the respondents' engagement with the Challenge to the TRL

that was realised at the end of the Development Phase. Over six in ten (63%) of those involved in the Development Phase reported that the TRL achieved at the end of their engagement with the Challenge was higher than at the start of their engagement. Around one in three (35%) said that the TRL had stayed the same as at the start of their engagement with the Challenge.

A very small minority (2%) said that the TRL realised at the end of their engagement with the Challenge was lower than at the start. This is likely due to respondents selecting the wrong answer for either of these questions.

Figure 5   TRL at the start and end of engagement with the FFC: Development Phase
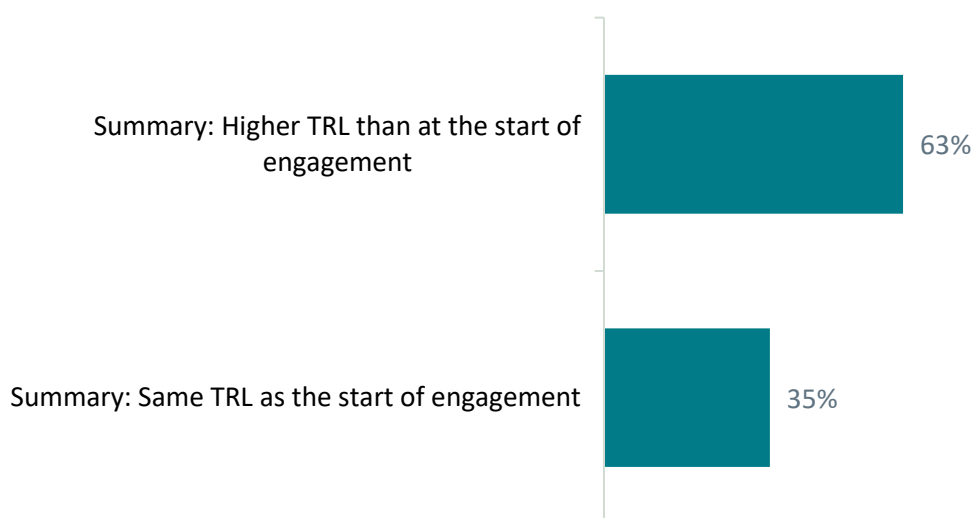
Source: *Contact survey. D9. At the start of your engagement with the FFC, what stage of development was the technology at in terms of Technology Readiness Level (TRL)? D13. After your engagement with the FCC, what stage of development was the technology at in terms of TRL?*

Note: *Base: valid responses, successful applicants, Development Phase (Interim survey: D9:69, D13: 51). 2% reported a lower TRL than at the start of the engagement, likely due to selecting the wrong answer for one of the component questions.*

At the baseline survey, respondents involved with the Development Phase were asked which TRL they expected to achieve by the end of their engagement with the Challenge. At the interim survey, respondents involved with the Development Phase were asked which TRL they had achieved by the end of their engagement with the Challenge. Figure 6 below is based on successful applicants and compares answers to these two questions at the baseline and at the interim surveys in order to understand whether realised TRL for the Development Phase was in line with expectations.

The results at the interim survey are broadly in line with the baseline, with the exception of the highest TRLs (8/9). While at the baseline survey 11% of successful applicants expected to achieve a TRL of 8 or 9 by the end of their engagement with the Challenge, only 2% said at the interim survey that they had achieved such levels by the end of the Development Phase. It is worth noting that, while all contacts that had engaged with the Challenge were invited to take part in the survey at both iterations, those who ended up taking part and had been involved at the Development Phase were not exactly

the same respondents, which may have contributed to some of the differences between expectation and reported realisation of TRLs 8/9 at the Development Phase.

Figure 6   TRL expected and realised at the end of engagement with the FFC: Development Phase

	Expected	Realised
Developing basic principles or formulating the concept: TRL 1 and TRL 2	5%	8%
Developing the proof of concept or testing in laboratory conditions: TRL 3 and TRL 4	16%	20%
Being validated or tested in a real but controlled environment: TRL 5 and TRL 6	36%	39%
Being tested and scaled in an operational environment: TRL 7	33%	31%
Fully commercialised and brought to market: TRL 8 and TRL 9	11%	2%

■ Expected TRL at the end of Development Phase
■ Realised TRL at the end of Development Phase

Source: Contact survey. D10. And what stage do you expect the technology to reach at the end of period covered by the FFC funding?
Note: Base: valid responses, successful applicants, Development Phase (Interim survey: D10:69, Baseline survey: D10:83).

Figure 7 shows the total expected TRL progression for respondents funded in both the Development and Demonstration Phases.[12] Among these respondents, the proportion of projects with TRL of 1 or 2 was 20% at the start of the phase and expected to be 0% at the end of the phase; for TRL 3 or 4, the proportion was expected to fall from 46% to 0%; for TRL 5 or 6, the proportion was expected to increase from 25% to 61%; for TRL 7, the proportion was expected to increase from 5% to 17%; for TRL 8 or 9 the proportion was expected to increase from 0% to 22%.

The respondents who reported on the Demonstration Phase had higher expected TRLs at the end of their engagement with the FFC, which is in line with the expectation that the later Phase focused on projects that are closer to commercial readiness.

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[12] The sample size of respondents that provided start-TRL and expected end-TRL for the Demonstration Phase only is too small to provide robust information.

Figure 7   Expected TRL at the start and end of engagement with the FFC: Development and Demonstration Phases
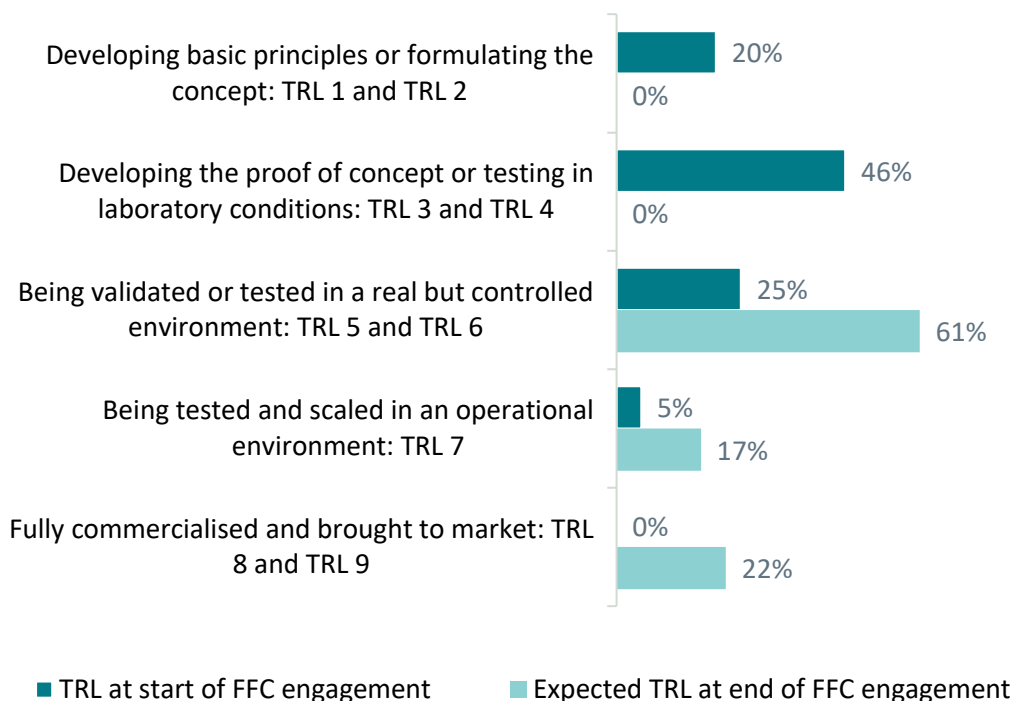
Developing basic principles or formulating the concept: TRL 1 and TRL 2 — 20% / 0%

Developing the proof of concept or testing in laboratory conditions: TRL 3 and TRL 4 — 46% / 0%

Being validated or tested in a real but controlled environment: TRL 5 and TRL 6 — 25% / 61%

Being tested and scaled in an operational environment: TRL 7 — 5% / 17%

Fully commercialised and brought to market: TRL 8 and TRL 9 — 0% / 22%

■ TRL at start of FFC engagement   ■ Expected TRL at end of FFC engagement

Source: *Contact survey. D9. At the start of your engagement with the FFC, what stage of development was the technology at in terms of Technology Readiness Level (TRL)? D10. And what stage do you expect the technology to reach at the end of period covered by the FFC funding? D13. After your engagement with the FCC, what stage of development was the technology at in terms of TRL?*

Note: *Base: valid responses, successful applicants, Development and Demonstration Phases (Interim survey: D9:56, D10, 18).*

These results are broadly consistent with the FFC project close-out data for the Development Phase.[13] Ninety-three percent of respondents reported an increase in TRL. A TRL increase of 1 level was the most commonly reported increase (29% of respondents), but a few respondents reported much larger increases in TRL; 29% of respondents reported a TRL increase of 5 levels or more.

Intellectual property (IP) protection activities are another indication that consortia progressed technologies during the competition. In project applications, 75% of funded projects indicated that IP was expected to be generated. Project close-out data suggests that a substantial majority of Development Phase projects were considering applying for IP protection at the end of the phase, and four projects reported they had applied to or been granted IP protection.[14]

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[13] This item had 14 responses and there were 48 projects in the Development Phase, and so results may be subject to non-response bias.

[14] The sample size for project close-out data for the Development Phase was limited (15 out of 48 projects) and so conclusions may be subject to non-response bias.

"If the FFC had not existed, the industry would have moved more slowly, and would have been more fragmented."

<div align="right">

Industry expert stakeholder

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Consortia stakeholders who were interviewed agreed that the FFC had been a driving force in accelerating project cycles from initial ideas and theories to R&D, testing and delivery. They recognised that there were other funding mechanisms that addressed similar issues (e.g. ATI-FlyZero). However, stakeholders thought that the FFC had uniquely driven TRL progression through its focus on generating new collaborations between future flight organisations. They recognised that the FFC had contributed to the development of integrated solutions which brought together core and non-core future flight technologies (e.g. batteries for electric aircraft and electric charging stations) that otherwise would have been developed at a slower rate. These integrated solutions were more likely to be commercially viable than isolated products and services.

"The funding helped us tremendously but ultimately the network that evolved as a consequence of the Challenge is the main element that made us progress in TRL."

<div align="right">

Industry stakeholder

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One stakeholder highlighted that the funding was especially valuable for SMEs, because it allowed them to dedicate staff to delivering a particular project: *"if we are a startup company with not as yet any revenues and a million things to do and we do not have the money and the time to do all of them, what this [funding] allows us internally, at a very practical level, to say here's somebody who can just spend their time making this demo really work".*

Consortia stakeholders mentioned that the objectives of both the Development and Demonstration Phases were well aligned with the technological readiness of UAS and AAM, particularly BVLOS and eVTOLs, and that the step-up in programme ambition from the Development to the Demonstration Phase appropriately fitted the technological progression of the sector over the last few years. These stakeholders also mentioned that, in their consortia, the FFC funding during the Development Phase had been effective for accelerating digital modelling, avionics and airspace management technologies; their projects did not focus on core technology.

In some cases, measurement of technology readiness did not adequately capture the technological benefits of certain projects – particularly those that involved pure research modelling and simulations – as the TRL definitions were equipment focused after TRL 3 and therefore did not capture these types of contributions to increasing the technology readiness of related future flight technologies and integrated systems. One consortia stakeholder specified: "*due to its pure research nature, the project has positioned us to take a step forward from TRL 0 to TRL 3, but it is also enabling other technologies to move from TRL 3 to TRL 5 or 6. TRL doesn't assess this*". One stakeholder mentioned that these

types of projects were critical inputs to developing future planning and building business cases for more specific applications beyond the Challenge.

Consortia stakeholders commonly noted that the competition's specific targets and deadlines were helpful in gaining internal traction within their organisations, focusing resources on specific objectives, mobilising resources and overcoming barriers. Some of these stakeholders also noted that the deadlines and targets needed to be feasible: realistic and accompanied by a clear political backing and a supporting regulatory framework. One consortia stakeholder emphasised that success in the Development Phase heavily depended on the motivation and commitment of individual consortia members to identifying and developing new future flight technologies that could contribute to organisations' medium- to long-term strategies.

> **"The growth I see [in the sector] is reasonably substantial but if would be overly simplistic to say that the development is only because of Future Flight…is partly due to the opportunity we get with the funding but is also down the strategies of individual businesses."**
>
> **Industry stakeholder**

The Development Phase funded projects at different stages of TRL, ranging from conceptual work to flight demonstrations. Consortia stakeholders that were working on projects at different TRLs emphasised different types of non-monetary support from the Challenge (e.g. business case advice or support with live demonstration approval) that they found most useful. One Demonstration Phase stakeholder recommended that future funding mechanisms consider these types of differences in their design to ensure that projects had access to the support and advice that matched their TRLs. They commented on the Demonstration Phase: *"some duplication of effort is happening in terms of conducting evaluation of the case studies and the business case and things like this. We have now an order book of customers who are clearly demonstrating years in advance that they want to purchase .... So, I feel like we're beyond the point at which we need to deploy public money to evaluate business cases"*.

One industry expert stakeholder mentioned that there were more viable applications to the Demonstration Phase than could be funded by the FFC, due to resource limitations. The stakeholder recommended that other funders with available resources investigate opportunities for working with near-miss unsuccessful projects or consortia that were funded in the Development Phase but not in the Demonstration Phase, to ensure they maintain momentum.

One industry stakeholder suggested that future government funding should focus on workstreams that (1) make use cases operational at scale, and (2) integrate future flight products and services with other modes of transport.

As we will explore in more detail in Section 4.4, the CAA capacity constraints over the course of the Development Phase were a significant barrier to achieving TRL progression for some projects (e.g. BVLOS) as they had experienced difficulties in conducting demonstrations within the timelines of the

Development Phase. Stakeholders agreed that these constraints represented a major risk for the advancement of technology readiness in the Demonstration Phase and beyond 2024.

Effect of the FFC on technology readiness in the future flight sector

In addition to affecting the technology readiness of competition projects, the Challenge aims to accelerate technological development in the wider future flight sector.

As Figure 8 shows, a greater proportion of respondents in the interim evaluation survey than in the baseline survey reported that the FFC had accelerated technological development significantly (30% compared to 13%). The difference is statistically significant. Over nine in ten (93%) felt that the FFC had had at least some accelerating impact on technological development.

Figure 8   Extent to which FFC has accelerated the development of future flight technologies

Category	Interim	Baseline
Accelerated development significantly	30%*	13%
Accelerated development moderately	35%	39%
Accelerated development slightly	28%	37%
Not accelerated development at all	7%	11%
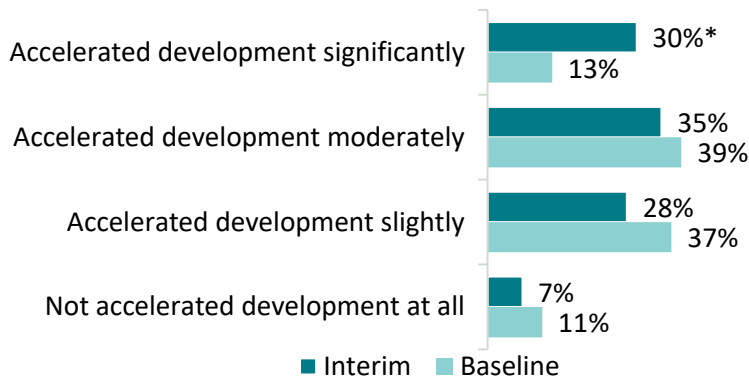
Source: Contact survey. G2. Thinking about the Future Flight Challenge overall, how much do you think it has accelerated development of future flight technologies in the UK?

Note: Base: valid responses, all respondents (Interim survey: 174, Baseline: 143). Figures with asterisks are statistically significant between baseline and interim at the 95% confidence level.

Although it is early to assess the effects of the FFC on technological development in the sector, an industry and a public sector stakeholder noted that since the FFC had been created, more companies were undertaking R&D into eVTOLs in the UK and it was likely than in five years there would be products and services ready for certification. However, it is difficult to robustly attribute these wider trends to FFC funding and activities.

"Now other companies are starting to pop out which might be due to the Challenge."

An industry stakeholder noted that the UK had a prime geography for the development of future flight technologies and AAM use cases. From an AAM perspective, the UK benefits from a relatively high population density – in comparison to the USA or Australia for example – with large population densities (cities) being relatively closely spaced.

It is recognised within the sector that this population distribution, combined with a congested ground-based transport network both within and between cities, suggests significant societal benefit from opening the airspace to future flight technologies. This is particularly valid when the range limitations of current flight battery technology are considered, which is likely to restrict the realisation of continental distance flights. However, a high population density also increases the risk-to-life safety concerns which will need to be considered.

Industry stakeholders tended to emphasise the impact of regulatory uncertainty on their operations (as described in Section 4.4) and the uncertainty around the digital and physical infrastructure required to cater to new integrated aviation systems, including vertiports, charging or refuelling stations and unmanned traffic management systems (UTM). One of these stakeholders noted that it was challenging to anticipate the future demand for underlying infrastructure and identifying potential suppliers of services that currently did not exist.

Ease of conducting demonstrations

A key enabler of the progression of future flight technologies is the ease of conducting demonstrations, particularly the efficiency and effectiveness of the CAA demonstration approval process. An industry stakeholder summarised: *"if we could just start flying the aircraft from day one without any approval from a regulatory agency, that would definitely speed up development….[but we need to ensure]…that what we're doing is not going to put the British public in any undue harm"*.

This issue is also discussed in Theme 3 (development of regulation). The material discussed in Theme 3 focuses on regulatory readiness and innovation, including the effect of FFC interventions on these outcomes. This section focuses on the extent to which current demonstration approval processes hinder or enable technological development.

Survey respondents (both at baseline and for this interim impact evaluation) were asked about the efficiency of the CAA approval process for conducting demonstrations. The results are presented in Figure 9. While views about the current process tended to be more negative than positive, (57% felt it was inefficient, and 43% felt it was efficient), this was an improvement relative to views at baseline (only 33% felt it was efficient). Respondents involved with electric, hybrid-electric or hydrogen regional aircraft were more likely than average to feel that the CAA approval process was efficient (54%). Based on expert input, a possible interpretation for this finding may be that crewed aircraft technologies are similar to existing test aircraft in terms of flight operations and air traffic services, and therefore the CAA has had relatively more experience with that type of application when compared with the exponential increase in demand for approval of UAS operations. The UAS sector is closer to achieving entry into service before electric, hybrid-electric or hydrogen regional aircraft.

The quantity of UAS in operation is a direct correlation to the significant quantity of UAS flight approvals for the CAA to review. This may therefore affect the timescales relating to UAS flight approvals and could be the reason for non-UAS aircraft, suggesting a more positive level of CAA efficiency.

Figure 9   Efficiency of CAA approval process for conducting demonstrations
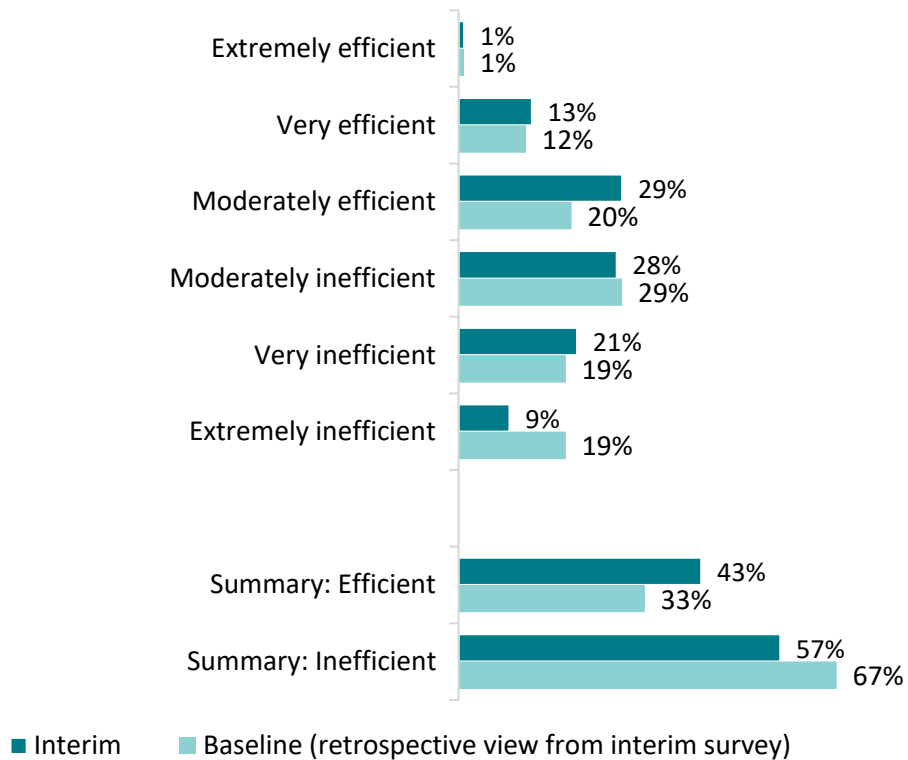
Source: Contact survey. C4A. How efficient was the CAA approval process for conducting demonstrations in the UK in 2019 at the start of the FFC? C4B. Using the same scale, how efficient is the current CAA approval process for conducting demonstrations in the UK?

Note: Base: valid responses, all respondents (Interim survey: 108, 116). Item responses may not sum to summary figures due to rounding.

Respondents were also asked about the extent to which the demonstration approval process supported future flight innovation. More viewed the process as a barrier to rather than supporting innovation (44% and 36%), and the views on the current process and the 2019 process were very similar.

Figure 10   Extent to which the CCA's demonstration approval process supports future flight innovation in 2019 vs currently
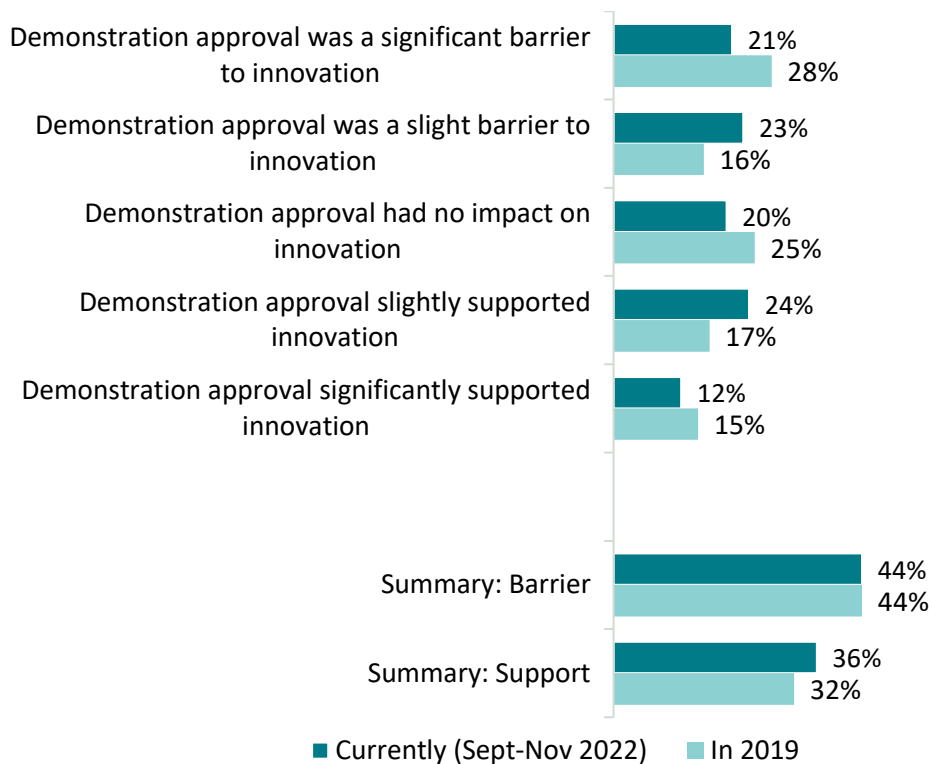
Source: Contact survey. C4D. In 2019, to what extent did the CAA's demonstration approval process support future flight innovation? C4E. Currently, to what extent does the CAA's demonstration approval process support future flight innovation?

Note: Base: valid responses, all respondents (Interim survey: C4D: 114, C4E: 118). Item responses may not sum to summary figures due to rounding.

One industry stakeholder who had not been involved in obtaining demonstration approval for a FFC project stated that *"we are happy to work within the existing framework that is on offer".* However, consortia stakeholders involved in the Development Phase unanimously reported that difficulties in obtaining approval for demonstrations were a significant challenge for achieving project outcomes. One consortia stakeholder added that both the CAA and DfT received a large volume of complaints about difficulties in getting approvals to conduct live demonstrations.

Development Phase consortia agreed that the CAA demonstration approval process took longer than could easily fit within the timelines of the Development Phase. One company interviewed noted that there was a disconnect between the ambitions of the Development Phase projects selected by the FFC and the relatively reduced scope that the CAA would approve for demonstration. Regulatory stakeholders felt that some FFC Development Phase projects were *"trying to do everything at once"*.

Some consortia needed to scale down their demonstrations to be able to conduct them within project timelines. For example, for demonstrations involving drones, the CAA suggested using dummy payloads instead of dangerous goods or flying over sparsely populated areas instead of densely populated areas like London. A consortia stakeholder reported that "*the reason for doing demonstrations is to demonstrate that you can … fly something which you have a business case for, and you can make money on*" and found that the changes to demonstrations significantly reduced the usefulness of the demonstrations. Some consortia stakeholders reported being unable to achieve project objectives dependent on flight demonstrations.

Regulatory stakeholders emphasised that the Development Phase provided useful experience in engaging with future flight companies and they had found that the quality of communication between the CAA and consortia at the start of the Demonstration Phase had improved. One industry stakeholder involved in both the Demonstration and Development Phases found that at the start of the Development Phase "*[the CAA] are engaged a bit more and they're talking to us more*". But multiple consortia stakeholders involved in both the Development and Demonstration Phases were concerned that engagement, resources and capacity from the CAA had not improved sufficiently so that consortia with planned flight demonstrations could achieve their Demonstration Phase objectives. At the time of interim evaluation fieldwork in autumn 2022, it was too soon to predict effects on project outcomes.

One consortia stakeholder emphasised that the process for a company applying for demonstration approval was intrinsically challenging to navigate and felt that "*building testing environments (such as a gateway between Heathrow and Milton Keynes) together with engagement activities is more important than having multiple companies applying for approvals to conduct live demonstrations in different places*".

One consortia stakeholder noted that projects with a lower TRL or projects that focused on conceptual analysis were less directly impacted by these issues, as they did not aim to conduct flight demonstrations.

The CAA engages actively with members of the ADS Advanced Air Mobility Special Interest Group and recognises the challenges of the industry, but it is equally incumbent on industry to recognise that the CAA has significant challenges itself.

For a related discussion on the effect of the FFC on the CAA's regulatory readiness to support innovation, please see Section 4.4.

4.3 Theme 2 - Has the FFC increased collaboration within the future flight sector, and between the sector and other stakeholders?

4.3.1 Overview

To assess this theme, we analysed the metrics summarised in Table 10.

Table 10   Summary of evaluation subthemes

Subtheme	Metric	Data source
How the FFC supported forming FFC-related consortia	FFC actions with the greatest impact on forming FFC-related consortia	Survey data
	Extent to which the Discovery Phase of the FFC supported the formation of consortia	Survey data
	Ways in which the Discovery Phase supported the formation of consortia	Survey data
Effects of the FFC on forming consortia	Influence of the FFC on forming FFC-related consortia	Survey data
	Composition of FFC consortia	Survey data
	Effects of the FFC on forming consortia	Stakeholder views
How the FFC supported collaboration	FFC actions with the greatest impact on collaboration	Survey data; stakeholder views
	Extent to which the FFC competition process encouraged organisations from different disciplines to work together	Survey data
Effects of the FFC on collaboration	Impact of the FFC on collaboration	Survey data; stakeholder views
	Effect of the FFC on collaboration between the future flight sector and central government	Stakeholder views
	Effect of the FFC on collaboration between the future flight sector and end-users	Stakeholder views
	Effect of the FFC on collaboration between the future flight sector and local authorities	Stakeholder views
Trends in collaborations outside of Challenge consortia	Number of collaborations by organisation type	Survey data
	Sector of non-future flight commercial collaborators	Survey data
	International collaborators	Survey data

Source: Frontier Economics

Theme 2 – Key messages

- The survey and qualitative evidence suggest that the FFC has led to collaboration at a scale and complexity that would not have occurred otherwise.

- The competition brought together diverse organisations including end-users, commercial airlines, academia, government agencies, local authorities, operators, newer companies and older companies, incumbents and SMEs/start-ups, and international companies operating in the UK.

- Surveyed consortia reported that the FFC took an active role in supporting the formation of competition consortia, most frequently through the Discovery Workshop, through introductions, and through jointly attending FFC events.

- Both public sector and industry stakeholders indicated that the FFC bridged a communication gap between the industry and central government, especially with the DfT, BEIS and the CAA.

- Survey respondents reported decreases in their non-FFC collaborations between the baseline and interim surveys. These decreases occurred across all surveyed types of future flight organisations. This likely reflects increased specialisation due to TRL progression.

4.3.2   Aims and activities

Knowledge exchange and collaboration within and beyond the future flight sector is a key driver for developing future flight technology clusters and for increasing the contribution of the sector to the UK economy. The FFC considers that large and diverse consortia are particularly equipped to address the FFC problem statements, because collaboration between a wide variety of organisations provides diverse expertise and capabilities to successfully integrate the technical, regulatory and social challenges necessary to develop, test and deploy future flight technologies at scale.[15]

The FFC aims to encourage stronger links between large and more established companies in the future flight sector and a range of other stakeholders including SMEs, government policy makers, regulators, local authorities, end-users and international players. The FFC also aims to improve information and knowledge exchange between the future flight sector and policy makers for the former to be more aware of government policy direction and the latter to be more informed of sector needs.

With this in mind, the FFC has implemented activities that encourage collaboration between different stakeholders in the sector: (1) knowledge exchange events, (2) within-sector and cross-sector

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[15] KTN (2022) Future Flight Challenge. Innovate UK KTN Interim Report 2020 - 2022

workshops and webinars, (3) networking events, (4) working groups, including the FAIWG:AI (see Section 4.4),[16] (5) regular newsletters, and (6) cross-government forums.

FFC events

In 2021 and 2022, the Challenge and KTN held a series of future flight events aimed at encouraging collaboration and knowledge sharing. These included:

■ An ambition event to articulate objectives for the Demonstration Phase;

■ A Demonstration Phase briefing event for potential applicants;

■ A Demonstration Phase launch event for successful participants;

■ A café series; each instalment had a specific theme (e.g. sustainable freight and logistics; zero emission Uncrewed Aerial Vehicle (UAV) flight);

■ A workshop on creating accessible future flight;

■ Friday seminars on particular topics (e.g. future flight economic benefits, or the Future Flight Roadmap);

■ A workshop on modelling and simulation, exploring collaborations with mathematical sciences;

■ An event for Development Phase participants; and

■ An event with Net Zero Places Innovation Network for Local Authorities

The FFC intended that knowledge exchange activities supported by the KTN would strengthen collaborations across consortia, and between consortia and adjacent supply chain sectors. However, one consortia stakeholder noted that these networking activities had been quite delayed during the Development Phase – after the competition winners were announced. It was recognised that this might have been due to the COVID-19 pandemic, which had led to a six-month extension of the phase and programme. The stakeholder felt that the knowledge exchange events would have been more useful to them at an earlier stage of planning and scoping projects, rather than the events happening after project plans had been finalised.

The KTN recorded making 145 future flight introductions from December 2020 to July 2022, since the baseline. The two most frequent types of introductions since the baseline were introductions made within the field of regulation (47 introductions) and within the field of autonomous aviation (24 introductions). This volume of introductions shows a decrease in activity from the 451 introductions that the KTN made from October 2019 to November 2020, recorded in the baseline report. Based on expert input, the reduction in introductions likely reflects sector demand. The value of introductions and networking is expected to diminish over time, as contact networks in the sector are strengthened and organisations invest in working with particular collaborators. This issue is discussed in more detail below.

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[16] Future Aviation Industry Working Group on Airspace Integration. The FFC also plans to launch two additional working groups (Safety Case and Community Integration).

The FFC also required companies to form large and diverse consortia[17] to apply to competitions in order to strengthen collaboration between newer SMEs and larger and more established companies in the future flight ecosystem. For the Development and Demonstration Phases, project lead organisations had to involve at least one registered SME or be an SME themselves. Depending on the competition strand, the FFC also required or encouraged consortia to include end-users and operators, and engagement with local authorities.

It was expected that these stronger links across stakeholders would not have been able to occur organically without the support of the Challenge. Some companies in the sector would have naturally formed links with each other as the sector matured, either through normal business interactions or organisations like the Connected Places Catapult or Nesta. However, these interactions were expected to be more limited as they had been historically in the sector.

It was also expected that improved collaboration between the future flight sector and end-users, local and national policy makers, and regulators would accelerate the deployment of technologies by ensuring that new technologies met UK-specific requirements, government priorities and user needs. This collaboration was also expected to contribute to government policy (see Section 4.6) and to the development of regulatory frameworks (see Section 4.4). A certain degree of communication between these stakeholders would be expected to take place regardless of FFC activities.

4.3.3   Evaluation evidence

How the FFC supported forming FFC-related consortia

Survey respondents were asked about the ways in which the FFC had been most influential in forming consortia, and the results are presented in Figure 11.

Around two in five respondents reported meeting other members of the consortium during the Discovery Workshop in February 2020 (45%), being introduced to other members by the FFC (42%) and meeting other members during other FFC engagement activities (40%). A third (36%) mentioned receiving guidance from the FFC on the types of organisations that should be included in the consortium, and one in four (23%) mentioned receiving contact details for other members of the consortium. Respondents who had had all of their applications rejected were less likely than other respondents to mention meeting other members of the consortium during the Discovery Workshop (19%) and meeting other members during other Challenge engagement activities (22%). Those who felt that the Challenge had significantly accelerated technology development in the sector (see Section 4.2) were significantly more likely than average to mention meeting other members of the consortium during the Discovery Workshop (59%).

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[17] Both the Development and Demonstration Phases included an eligibility requirement that lead organisations should collaborate with other businesses, research or academic institutions, public sector organisations, research and technology organisations or non-for-profits.

Figure 11   FFC actions with the greatest influence in forming FFC-related consortia
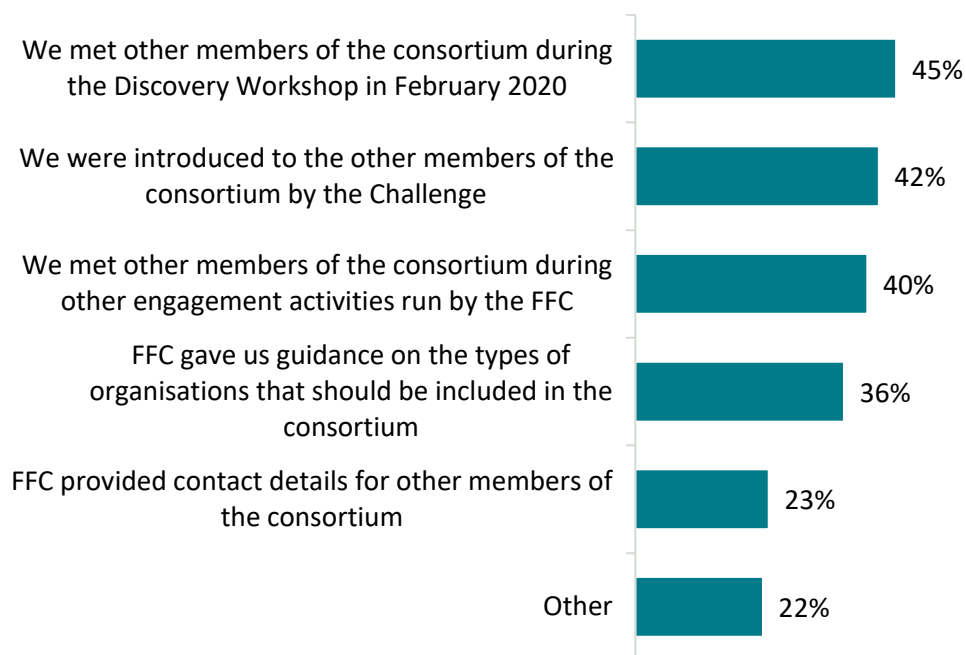
We met other members of the consortium during the Discovery Workshop in February 2020 — 45%

We were introduced to the other members of the consortium by the Challenge — 42%

We met other members of the consortium during other engagement activities run by the FFC — 40%

FFC gave us guidance on the types of organisations that should be included in the consortium — 36%

FFC provided contact details for other members of the consortium — 23%

Other — 22%

Figure 12 summarises views on the extent to which the Discovery Phase of the FFC supported the formation of consortia. Around three in five (57%) agreed, to an extent, that the Discovery Phase had supported the formation of consortia, while a quarter (24%) disagreed, with the remaining 20% offering a neutral response. Those involved with regulation and governance and autonomous aviation systems were more likely to disagree that the Discovery Phase had supported the formation of consortia (36% and 33% respectively). These findings align with the view from the FFC that, although a few Development Phase projects could have been funded and begun earlier if the Discovery Phase had not occurred, other organisations needed the Discovery Phase to arrange their consortia in order to apply to the Development Phase.

Those who had had all their applications rejected were less likely than those who had had at least one successful application to agree that the FFC competition process had encouraged organisations from different disciplines of the future flight sector to work together (40% compared to 67%).

Figure 12   Did the Discovery Phase of the FFC support the formation of consortia?
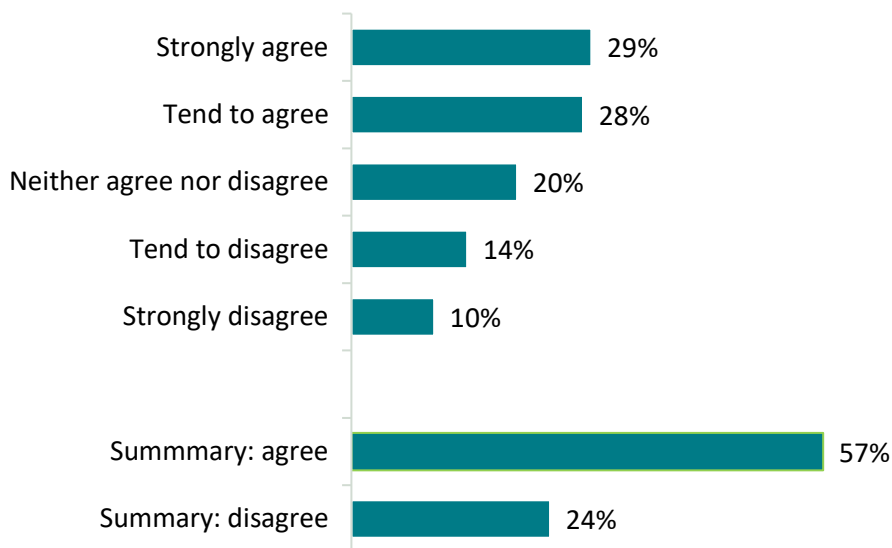
As can be seen from Figure 13, among respondents who agreed that the Discovery Phase had supported the formation of consortia, a large majority found that the Discovery Phase had brought together many different types of organisations (85%) and allowed organisations with similar goals to come together (82%). Three-quarters mentioned bringing together organisations from different sectors (77%), bringing together organisations of different sizes (76%) and bringing together organisations that were not previously aware of each other (76%). Seven in ten (70%) felt it had encouraged organisations which would not usually consider forming consortia to do so. Half (53%) agreed that the Discovery Phase had helped consortia to avoid over-committing at an early stage.

Figure 13 Reasons why the Discovery Phase supported the formation of consortia

Reason	Percentage
It brought together different types of organisations, such as businesses, academia, research and technology organisations and government	85%
It allowed organisations with similar goals to come together	82%
It brought together organisations from different sectors	77%
It brought together organisations of different sizes	76%
It brought together organisations that were not previously aware of each other	76%
It encouraged organisations that would not usually consider forming consortia to do so	70%
It meant consortia did not have to over commit in early stages	53%

Source: Contact survey. B6. In what ways did the Discovery phase support the formation of consortia?
Note: Base: valid responses, where agree the Discovery phase supported the formation of consortia (Interim survey: 87).

Effects of the FFC on forming consortia

Figure 14 shows that three in five (60%) survey respondents who had formed or joined an FFC-related consortium felt that the FFC had been very influential in achieving this, and a further 21% said that it had been fairly influential. One in five (19%) felt the FFC had been not very or not at all influential. This figure was largely driven by respondents who had had all of their applications rejected, 29% of whom felt the FFC had been not very or not at all influential. Among respondents who had had at least one application accepted, only 4% felt that the FFC had been not very or not at all influential.

Respondents involved with non-future flight technologies and electric, hybrid-electric or hydrogen regional aircraft were more likely than average to rate the FFC as very influential in the forming of consortia (75% and 72% respectively).

Figure 14 Influence of the FFC on forming FFC-related consortia

Bar chart:
- Very influential: 60%
- Fairly influential: 21%
- Not very influential: 9%
- Not influential at all: 10%
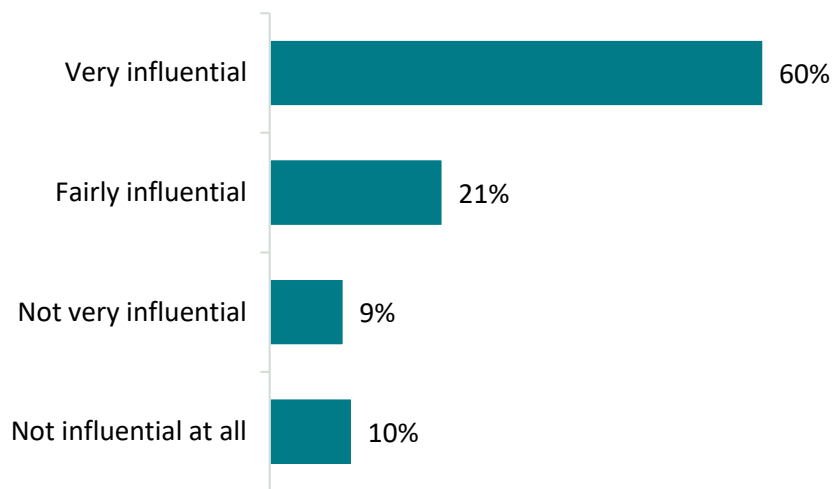
Source: Contact survey. B3. How influential was the Future Flight Challenge in the forming of this consortium?
Note: Base: valid responses, where joined or formed FFC-related consortium (Interim survey: 122).

Multiple consortia stakeholders reported that it was important that the FFC provided a formal framework within which organisations had to collaborate, which existed outside their usual commercial or academic circles. One of these stakeholders added that this was especially beneficial for companies that were cautious about collaborating with potential competitors, were protective of their IP, or already had an internal R&D team.

"It is very hard to bring together all of these companies into this kind of collaborative environment without a framework around it. The Challenge not only provides funding but also provides a protective net around everyone in terms of the way that collaboration is intended to work."

Industry stakeholder

Characteristics of future flight consortia

Over four in five (83%) survey respondents who had completed a competition application reported having worked within a consortium related to future flight. For the majority (78%), the consortium was related to the FFC. Half of those in an FFC consortium had participated in the Development Phase (51%), half had participated in the Demonstration Phase (51%), and four in ten (39%) had participated in the Discovery Phase. One in ten (9%) had joined or formed a consortium unrelated to the Challenge, and 17% had not joined a consortium at all (whether related to FFC or not).

A few specialisms were relatively likely to form consortia at particular phases:

■ Respondents involved with urban air mobility were more likely than average to have formed a consortium during the Discovery (53%), Development (64%) and Demonstration (70%) Phases.

■ Respondents involved with unmanned aerial systems and drones were more likely than average to have formed a consortium during the Discovery (53%) and Demonstration (58%) Phases.

■ Respondents involved with air traffic management (67%), physical future flight infrastructure (65%), autonomous aviation systems (64%) and digital future flight infrastructure (62%) were more likely than average to have formed a consortium during the Demonstration Phase.

All consortia interviewees agreed that the competition had brought together different people and organisations to address common sector challenges, including end-users (e.g. NHS, Royal Mail), commercial airlines (e.g. Virgin Atlantic Airways), academia (e.g. Coventry University, Cranfield University), innovation centres (e.g. Connected Places Catapult), local authorities (e.g. Coventry, Oxfordshire, Reading, Cornwall), operators (Heathrow Airport, London City, Bristol Airport), newer companies (e.g. Skyports, ANRA Technologies) and older companies (e.g. Arup, Atkins, NATS), incumbents (e.g. Rolls Royce, GKN) and SMEs/start-ups (e.g. sees.ai, SKY Drones Technologies), and international companies operating in the UK (e.g. Thales, Rockwell Collins).

"Collaboration wouldn't have happened at this scale without the Challenge."

Industry expert stakeholder

The Demonstration Phase consortia included more end-users and large companies relative to the Development Phase. This was likely due to competition rules[18] and to the different aims of these

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[18] The Demonstration Phase included an eligibility requirement that consortia should include the participation of end-users or operators in the project, and engagement with appropriate local authorities was encouraged.

phases.[19] Two industry stakeholders involved in Demonstration Phase projects emphasised that the FFC had been a useful impetus to engage large companies in future flight projects, because these companies were less accustomed than future flight start-ups to working on development projects whose medium-term impacts were subject to high levels of uncertainty.

"[With] a number of the institutional partners in the UK aviation ecosystem, we definitely wouldn't have had the sort of depth of collaboration or the impetus to collaborate for a capstone demonstration. Future Flight Phase 3 was a forcing function and also for some a … sweetener to bring these people to the table."

Industry stakeholder

How the FFC supported collaboration

Survey respondents reported which FFC activities had had the greatest impact on collaboration. The results were largely aligned with the baseline results, as shown in Figure 15. Encouraging collaboration was the most commonly mentioned action (32%), followed by providing access to funding (21%) and events (20%).

There was a significant decrease in the proportion who mentioned networking than was the case at the baseline (9% compared to 37%). This change is consistent with the sector strengthening its networks, such that there is diminishing value to additional FFC-led networking activities. It could also mean that the type of networking support that future flight stakeholders would most value has evolved over time, which may be useful for the FFC and KTN to consider when designing future events.

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[19] Whereas the Development Phase aimed at developing and enabling system capabilities to support the introduction of new classes of electric and/or autonomous air vehicles, the Demonstration Phase seeks to have demonstrations in representative environments with real use cases involving UAS, AMM and electric regional aircraft.

Figure 15 FFC actions with greatest positive impact on collaboration

Action	Interim	Baseline
Encouraging collaboration/working towards a common goal	32%	37%
Providing funding/access to funding	21%	22%
Events	20%	26%
Funding stipulations/eligibility criteria are related to collaboration/consortiums	13%	12%
Networking (inc. sharing skills/info with others)	9%*	37%
Industry regulation/safety standards	3%	7%
Encouraging progress/proactivity by incentivising/giving timetables	1%	4%
Support is biased towards traditional/well-known companies	1%	1%
My application was unsuccessful	1%	3%
The collaboration has not always been beneficial/good quality	0%	1%
Other	13%	9%

Source: *Contact survey. E4. Of the things that the FFC has done, which have had the greatest impact on collaboration?*

Note: *Base: valid responses, where respondents feel FFC has increased collaboration (Interim survey: 111, Baseline: 116). Figures with asterisks are statistically significant between baseline and interim at the 95% confidence level.*

Figure 16 shows views about whether the FFC competition process had encouraged organisations from different disciplines to work together. Three-quarters (73%) agreed that this was the case, one in five (19%) disagreed, and one in ten (8%) offered a neutral response. Respondents who had had at least one of their applications accepted were significantly more likely than average to agree that the FFC competition process had encouraged organisations from different disciplines of the future flight sector to work together (81%), as were those involved with unmanned aerial systems and drones (82%).

Figure 16   Did the FFC competition process encourage organisations from different disciplines of the future flight sector to work together?
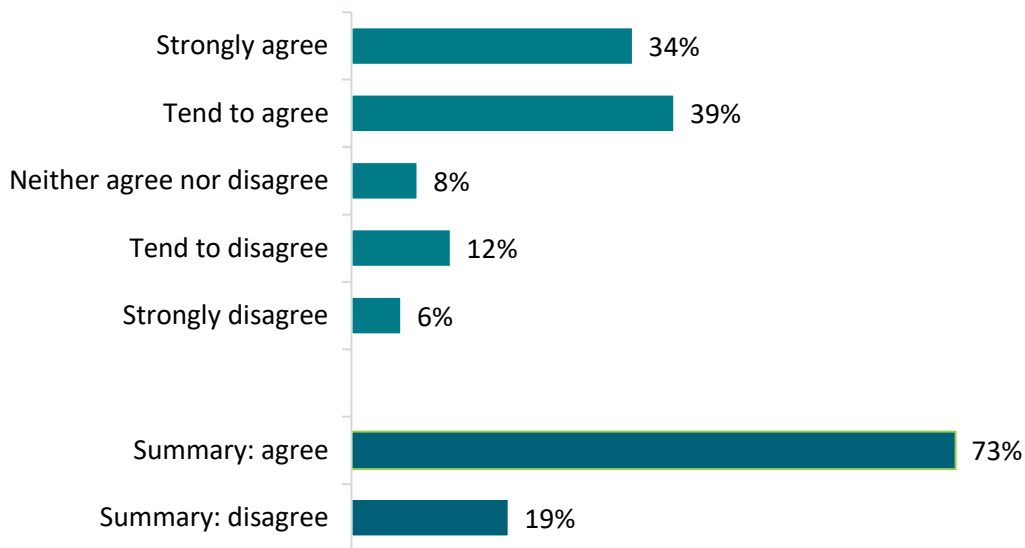
Stakeholders reported that consortia members typically knew the other organisations in their consortium reputationally, but that the competition had given them an opportunity to test out working arrangements. In particular, the Development Phase had provided companies with valuable information about which other members of their consortium had skills and working processes that were compatible with and complementary to their own, which shaped Demonstration Phase consortia. As the future flight sector is relatively young, and many key players are start-ups and SMEs that do not have a long track record or established working arrangements, it may be difficult for companies to know with whom they can collaborate, unless they attempt to jointly deliver a project. Consortia that collaborated well together described the importance of delineating each organisation's area of expertise and specific responsibilities.

Effects of the FFC on collaboration

Effect of the FFC on collaboration within the future flight sector

Overall, there was a consensus among consortia stakeholders that the FFC had contributed to the joint delivery of future flight technologies and services that otherwise would have been developed in isolated workstreams, at a slower pace, or not at all.

Working in large and diverse consortia had helped future flight companies engage with companies in adjacent sectors (e.g. aviation infrastructure companies or commercial airlines) that historically had not been heavily involved in future flight but whose engagement would be important for bringing technologies to market. As one consortia stakeholder summarised when speaking about their

projects: *"I honestly think that in Future Flight Phase 2 and Future Flight Phase 3, the biggest benefit of the Challenge has been putting everyone who needs to work together in a room, and giving them money to make sure that people who might have thought that it was a waste of time to be in that room in the first place… come together".* Another stakeholder noted that, for large companies, the level of FFC funding was probably not large in comparison to their total R&D budgets, but the funding was nevertheless an important 'hook' to get traction within companies.

One industry expert stakeholder mentioned anecdotal evidence that the language used by the FFC around 'building a national future flight ecosystem' had been influential in the UK in encouraging a collaborative approach to address complex system challenges.

"[Before the FFC] there were a number of products and ideas going around, but there was no real direction, no market push or pull on what was being developed."

"FFC has helped solidifying a Team GB."

Industry expert stakeholder

Survey respondents had a very positive general view of the effect of the Challenge on collaboration, as shown in Figure 17. In line with the baseline, over four in five (83%) felt it had increased collaboration to an extent, including 40% who felt it had done so significantly. Three percent felt it had had a negative impact. Respondents who had had at least one of their applications accepted were significantly more likely than those who had had all of their applications rejected to agree that the FFC had increased collaboration (91% compared to 77%), and researchers were almost universally positive in this respect (97%).

Figure 17   Impact of the FFC on collaboration

FFC has increased collaboration significantly — Interim 40%, Baseline 45%
FFC has increased collaboration slightly — Interim 44%, Baseline 40%
FFC has not impacted collaboration — Interim 15%, Baseline 9%
FFC has decreased collaboration slightly — Interim 2%, Baseline 5%
FFC has decreased collaboration significantly — Interim 1%, Baseline 1%
Summary: Increased — Interim 83%, Baseline 85%
Summary: Decreased — Interim 2%, Baseline 6%

■ Interim ■ Baseline

Source: Contact survey. E3. How much do you think the Future Flight Challenge has impacted collaboration in general?
Note: Base: valid responses, all respondents (Interim survey: 186, Baseline: 151). Item responses may not sum to summary figures due to rounding.

One respondent from a successful consortium mentioned that the competition had created long-term commercial relationships between consortia members by securing pre-orders for future delivery. However, for unsuccessful consortia it had been challenging to keep interests aligned between private and public sector organisations once the application process had ended. The evidence suggests that competition participation, rather than just the application process, was key for creating productive collaboration between organisations.

Consortia stakeholders noted that there was already a certain level of collaboration between the sector and other stakeholders – particularly between academia and local authorities/airports, and between airlines and aircraft manufacturers – but this previous collaboration mostly focused on innovation initiatives not specific to the future flight sector (e.g. Smart Cities, Connected Places) or on ground transport (e.g. parking sensors, smart traffic lights) or the collaborations were merely commercial or funding relationships. These past collaborations formed the basis of some consortia.

One consortia stakeholder expressed interest in centralised publication and dissemination of FFC competition project outputs. Consortia members published their results on their firms' websites, but the stakeholder noted that it would be helpful to have a centralised space where this information could be easily found.

Effect of the FFC on collaboration between the future flight sector and central government

Consortia stakeholders interviewed reported that direct collaboration between industry and central government could be challenging because there could be many different relevant government stakeholders in different departments. One consortia stakeholder had found it difficult to access information about current regulation, funding opportunities and other supporting services (e.g. the CAA's 'Regulatory Sandbox' concept). Another consortia stakeholder emphasised that it was challenging for future flight companies to identify the correct person or team in central government to answer queries.

Consortia members indicated that the FFC bridged a communication gap between the industry and the government, especially with the DfT, BEIS and the CAA, by acting as a main contact point and intermediary. They highlighted two key types of FFC support:

■ Receiving FFC advice on navigating CAA processes, permits and approvals. Most stakeholders agreed that it had been challenging for future flight companies to understand how best to operate under the current regulatory frameworks, and to work efficiently and effectively with the CAA; and

■ Through the FFC, communicating a sense of urgency to government to develop the policy and regulatory frameworks needed to support the international competitiveness of the UK in future flight. Consortia members highlighted that this sense of urgency was important when working with a rapidly evolving sector.

The FFC has maintained bilateral relationships with the USA (NASA), Australia and Norway to exchange information and experiences on latest developments in the future flight sector as well as exploring new avenues for collaborations. However, two stakeholders felt that the FFC (and the UK) could increase its international presence in global events. A different stakeholder noted that access to international funding streams including EU funding would be important in the future.

Consortia stakeholders indicated that they would like to continue to have a point of contact for central government who was focused on the future flight sector beyond the current end date of the FFC in 2024. This role would help to inform government about the priorities and needs of industry, and to inform industry about navigating governmental and regulatory processes.

"The Challenge need to encourage more international collaboration, aviation is an international industry...let's connect with some of our colleagues elsewhere in the world."

Industry stakeholder

Effect of the FFC on collaboration between the future flight sector and end-users

Some stakeholders mentioned that future flight companies, particularly those focused on core technologies, could struggle to collect evidence about end-users and understand demand for future flight services. A key enabler for achieving FFC objectives was improving the social desirability of

future flight technologies by ensuring that new products and services met user needs. One stakeholder mentioned that public engagement was crucial for increasing future demand in the sector, and user views must shape use cases.

"Public engagement is one of the core elements to genuinely trying to shape these services in ways that will be both beneficial and also in line with what people want to see, which I think is different from public engagement being kind of like PR exercises for the industry to win people over."

Industry stakeholder

At this stage, it is too early to assess the outputs and outcomes of Demonstration Phase projects which aim to investigate and incorporate end-user requirements in order to understand how input from end-users shaped project delivery.

Effect of the FFC on collaboration between the future flight sector and local authorities

Local government stakeholders perceived that local authorities tended to be aware of innovation initiatives and how these can be beneficial for local development. However, stakeholders agreed that only a small minority of local authorities had the necessary knowledge, skills and resources to engage with these initiatives.

Public sector and FFC stakeholders identified four main factors that drive the level of engagement of local authorities: (1) their past interactions with other stakeholders in the sector, particularly operators (e.g. airports) and universities within the local authority, (2) their previous involvement in other innovation initiatives, (3) their experience applying to other funding opportunities (e.g. Horizon Europe), and (4) local priorities which compete for local authority resources (e.g. cost of living crisis). These stakeholders also identified four main barriers that hinder the participation of local authorities in future flight innovation projects: (1) negative public perception towards future flight technologies, (2) limited political buy-in and senior management engagement, (3) a skills gap, and (4) a lack of resources and staff to allocate to initiatives. These factors limited the number of city and county councils that had participated in FFC projects. A public sector stakeholder emphasised that if local authorities decided to invest resources in supporting future flight technologies, these investments should align with their own strategic priorities and the benefits should be tangible to residents.

Local authority stakeholders who had been involved in Development Phase FFC projects reported being active partners in delivering demonstrations. Their responsibilities included providing sites, infrastructure and planning resources, coordinating local permits and approvals, and conducting feasibility studies, societal acceptance analyses and communication campaigns. These stakeholders found that their involvement in FFC competitions – and therefore their exposure to the sector – had allowed them to enrich their own vision of a technology-enabled transport service that integrated emerging future flight technologies, ground infrastructure and related services (e.g. mobility as a service). Coventry City Council was repeatedly highlighted as a success, as it had continued

involvement in innovative initiatives and national and international forums since participating in the Development Phase.

"There is no other funding route outside of Innovate UK and UKRI that understands the future flight sector and provides funding opportunities to local authorities at this scale."

"We wouldn't have initially built our vision without the future flight project, the FFC funding has been a catalyst [to local authority involvement]."

Local authority stakeholder

Some consortia stakeholders suggested that local authorities could have been useful partners in more Development Phase projects, but it was challenging for consortia to identify suitable local authority partners. The Community Integration Working Group – which aims to ensure that local authorities are included in key discussions for the industry to understand local needs – has not yet been established, and the remit and actions of the working group have not been defined.

Some consortia stakeholders mentioned that they would value additional support to encourage collaboration between industry and local government, to support the development of technology clusters. Currently, industry finds it challenging to identify regions and local authorities that will be strong collaborators in testing and deploying technologies, and one industry stakeholder mentioned they would value a service that could suggest potential local government collaborators. For example, knowledge exchange events could be held that are specifically focused on identifying regions that will enable technological development and local government collaborators, with the aim of fostering regional development. FFC stakeholders noted that upskilling local authorities so that they could engage with these initiatives was an important enabler of collaboration.

Trends in collaborations outside of Challenge consortia

The FFC aimed both to encourage collaboration within consortia and to broadly support collaboration across the sector. It is challenging to attribute sector trends in collaboration to specific FFC activities. We drew on evidence from the survey, but it is important to be mindful that trends may have occurred independently of FFC interventions.

Survey respondents were asked how many partners of different types they were currently collaborating with on future flight sector projects, outside of their FFC consortium. Table 11 shows the proportion of respondents who were collaborating with different stakeholder groups, and the average number of collaborations with each group per respondent. The average number of collaborations with researchers was 3.6, and 60% of respondents said that they were collaborating with at least one research organisation, making researchers the most common type of collaboration partner. The second most common partner was small or medium aviation companies (3.4 average collaborations

and 57% collaborating with this group) and end-users (4.6 average collaborations and 50% of respondents collaborating with this group).

Between the interim and baseline surveys, there was a decrease in the rate of collaborating with each type of partner and a decrease in the average number of partners of each type. The largest decreases in the rate of collaboration were with end-users (decrease of 22%), small or medium aviation companies (decrease of 19%) and researchers (decrease of 16%). These were the three types of collaborators that had the highest rates of collaboration with survey respondents in both waves of the survey.

Based on expert input, these trends likely reflect increasing technological development and specialisation in the sector. Future flight companies, as they grow and achieve higher TRLs, develop habitual collaborators on fewer and larger contracts. Academic collaborators become less relevant as the technology approaches commercialisation. As a company's revenue streams grow larger, the smaller funding opportunities that encourage collaboration but are peripheral to the company's business case become of lower priority, especially because they can divert key staff from the company's core projects. In addition, by developing reliable revenue streams, companies can reduce risk and tend to protect revenue streams by not involving non-essential collaborators. As companies grow, they also develop in-house capabilities and do not need to outsource as many functions.

It is possible that some of the trends observed in collaboration rates are short-run changes due to the COVID-19 pandemic, but we do not have evidence for or against this hypothesis.

Those who had had at least one successful application had collaborated with a higher average number of companies than those who had had all their applications rejected (11.4 compared to 4.3).

Table 11   Number of collaborations outside FFC consortia, by organisation type

	% of respondents collaborating with this group		Average number of collaborations with this group, per respondent	
	Interim	Baseline	Interim	Baseline
Researchers	60%	76%	3.6	3.0
Small or medium aviation companies	57%	76%	3.4	3.9
End-users	50%	72%	4.6	4.8
Regulators and policy makers	48%	64%	1.2	1.9

Small or medium non-aviation future flight sector companies	43%	49%	2.7	2.5
Companies outside of the future flight sector	42%	48%	4.4	4.2
Large aviation companies	42%	47%	1.5	2.0
Large non-aviation future flight sector companies	32%	38%	1.1	1.4

Source: Contact survey. E1 Outside of your FFC consortium, how many of the following types of partners are you collaborating with on future flight sector projects?

Note: Base: all respondents (Interim survey: 197, Baseline: 154)

Figure 18 shows the non-future flight sectors with which respondents were collaborating, among those respondents who reported collaborations with other sectors (78 respondents). One in five (18%) were collaborating with companies in the IT sector, 15% the energy, oil and gas sector, and 13% the automotive sector. Other sectors were mentioned by less than 10% of respondents.

Figure 18   Sector of non-future flight companies' collaborators

Sector	Percentage
IT/digital technology	18%
Energy/oil/gas	15%
Automotive	13%
Transport	9%
Aerospace/aviation	6%
Marine	6%
Manufacturing/engineering	6%
Construction	5%
Education	5%
Healthcare/NHS	5%
Logistics	5%
Military/defence	4%
Telecommunications	4%
Rail	4%
Economics	4%
Other	50%
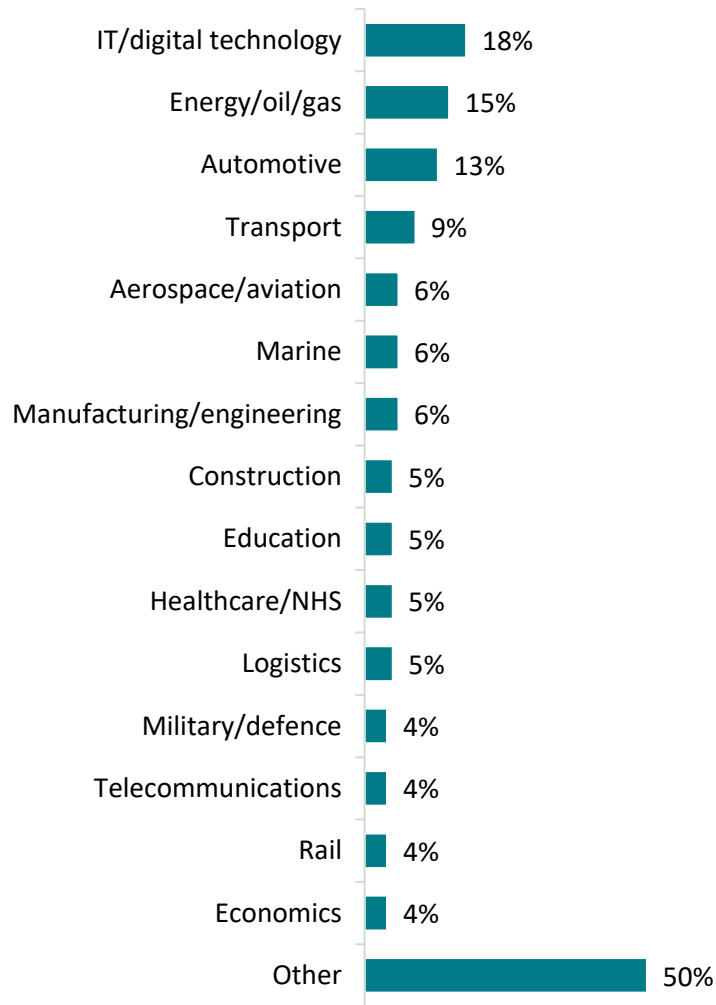
Source: Contact survey. E1A. You said you are collaborating with companies outside of the future flight sector. Which sectors are these companies in?

Note: Base: valid responses, where collaborate with companies outside of the future flight sector (Interim survey: 78).

Over three in five (61%) of those with more than one collaboration reported that at least one of these was with a business based outside the UK, with an average of 3.7 such companies. While the overall percentage was in line with the baseline (62%), the average at interim survey was significantly lower than the average at the baseline of 7.6. Half (52%) of those with more than one collaboration reported that at least one of these was with businesses within aviation/future flight companies based outside the UK, with an average of 1.8 such companies. This was in line with the baseline.

Figure 19 shows that around one in three (35%) survey respondents who said they were collaborating with at least one partner were not collaborating with any international companies. Just under one in five (19%) were collaborating with five or more. Technology developers were more likely to collaborate with international companies (69%). Those who were involved with physical future flight infrastructure were also more likely to be collaborating with international companies (73%).

Figure 19   International collaborations
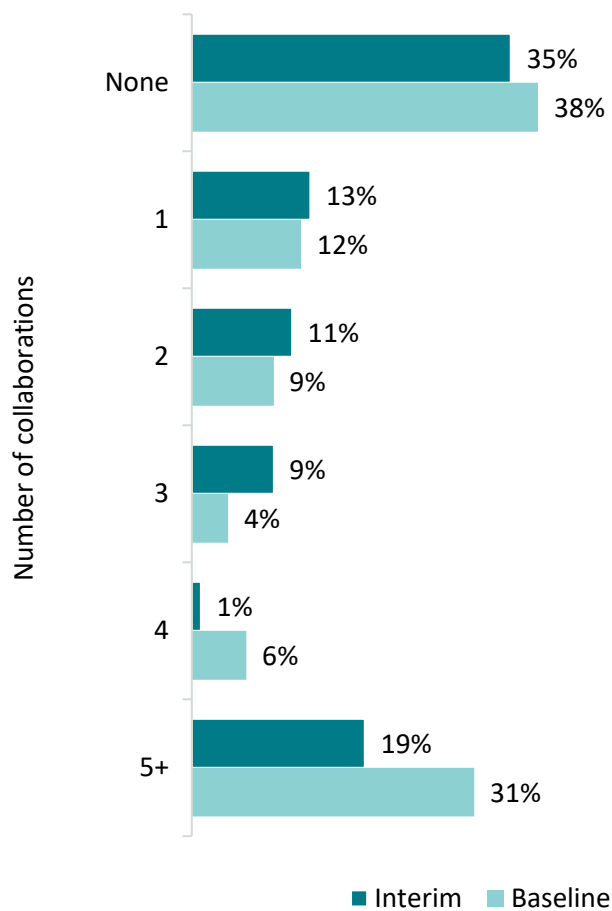
Source: *Contact survey. E2. And how many of these partners are based outside the UK?*

Note: *Base: where at least one partner (Interim survey: 150, Baseline: 117). *Please note that there was a scripting issue with this question – more details have been included in the annexes. The data shown here, however, is not affected by this.*

4.4   Theme 3 - Has the CAA [Civil Aviation Authority] developed a set of robust regulatory frameworks to support the future flight sector?

4.4.1   Overview

To assess this theme, we analysed the metrics summarised in Table 12.

Table 12   Summary of evaluation evidence

Subtheme	Metric	Data source
Access to the CAA's expertise and guidance	Impact of the FFC on the efficiency of the CAA approval process for FFC-funded consortia	Survey data; stakeholder views
Regulatory readiness to support innovation	Extent to which the regulation of future flight technologies is a barrier or an enabler	Survey data
Development of new policies and regulations	Recent policy and regulatory developments	Stakeholder views
UK regulation in comparison to other countries	UK performance in regulation of future flight technologies	Survey data

Theme 3 – Key messages

- Views among those surveyed about the impact of the FFC on the efficiency of the CAA demonstration approval process were somewhat positive, with half (50%) believing it had increased efficiency, just one in ten (10%) feeling it had decreased efficiency, and the remaining 40% believing it had had no impact on efficiency.

- Stakeholders agreed that the FFC had accelerated the development of some strands of regulation and guidance as part of CAA engagement with competition winners and funding the CAA Innovation Hub, and noted the publication of guidance for RPAS operators carrying dangerous goods.

- Regulatory and other stakeholders indicated that the timelines for developing new regulation would be delayed relative to the FFC's ambitions at its inception. CAA capacity constraints over the course of the Development Phase had been a significant barrier to achieving all FFC regulation objectives.

- Fifty-seven percent of survey respondents viewed regulation to be a barrier to the progression of future flight technologies, an increase of 15% over the baseline figure.

4.4.2   Aims and activities

One of the main challenges that motivated the design of the FFC was the limited regulation in the UK that would allow coherent and economically viable development of future flight technologies. At the start of the Challenge, the conventional system of regulatory compliance and certification in the country may not have been suitable for the future operations currently in circulation relating to both AAM and UAS, including a lack of focus on key drivers such as BVLOS operations. While the CAA provided some guidance through its 'Regulatory Sandbox' and 'Innovation Hub' services, a need was identified for new standards and operational models for upcoming aviation products to be able to fly in the UK.

The Challenge provided £5 million to the CAA to accelerate the level of regulatory readiness of future flight technologies. This additional funding was intended for the CAA's Innovation Team to increase its capacity to support Development and Demonstration Phase projects in three different ways: (1) by providing a point of contact for competition winners to access CAA's expertise and guidance, (2) by helping winning consortia to maximise regulatory readiness to test their technologies in live demonstrations by ensuring their projects incorporate regulatory planning throughout, and (3) by accelerating the development of new policies and regulations by anticipating regulatory challenges.

The portfolio review of the Development and Demonstration Phases examined the extent to which competition projects had objectives related to regulation. The review found that project outputs were

relatively less likely to relate to developing validated air traffic management systems and suitable regulatory frameworks. Although developing new models of airspace management was not a strong focus of the entire project portfolio, between the Development and Demonstration Phases there was a substantial increase in project focus on this objective, on aspects such as regulation, safety and commercial viability.

At its inception, the FFC expected new regulatory frameworks in the UK for drones, AAM and regional hybrid aircraft to become available for innovators by 2023. In the absence of FFC funding, it was anticipated that the CAA would have progressed towards a future flight regulatory framework but at a slower rate. These regulatory frameworks are highly important enablers for the FFC to achieve other programme objectives.

The FFC founded the Future Aviation Industry Working Group on Airspace Integration (FAIWG:AI), to bring together stakeholders from industry to provide expert input to inform government policy and regulation. It published a plan in early 2023 which set out strategy for government and the CAA and a set of industry actions that support the introduction of commercial services.

The FFC has begun working with the British Standards Institution (BSI) to directly fund the development of new standards for the sector. This work will start with assessing existing standards in order to identify gaps and opportunity areas where the UK could lead international development.

4.4.3   Evaluation evidence

Access to the CAA's expertise and guidance

During the Development Phase, the CAA engaged with competition winners to help them understand the regulatory barriers they might face in conducting their proposed demonstrations. As the aim of this phase was to demonstrate technologies rapidly, the role of the CAA was to help consortia to 'de-risk' their applications to make demonstrations more likely to be approved within project timelines. These recommendations could include changes in project scope. For the Demonstration Phase, the CAA has revised its approach and is planning to support consortia to understand their safety risks and identify mitigation strategies to assure safe flight while maintaining projects' original scope. This is because this phase involves the demonstration of new services for which there is often no existing or appropriate regulation (e.g. some aspects of BVLOS flight, such as the definition of an acceptable detect and avoid capability).

Figure 20 shows that views among those surveyed about the impact of the FFC on the efficiency of the CAA approval process were somewhat positive, with half (50%) believing it had increased efficiency, just one in ten (10%) feeling it had decreased efficiency, and the remaining 40% believing it had had no impact on efficiency.

Figure 20   Impact of the FFC on the efficiency of the CAA approval process for FFC-funded consortia

FFC has increased efficiency significantly	5%
FFC has increased efficiency slightly	45%
FFC has not impacted efficiency	40%
FFC has decreased efficiency slightly	4%
FFC has decreased efficiency significantly	6%
Summary: Increased	50%
Summary: Decreased	10%
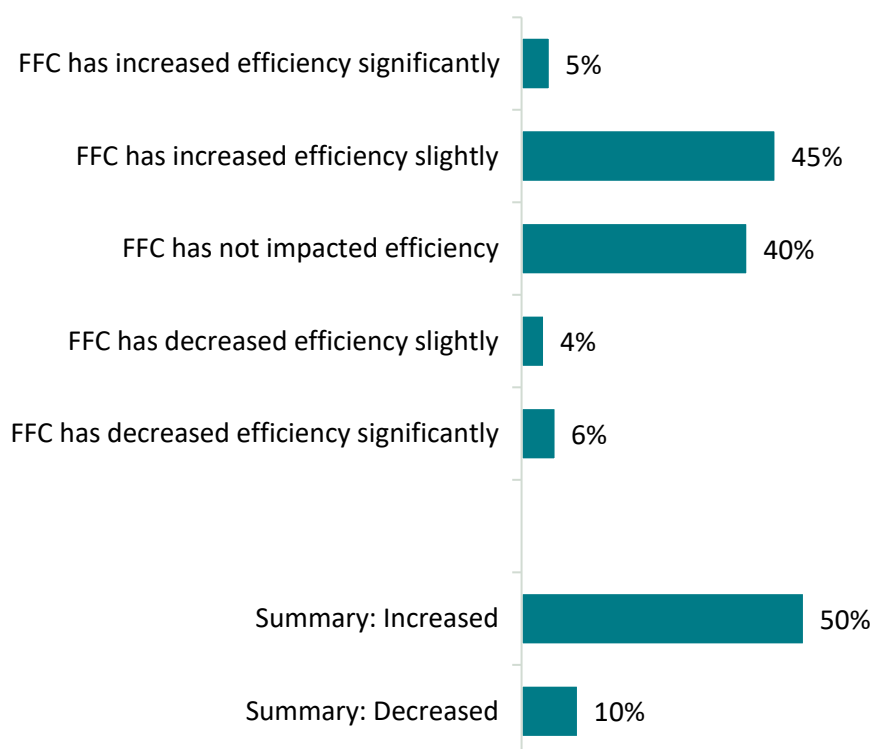
Source: Contact survey. C4C. How much do you think the FFC has improved the efficiency of the CAA's demonstration approval process for FFC-funded consortia?
Note: Base: valid responses, where completed application (Interim survey: 84).

Interviewed consortia viewed the main bottleneck in demonstration approval to be a lack of CAA capacity, flexibility and innovation. Industry and regulatory stakeholders noted that a contributing factor to the process length was the CAA's lack of capacity due to the COVID-19 pandemic and the Brexit transition. As part of the Brexit transition, the CAA has commenced functions that were previously performed by the European Union Aviation Safety Agency (EASA), which require substantial resources. As one industry stakeholder noted, the CAA *"are rapidly hiring and they are rapidly rebuilding that [EASA] capability and processes in-house. And we're now at the moment trying … to secure approvals to do all of this experimental flying. There's some friction in the process".*

Regulatory stakeholders reported a steep learning curve for both the CAA and industry consortia during the Development Phase in working through the demonstration approval process. They found that interactions tended to be more effective with organisations that had previous experience with the CAA or had worked in a regulatory role in the past. One regulatory stakeholder emphasised the benefits to future flight companies of employing experienced regulatory affairs managers. In some cases, a lack of regulatory experience among consortia had delayed demonstrations. One consortia stakeholder mentioned that they had had to delay their live demonstration for weeks because they

were unaware of the full set of permits they needed to build a physical infrastructure. This experience, combined with the views of regulatory stakeholders, suggests that particular consortia could have engaged more with the CAA Innovation Team in order to improve their approval processes.

Based on expert input, different organisations may value their experience and relationship with the CAA to differing degrees. It was perceived that eVTOL companies could have a vested interest in collaborating with the CAA over longer timescales and have the resources for regulation upskilling. As UAS regulation is more advanced than that of the eVTOL sector, organisations that focus on RPAS technologies have existed for a much longer period of time and have built up strong regulation knowledge and relationships with the CAA.

Multiple consortia stakeholders mentioned that accessing the CAA's support was helpful for Development Phase consortia that had applied to the Demonstration Phase, as they had a better understanding of what the CAA would likely approve.

Regulatory readiness for technological development

Figure 21 shows the extent to which respondents felt that the regulation of future flight technologies was a barrier to or an enabler of the progression of future flight technology in the UK. While a third (35%) of respondents in the interim survey felt that regulation was an enabler, this was significantly lower than the 50% who did so at the baseline. Correspondingly, respondents for the interim survey were significantly more likely to feel that regulation was a barrier than at the baseline (57% compared to 42%). Technology developers were more likely than average to feel that regulation was a barrier (64%), as were those involved with autonomous aviation systems (62%).

This may be associated with an increase in the technological maturity of the systems and technology used by the respondents between the baseline and interim surveys. Over that time, it is likely that respondents would have begun to work with higher TRL technology. In this situation, it is likely that they are more dependent on a regulator to provide approval for their continued development, demonstration or commercial operation.

As noted above, in this same period the CAA has had to hire significant new resources to replicate some of the services and functions that had previously been undertaken by EASA. There was therefore a likely increase in demand from respondents for demonstration or certification support from the CAA at a time when the CAA was taking on more responsibility, leading to increased demand from the traditional and established aviation industry. This compound effect of demand on the CAA is a likely contributor to the increased perception of regulation as a barrier to technological development from baseline.

Figure 21   Extent to which the regulation of future flight technologies is a barrier or an enabler

Significant barrier — Interim 27%*, Baseline 15%
Moderate barrier — Interim 17%*, Baseline 9%
Slight barrier — Interim 13%, Baseline 18%
No impact — Interim 8%, Baseline 8%
Slight enabler — Interim 13%, Baseline 16%
Moderate enabler — Interim 9%*, Baseline 18%
Significant enabler — Interim 13%, Baseline 16%

Summary: Barrier — Interim 57%*, Baseline 42%
Summary: Enabler — Interim 35%*, Baseline 50%

■ Interim   ■ Baseline
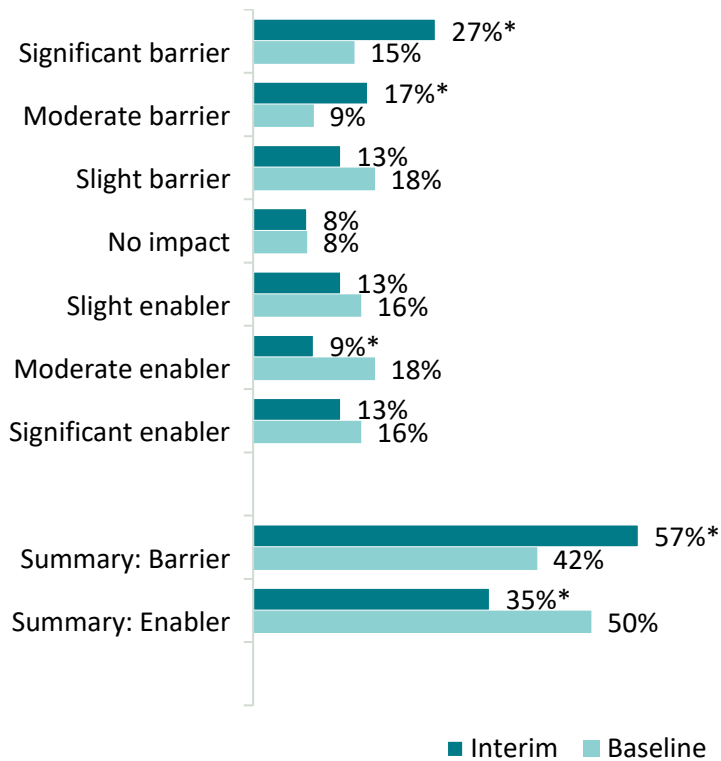
Source: Contact survey. C5/4. For each of the following, please indicate whether you think they are a barrier or enabler to the progression of future flight technology in the UK.

Note: Base: valid responses, all respondents (Interim survey: 173, Baseline: 147). Figures with asterisks are statistically significant between baseline and interim at the 95% confidence level.

Development of new policies and regulations

Industry stakeholders agreed that innovations in the regulatory environment in the UK, innovations in flight testing environments and reductions in regulatory uncertainty were very important for fostering technological innovation.

At its inception, the FFC aimed to accelerate the pace of regulatory innovation and for new regulatory frameworks to be introduced by 2023. Regulatory stakeholders reported that the development and publication of some pieces of regulation and guidance had been faster due to the CAA's engagement with competition winners in the Development Phase, for example the published guidance *Carriage of Dangerous Goods by Remotely Piloted Aircraft Systems.*[20] The CAA has released a range of Civil

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[20] CAP 2248: Carriage of Dangerous Goods by Remotely Piloted Aircraft Systems

Aviation Publications (CAPs) that are directly related to FFC objectives,[21] but it is difficult to attribute these directly to FFC activities.

Stakeholders emphasised that the pace of regulation change in response to innovation had historically been a challenge in the sector, both in the UK and internationally. The CAA is typically incentivised to consider longer time frames in developing a regulatory framework, whereas the FFC has shorter-term objectives and design. Government and regulatory stakeholders stated that some guidance needed by Demonstration Phase projects (e.g. BVLOS use cases) might not be ready by the end of the Challenge in 2024.

Regulatory and consortia stakeholders noted that regulatory innovation had been impacted by the recent lack of CAA capacity, partly due to the COVID-19 pandemic and the Brexit transition. As mentioned above, as part of the Brexit transition, the CAA has commenced functions that were previously performed by the EASA, which require substantial resources. One stakeholder commented that the CAA currently had limited capacity *"to get their heads up from day to day activities and look at innovation".*

Regulatory stakeholders commented that the FFC funding had been highly valuable for securing capacity to look at future flight innovation, that it had led to increased "*focus*" within the CAA on future flight, and that it had enabled the CAA to accomplish substantially more innovation work than would have been possible without the Innovation Team funding.

At the same time, regulatory stakeholders noted that internal momentum was currently a barrier to innovation. They noted that it was important for the CAA to develop an "*innovation standard*" in order to achieve the regulatory objectives of the FFC. They added that the involvement of consortia members that were high profile or relatively familiar with the CAA, typically end-users or legacy aviation companies (e.g. the NHS, Royal Mail, Heathrow Airport), had been helpful for gaining internal traction within the CAA for future flight.

No consensus emerged among stakeholders about how to accelerate the pace of regulatory innovation. In general, industry stakeholders called for the CAA to explore other mechanisms to bridge the gap between the innovation and regulation teams, and to encourage regulation developing alongside advancements in future flight technologies in a timely way. One stakeholder wished that the FFC funds that had been spent on BVLOS Development Phase projects could have instead been invested in the CAA to support regulatory innovation; however, any CAA funding would need to be designed to avoid regulatory capture.[22]

Regulatory stakeholders found that the potential for information sharing between consortia and the CAA during the Development Phase had not been fully realised, due to engagement challenges. This

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[21] These include: research on safety risks of atypical air environments, *Developing a Vision for UK UTM, Detect and Avoid Challenge, Future Flight Mobility: Regulatory Sandbox, CAP2122* which outlines the Innovation Hub current thinking on AAM and its implications for regulation*, CAP2172* presenting the roadmap of what needs to happen for stakeholders to accept BVLOS plus examples of concepts and operators, *Volocopter (CAP1949), Flylogix (CAP2261)* and *Eve (CAP2272).*

[22] Regulatory capture refers to the case when a regulator gives preferential treatment to a sector or particular set of firms within its remit, usually due to this group providing financing or resources to the regulator.

had reduced the quantity and quality of evidence provided to the CAA in order to inform new regulation. Additionally, it was difficult for the CAA to obtain insights from consortia after the Development Phase finished because consortia had disbanded.

The CAA sits on the Advisory Group and FFC Programme Board and is part of the Future Aviation Industry Working Group on Airspace Integration (FAIWG:AI) working alongside the FFC, the DfT, the Connected Places Catapult and industry stakeholders. The FFC established the FAIWG:AI in 2022 and seeks to provide inputs and insights to feed into government strategy and regulatory policy for safely integrating future flight technologies (e.g. eVTOLs, drones and others) in UK airspace, and to start commercial services as soon as possible, no later than 2025. Most stakeholders highlighted that FAWIWG:AI had been helpful for assembling industry expertise and coordinating common objectives. One government stakeholder noted that this was an example of how the FFC "*is quite good at bringing people together*", and that "*groups like an airspace group, [policy makers] needed that, and the FFC created it*". The FAIWG:AI published a strategic plan for regulators and industry in early 2023.

It was recognised that the FFC had the potential to influence international regulation. At its inception, the FFC expected that new future flight regulatory frameworks and guidance developed by the CAA could help inform international standards and therefore facilitate cross-country alignment guided by the UK. This was intended to be led by the CAA's international group. There was limited evidence of international activity from the CAA or from the FFC towards these objectives, although the FFC maintains strong communication with NASA, the Civil Aviation Safety Authority in Australia, and the Civil Aviation Authority in Norway.

There was no consensus among stakeholders about how FFC resources might have previously been, or could in future be, allocated to address the barriers outlined above. One consortia stakeholder mentioned that reducing the number of competition winners and allocating more funding per project could have led to more information being shared with the CAA.

UK regulation of future flight technologies in comparison to other countries

Figure 22 shows how respondents felt the UK was currently performing in terms regulation of future flight technologies in comparison to other countries. While a quarter (26%) of respondents in the interim survey felt that the UK was the world leader or ahead of most countries in terms of regulation of future flight technologies, this was significantly lower than the 40% who did so at the baseline. Correspondingly, respondents in the interim survey were significantly more likely to feel that the UK was slightly or a long way behind most countries than was the case at the baseline (40% compared to 17%).

Those involved with urban air mobility (51%), regulation and governance (51%) and non-future flight technologies (50%) were more likely than average to feel that the UK was slightly or a long way behind most countries.

This is reflected in 'Let's Get Flying' the FAIWG:AI publication, which states that there is an imperative for the UK to act swiftly in various stakeholder groups, from central government to the CAA and

industry. This is to avoid the UK falling behind the rest of the world on effective airspace integration to enable future flight technologies.

Figure 22   UK performance in regulation of future flight technologies
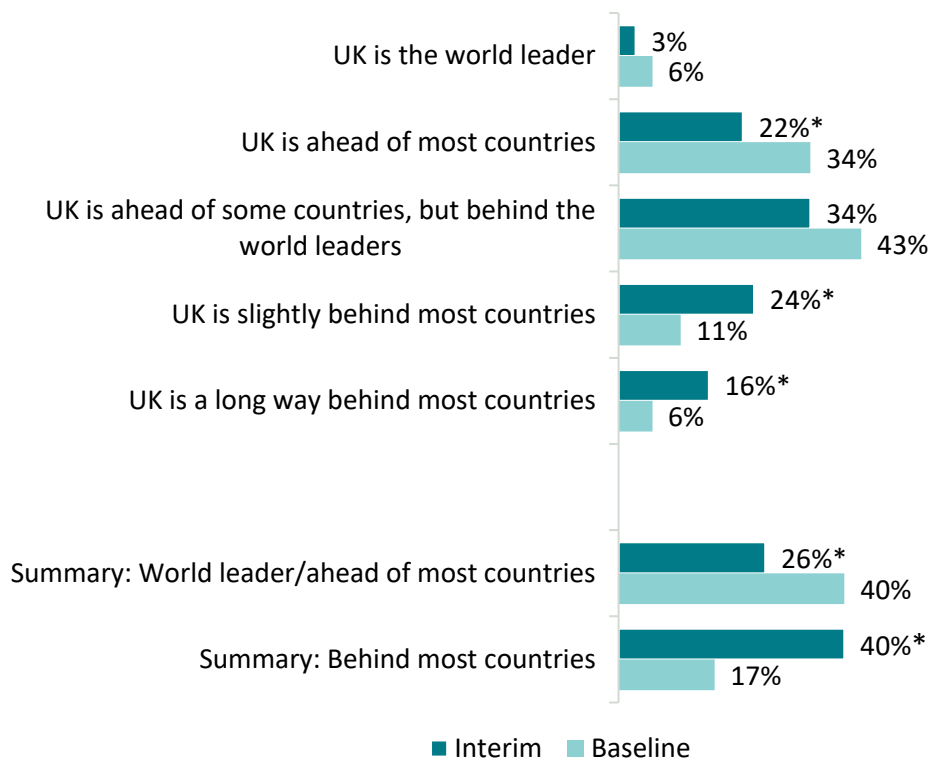
Source: *Contact survey. C1/4. I'm now going to read out some elements of future flight technology development and support. For each, please can you tell me how you think the UK is currently performing in comparison to other countries?*

Note: *Base: valid responses, all respondents (Interim survey: 174, Baseline: 143). Figures with asterisks are statistically significant between baseline and interim at the 95% confidence level. Item responses may not sum to summary figures due to rounding.*

4.5   Theme 4 - Has the FFC increased investment and R&D in future flight technologies?

4.5.1   Overview

To assess this theme, we analysed the metrics summarised in Table 13.

Table 13   Summary of evaluation evidence

Subtheme	Metric	Data source
Trends in perceptions of future flight investment in the UK	Extent to which private sector investment is a barrier or an enabler	Survey data

Subtheme	Metric	Data source
	UK performance in terms of private sector investment for the future flight sector	Survey data
	Extent to which government funding or investment is a barrier or an enabler	Survey data
	UK performance in terms of government funding or investment for the future flight sector	Survey data
Effect of the FFC on private sector investment	Impact of FFC on the ease of securing investment for the development of future flight technology	Survey data; stakeholder views
	Co-investment estimates	Monitoring data
Effect of the FFC on public investment	Impact of the FFC on public sector investment for the development of future flight technology	Monitoring data; stakeholder views

Source: Frontier Economics

Theme 4 – Key messages

■ Surveyed views of the FFC's impact on funding and investment were positive. Seventy-one percent of survey respondents thought that the FFC had had a positive impact on the ease of securing investment, and 24% thought it had had a large positive impact.

■ The survey evidence suggests that the sector view of UK private and public funding and investment is generally positive, but it is somewhat less positive than at baseline and suggests that the sector feels that the UK has lost some competitiveness internationally in terms of investment opportunities since the baseline.

■ Key uncertainties include: the availability of public funding mechanisms after the FFC ends, access to European initiatives and the ability of the UK to increase its competitiveness to attract foreign investment.

4.5.2   Aims and activities

Across many industries, R&D underinvestment among private companies is a recognised market failure (the benefits from R&D investment spill over to other companies, and companies lack the information to understand potential investment benefits). In future flight, this issue is exacerbated by the gap between the research conducted by the academic community and the ability of businesses to commercialise this research and bring products and services to the market. Although there has historically been substantial investment in R&D in the UK aerospace sector led by a few companies, the investment level varies by future flight technology and across company sizes.

In the Development Phase, the FFC allocated £33.5 million to 48 projects distributed in three strands for R&D into enabling system capabilities to support the introduction of new classes of electric or autonomous air vehicles. In the Demonstration Phase, the FFC allocated £73 million to 17 projects which aim to deliver live demonstrations in representative environments with real use cases involving UAS, AMM and electric regional aircraft.

One of the main objectives of the FFC is to increase business investment and R&D in the future flight sector, including diverting R&D investment from other jurisdictions. To achieve this objective, the FFC required winning consortia to match competition grants[23] with up to £175 million in pledged and additional co-investment. The FFC intends that FFC-funded projects will help stakeholders identify investment opportunities, raise the profile of the UK future flight sector globally and increase the sector's competitiveness to unlock further public and private funding. In the absence of the FFC, it was expected that investment in future flight technologies would have increased in line with sector growth.

The FFC portfolio review found that competition project outputs were expected to contribute to private investment through a number of channels. The project portfolio particularly supports accelerating new technology and capabilities available for existing classic aviation markets, and this has the potential to increase external investment. The review noted that introducing new models of airspace management was a relatively infrequent project objective, but it is an important enabler of the adoption of future flight technologies and therefore an important enabler of investment.

The FFC measures investment related to competition projects from non-FFC sources (co-investment) in a number of ways, which are shown in Table 14. The FFC has estimated realised co-investment based on data from a co-investment survey of consortia conducted at the end of the Development Phase. These estimates combine private and public investment. Importantly, these figures may or may not be incremental investment in the future flight sector, or in the particular future flight technology, as the investment may have occurred regardless of FFC funding. This issue is discussed in more detail in Section 4.5.3.

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[23] Match funding requirements ranged from 50-75% for large organisations, 40-65% for medium size organisations and 30-55% for micro or small organisations, depending on the type of project (industrial research or experimental development).

Table 14   FFC co-investment estimates

Type	Description	Realised Development Phase co-investment
Pledged co-investment	Investment that consortia plan to spend on the FFC project	£13m
Accompanying co-investment	Extra public (non-UKRI) and non-public investment in R&D over and above the pledged co-investment that contributes to achieving project objectives	£45m
Aligned co-investment	Investment in technologies or R&D projects aligned to and prompted by the FFC-funded project	£34m
Follow-on co-investment	Investment in bringing to market or exploiting outcomes from FFC-funded projects (often combined with other intellectual property to achieve commercial projects)	£3m

Source: Pledged co-investment estimate is from FFC internal monitoring. Other figures are FFC estimates based on co-investment survey, June 2022. Estimates are based on data from 28 participants out of 227 total participants (20% response rate) reporting on 143 private investment streams from consortia organisations, associated with 27 projects out of 48 total projects (56% response rate), in the Development Phase.

In the Development Phase, the FFC estimated that realised pledged co-investment as of June 2022 was £13 million, which is 59% of the £22 million that consortia committed to spend on the Development Phase FFC projects. The total grant funding claimed to date was £22 million, which is 58% of the £38 million of grant funding offered. The FFC reported in January 2022 that the remainder of the pledged co-investment and grant funding for the Development Phase was on track to be realised. The FFC diverted £1.15 million in unspent programme funds from the Development Phase to the Demonstration Phase, to fund an additional Demonstration Phase project.

The FFC has a target of £175 million total co-investment for the Development Phase, which was expected to extend beyond the length of the Development Phase projects. At this stage, due to higher-than-expected accompanying and aligned co-investment figures, it is expected that the FFC will meet or exceed its target.

4.5.3   Evaluation evidence

Trends in perceptions of future flight investment in the UK

Figure 23 shows the extent to which survey respondents felt that private sector investment for the future flight sector was a barrier to or an enabler of the progression of future flight technology in the UK. While two in three (67%) felt it was an enabler, this was lower than the 80% who did so at the

baseline, and there was a corresponding increase in the proportion who felt it was a barrier (29% compared to 15%).

Figure 23   Extent to which private sector investment is a barrier or an enabler

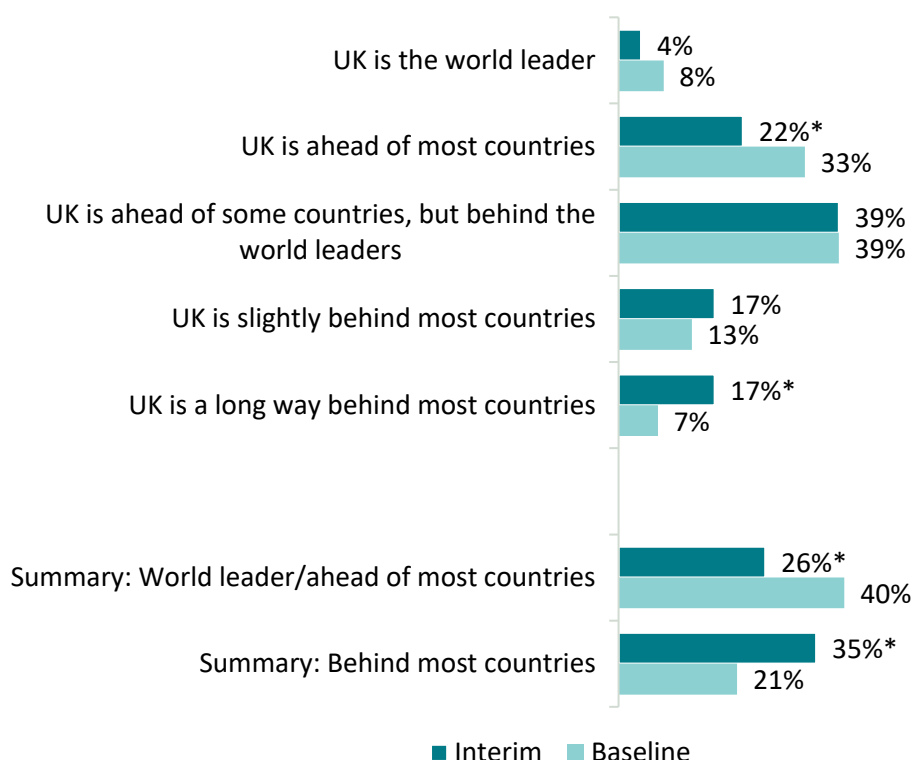|	Interim	Baseline
Significant barrier	12%*	4%
Moderate barrier	10%	5%
Slight barrier	7%	6%
No impact	4%	5%
Slight enabler	24%	16%
Moderate enabler	21%	28%
Significant enabler	23%*	36%
Summary: Barrier	29%*	15%
Summary: Enabler	67%*	80%
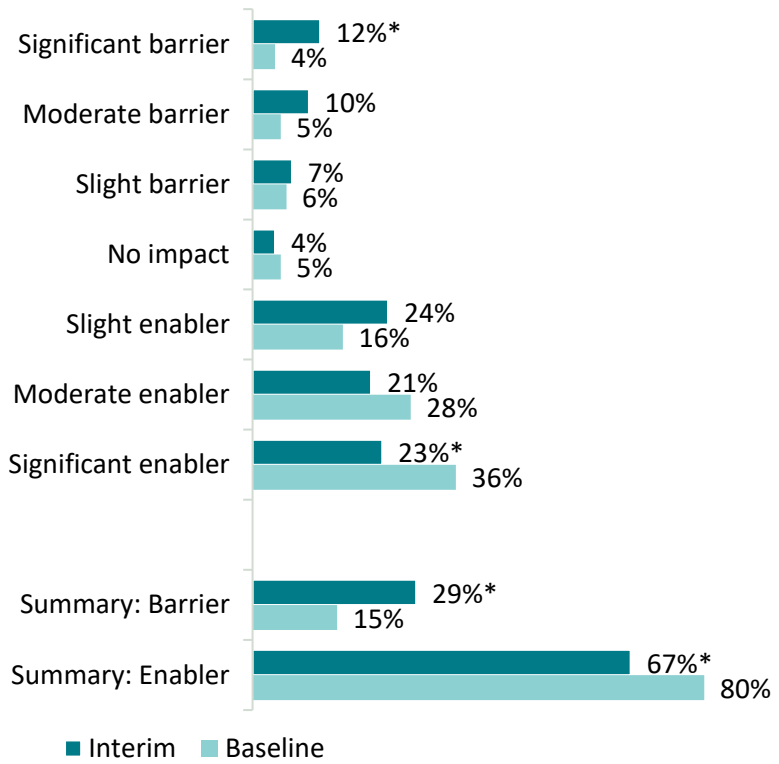
Source: Contact survey. C5/1. For each of the following, please indicate whether you think they are a barrier or enabler to the progression of future flight technology in the UK.

Note: Base: valid responses, all respondents (Interim survey: 180, Baseline: 148). Figures with asterisks are statistically significant between baseline and interim at the 95% confidence level. Item responses may not sum to summary figures due to rounding.

Figure 24 shows how respondents viewed UK performance in terms of private sector investment for the future flight sector.

While one in five (18%) felt that the UK was the world leader or ahead of most countries in this respect, twice this proportion (36%) felt it was slightly or a long way behind most countries, a significant increase on the 24% who did so at the baseline. Examining subgroups of respondents, those involved with physical future flight infrastructure were more likely to regard private sector investment as a barrier (42%).

There have been significant increases in demand for UAS technology by the UK defence industry, and it is likely that companies have directed their organisational strategies elsewhere instead of to civilian or commercial use cases that potentially have more profitable routes to market.

There is a key focus on air vehicle demonstrations across the sector. Future air use cases are a positive way to increase public perception, industry investment and air regulation. Although future flight infrastructure is also significant for enabling future flight technologies, it may be seen as a

secondary or future focus area rather than an immediate factor. Infrastructure should develop in parallel to ensure that delays in entry into service are avoided.

Figure 24   UK performance in terms of private sector investment for the future flight sector

UK is the world leader — Interim 2%, Baseline 2%
UK is ahead of most countries — Interim 16%, Baseline 24%
UK is ahead of some countries, but behind the world leaders — Interim 46%, Baseline 50%
UK is slightly behind most countries — Interim 20%, Baseline 14%
UK is a long way behind most countries — Interim 16%, Baseline 10%
Summary: World leader/ahead of most countries — Interim 18%, Baseline 26%
Summary: Behind most countries — Interim 36%*, Baseline 24%

■ Interim ■ Baseline

Source: *Contact survey. C1/1. I'm now going to read out some elements of future flight technology development and support. For each, please can you tell me how you think the UK is currently performing in comparison to other countries?*

Note: *Base: valid responses, all respondents (Interim survey: 166, Baseline: 136). Figures with asterisks are statistically significant between baseline and interim at the 95% confidence level. Item responses may not sum to summary figures due to rounding.*

Based on expert input, there are several plausible explanations for the decline in perceived private investment opportunities in the UK, which are trends in the broader UK aerospace sector. These include COVID-19 pandemic effects on the aviation sector's financial performance, other disruptions to funding streams caused by the pandemic, and investors' concerns about post-Brexit UK economic performance. One stakeholder noted that future flight start-ups were particularly exposed to Brexit risks, as they share much of their supply chain with large incumbent aerospace systems integrators and are therefore dependent on the geographic location of other companies.

Figure 25 shows the extent to which respondents felt that government funding or investment was a barrier to or an enabler of the progression of future flight technology in the UK. While two in three (68%) felt it was an enabler, this was lower than the 86% who did so at the baseline, and there was a corresponding increase in the proportion who felt it was a barrier (27% compared to 12%).

Figure 25   Extent to which government funding or investment is a barrier or an enabler
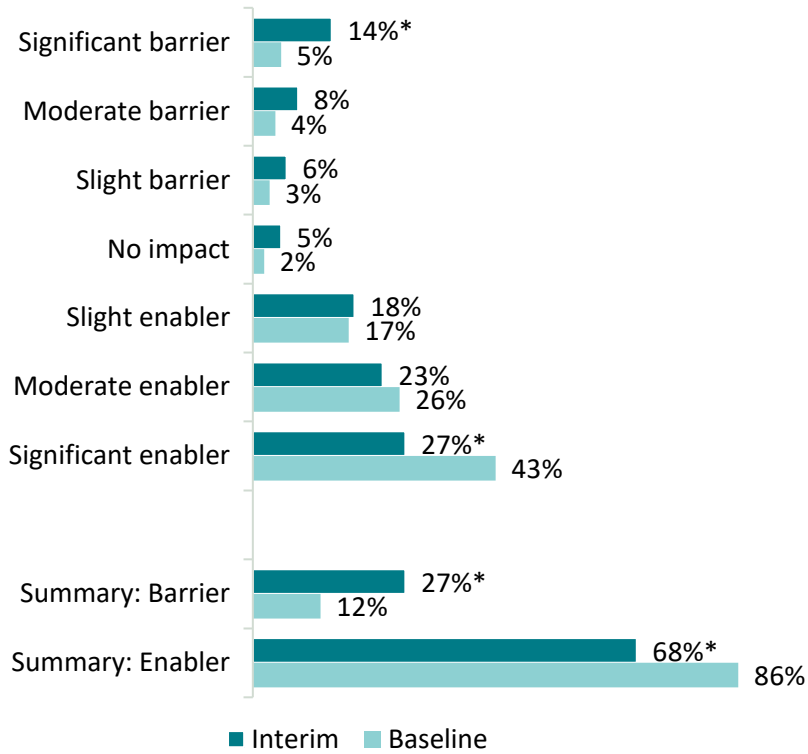
Significant barrier: Interim 14%*, Baseline 5%
Moderate barrier: Interim 8%, Baseline 4%
Slight barrier: Interim 6%, Baseline 3%
No impact: Interim 5%, Baseline 2%
Slight enabler: Interim 18%, Baseline 17%
Moderate enabler: Interim 23%, Baseline 26%
Significant enabler: Interim 27%*, Baseline 43%

Summary: Barrier: Interim 27%*, Baseline 12%
Summary: Enabler: Interim 68%*, Baseline 86%

■ Interim ■ Baseline

Figure 26 shows how respondents viewed UK performance in terms of government funding or investment for the future flight sector. While a quarter (26%) felt the UK was the world leader or ahead of most countries in this respect, this represented a significant decrease on the 40% who did so at the baseline. Correspondingly, 35% felt it was slightly or a long way behind most countries, a significant increase on the 21% who did so at the baseline. Those involved with electric, hybrid-electric or hydrogen regional aircraft were more likely than average to regard government funding or investment as being slightly or a long way behind most countries (45%), as were those involved with non-future flight technologies (43%).

Figure 26   UK performance in terms of government funding or investment for the future flight sector

Category	Interim	Baseline
UK is the world leader	4%	8%
UK is ahead of most countries	22%*	33%
UK is ahead of some countries, but behind the world leaders	39%	39%
UK is slightly behind most countries	17%	13%
UK is a long way behind most countries	17%*	7%
Summary: World leader/ahead of most countries	26%*	40%
Summary: Behind most countries	35%*	21%

■ Interim ■ Baseline

Source: *Contact survey. C1/2. I'm now going to read out some elements of future flight technology development and support. For each, please can you tell me how you think the UK is currently performing in comparison to other countries?*

Note: *Base: valid responses, all respondents (Interim survey: 179, Baseline: 141). Figures with asterisks are statistically significant between baseline and interim at the 95% confidence level. Item responses may not sum to summary figures due to rounding.*

The survey findings indicate that respondents perceived a decline in public funding opportunities over the past two years. Interviewed stakeholders suggested a few potential explanations for this trend.

Brexit affected the availability of public funding in the future flight sector as it had profound implications for the location of business activity and R&D and the access of UK firms to European initiatives (e.g. SESAR[24]) and collaborative R&D programmes (e.g. Horizon Europe).

One stakeholder mentioned that some aviation investors "*lacked confidence*" after the experience of the COVID-19 pandemic.

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[24] SESAR is the technological pillar of Europe's Single European Sky initiative, a partnership between private and public sector stakeholders set up to accelerate R&D and take-up of technological solutions to manage conventional aircraft, drones, air taxis and vehicles flying at higher altitudes.

Another stakeholder thought that policy uncertainty was constraining large investments in future flight: *"additional clarity is going to be needed [on government policy] if UK PLC wants to see substantial eight or nine figure investment volumes made into the country".*

As future flight technology advances, and estimates of its commercial value increase, industry expectations for investment may outstrip growth in investment opportunities. One consortia stakeholder felt that "*the amount of [public] money that's being spent on [their competition project] is peanuts compared to the potential ROI [return on investment]*".

Effect of the FFC on private sector investment

Figure 27 shows how respondents viewed the impact of the FFC on the ease of securing investment for the development of future flight technology. Interim survey views were largely positive, with 71% believing the FFC had had a positive impact and just 5% believing it had had a negative impact. However, these views were less positive than at the baseline, when 81% believed the FFC had had a positive impact.

Figure 27   Impact of FFC on the ease of securing investment for the development of future flight technology
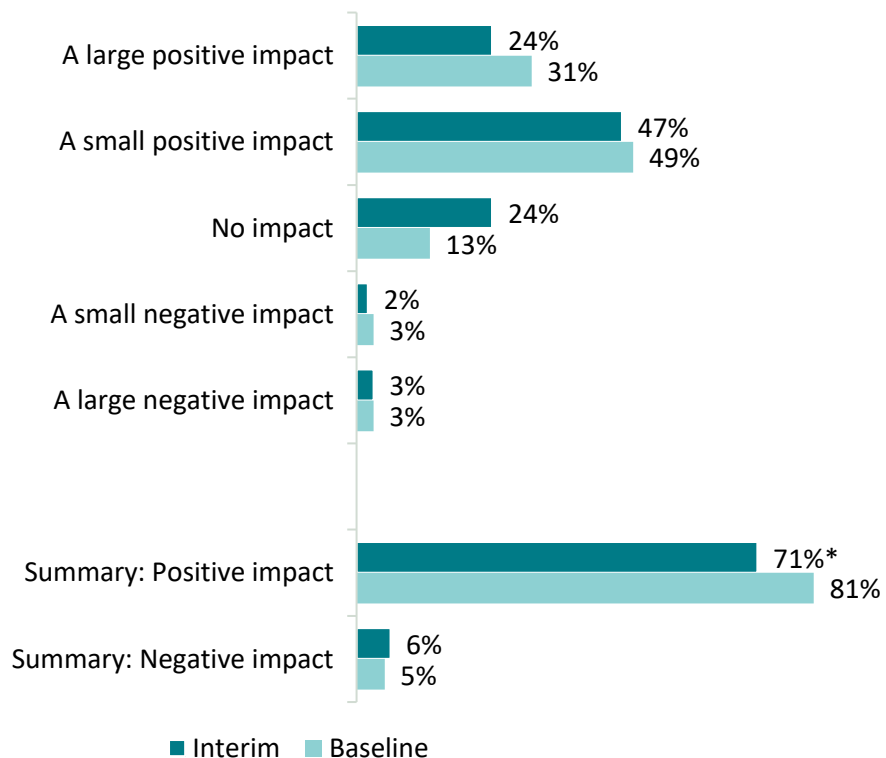
Source: Contact survey. C4. What impact, if any, do you think the Future Flight Challenge has had on the ease of securing investment in relation to development of future flight technology?

Note: Base: valid responses, all respondents (Interim survey: 176, Baseline: 144). Figures with asterisks are statistically significant between baseline and interim at the 95% confidence level. Item responses may not sum to summary figures due to rounding.

At this stage, it is too early to assess the full extent to which the FFC has led to changes in capital investment and R&D spending in the future flight sector. Among stakeholders from companies that specialise in future flight, there was no evidence of incremental private investment. However, there was anecdotal evidence that the 'official nature' of the FFC had incentivised some firms that typically operate in adjacent sectors to divert their own R&D funds that would otherwise have been spent on other types of initiatives. One consortia stakeholder highlighted an example of a large international organisation headquartered outside the UK that was funded in the Demonstration Phase. The company had been able to get internal approval for the matched funding requirements, which "*was for them quite unheard of and it wouldn't have happened if [the FFC] hadn't been seen to be a successful program*".

In general, whether matched R&D spending was incremental depends on what the alternative R&D activity would have been in the absence of the FFC. For companies that perform different activities or operate across different subsectors (e.g. commercial airlines, engineering companies) it is more likely that the match funding required by the FFC was incremental, as they would likely have diverted resources from non-future flight aerospace activity.

"When [development] activities are important to our core activities they get internal funding anyway, but when they are slightly parallel to our core activity, when they are not traditional technology development, the match funding would not have happened without the Challenge."

Industry expert stakeholder

For companies that specialise in core future flight technologies (e.g. BVLOS, AAM) it is possible that co-investment does not represent incremental investment in future flight, because the funds would have been spent on the development of some other aspect of future flight technology, in the absence of the FFC. The co-investment would only be incremental if SMEs requested additional capital from investors in order to be able to match FFC grants.

"Large companies can match whatever they are asked to because they are well funded and have resources available but SMEs have to find resources elsewhere, and is quite challenging."

Industry expert stakeholder

As mentioned above, the Development Phase funded projects at different stages of TRL that ranged from conceptual work to flight demonstrations. Industry stakeholders highlighted that the higher the level of TRL, the more important it was for businesses to demonstrate that investors would have an acceptable return on investment.

Public sector stakeholders expected that the Challenge would lead to additional investment both from UK companies thinking about investing in new technologies or expanding their R&D projects and from

international companies considering whether to invest in the UK (e.g. Joby Aviation, a US company seeking UK certification).

Industry stakeholders highlighted that there were uncertainties in the UK around the underlying digital and physical infrastructure needed to support the commercialisation at scale of these technologies, as well as a supporting regulatory framework. Other jurisdictions could potentially offer greater policy and regulatory support and certainty. The UK was currently competing with these jurisdictions for future flight investment, some with large-scale investments that have attracted companies away from the UK (e.g. Singapore and France).

Effect of the FFC on public investment

Consortia stakeholders agreed that there were currently no public funding mechanisms similar to the FFC that provided grants to develop future flight technologies at a large scale, particularly including local authorities and SMEs. Stakeholders noted that the FFC marked a step forward in the government's commitment to raise the profile of the UK future flight sector in the global market.

In previous years, businesses, academia and local authorities could apply to other public funds (e.g. Nesta's Flying High, ATI's funding for core technologies, Horizon Europe), but these have been interrupted by external factors such as the COVID-19 pandemic and Brexit. There is currently uncertainty around future funding mechanisms, and some stakeholders remarked that new funding sources were needed to support the international competitiveness of the UK. Multiple industry stakeholders mentioned that they needed a timely and stronger signal from politicians and policy makers about the future of public investment in the sector beyond the end of the Challenge in 2024. More specifically, some consortia stakeholders mentioned that the R&D spending in eVTOL that had been directed to building up a production supply chain needed to be properly supported by the government to be able to compete internationally.

"[Failing to create a follow-on programme to the FFC] would be missing a trick. [government] would be missing the opportunity to do whatever is appropriate...to push on further and maintain UK leadership."

Industry stakeholder

4.6 Theme 5 - Has the FFC helped to shape a coherent government policy that supports the development and operation of future flight technologies in the UK?

4.6.1 Overview

To assess this theme, we analysed the metrics summarised in Table 15.

Table 15   Summary of evaluation evidence

Subtheme	Metric	Data source
Trends in perceptions of government policy	Extent to which government policy is a barrier or an enabler	Survey data
	UK performance in terms of government policy towards future flight technologies	Survey data

Theme 5 – Key messages

■ The government's strategic framework for the aviation sector is laid out in the 'Flightpath to the Future' strategy, published by the DfT in May 2022.

■ The FFC has also supported and informed government policy in a range of other initiatives (Future Flight Vision and Roadmap, Aviation Council, Drones Industry Action Group, ADS AAM Market Group).

■ The rate at which survey respondents perceived government policy to be an overall barrier increased by 10% between the baseline and interim survey, and the rate at which respondents felt that the UK was a world leader or ahead of most countries in terms of government policy decreased by 8%.

4.6.2 Aims and recent policy developments

The FFC aims to influence the policy environment of the future flight sector, a key enabler of the establishment of future flight technology clusters in the UK. The competition projects will help to

identify and demonstrate policy gaps, and relevant national and local policy makers will be more informed about these policy needs. The stronger links between industry and the government will enable the government to develop coherent national policy and develop supporting infrastructure. At the same time, the sector will be more aware of the direction of government policy (informed where appropriate by the policy needs of competition projects), to reduce policy uncertainty and incentivise UK investment.

The government's strategic framework for the aviation sector is laid out in the 'Flightpath to the Future' strategy,[25] published by the DfT in May 2022. This document established the DfT's vision for the UK aviation sector over the next decade. The FFC (under the remit of BEIS) contributed substantially to the development of its future flight content, by providing expertise and strategic advice, and by communicating the industry's sense of urgency. The FFC continues to remain involved in many of the policy-level activities which are described in the ten-point plan within the strategy document, identifying the key priority areas that will support an innovative and sustainable aviation sector. These priority areas, which demand engagement with UK and international industry to realise them, are as follows:

■ **Put the sector on course to achieve Jet Zero by 2050**. The strategy acknowledges that this will require extensive collaboration between government and industry, including through the Jet Zero Council which FFC is able to influence through the Department for Energy Security and Net Zero and Innovate UK representation.

■ **Capture the potential of new technology and its uses**. The strategy includes setting up a Future of Flight Industry Group (FFIG) which aims to bring together stakeholders from across different technologies together with the CAA to address shared challenges and establish deliverables. Government stakeholders found that the FFC had accelerated the creation of the FFIG in several ways. First, the FFC had bridged a communication gap between industry and government. Unlike other sectors within aerospace, future flight companies are not concentrated in a few large organisations with existing government relationships. Instead, there are many small organisations that it would be time-consuming and complex for central government departments to frequently consult in a thorough way. One government stakeholder reported that they heavily relied on the FFC as a source of industry information in order to formulate ambitious but realistic policy objectives and outcomes. This filtered and consolidated information source allowed government to progress workstreams, including deciding the structure and agenda of the FFIG, faster than would have otherwise been possible. Two government stakeholders reported that the FFC materially reduced barriers to involving industry in the group, and the industry group structure was expected to reduce some administrative hurdles that could slow collaboration between government departments. They reported that the FFC Vision and Roadmap had been useful references for strategic activities.

The FFIG represents a significant advancement from the role that the FFC plays in the industry, as the group will develop, publish and implement a 'Future of Flight' delivery plan which will define the steps DfT and CAA will take to facilitate bringing future flight technologies to the market. This

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[25] [DfT (2022) Flightpath to the future](#)

delivery plan will use the FFC Roadmap[26] to inform initial thinking. It will include the necessary policy and regulatory framework to promote innovation in the sector and provide a vision to help businesses understand how to focus resources and investment. The FFC is heavily involved in the initial phase of the FFIG, with the intention of passing ownership of the relevant strategic areas to the CAA, the DfT and industry, who will be responsible for delivery. The involvement of the CAA in the FFIG is particularly important. The delivery plan will provide external accountability for the CAA, which stakeholders agreed was important for accelerating innovation in regulation.

Other areas where the FFC has supported and informed government policy are as follows:

- **Future Flight Vision and Roadmap August 2021**. A publication by the FFC outlines the vision for the future aviation system of 2030. A set of strategic roadmaps which focus on how to position the UK as a global leader in advanced aviation solutions will undoubtedly help inform government policy. Industry vision statements and future aviation use cases will further inform the direction of the sector, identifying key challenges to address that will support the future aviation system of systems.
- **Aviation Council**. A new initiative under the 'Flightpath to the Future' strategy which brings together attendees from across the whole of aviation, as well as key cross-government and devolved administration representatives.
- **Drones Industry Action Group (DIAG)**. The FFC is a member of the DIAG and has contributed to the group's Ambition Statement for the drone sector, which was jointly published by the DIAG and government.
- **ADS Advanced Air Mobility (AAM) Market Group**. Contributions by the FFC have led to such documents as the ADS AAM Annual Market Outlook, providing an underpinning baseline for government and companies to inform business cases for investment across the sector.
- **Future Aviation Industry Working Group on Airspace Integration (FAIWG:AI)**. The FFC is a founding member and co-chair of the FAIWG:AI, which published the 'Let's Get Flying' paper in February 2023, providing a list of targeted actions and benefits to government, industry and the regulator.
- The planned **Community Integration Working Group** will also convene central government and will bring local authorities into the deliberations.

The expected benefits of policy are more likely to be visible over a longer period of time in comparison to other evaluation criteria.

Stakeholders emphasised that senior political sponsorship could help galvanise cross-government efforts and coordination through public statements or strategies. This could be accompanied by high-profile live demonstrations conducted by well-known and familiar end-users or legacy companies in the sector.

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[26] UKRI/FFC (2021) Future Flight Vision Roadmap

4.6.3 Evaluation evidence

Trends in perceptions of government policy

Figure 28 shows the extent to which respondents felt that government policy was a barrier to or an enabler of the progression of future flight technology in the UK. The survey suggests some shifts in perceptions towards policy being a barrier rather than an enabler compared with the baseline findings. In the interim survey, 38% identified it as a barrier (compared to 28% at baseline) and 53% as an enabler (compared to 63% at baseline). These changes were not statistically significant; however, significantly more respondents in the interim survey regarded policy as a significant barrier (13% compared to 6% at baseline), and significantly fewer as a significant enabler (19% compared to 32% at baseline).

Figure 28   Extent to which government policy is a barrier or an enabler
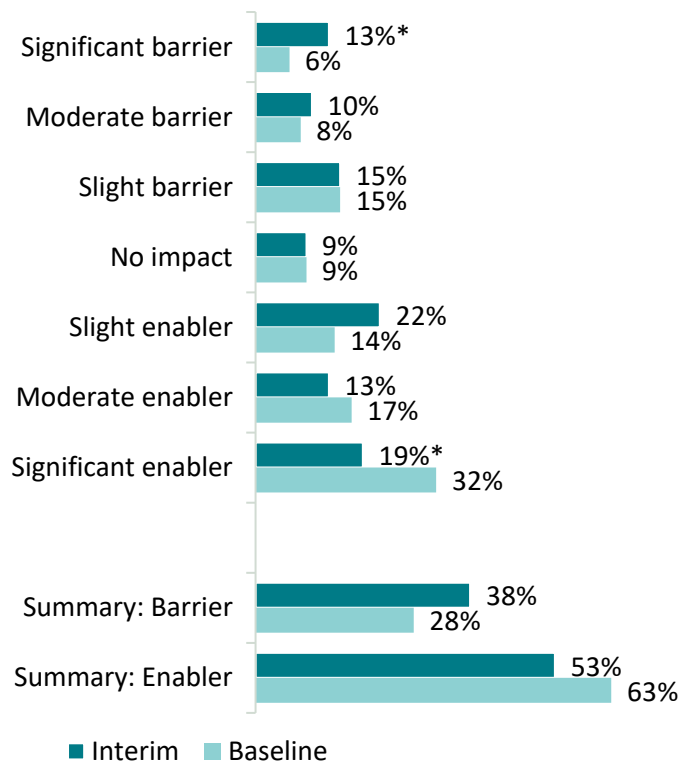
Source: Contact survey. C5/3. For each of the following, please indicate whether you think they are a barrier or enabler to the progression of future flight technology in the UK.

Note: Base: valid responses, all respondents (Interim survey: 176, Baseline: 145). Figures with asterisks are statistically significant between baseline and interim at the 95% confidence level. Item responses may not sum to summary figures due to rounding.

Figure 29 shows how respondents viewed UK performance in terms of government policy towards future flight technologies in comparison to other countries.

A quarter (25%) felt that the UK was the world leader or ahead of most countries in this respect, a slightly lower proportion than the 33% who did so at the baseline. However, over a third (35%) felt it was slightly or a long way behind most countries, an increase from 22% at baseline. Examining subgroups of respondents, those involved with urban air mobility, regulation and governance and non-future flight technologies were more likely to regard government policy as slightly or a long way behind most countries (all 41%).

Figure 29   UK performance in terms of government policy towards future flight technologies

Multiple industry stakeholders expressed the view that better understanding of the direction of government policy was important for the sector. One industry stakeholder commented: *"the government needs to come and spell out some road map to commercialization. How can you actually use these technologies? For the UK economy, that's really the clarity that's needed".* We note that this comment was made in September 2022, and does not reflect any subsequent government strategic activities.

Multiple consortia stakeholders emphasised that government policy certainty was important to future flight companies in order to attract investment. One industry stakeholder emphasised that it was risky to build UK manufacturing and infrastructure in the absence of clear government strategy. Another

industry stakeholder discussed how their focus had shifted to overseas markets, partly due to closer collaboration between industry and government.

4.7 Theme 6 - Has the FFC helped to improve public attitudes to future flight technologies?

4.7.1 Overview

In the interim evaluation, it is relatively early to assess the FFC's effect on public acceptance. The results in this theme therefore focus on early trend results and initial activities in the FFC social science research workstream. In interviews with stakeholders, we did not gather views on the influence of the FFC on public acceptance.

Table 16   Summary of evidence

Subtheme	Metric	Data source
Trends in perceptions of public acceptance	Extent to which public perceptions of future flight technologies are a barrier or an enabler	Survey data; social science research findings
	UK performance in terms of public perceptions of future flight technologies	Survey data

Theme 6 – Key messages

■ The FFC has progressed its social science research workstream, including commissioning research, designing and funding a grant scheme and policy fellowships, and engaging with Demonstration Phase projects.

■ Survey respondents exhibited mixed views about the degree to which public acceptance was a barrier to or an enabler of UK future flight development, and how the UK compared to other countries in terms of public acceptance. This is consistent with the FFC's qualitative research findings that the public acknowledges potential benefits from future flight (e.g. transport in rural or remote areas, sustainability) but it also has concerns about a range of possible disbenefits (e.g. safety, privacy, affordability).

4.7.2   Aims and activities

The FFC aims to influence public acceptance of future flight technologies, a key enabler of the establishment of future flight technology clusters and their deployment in the UK. Public acceptance and end-user demand expand the set of commercially viable use cases and make it easier for companies to demonstrate and sell future flight technologies in UK markets. This in turn makes the UK a more attractive place to establish economic clusters that produce these technologies.

The FFC commissioned research into social science aspects of the future flight sector and appointed a team of academics to lead the work, with a report issued in December 2021 (*Future Flight Social Science Considerations and Research*). The ESRC assumed the role of intermediary between the academic community and the FFC and coordinated the research. The research topics were identified and prioritised following the appointment of an FFC Research Director, responsible for writing academic papers and reports, organising conferences and conducting surveys.

The social science workstream utilised ESRC, UKRI and academic research experience gained from working with other technology areas and applied those methods to future flight. The FFC aims to deliver a new area of interdisciplinary research and to work in areas that are not currently being researched by other comparable international organisations. Social science research activities to date include:

- Engaging with industry experts and Development Phase award holders to refine priorities for social science research. This engagement produced a short- to medium-term plan for social science research.

- Gathering evidence from academics via online workshops to develop recommendations for research (key participants; priority topics).

- Gathering evidence on public attitudes using a deliberative methodology to help participants engage with technology with which they do not have personal experience. The findings were published in a research report in July 2022 (*Future Flight Challenge – Mini Public Dialogue*).

- Allocating up to seven project grants, each with funds up to £150,000. The projects begin in April 2023, and UK-based researchers who are eligible for ESRC funding may apply. The grants will focus on a set of themes, and no more than one grant will focus on each theme. These are:

  □ Innovation by and for social and community need: exploring how to best design and implement inclusive future flight systems, encompassing four subthemes which focus on (1) disability and accessibility, (2) marginalised groups' access and experiences, (3) digital exclusion from Future Flight transport, and (4) socio-economic exclusion/inclusion;

  □ Future flight ecosystems and enterprises: developing a deeper understanding of the future flight innovation ecosystem;

  □ Governance and trustworthiness: exploring and analysing how UK-based governance and public policy tools and processes may enable or constrain future flight; and

□   Spatiality of future flight: examining the implications, expectations and impacts of future flight technologies across different communities.

▪   Designing and funding two policy fellowships, starting in April 2023 and lasting 6-12 months, for UK-based researchers who are eligible for ESRC funding. The first fellowship will conduct a comparative economic/environmental assessment of investment in future flight versus existing public and private transport. The second fellowship will conduct research that seeks to understand how future flight technologies might be integrated into a UK-wide transport system.

The grants and fellowships are expected to produce outputs that will inform the FFC and policy initiatives (see Section 4.6) and the Aerospace Growth Partnership.

In addition, the FFC offered advice to Demonstration Phase applicants about incorporating social science aspects into their bids. The aim was to ensure that Demonstration Phase projects align with user and public needs and, in 2024, it will be possible to assess the extent to which public acceptance considerations affected Demonstration Phase project outputs.

The FFC portfolio review found that the project portfolio as a whole had a strong focus on the social readiness of technologies and on demonstrating the viability of new markets. However, there was a decreased focus on the social impact and social readiness of technologies between the Development and Demonstration Phases. The review noted that during the Development Phase projects typically had a broader scope, which included exploring the technology's potential societal uses and benefits. During the Demonstration Phase, projects tended to be more narrowly focused on preparing and conducting demonstrations.

4.7.3   Monitoring evidence

Figure 30 shows the extent to which respondents felt that public perceptions of future flight technologies were a barrier to or an enabler of the progression of future flight technology in the UK. Views were balanced, as was the case at the baseline, with 39% regarding public perceptions as an enabler and 41% as a barrier. There is little evidence of overall changes in perceptions between the baseline and interim surveys.

Figure 30 Extent to which public perceptions of future flight technologies are a barrier or an enabler

	Interim	Baseline
Significant barrier	12%	10%
Moderate barrier	13%	13%
Slight barrier	16%	16%
No impact	19%	23%
Slight enabler	17%	19%
Moderate enabler	9%	10%
Significant enabler	13%	10%
Summary: Barrier	41%	38%
Summary: Enabler	39%	39%
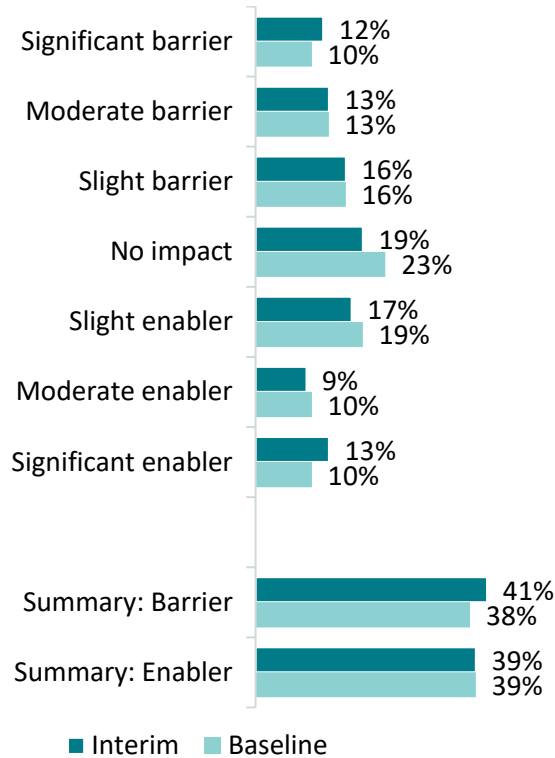
Source: *Contact survey. C5/7. For each of the following, please indicate whether you think they are a barrier or enabler to the progression of future flight technology in the UK.*

Note: *Base: valid responses, all respondents (Interim survey: 181, Baseline: 146). Figures with asterisks are statistically significant between baseline and interim at the 95% confidence level.*

Figure 31 shows how respondents viewed UK performance in terms of public perceptions of future flight technologies in comparison to other countries. Perceptions in this respect were mixed and, on balance, more negative than positive, with one in five (21%) regarding the UK as the world leader or ahead of most countries and a third (33%) feeling the UK was slightly or a long way behind most countries. There is some evidence that perceptions have deteriorated since the baseline survey: at baseline an even proportion (27% each) regarded the UK as ahead or behind other countries in terms of public attitudes. The changes were not, however, statistically significant. The survey did not seek views on the FFCs role or contribution towards changing public attitudes.

Figure 31 UK performance in terms of public perceptions of future flight technologies

UK is the world leader
- Interim: 2%
- Baseline: 0%

UK is ahead of most countries
- Interim: 18%
- Baseline: 27%

UK is ahead of some countries, but behind the world leaders
- Interim: 46%
- Baseline: 47%

UK is slightly behind most countries
- Interim: 16%
- Baseline: 17%

UK is a long way behind most countries
- Interim: 17%
- Baseline: 10%

Summary: World leader/ahead of most countries
- Interim: 21%
- Baseline: 27%

Summary: Behind most countries
- Interim: 33%
- Baseline: 27%

■ Interim ■ Baseline

Source: *Contact survey. C1/7. I'm now going to read out some elements of future flight technology development and support. For each, please can you tell me how you think the UK is currently performing in comparison to other countries?*

Note: *Base: valid responses, all respondents (Interim survey: 164, Baseline: 139). Figures with asterisks are statistically significant between baseline and interim at the 95% confidence level. Item responses may not sum to summary figures due to rounding.*

The research report *Future Flight Challenge – Mini Public Dialogue* explored the perceived benefits, disbenefits, risks and potential concerns of three technologies and their infrastructures: UAS, AAM and regional air mobility. The fieldwork was conducted in March-April 2022. This work highlighted several themes; participants recognised that the technologies had potential benefits, including jobs, and sustainability benefits. The following specific applications had favourable public acceptance: emergency and humanitarian use, improving infrastructure in rural or remote locations, or improving the sustainability of public transport. However, participants were concerned about personal safety and undue risk of harm, security and cybersecurity, collisions, intrusion and privacy, affordability, risk of 'greenwashing', and environmental and noise pollution disbenefits. In particular, participants wished governance to constrain uncontrolled expansion of commercial uses of future flight technologies and wanted the introduction of technologies to be intentionally slowed by regulation and licensing so that impacts could be better understood.

The qualitative findings are broadly consistent with the survey findings; in some aspects and for some use cases, public acceptance is relatively strong, but there are significant public concerns that present a barrier to successful commercialisation of some technologies and use cases.

4.8 Theme 7 - Has the FFC helped to build the skills needed to support future flight technologies?

4.8.1 Overview

In the interim evaluation, it is relatively early to assess the FFC's effect on skills. The results in this theme therefore focus on early summaries of FFC activities. Stakeholder perceptions on this theme were not collected as part of the interim evaluation.

Table 17 Summary of evidence

Subtheme	Metric	Data source
Effect of the FFC on skills	New skills developed in Development Phase projects	Monitoring data
Trends in perceptions of UK future flight skills	Extent to which workforce skills are a barrier or an enabler	Survey data
	Extent to which local authority engagement is a barrier or an enabler	Survey data
	UK performance in terms of workforce skills	Survey data

Theme 7 – Key messages

- The FFC is currently funding work to develop tools for workforce and local authority upskilling.

- There was a significant increase between the baseline and interim surveys in the rate at which workforce skills were perceived to be a barrier (from 18% to 40%). The rate at which respondents perceived the UK to be a world leader or ahead of most other countries in terms of workforce skills declined between the baseline and interim surveys (from 59% to 28%).

4.8.2 Aims and activities

The FFC has identified workforce skills as a barrier to the future development and deployment of future flight technologies. An industry expert noted that there were longstanding shortages of certain areas of expertise, such as digital skills, system engineers and manufacturing capabilities, as well as

skills that are unexpectedly required as technologies develop. The new required skills may be related to technology development (e.g. infrastructure design, oversight of autonomous systems), operations (e.g. drone pilots), servicing (e.g. infrastructure maintenance), supply chain (e.g. hydrogen transport and storage) and regulatory expertise, among others. These workforce issues can particularly affect SMEs, which can struggle to fill positions that require specialised expertise and have limited capacity to conduct in-house training.

Table 18   Development Phase consortia members expressed the need for a range of new skills

Category	Skills needed by Development Phase consortia members
Engineering	Aeronautical, high voltage power energy, service, aerospace electrical systems, electronic, UAV, chemical processing, manufacturing
Software	Software development, AI, diagnosis skills, data science, IT, cybersecurity
Infrastructure and operations	Hardware development, communications systems, infrastructure design, health and safety, regulatory, airspace management
Technology-specific expertise	UTM expertise, BVLOS expertise, Hydrogen, autonomous operations / assurance
New roles	Drone ATC authorisation, AI operations, EVTOL & BVLOS remote pilots, higher skilled logistics, vertiport staff

Source: FFC Benefits surveys (mid- and late-2021 and Jan 2022)

Improved skills will facilitate technological development, knowledge transfer and collaboration with other sectors and with local government, and they will enable the establishment of future flight technology clusters in the UK.

The portfolio review of Development and Demonstration Phase projects found that generating new skill requirements was a strong focus of the portfolio. The review noted that there was an increase in new skill requirements between the Development and Demonstration Phases, and that this is consistent with the Demonstration Phase focus on projects at higher TRLs. These projects are expected to help identify a range of new skills that will be required by the sector.

The Challenge has allocated £500,000 to a competition to develop upskilling initiatives that tackle immediate skills gaps in the UK aviation industry. The aim is to create and deliver course content and materials. The outputs will be aimed at different audiences (schools, apprenticeships, internships, existing workforce, technical courses, vocational training, undergraduate, postgraduate and continuing professional development). The projects will be carried out in 2023.

The FFC is currently developing a toolkit to 'upskill local authorities' to help them understand their potential role in the development of future flight technologies. Some local government stakeholders

mentioned that they had already developed some skills based on their past experiences with local training providers who had collaborated with future flight companies to develop appropriate curricula and apprenticeship programmes that address current skill gaps in the sector.

4.8.3   Evaluation evidence

There is evidence that the FFC contributed to upskilling some consortia members in the Development Phase. From Development Phase project close-out data, 66% of respondents[27] reported that they had developed new skills from their project, and the most frequently cited skills were technical skills/knowledge (53%), collaboration and planning, business planning and problem solving (all 27%). Other skills that projects mentioned were fundraising, leadership, project management and strategic thinking.

Figure 32 shows the extent to which evaluation survey respondents felt that workforce skills were a barrier to or an enabler of the progression of future flight technology in the UK. Views were, on balance, more positive than negative, with 55% of respondents regarding skills as an enabler and 40% as a barrier (net 15% an enabler). However, views were significantly less positive than the baseline, where a net 47% of respondents regarded skills as an enabler.

Figure 32   Extent to which workforce skills are a barrier or an enabler
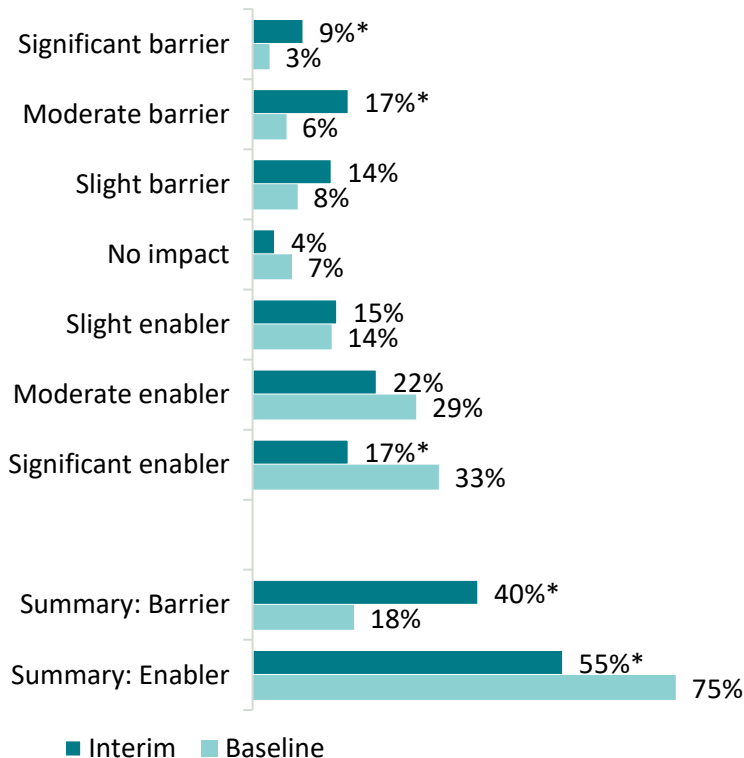
Source: Contact survey. C5/6. For each of the following, please indicate whether you think they are a barrier or enabler to the progression of future flight technology in the UK.

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[27] Please note that project closeout data had 15 responses from 48 projects and may be subject to non-response bias.

As well as the skills of the workforce, the overall size of the workforce may be seen as a barrier or enabler. Figure 33 shows the extent to which respondents felt that the size of the future flight sector workforce was a barrier to or an enabler of the progression of future flight technology in the UK. While relatively balanced, views about the size of the future flight sector workforce were more negative than positive, with 46% regarding workforce size as a barrier and 41% as an enabler. The size of the workforce was therefore a greater concern than the skills of the existing workforce, although the two are clearly related.

Figure 33   Extent to which the size of the future flight sector workforce is a barrier or enabler

Significant barrier	13%
Moderate barrier	18%
Slight barrier	15%
No impact	13%
Slight enabler	15%
Moderate enabler	14%
Significant enabler	12%
Summary: Barrier	46%
Summary: Enabler	41%
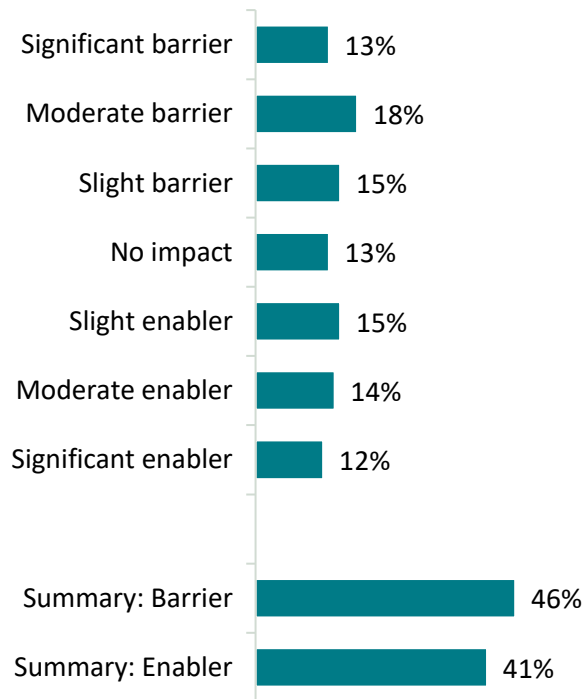
Source: Contact survey. C5/11. For each of the following, please indicate whether you think they are a barrier or enabler to the progression of future flight technology in the UK.
Note: Base: valid responses, all respondents (Interim survey: 164).

Local authority engagement is an enabler of local authority skills development, which the FFC aims to promote. In the interim survey, respondents were asked the extent to which they felt that local authority engagement was a barrier to or an enabler of the progression of future flight technology in the UK. As Figure 34 shows, similar proportions felt this acted as an enabler (44%) and as a barrier (37%). Those involved with physical future flight infrastructure were particularly likely to regard local authority engagement as an enabler (60%).

Figure 34   Extent to which local authority engagement is a barrier or an enabler

Significant barrier	8%
Moderate barrier	12%
Slight barrier	17%
No impact	19%
Slight enabler	18%
Moderate enabler	12%
Significant enabler	13%
Summary: Barrier	37%
Summary: Enabler	44%
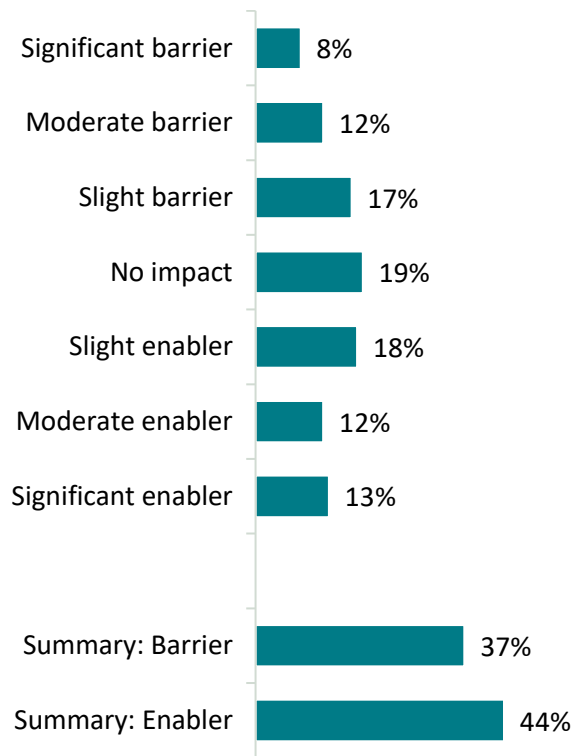
Source: Contact survey. C5/14. For each of the following, please indicate whether you think they are a barrier or enabler to the progression of future flight technology in the UK.

Note: Base: valid responses, all respondents (Interim survey: 165). Item responses may not sum to summary figures due to rounding.

Figure 35 shows how respondents viewed UK future flight workforce skills in comparison to other countries. Perceptions in this respect were significantly less positive than at the baseline, with 28% regarding the UK as the world leader or ahead of most countries (compared to 59% at the baseline) and 33% regarding it as slightly or a long way behind most countries (compared to 12% at the baseline).

Figure 35   UK performance in terms of workforce skills

UK is the world leader
- 2%* (Interim)
- 10% (Baseline)

UK is ahead of most countries
- 26%* (Interim)
- 49% (Baseline)

UK is ahead of some countries, but behind the world leaders
- 39% (Interim)
- 29% (Baseline)

UK is slightly behind most countries
- 22%* (Interim)
- 5% (Baseline)

UK is a long way behind most countries
- 11% (Interim)
- 7% (Baseline)

Summary: World leader/ahead of most countries
- 28%* (Interim)
- 59% (Baseline)

Summary: Behind most countries
- 33%* (Interim)
- 12% (Baseline)

■ Interim   ■ Baseline

Source: Contact survey. C1/6. I'm now going to read out some elements of future flight technology development and support. For each, please can you tell me how you think the UK is currently performing in comparison to other countries?

Note: Base: valid responses, all respondents (Interim survey: 172, Baseline: 146). Figures with asterisks are statistically significant between baseline and interim at the 95% confidence level.

4.9   Theme 9 - Has the FFC helped to encourage a diverse future flight sector?

4.9.1   Overview

In the interim evaluation, it is relatively early to assess the FFC's effect on diversity. Stakeholder perceptions on this theme were not collected as part of the interim evaluation.

Table 19   Summary of evidence

Subtheme	Metric	Data source
Diversity of future flight organisations	UK turnover for previous year	Survey data
	Headquarter arrangements	Survey data
	Non-UK regions of operation	Survey data
	Region of UK headquarters	Survey data

Subtheme	Metric	Data source
Diversity of future flight workforce	Demographic characteristics of survey respondents	Survey data

Theme 9 – Key messages

- The FFC competition's focus on collaboration between different types of organisations supports its diversity objective, particularly collaboration with end-users, local authorities, aviation companies and other organisations that are not specialised in future flight.

- FFC initiatives have had limited focus on diversity to date.

- Among survey respondents, there were a few shifts in organisational characteristics since baseline. The proportion of companies with a turnover of £1 million to £50 million increased from 20% at the baseline to 32% at the interim survey. Close to half (47%) reported being headquartered in the UK but also working in Europe, an uplift on the 24% who reported this at the baseline.

4.9.2   Aims and activities

The FFC aims to support diversity in the future flight sector, including the diversity of the workforce and the diversity of types of UK companies in the sector.

The FFC competition's focus on collaboration between different types of organisations supports this diversity objective, particularly collaboration with end-users, local authorities, aviation companies and other organisations that do not specialise in future flight.

The FFC surveyed Development Phase projects about whether their technology or service would benefit protected classes. A couple of projects noted that automating tasks so that they were conducted by drone operators had potential diversity benefits for the end-user workforce. For example, one project noted that infrastructure inspection was traditionally manual work, which had historically been conducted by male inspectors and required physical strength. The project contributed to the objective of conducting inspections remotely, and the consortia member noted: *"this will enable people [of older] age [or with a] disability to conduct the required tasks. We would also expect more female engineers/ inspectors to conduct such work"*.

4.9.3 Evaluation evidence

Evidence on the diversity of organisations supported by the FFC comes from analysis of the characteristics of those responding to the survey. Figure 36 shows respondent organisations' UK turnover for the previous year, including operations outside of the future flight sector. While the proportion with a turnover of less than £1 million remained stable (47% compared to 46% at the baseline), the proportion with a turnover of £1 million to £50 million increased from 20% at the baseline to 32% at the interim survey, suggesting increasing involvement of medium-sized companies in the sector.

Figure 36   UK turnover for previous year

Turnover band	Interim	Baseline
Zero	5%	11%
Less than £100,000	14%	20%
£100,000 - £499,999	20%	16%
£500,000 - £999,999	14%	10%
£1m - £4.9m	18%	11%
£5m - £9.9m	8%	5%
£10m - £24.9m	5%	2%
£25m - £49.9m	2%	1%
£50m or more	15%	23%

■ Interim ■ Baseline
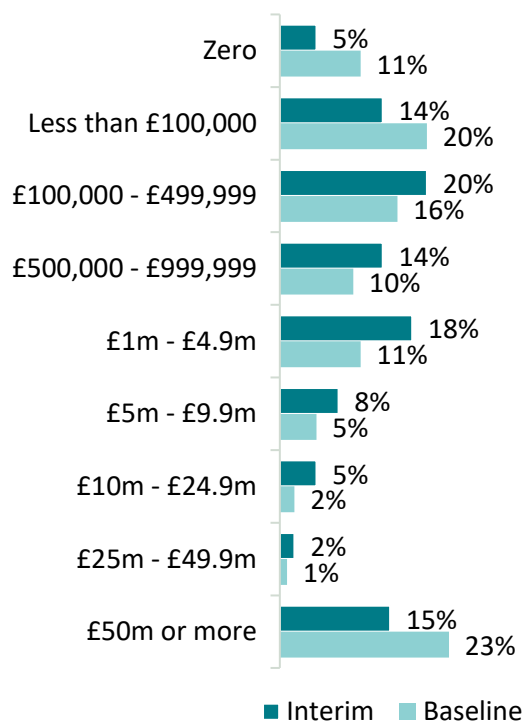
Source: Contact survey. A7A. Which of the following bands would best describe your UK turnover for the previous financial year? Please think about all UK turnover, even if some operations are outside of the future flight sector.

Note: Base: valid responses, commercial businesses (Interim survey: 130, Baseline: 91). Item responses may not sum to summary figures due to rounding.

Figure 37 shows the headquarter arrangements of commercial businesses which took part in the survey. Respondents could choose multiple responses to this question. Close to half (47%) reported being headquartered in the UK but also working in Europe, an uplift on the 24% who reported this at the baseline. Other than this, the interim results were in line with the baseline, with 43% headquartered in the UK but also working outside of Europe, 38% headquartered and working only in the UK, and 6% headquartered outside the UK.

Figure 37   Headquarter arrangements
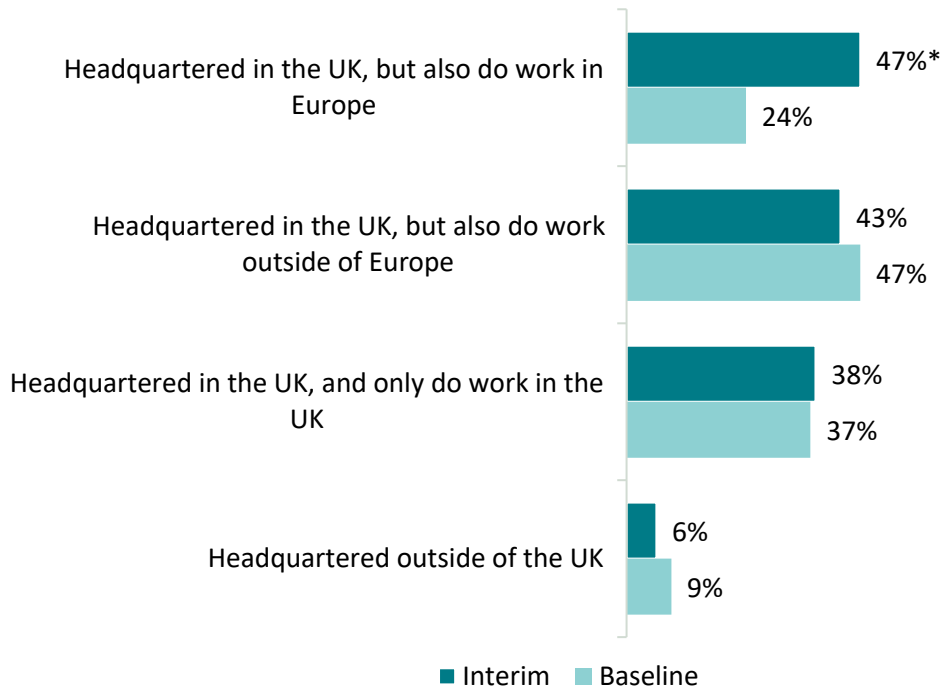
Headquartered in the UK, but also do work in Europe: Interim 47%*, Baseline 24%

Headquartered in the UK, but also do work outside of Europe: Interim 43%, Baseline 47%

Headquartered in the UK, and only do work in the UK: Interim 38%, Baseline 37%

Headquartered outside of the UK: Interim 6%, Baseline 9%

■ Interim ■ Baseline

Figure 38 shows regions outside of the UK in which respondents had operations. Interim results were broadly consistent with the baseline, with nine in ten (90%) working in the European Union, two in three (65%) in the rest of Europe, 61% in North America and over half (54%) in Asia.

Figure 38 Non-UK regions of operation

Region	Interim	Baseline
European Union (excluding UK)	90%	89%
Rest of Europe (excluding EU)	65%	60%
North America	61%	65%
Asia	54%	65%
Middle East	49%	62%
Australasia	40%	44%
South America	32%	32%
Africa	32%	41%
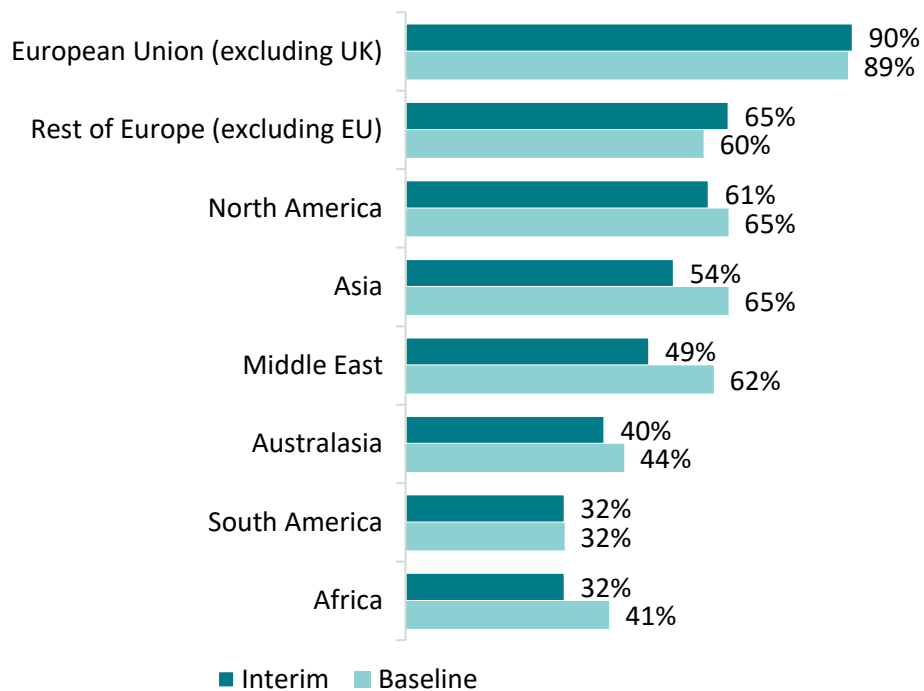
■ Interim ■ Baseline

Source: Contact survey. A4B. And what other regions, other than the UK does your organisation do work in?
Note: Base: valid responses, commercial businesses which work outside the UK (Interim survey: 82, Baseline: 63).

Figure 39 shows where UK headquarters were located, and shows that seven in ten were in the South of England (69%, including 28% in the South East, 18% in London and 16% in the South West), and around one in ten were in the Midlands (10%), the North of England (9%) and the devolved nations (11%, including 8% in Scotland). Interim results were in line with the baseline.

Figure 39   Region of UK headquarters
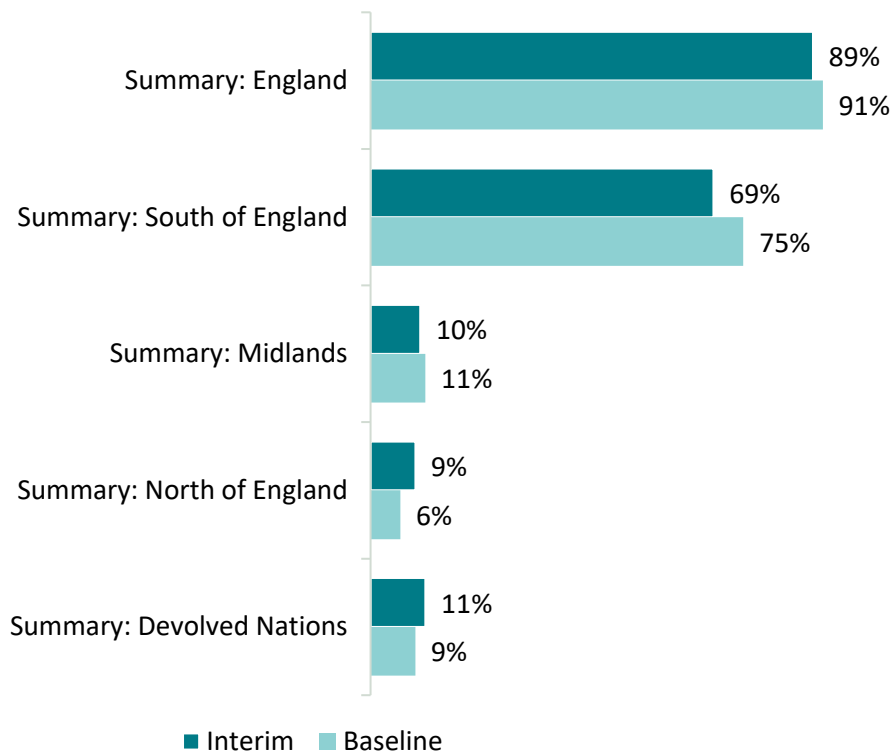
Among respondents, a third of commercial organisations (34%) reported having no R&D staff identifying as female or non-binary, and two in five (38%) reported having up to 25% of such staff. A further one in five (22%) said that between 26% and 50% of their R&D staff identified as female or non-binary. Just 6% reported that over 50% of their R&D staff identified as female or non-binary.

4.10   Conclusions and recommendations

The survey and stakeholder evidence indicate that the FFC has positively impacted the sector through accelerating different types of collaboration, especially multidisciplinary, multi-sector and cross-government collaboration. This has led to a number of positive short-term outcomes. Key points are:

■   The Development Phase rules required cross-organisation collaboration within consortia. Both the survey and interview evidence indicate that the Development Phase had a positive effect on technology readiness, and industry stakeholders interviewed emphasised that the technology

advancement had occurred in areas that complemented core technologies that required interdisciplinary expertise (e.g. digital modelling, avionics and airspace management technologies).

■ Consortia stakeholders reported that the FFC was widely seen as a signal of sustained government interest in future flight, and that this was an important enabler of private investment, particularly among companies whose main focus was not future flight. The FFC reports that it is on track to achieve its matched funding targets and additional co-investment targets. Survey evidence suggests that the FFC has had a positive impact on private investment.

■ Government stakeholders reported that the FFC was valuable as a link with industry, allowing them to gather industry information and coordinate industry participation faster and more comprehensively than would otherwise have been possible. Industry stakeholders also reported that this communication channel was valuable in communicating a sense of urgency to government. These activities have contributed to the creation of the ministerially chaired Future of Flight Industry Group.

■ Most Demonstration Phase consortia stakeholders valued that the FFC advised them on navigating CAA processes, permits and approvals. Most stakeholders agreed that was challenging for future flight companies to understand how best to operate under the current regulatory frameworks and to work efficiently and effectively with the CAA.

Overall, interviewed industry stakeholders reported that the FFC had played a coordinating role that had brought new focus and direction to the sector, through links to both government and industry.

There are early warning signs that views on barriers to sector development have deteriorated since baseline, and that the UK may be falling behind international competitors. These views are not necessarily related to the FFC, and they appear to apply to the wider sector landscape.

■ Regulation is perceived to be a risk, and there have been delays in introducing new regulatory frameworks, relative to the timelines that the FFC initially envisioned. There is an increasing perception that the UK is slipping behind international competitors in terms of eVTOL regulation. Views on funding opportunities have become more negative; based on expert input, this may relate to macro trends and events (e.g. COVID-19 pandemic effects or uncertain access to EU research funding).

■ There is also the perception that government policy has lagged behind other countries, and skills are increasingly seen as a barrier, which may be due to sector growth and demand for more specialised and new skills.

■ Development Phase consortia stakeholders who had attempted flight demonstrations reported that CAA processes and capacity were a very significant barrier to achieving objectives within timelines. Achieving CAA flight demonstration approval (especially for BVLOS) within FFC timelines was identified as a material risk to achieving Demonstration Phase objectives.

Multiple industry stakeholders mentioned that they needed a timely and stronger signal from politicians and policy makers about the future of public investment in the sector beyond the end of the Challenge in 2024. Some consortia stakeholders emphasised that the R&D spending in eVTOL that

had been directed to building up a production supply chain needed to be properly supported by the government to be able to compete internationally.

While the FFC seems to be having a positive impact on the sector, the international landscape and external factors pose risks to Challenge objectives. This suggests that the FFC should:

- Work with the CAA and Demonstration Phase consortia to promote productive working arrangements and set feasible objectives for flight demonstrations, in particular to ensure that BVLOS projects can progress at pace;
- Continue to support government in developing a future flight delivery strategy, and the CAA in developing regulation, by contributing expertise and acting as a point of contact between government and industry;
- Consider options to promote local authority engagement, which has the potential to enable future flight growth in local and regional transport;
- Consider options to further tackle the issue of skills, which has consistently been seen as a significant barrier to future flight growth and development;
- Consider opportunities to encourage diversity in the sector workforce; and
- Develop and communicate a plan for 2024 and beyond, detailing how particular FFC functions are expected to continue beyond the life of the Challenge, as an important signal for the longer-term development of the sector.

5 Process evaluation findings

5.1 The management and governance of the FFC

This theme focuses on the overall governance and programme management, including risk management and financial accountability.

5.1.1 Extent to which the programme builds on previous investments

Delivery leads were asked the extent to which they thought the FFC had built on previous investments and initiatives.

There was consensus among delivery leads that, prior to the FFC, there were no other programmes specifically targeting future flight as an area of innovation.

"I think that nothing like us existed before, in the sense of what innovation area we were targeting."

Delivery lead

Nonetheless, it was mentioned that the FFC had built on prior general aerospace innovation calls from the former Technology Strategy Board and Department of Trade and Industry. A delivery lead commented: *"you could go along and sort of say well we've got this call out there, general aerospace call … we've got this idea, we think it's going to work, but we're not sure, we don't want to throw all our money at it, neither do our partners … public funding will be available to cover up to 50% of it and take the chance and trying to ensure innovation does happen".*

The FFC was also seen as complementing concurrent initiatives, most notably the Aerospace Technology Institute (ATI) and the Connected Places Catapult. It was seen to complement ATI both by focusing on the technology itself (as ATI does) and by adopting a system of systems approach, which also considers other aspects, including infrastructure, software, legal aspects and AI, that are needed to ensure that vehicles can operate. One respondent also highlighted that the FFC had funded the Connected Places Catapult to distribute funds to relevant stakeholders.

5.1.2 Decision-making

Delivery leads were asked to consider whether decisions about the FFC were made at the right level and in a timely manner.

In relation to competitions, there was a feeling among delivery leads that more time and resource could have been allocated to the process of setting up the actual competitions and up to the point when grant letters were delivered to beneficiaries. One delivery lead noted: *"some more time being planned in for everything or more resource being allowed would have definitely helped. I think people*

underestimate what it takes to deliver a competition and all the moving parts and talk to all the different teams and it kind of needs a project manager of its own, let alone all the other activity that's going on. So probably the one way we could have improved the delivery of Future Flight in a timeline sense would have been to have had more resource and/or more time to deliver".

Specifically, there was feedback that this lack of resource had led to delays in relation to the process of allocating funding to organisations that were successful in their application for funding. There was an initial target of 90 days from a beneficiary being notified as successful to receiving a grant letter. However, it seems that this process took almost double the time initially intended. A delivery lead commented: *"our 90-day process is probably one of the biggest hurdles that we faced. And I think that's possibly because the level of requirement to collaborate and push very large consortia is something that hasn't quite been delivered at this scale before. And I think that other programmes within the ISCF felt that as well. And so the 90 day process turned into more of 180 day process".*

"It still took longer than 90 days, so when we talk about 90 days set up and I think either you put more resources to it or alternatively actually call it a longer process."

Delivery lead

We understand from the Challenge that, apart from resourcing, COVID-19 also had an impact on this process taking longer than intended. It is also worth noting that UKRI is currently reviewing this process with the intention of improving the timeline.

In terms of the level of decision-making, it was noted that there were several levels of governance within the FFC. Outside the direct control of the FFC, these range from the Treasury, which is responsible for signing off the FFC's business case, to the Industrial Strategy Challenge Fund steering board, which takes decisions around the scope of the budget. Within the FFC, governance includes the Programme Board and those involved operationally in setting up projects. There is also a performance monitoring function which sits between different ISCF Challenges and the ISCF steering board, and which provides a portfolio overview of the activities that the FFC is undertaking. Moreover, UKRI monitoring and evaluation governance applies to the FFC.

While these different levels of governance were seen as positive for ensuring due diligence, the comments suggest that these multiple layers of governance can lead to competition processes taking longer than desired, particularly when it comes to the allocation of funding to beneficiaries. These concerns around timelines were brought up by industry participants in workshops (see Section 5.2.2).

5.1.3 Budget management

This metric analyses whether the FFC is meeting its budgetary expectations, using evidence from the delivery lead workshop and accounting data provided by the FFC.

Delivery leads stated that, while there had been some underspend, particularly in the Development Phase, the FFC was on track to spend the £115 million originally allocated to it by the end of the programme.

"With COVID and some of the projects didn't close out and for one reason or another we got a few others. So that tends to knock the funding a little bit. So, in Phase 2, we have a bit of an underspend, and we are looking at how we can reinvest that funding and we have plans to do that."

Delivery lead

We understand from the Challenge that there are also other reasons (apart from COVID-19), such as a minority of consortia failing to claim the final grant payment, why projects have not closed out. Around 25% of projects have not closed out because COVID-19 caused delays or due to consortia failing to make the final claim. A new team has been designated at the Challenge to look into projects that have not closed out to ensure that this is done.

Nonetheless, some delivery leads felt that internal processes can make the process of using the budget difficult. It could take up to three months to procure new work or research. This was then followed by onboarding the organisation and delivering the work before invoicing. All of this can be hard to accomplish within a financial year. One delivery lead commented: *"[it] can take nearly three months' time for procuring contract work or particular research pieces […] We've got six months to the end of financial year and you think you've got six months to spend money. No, we don't, because it'll take three months to procure now and that's if we know exactly what we want. And then we've got onboard them. Then we've got to deliver work and then we're going to invoice them. So it takes a year to spend money because you've got planning and implementation time before you can invoice. And then the three months to procure. So honestly, the internal processes make it very hard to spend all of our money, but we do have plenty to spend our money on"*.

One of the delivery leads, however, mentioned that the annual spending review had changed to a three-year settlement in 2022, which should make using underspent funding somewhat easier than following a financial year schedule. It will be important to publicise this information among delivery leads to ensure that funding is requested and spent where it can have the largest impact.

The FFC's finance report from October 2022 validates that, while there was underspend in the Development Phase (for example a revised budget of £26.4 million for 2022/23 compared with the £30.2 million originally budgeted), the forecast shows that the plan is to use the total £115 million by the end of the programme in 2024. There are also indications that the underspent budget from the Development Phase is now being used, e.g. by funding an additional project in the Demonstration Phase.

5.1.4   Management of funding and resources

Delivery leads noted that monitoring projects had at times put a strain on innovation leads given the number of projects funded by the Challenge. However, this had been recognised by the FFC and

additional resource had been brought in. A delivery lead reported: *"[being a lead] is such a wide thing to do a but also beyond the projects and that has taken strain on our Innovate lead resources and therefore we got an extra FT associated to that. That was recognised so we do have that in the books and another Innovate lead coming on board. So they try and get the wider ecosystem dealt with as well as the projects"*.

Despite some of these pressures, the allocation of funding and resources from the FFC to social science research was viewed positively, given that future flight technologies and regulation will need to take account of the views of the public.

"We always wanted to deliver some work in social science. And as we started Phase Two, it became apparent that there wasn't a lot of our projects that had worked very focused in this area. So we were able to address that, put some funding aside and we've now got our social science research director and there's an embedded piece of work that's working along with our Phase Three projects."

Delivery lead

There was agreement among delivery leads that the benefits map that the FFC had put together had been essential in allocating resources effectively and efficiently. The benefits map shows how the different components of the FFC, including projects, relate to the benefits that the FFC is trying to realise. This in turn allows the FFC team to make informed decisions about how resources and funding are allocated to ensure impacts are realised. As a delivery lead described: *"[Without] the benefits map [there's] no way this Challenge is able to understand how it's achieving its benefits objectives. That whole amount of work and effort that's gone into understanding the benefits and how all the different parts of the Challenge fit with that is astonishingly good"*. Another delivery lead described the map's uses: *"[t]he benefits understanding does two things: it should enable us to see what's happening in flight and adjust what we do to address any gaps and then it will also enable us to demonstrate impact as we come to completion and start understanding what our funding enabled and realised and delivered"*.

"The whole team knows or should know well where each project sits within their kind of benefits delivery and how if one of them fails, what impact that's going have. It's really good."

Delivery lead

5.1.5   Risk management and due diligence

This metric is divided into two indicators:

■   Effectiveness of the FFC in identifying and mitigating risks; and

■   Effectiveness of the due diligence process in identifying projects with unacceptable technical or project delivery risks.

These indicators were analysed using evidence from the delivery group workshop.

In terms of risks, delivery leads highlighted the Challenge process to identify and monitor risks with quarterly updating and presentation to the Programme Board. The process of identifying and reviewing risks at Challenge level was seen to be working well. A delivery lead described: *"[r]isks has been a fairly well prescribed process since early 2020 and we review it every quarter. It's put forward to the Programme Board and we've never really had any complaints on the list, it's getting smaller and smaller as we move to the end of the programme, which is really nice".*

As part of this process, the Challenge liaises with other organisations such as the CAA when there are identified risk dependencies.

There is also evidence that risks are mitigated when they are identified, and the phased structure of the FFC helps to implement these mitigation actions. A delivery lead reported: *"[o]ne of the risks that came up initially in early 2020 was what if we put our projects at risk of losing their own resource and staff through a gap in funding. So that work was then put on the risk register. The work was put in place. The planning and strategic meetings occurred in order to reduce that risk and we actually took that off when we knew that we'd built in a nice healthy overlap between phase two and Phase Three".*

Delivery leads stated that, as part of the application, project teams were required to identify all of their project delivery risks. Risks were then updated quarterly at review meetings between project teams and the monitoring officer. Successful companies also underwent a due diligence process before the funding was granted. Despite these processes, a small minority of projects had encountered issues that had not been identified by the due diligence process. For example, it was mentioned that one of the projects was struggling to obtain matched funding. There were also two cases where the funding rules relating to funding from outside the UK and companies going into administration had not been followed. While these issues affected only a very small minority of all FFC-funded projects, with teams within the FFC working to resolve them as they were identified, it does suggest that careful reflection on the approach to due diligence is needed to minimise risks of similar issues in future.

One of the delivery leads mentioned that there was no way at present of easily looking at projects' risks in combination. While the FFC team had a good understanding of project risks from quarterly reports and conversations with project teams, it was felt that a more holistic approach of looking at project risks across all projects (or at least the most critical risks) would allow the team to identify patterns across projects, which would help inform the FFC's internal risk register. A delivery lead commented: *"I do think there's a gap in process that allows for us to readily get access to those without creating a list of probably 400 risks, and that's just phase two, because if we had [48] projects and each had like 10 or so risks. We're talking a lot of risks to look at. But I do think that there ought to be on the IFS system somewhere that each project can log their top risk that would prevent them from achieving their outcome. And if we had access to run a report off that, we could then potentially review our internal risks better and have an overarching risk that encompasses something that's a repeating issue [across projects]".*

5.1.6   Unique features of programme delivery

Delivery leads agreed that a unique feature of the programme was that it focused on future flight as an innovation area, which (as discussed in Section 5.1.1) was not an area of focus in previous programmes. The system of systems approach was also seen to be innovative.

In terms of the specific design of the programme, delivery leads mentioned the requirement for funded projects to include at least one SME in the consortium as a prerequisite to be granted funding: *"a target that we had that other funding hasn't before is that we were forced to fund through collaboration only and a core part of our competitions is that they had to include small businesses. So in phase two, or I think phase one, the consortia had to include a small business and I don't think that's been required as a prerequisite to funding before".*

Delivery leads also felt that they had a closer relationship with their Monitoring Officers compared to other Challenges. In addition to monthly meetings between the Challenge team and Monitoring Officers, the latter were often invited to FFC events and they could easily liaise with the FFC team when internal Innovate UK processes took longer than expected. This was felt to enable more rapid resolution of issues. However, from the point of view of industry workshop participants, some project processes such as project change requests (PCRs) took too long to resolve (see 5.4.3).

"We've been very hands on with the Monitoring Officers in the sense that we wanted to be close to our projects and we didn't always have the opportunity to go and see them ourselves because we've been really busy and the Monitoring Officers have been a vital part of feeding information back to us."

Delivery lead

5.2   The structure and delivery of the FFC competitions

This theme focuses on the design and implementation of the competition activities, with an emphasis on how the structure of the phases has helped to facilitate outcomes and impacts.

5.2.1   Views of competition' guidance

This metric encompasses the following indicators:

■ Extent to which the Future Flight Roadmap and Vision assisted in the setting up or carrying out of Future Flight projects;

■ Extent to which the six problem statements evolve and provide effective guidance to interested parties; and

■ Extent to which the system of systems approach helps consortia to identify problems to address.

The above indicators were analysed using evidence from the industry and the delivery group workshops, as well as the contact survey.

Extent to which the Future Flight Roadmap and Vision assisted in the setting up or carrying out of Future Flight projects

The Future Flight Vision and Roadmap was led by the FFC and developed by experts from industry, academia and government. It sets out how zero emission air travel within and between British cities could be commonplace by 2030,[28] and how this will benefit the public.

The vision and roadmap document has the following aims:

■ Develop a comprehensive understanding of Future Flight, its key players, roles, interdependencies, threats and opportunities;

■ Map the key milestones (including technological, regulatory, societal, legislative milestones) to achieve the UK vision;

■ Provide direction to stakeholders for engagement and collaboration across sectors; and

■ Determine key demonstration examples required to achieve the Future Flight vision.

Survey respondents were asked about the extent to which they thought the Future Flight Roadmap and Vision assisted in setting up or carrying out future flight projects. As Figure 40 shows, the vast majority of respondents who had been involved in project applications (86%) felt that the Future Flight Roadmap or Vision assisted in the setting up or carrying out of future flight projects at least a little, including 57% who felt it did so a great deal or a fair amount. Only 14% felt that the Future Flight Roadmap or Vision did not assist at all in setting up or carrying out projects.

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[28] The Future Flight roadmap and vision document can be accessed at https://www.ukri.org/wp-content/uploads/2021/08/UKRI-130821-FutureFlightVisionRoadmap.pdf [Last consulted on 11.01.2023]

Figure 40   Views about the extent to which the Future Flight Roadmap and Vision assisted in setting up or carrying out future flight projects

Category	Percentage
A great deal	22%
A fair amount	35%
A little	29%
Not at all	14%
Summary: At least a little	86%
Summary: Great deal/fair amount	57%
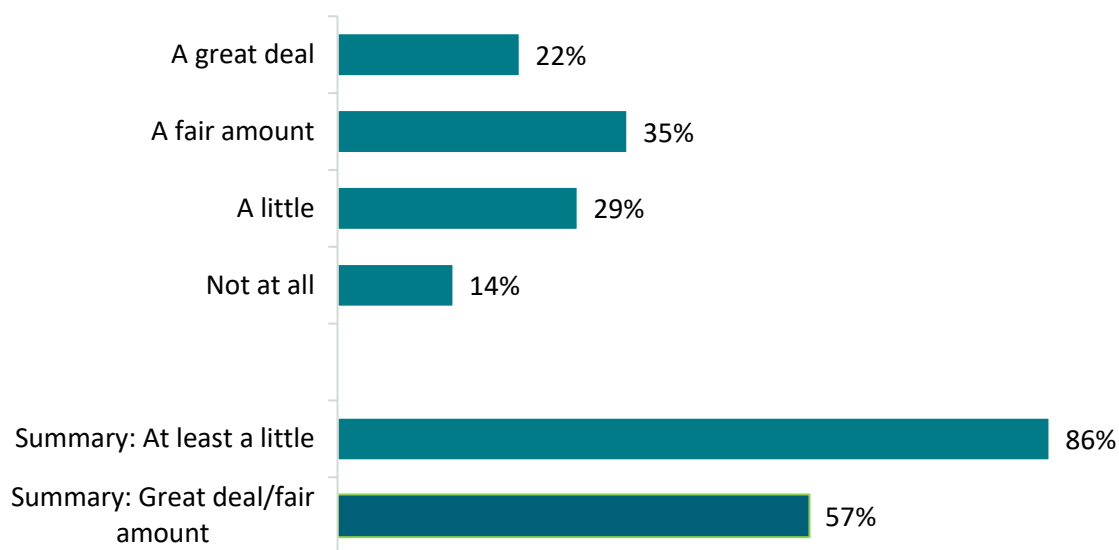
Source: Contact survey. B13. To what extent did the Future Flight Roadmap or Vision assist in the setting up or carrying out of future flight projects?

Note: Base: valid responses, where prepared applications (Interim survey: 176).

Those who said that the Future Flight Roadmap or Vision did not assist a great deal in setting up or carrying out future flight projects (115 respondents) were then asked what other, if any, centrally defined outputs from the FFC would have assisted in setting up or carrying out future flight projects. This was asked as an open question and the answers were then coded into themes. The most commonly mentioned themes were funding (13%), greater communication (11%) and a clearer vision/strategy (6%).

Interestingly, two out of the three industry workshop participants who had been unsuccessful in their application for funding from the Challenge said that they disagreed with individual elements of the Future Flight Vision. The reasons for this varied but included concerns about noise when using vehicles within cities, lack of parking spaces and potential safety issues. This suggests that, while there is a broad view that the vision has been helpful, as seen in the survey, continuing to engage with and addressing the concerns of those with different views may be needed to generate even broader buy-in.

Extent to which the six problem statements evolve and provide effective guidance to interested parties

The six problem statements[29] were developed by the working groups of the FFC at the start of the programme. The statements define and highlight the key issues and restrictions to government, including restrictions in relation to regulation, technology and operations, and call on stakeholders

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[29] The six problems statements can be accessed at https://www.ukri.org/publications/future-flight-working-group-problem-statements/future-aviation-industry-working-group-on-airspace-integration-problem-statement-future-airspace-integration-leading-the-world/ [Last consulted on 11.01.2023].

across the aerospace and aviation industries to get involved in developing strategies to address these issues.

One of the delivery leads who took part in the focus group stated that while the statements had been seen as helpful in defining areas of focus and getting initial engagement, they ended up being too restrictive when used at the Discovery Phase as they potentially excluded some audiences because of their specificity: *"[d]uring the Discovery Phase … [it] felt as though it actually distracted from future flight a little bit and I think we were quite quick to move on from the six problem statements. They were a great way to stimulate conversation but making the whole Discovery [Phase] around those six problem statements probably confined the programme a little bit too much and we wanted to target broader audiences".*

As a result, the statements evolved at each phase and became wider themes that were used by the FFC to understand which theme applied to each project as a way of understanding how the FFC was addressing its original objectives. The problem statements mostly stopped being referenced on Development and Demonstration Phase competition calls. A delivery lead noted: *"I guess there was almost no reference to the problem statements [at the Development and Demonstration phases] … it kind of grew into what we established as a portfolio of themes that we later assessed the Phase Two and Phase Three against … The problem statements were a bit too prescribed and we wanted a wider theme for each of them".*

Given this evolution of the statements into themes and the lack of reference to them in communications directed towards external stakeholders after the Discovery Phase, industry workshop participants had no knowledge of the six problem statements.

Extent to which the system of systems approach helps consortia to identify problems to address

A system of systems approach considers multiple independent systems in context as part of a larger, more complex system. The FFC has adopted a system of systems approach to address the obstacles outlined within the roadmap and the six problem statements. The vision is to showcase a real-life operational demonstration of multiple, novel air vehicles in challenging environments. This involves focusing both on vehicle technologies and on the wider systems that are needed to ensure vehicles can be deployed.

Industry workshop participants were asked if they were aware of the system of systems approach adopted by the FFC and, if so, whether this approach had helped the consortium to identify problems.

Awareness of the system of systems approach adopted by the FFC was low among unsuccessful workshop participants. While most were aware of this approach through their work, they did not necessarily remember this being mentioned by the FFC or as part of Future Flight competition calls.

"We use systems of systems for all design [activities], so whether it is used by Future Flight or not. It didn't make a difference to my work. We used systems of systems before [the Challenge] and now."

Among successful applicants, awareness of the system of systems approach was mixed, with one consortium having no knowledge about this and another one being aware. Those who had some knowledge about this approach thought that it was valid and necessary to realise future flight innovation:

"Revolution in aviation is a system of systems approach. Nobody's going do it alone. Everything has to move together. And I think that that was a beauty of the Future Flight Challenge, I think it was well understood."

"I was loosely involved when [the Challenge] was being set up [...] That system of systems approach was kind of key from the outset and was essentially what got picked up for proposals."

Industry workshop participants
(successful applicants)

While industry workshop participants who had been successful in their funding application were not able to provide examples of how the system of systems approach might have helped their consortium to identify problems to address, they were able to provide examples of how this approach had helped them develop and present solutions to problems that they had identified.

Moreover, the project team which took part in one of the industry workshops and was aware of the system of systems approach saw this as the reason why it had formed a multidisciplinary consortium, given the need to address the interdependent aspects required for developing and deploying future flight vehicles. A successful applicant workshop participant commented: *"I think we're an example of a multidisciplinary consortium and I think that just falls out of the system of systems [approach]. […] It's just kind of the same thing"*.

5.2.2   Views of the application process

This metric was analysed using evidence from the industry workshops, the delivery group workshop and the contact survey.

Survey respondents were asked the extent to which they agreed with statements relating to the application process for competitions. The results are presented in Figure 41.

Around seven in ten agreed that there was clear guidance about the focus of the FFC (71%) and a similar proportion agreed that the application process was easy to understand (70%). A relatively small proportion of respondents disagreed with these statements (15% and 17% respectively). These findings are similar to those seen in the baseline survey.

SMEs with up to 49 employees (57%) and unsuccessful applicants (63%) were less likely to agree that there was clear guidance about the focus of the Challenge. This was also the case when asked about the application process being easy to understand: 64% of SMEs with up to 49 employees

agreed and 58% of unsuccessful applicants agreed, with the levels of agreement for these subgroups being lower than average.

Figure 41   Views of competition' guidance and application process
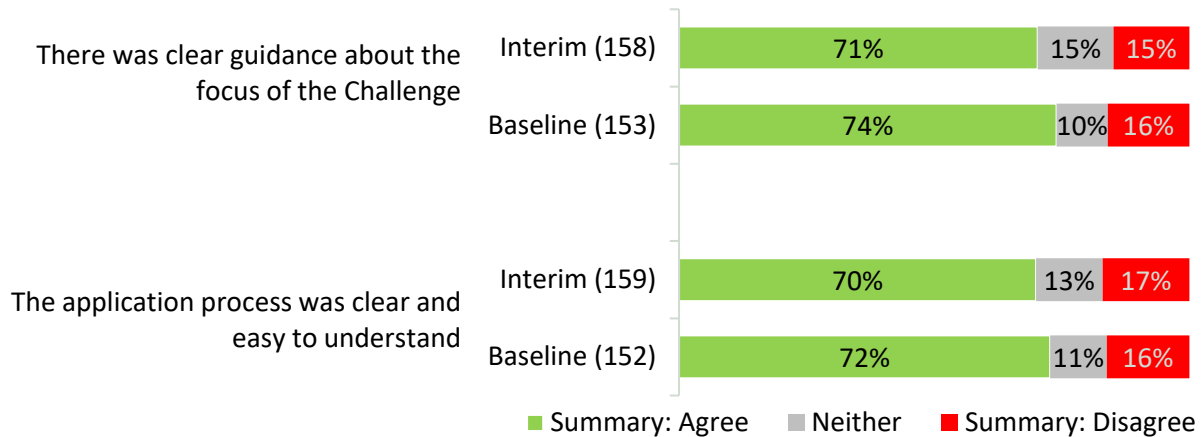
These results relating to SMEs and unsuccessful applicants were echoed by industry workshop participants and delivery leads.

Both successful and unsuccessful applicants who took part in industry workshops and who did not have prior experience of applying for government funding said they would have liked to receive additional support from the FFC to prepare their application, and they felt that those with more prior experience would have been at an advantage.

"There's not much support for putting the bid together and I think what happens is companies get good at doing bids for government funding. They put together a bid team. We didn't really do that. We just used the consortium members. I've never done it before and I was putting the bid together."

Industry workshop participant
(successful applicant)

One of the delivery leads who took part in the workshop explained that SMEs were less likely to have experience of completing applications compared to larger organisations, meaning that they could find this process harder and were more likely to require support when writing bids. While the FFC signposts applicants who may need support to the KTN, which can offer such support, this was felt to be relatively ad hoc. Participants felt that *upfront* information about the FFC and how to write bids should be made available to prospective applicants. This should include publicising the support that was already available and provided by the KTN.

A delivery lead described: *"[f]or a lot of SMEs, the Innovate landscape is quite a confusing one and applying for funding is actually far more burdensome to them … because they've never completed*

an application so they don't know our processes, they didn't know our language and it can favour big companies who've got teams that they can put on these funding bids and applications. So a failure, probably less so just at Future Flight and more to the system, is that the there's not a lot of upfront 'get to know us' information, figure out how to write a bid, what success looks like in a funding application and potentially just engagement events to engage potential future bidders. And there's more and more work being done. The KTN have done their best to bridge some of the knowledge gaps there, and it's who we point to a lot. So if we've got someone who doesn't know the landscape at an event, we always ring up the KTN to let them know which sector you're working in and they'll do their best to share that with you. But SMEs are kind of left in the dust sometimes because they just don't know these things are going on and the application processes. It's tough and it's not always obvious what they're going to need".

There was specific feedback that the application process could be improved to ensure that it was inclusive for neuro-diverse applicants, with more flexibility around word limits and presentation styles, summaries available of guidance documents, and training for assessors and interviewers.

Additionally, some industry participants felt that further support could be provided in relation to the formation of consortia for applications. While acknowledging that the Discovery Phase was focused explicitly on this, this phase occurred in 2020 and at that point not all applicants of the Development and the Demonstration Phases were involved with or aware of the FFC. Smaller organisations would particularly benefit from events or activities targeted at forming consortia prior to new rounds of competitions.

> **"I didn't know about the Challenge back in 2020 but I think a meeting like that [the one in Birmingham in 2020] would definitely have been helpful to meet other partners."**
>
> Industry workshop participant
> (unsuccessful applicant)

It was also said that the time provided to prepare presentations for the interview stage of applications was at times insufficient; some said that they had only been given six calendar days to prepare. Given the requirement to form consortia that include a range of partners, applicants would have liked a minimum of three to four weeks to prepare this presentation. A successful applicant workshop participant stated: *"[f]or the presentations for the interview phase for Phase Three, we had less than a week to get our presentation for 14 companies together and submit it where it could then never be changed again, even though the interview was two months away".*

Also in relation to timelines, a minority of industry workshop participants stated that delays in communicating outcomes for some competitions may have compromised consortia as time and resource had been allocated for a certain period by consortium members. We understand from the Challenge, however, that this delay was driven by BEIS spending review processes.

> **"A matter of one or two months before the project was due to start, we were told that there was going to be a three-month delay. Now when you've got project resources lined up that you can't**

charge to the project cost, a lot of people, quite a lot of money... That was a pain, a significant pain."

<div align="right">

Industry workshop participant (successful applicant)

</div>

The feedback above suggests that the FFC could take steps to make the application process more efficient, including aligning with DSIT so as to avoid delays.

5.2.3 Views of the structure of competitions

This metric encompasses the following indicators:

■ Extent to which the Discovery Phase supported the formation of consortia;

■ Extent to which the three-phase structure of competitions enabled the Challenge to achieve its objectives;

■ Extent to which the design of the programme enabled consortia developed for Phase Two to move into Phase Three; and

■ How different competitions within each phase aligned to complement one another and add value.

These indicators were analysed using evidence from the contact survey, the industry workshops, the delivery leads' workshop and Challenge management data.

Extent to which the Discovery Phase supported the formation of consortia

As discussed in Section 4.3.3, a majority of survey respondents (57%) agreed that the Discovery Phase did support the formation of consortia, while a quarter (24%) disagreed, and the remaining 20% offered a neutral response.

Only one of the successful consortia that took part in the process evaluation workshops had attended the Discovery Workshop in 2020. This group considered that the Discovery Workshop had helped core members of the consortium to come together.

"I would say primarily how the core of the consortium early founders came together was at the Birmingham Conference."

<div align="right">

Industry workshop participant (successful applicant)

</div>

Delivery leads also saw the Discovery Phase approach as supporting consortia formation, and this phase was seen as particularly useful for attracting SMEs ahead of the Development Phase. However, no funding was granted at the Discovery Phase (late 2019 to early 2020), which had delayed industry getting access to funding as they had had to wait until the Development Phase (mid 2020 to early 2022). A delivery lead commented: *"[h]onestly it was an excellent activity that allowed for collaboration and really a chance for industry to talk with academia and small businesses.*

However, on the other side of the coin, it delayed industry getting funding sooner and because the whole setup of the programme had taken so long from the 2016 outset when Brexit was announced and I think the industry had been told this money was coming and they were waiting so long for it. And actually that initial Discovery phase just delayed them getting the money even more. So there's two sides of a coin: I think without that Discovery phase, we would not have had the SMEs we had in phase two, but I think that industry could have done with that money sooner and they didn't appreciate how slow we were to mobilise as a programme".

Extent to which the three-phase structure of competitions enabled the Challenge to achieve its objectives

About two-thirds (63%) of survey participants agreed that the three-phase structure of competitions was suitable for driving real-life operation demonstration of multiple novel air vehicles in challenging environments. Almost a quarter (23%) disagreed (Figure 42).

Unsuccessful applicants were less likely to agree with the statement (51% agreed), while successful applicants were more likely to agree (71%). Other breakdowns of the responses suggest that those organisations predominantly focused on future flight[30] were slightly less likely to agree (45% agreed), as were those who operated exclusively in the UK (50% agreed).

Figure 42   Views about the structure of competitions
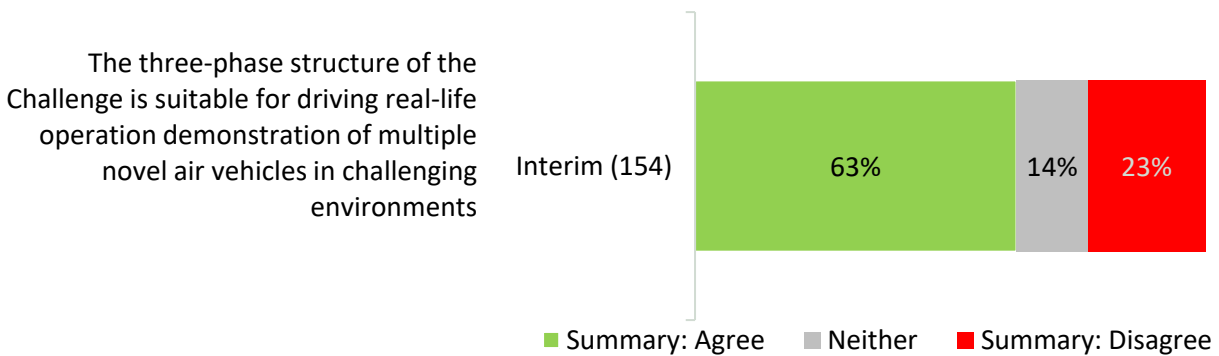
The three-phase structure of the Challenge is suitable for driving real-life operation demonstration of multiple novel air vehicles in challenging environments

Interim (154): Agree 63% | Neither 14% | Disagree 23%

■ Summary: Agree   ■ Neither   ■ Summary: Disagree

Source: Contact survey. B1. Thinking about the Future Flight Challenge overall, including the application process, how much do you agree or disagree with the following statements?

Note: Base: valid responses, all respondents (bases in parentheses, Interim survey). Figures with asterisks are statistically significant over time at the 95% confidence level.

The successful consortia which participated in our workshops largely agreed that the phased structure was appropriate. A successful applicant workshop participant stated: *"[the structure] seems reasonable, yeah, any projects can have a development stage and then move from that".*

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[30] Defined as three-quarters or more of an organisation's output being focused on future flight as self-reported by respondents.

Extent to which the design of the programme enabled consortia developed for the Development Phase to progress into the Demonstration Phase

Management data from the Challenge shows that 14 projects funded in the Development Phase transitioned into being funded in the Demonstration Phase. Survey respondents who had submitted applications were asked about the extent to which they thought that the structure of the FFC had enabled consortia that were developed for the Development Phase to successfully move into the Demonstration Phase. More than half (57%) agreed that the structure of the Challenge had enabled this, while 29% disagreed (see Figure 43).

Respondents involved with the Development and Demonstration Phases were more likely to agree that the structure of the FFC had enabled consortia developed for the Development Phase to successfully move into the Demonstration Phase (65% of those involved in the Development Phase and 64% of those involved in the Demonstration Phase agreed with this statement).

Figure 43   Agreement that the structure of the FFC enabled consortia developed for the Development Phase to successfully move into the Demonstration Phase
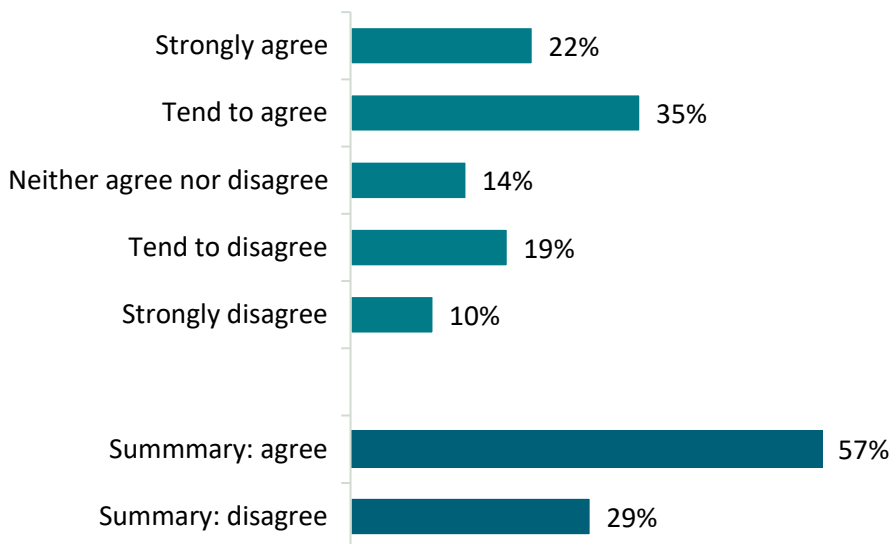
Source: Contact survey. B9. How much do you agree or disagree that the structure of the FFC enabled consortia developed for the Development Phase to successfully move into the Demonstration Phase? The Development Phase took place between 2020 and 2022. The Demonstration Phase is from 2021 to 2024.

Note: Base: valid responses, competition applicants (Interim survey: 159).

Evidence from the industry workshops provided mixed views about whether the structure of the competitions allowed for smooth transitions between phases. One consortium that had been successful at both phases found the overlap between phases somewhat difficult as the Development Phase project was still ongoing while the Demonstration Phase application needed to be prepared, and this had resulted in delays to the Development Phase project. A successful applicant workshop participant stated: *"I thought [the time allowed to prepare the application] wasn't long enough for Phase Three. And as a result, part of that was that Phase Three affected Phase Two because we were concentrating for a period of time, almost for some aspects of it, on the preparation for the Phase Three bid at the expense of Phase Two".*

Conversely, one consortium that had been successful in the Development Phase but not the Demonstration Phase did not see the overlap between phases as problematic as it had intended to apply for the Demonstration Phase from the outset. A successful applicant workshop participant commented: *"[w]e built into our description of Phase Two successful bid the fact that it was always designed to move forward to Phase Three. So it was oven ready for Phase Three effectively. That was the approach for Phase Two. Therefore, we were intending to move seamlessly from one project to the next and timing wise that would have worked just about exactly right"*.

The FFC deliberately opted for the overlap between phases in order to avoid consortia losing resource and partners due to a gap. The findings suggest that timings could have been set up in a way that allowed Development Phase project activities to wrap up so that some time could be spent on Demonstration Phase applications without impacting the delivery of Development Phase projects, or that bidders for the Development Phase could have built Demonstration Phase application preparation into their project timelines. This is all the more important given that projects going into the Demonstration Phase were encouraged to expand their consortia. A delivery lead noted: *"[m]ost of them did expand their consortia from Phase Two, so the encouragement to get them into Phase Three was that they should expand their consortia further and we gave them access to that via networking events closed within Future Flight. And we also sponsored some of their attendance at some of our events on stands as well to support them and then Phase Three was open for other people as well"*. We understand from the Challenge that COVID-19 delayed the timings of the Development and Demonstration Phases.

Another consortium which had been successful at the Development Phase but not the Demonstration Phase identified the following three main reasons why it had been unable to progress: (1) a lack of support from the FFC to prepare the application for Demonstration Phase, (2) the fact that the work completed as part of the Development Phase was not taken into account when assessing the Demonstration Phase application, and (3) the fact that it was still working on the Development Phase project, which it perceived to have put it at a disadvantage compared to a brand-new consortium which would have had more free time. Nonetheless, the continuity between the phases (as opposed to having a gap) was seen as positive in ensuring the continuity of staff and resources allocated to the project.

"Basically, everybody starts from a blank sheet of paper almost. So the fact that we've been running a project with fourteen companies for two years delivering some stuff is not taken into account [...] We were specifically told that the project that was running would have no bearing on the bid."

"A new consortium with a specific bid team not running another project has actually got an advantage over an ongoing project because you're trying to get the bid out alongside delivering the deliverables for the previous phase and there seems to be no credit for that."

"If you have a gap in there, you're going to lose resources. You're planning resources ahead. You can't go: 'We'll plan them, then we'll get rid of them for three or six months, and then we'll restart'. It doesn't work. You're going to lose continuity of resources."

These findings suggest that more could have been done by the FFC to help consortia formed for the Development Phase to move into the Demonstration Phase, particularly when it came to publicising the support available from KTN for preparing bids and ensuring that sufficient time was provided to enable Development Phase participants to carry out their project activities while preparing the bid for the Demonstration Phase.

How different competitions in each Phase aligned to complement one another and add value

Delivery leads who took part in the workshop explained that a way in which the FFC ensured the competitions added as much value as possible was by allocating the majority of the funding to the Demonstration Phase, as these projects were likely to have higher TRLs than those in the Development Phase and were therefore closer to having real-life applications. A delivery lead reported: *"[i]n terms of the funding itself, we realised that in the final two years we have the Demonstration Phase and effectively we're going to want more funding allocated. So more than half the spend, £75 million, was put into the final phase, whereas Phase Two was very much half that spend because it's about getting an understanding of concepts and things like that, which is what that phase was about and then allow it to move. So we spread the budget accordingly to maximise the benefit towards the back end of the programme"*.

Additionally, the different strands of competitions had particular requirements in terms of value of projects (from lower to higher value) and the aspects the projects should focus on (in the Demonstration Phase). There was also a requirement in the Development Phase to include SMEs in consortia. The impacts of these requirements are discussed in Section 4.3.

Management data shows that a range of organisations were successful in securing funding at each phase. These ranged from micro to large companies including academic organisations, Catapults, reverse take-over companies (RTOs) and Project Support Offices (PSOs). In line with the intention, beneficiaries in the Development Phase Strand One were weighted towards SMEs and academic organisations. In the Demonstration Phase, larger firms were represented more heavily in Strand One (with larger value projects) than Strand Two.

Table 20   Types of partners involved in competitions by phase and strand

Organisation type	Development Phase - Strand One	Development Phase - Strand Two	Demonstration Phase - Strand One	Demonstration Phase - Strand Two
Micro/Small	34	48	46	30
Medium	0	12	9	2
Large	1	38	25	4

Organisation type	Development Phase - Strand One	Development Phase - Strand Two	Demonstration Phase - Strand One	Demonstration Phase - Strand Two
Academic	14	16	11	4
Catapult	3	7	4	1
RTO	1	1	1	0
PSO	1	6	10	1
Total	**54**	**128**	**106**	**42**

Source: Challenge management data

5.3 The design and implementation of engagement activities

This theme focuses on how the design and implementation of the FFC supported engagement with knowledge exchange between and collaboration between a wide variety of organisations.

5.3.1 Views of FFC communications

This metric was analysed using evidence from the contact survey and the industry workshops.

Survey respondents were asked how informative they found a range of communications from the FFC (Figure 44). FFC events for competition winners were rated as the most informative means of communication (61% rated them 4 or 5 out of 5), followed by FFC workshops and events for future flight stakeholders (57%) and FFC publications (54%). Views were more mixed in relation to FFC personal contacts (46%) and KTN introductions and newsletters (37%). Social media posts by the Challenge had the lowest rating (28%).

These results suggest that there is room for improvement in communications via social media, KTN introductions and newsletters.

Figure 44   Views of FFC communications
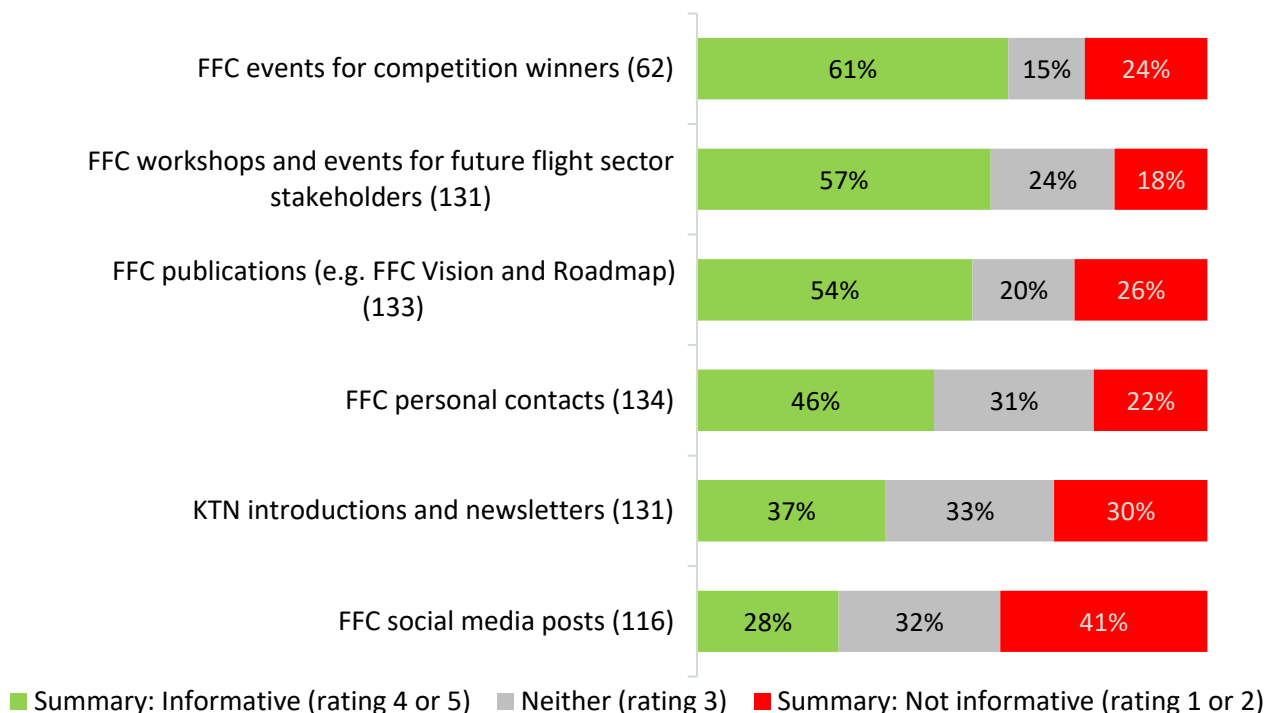
	Summary: Informative (rating 4 or 5)	Neither (rating 3)	Summary: Not informative (rating 1 or 2)
FFC events for competition winners (62)	61%	15%	24%
FFC workshops and events for future flight sector stakeholders (131)	57%	24%	18%
FFC publications (e.g. FFC Vision and Roadmap) (133)	54%	20%	26%
FFC personal contacts (134)	46%	31%	22%
KTN introductions and newsletters (131)	37%	33%	30%
FFC social media posts (116)	28%	32%	41%

Evidence from the industry workshops shows that the reason why events for competition winners were seen as useful was because they enabled the consortia to meet, have informal conversations and kickstart projects. A successful applicant workshop participant commented: *"[at Phase Two] there were hardly any events and we were working from home to be fair. But I did see a change once Phase Three came along and this was post bid phase for the successful projects. I know they held a couple of events bringing the cohorts together and that was pretty good because it does put you in front of people that you don't usually talk to. […] People were able to meet up and have those more informal discussions and so get off on the right foot".*

Nonetheless, some industry workshop participants stated that communications about events had not always been timely or directed to the right person. It was felt that at least a month's notice should have been provided for events. A successful applicant workshop participant thought that *"[e]ven though I was the project leader from literally day one, a lot of emails about these events would go to our finance contact and not to me. And she'd then forward me some e-mails a couple of weeks later if she's been on holiday or something and said 'oh, this might be for you'. It's very difficult to keep on top of events and plan properly if the communications are a bit patchy and random".* Another commented: *"I think there was a challenge in terms of timing and communication of a lot of them in that we just didn't know when they were happening until far too late to be able to adequately support them and get buy in from across the consortium to do that".*

Industry workshop participants stated that issues related to the timeliness of communications extended to applications for funding (as discussed in Section 5.2.2).

Apart from top-down communications from the FFC to stakeholders, the survey also explored bottom-up communications. Survey respondents were asked whether opportunities had been provided by the FFC to give feedback on policy needs of the sector and its role as a contact point between industry and government (see Section 4.6).

Figure 45 shows that around half (51%) of respondents agreed that there had been opportunities to give feedback on policy needs of the sector. However, just under one in three (32%) disagreed with this. There was a slight shift towards agreeing with the statement between the baseline and interim evaluation survey.

Figure 45 Views of feedback opportunities on policy needs
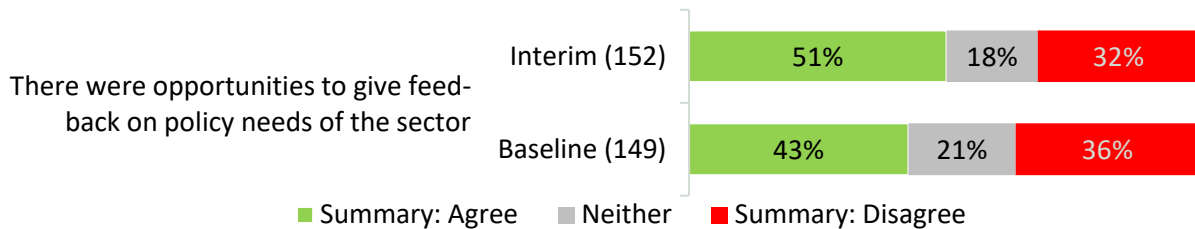
Source: *Contact survey. B1. Thinking about the Future Flight Challenge overall, including the application process, how much do you agree or disagree with the following statements?*

Note: *Base: valid responses, all respondents (bases in parentheses, Interim survey). Figures with asterisks are statistically significant over time at the 95% confidence level.*

5.3.2 Extent to which the programme has encouraged collaboration between different types of organisations

This metric was analysed using evidence from the contact survey and the industry workshops.

Survey respondents were asked whether the FFC was structured in a way that facilitated collaboration between future flight sector organisations as well as across different sectors. The results for these questions are shown in Figure 46.

More than three-quarters (76%) of respondents agreed that the FFC was structured in a way that facilitated collaboration between future flight sector organisations, with a similar proportion (70%) agreeing that the FFC was structured in a way that facilitated collaboration across different sectors. Fewer than two in ten actively disagreed with these statements (12% and 17% respectively). The responses were broadly similar to those seen in the baseline survey, although with some evidence of 'convergence' in views on the extent to which the FFC facilitated collaboration with and between sectors.

Figure 46   Views of the Challenge facilitating collaboration between different types of organisations
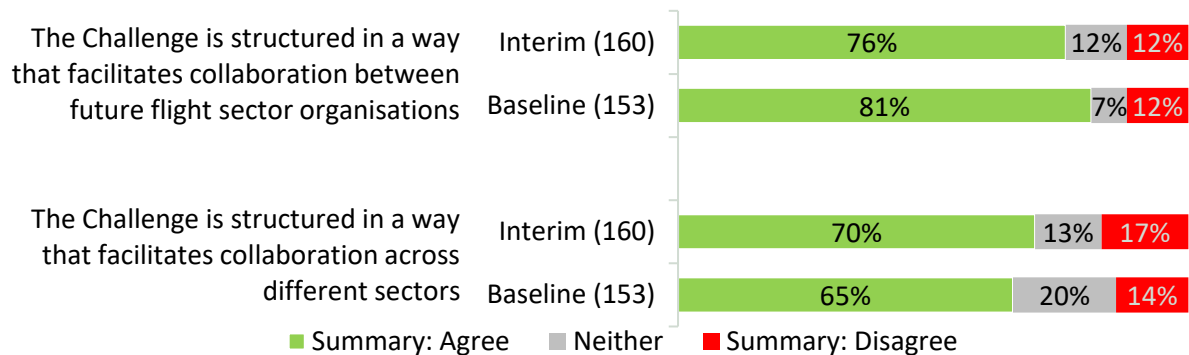
The Challenge is structured in a way that facilitates collaboration between future flight sector organisations
- Interim (160): Agree 76%, Neither 12%, Disagree 12%
- Baseline (153): Agree 81%, Neither 7%, Disagree 12%

The Challenge is structured in a way that facilitates collaboration across different sectors
- Interim (160): Agree 70%, Neither 13%, Disagree 17%
- Baseline (153): Agree 65%, Neither 20%, Disagree 14%

■ Summary: Agree   ■ Neither   ■ Summary: Disagree

Source: Contact survey. B1. Thinking about the Future Flight Challenge overall, including the application process, how much do you agree or disagree with the following statements?

Note: Base: valid responses, all respondents (bases in parentheses, interim survey) Figures with asterisks are statistically significant over time at the 95% confidence level.

This theme – the extent to which the Challenge has facilitated collaboration between different types of organisations – was also explored through the industry workshops. Two out of the three successful consortia that participated in workshops suggested that the structure of the competitions had encouraged collaboration between different types of organisations, because different types of organisation were entitled to different levels of public funding. Academic and smaller firms were entitled to claim 70% of costs or more, while larger firms were eligible to claim 50% (with the rest raised through matched funding), while also recognising the importance of the capabilities being brought by different partner organisations. A successful applicant workshop participant commented: *"I think it's the structure of the competitions. I think a key bit is the different levels of grant funding ... I think that's key in enabling different levels of participation … when you're assessing the consortiums, [if] you didn't put a value on the breadth of capabilities that a consortium brings together or the range of different problems that you set for people to approach, it wouldn't work. So I think the structure of the funding is key and the fact that Future Flight set a broad Challenge and actively encouraged and supported broad consortiums to come together. If they hadn't done any of one of those things, then it probably wouldn't have worked".*

There was also consensus among successful consortia that the FFC had encouraged collaboration between academic and industry partners, as this was a requirement of the application for funding. A successful applicant workshop participant felt that *"it was really positive in that sense. In [our project] we value our academic colleagues as they bring a certain skill set that we don't necessarily use in commercial business, so it's really nice to get that input as well. It is encouraged and I think we did do a lot of that. […] In the bid phase there is something about having at least one academic in there".*

Similarly, unsuccessful applicants felt that the application itself had encouraged them to seek a range of partners, including academic partners and companies from different sectors. One unsuccessful applicant workshop participant reported: *"it was because of the application [that I chose a university as a consortium member]. I was forced".* Another reported that, more generally, *"the existence of that funding pushed us to link with other companies and develop those links and those collaborations".*

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5.3.3 Extent to which the programme has facilitated multidisciplinary working

This metric was analysed using evidence from the contact survey and the delivery group and industry workshops.

As discussed in Section 4.3.3, around seven in ten (73%) survey respondents agreed that the FFC competition process had encouraged organisations from different disciplines of the future flight sector to work together. Just under two in ten (19%) disagreed with this and 8% were neutral.

Among industry workshop participants, there was a consensus that multidisciplinary working had either taken place in projects funded by the FFC or had been encouraged by some of the FFC competitions as they focused on AI, operations and law aspects of future flight innovation. A successful applicant workshop participant said: *"I don't know whether the Challenge itself has pushed us in that direction. We have pushed in that direction as a group because not all the best answers come from aerospace, all the disciplines that you already know about, a lot of the best solutions to problems and to questions come from the people that maybe you've never met before or you least expected and being able to do things like the ability of service applications that's a great example. We'd never have really encountered them were it not for what we were doing in terms of branching out to people that we hadn't really discussed with before. So in that sense it's been good".*

As discussed in Section 5.2.1, participants in the delivery lead workshop and one of the participating successful consortia felt that the system of systems approach adopted by the FFC had encouraged multidisciplinary working by definition, as this approach entailed dealing with the different but interdependent aspects needed to allow for the deployment of future flight innovation.

5.3.4 How the programme design facilitated reaching target competition participants as well as wider stakeholders

This metric was analysed using evidence from the delivery leads and the industry workshops.

Delivery leads who took part in the workshop explained that there were three main ways in which potential competition participants were targeted. These included via the KTN's networks, via Innovate UK social media and via connections of the Challenge Director. One delivery lead reported: *"the KTN have pulled together a future flight network as such. So that does not only sit within our projects but it's anybody that's got an interest whether it be government or industry and research. With that ultimate network they will share a lot of updates and give out information with regards to where we are with the projects, etcetera. They certainly would be aware of competitions and stuff, so that's quite a significant network that's in place".*

Another delivery lead commented: *"[Challenge Directors] will have had probably some private network connections, but we can't send them onto the KTN and include them so some of those people might have been contacted individually to say 'this money is going to be launched', but initially it was a lot of social media, Twitter, LinkedIn, utilising the big Innovate UK banner. Whenever we post anything, it comes from Innovate UK so it doesn't just reach our sectors, it reaches everybody".*

Delivery leads agreed that the programme had successfully reached its target competition participants from sectors such as aerospace and organisations focusing on automation, software and robotics. A delivery lead concluded: *"we've definitely reached a broad enough spectrum of people because we've got the projects that we wanted and especially in Phase Three we are delivering what we expected to deliver at this point, with large amounts of consortia that are looking to do the demonstrations as per our business case. So arguably, yes, we've obviously reached who we wanted to because it's where we wanted to get […] So obviously we initially targeted traditional aviation and aerospace, we wanted to target software we wanted to target autonomy. We wanted to target robotics and it just expanded out"*.

However, there was a feeling that 'there had been no clarity about who needed to be targeted from the beginning given the nascent nature of the future flight sector. A delivery lead summarised: *"at the end of the day, when you're creating a new industry that needs solutions that don't exist yet, you don't really know who you need to be targeting. And that's probably the same with all innovation. There's probably sectors we still haven't engaged that could potentially support future flight innovation"*.

The areas to target are, therefore, a work in progress and, as a result, there are new areas that the FFC has started to focus on more recently such as social science, regulation, insurance and supply chains.

There was a feeling among one of the successful consortia which took part in workshops that involvement with the CAA had been limited and could have started earlier. CAA involvement with the FFC was seen to have been limited during the Development Phase, and pressures from COVID-19 and Brexit were considered part of the reason for this lack of engagement. While engagement between the CAA and the Challenge was thought to have improved at the start of the Demonstration Phase, it was still seen to be limited. This was considered a shortcoming given the CAA's role in setting regulation in aviation, which makes this organisation central to innovation in this area. As such, the possibility of deploying the innovation enabled by the Challenge is dependent on the CAA.

A successful applicant workshop participant stated: *"the CAA is absolutely critical for anybody doing any innovation in aerospace. The CAA has to be in there particularly for the scope of future flight. And I think everybody found that to be a major failing that the CAA just weren't able to properly support the programme. It's something they tried to fix for Phase Three. But there was a lot of money spent across the Future Flight Challenge, and almost everybody whose programme required significant engagement from the CAA was disappointed. That was a structural problem. The issue with the CAA was resource and focus. I understand that for Phase Three Future Flight have engaged more directly with the CAA and I think they're funding them to provide more resource to support the programmes. But even then, the input that we're getting is fairly basic. I wouldn't say we're getting a lot of expertise from them […] Perhaps Future Flight should have got stuck into the CAA earlier on, but I think there were big limitations around COVID as well. For so many people in aerospace, the CAA included, it was a very difficult time. And Brexit was also probably a factor. They were processing vast amounts of transition for them outside the EU […]"*.

Apart from the CAA, there was feedback from unsuccessful applicants who took part in workshops that the FFC could better engage with wider stakeholders (i.e. other than competition winners).

Suggestions included holding events, giving organisations individual points of contact within the FFC and providing opportunities for unsuccessful applicants to discuss innovation-related topics. An unsuccessful workshop participant recommended: *"I think Future Flight needs to look outside of its existing members and existing knowledge all the time. [They could do] it by having individuals [as points of contact between the Challenge and other organisations]. I think that works very well. And the other way is to have very open mass events. There could be a Future Flight Show almost or it could be showing off all the great work that's been funded and talking about what's going to come next, putting people in physical proximity".*

Successful consortia noted that the FFC had encouraged them to promote their projects through publications and conference presentations to raise visibility outside the FFC, and the networks accessible to senior FFC leadership were highlighted as a mechanism that supported this. A successful applicant workshop participant summarised: *"We are encouraged to get our publications out there and to get the wider world to understand what we're doing is useful […] There's an amount of self-promotion on behalf of our own consortium. And there is also some support with Future Flight that gets us into presenting at conferences and in publications. And that's been good. So particularly there are some folks like Gary who's head of the Future Flight Challenge who has been very, very effective at getting our stories out there to people with whom we can expand our horizons".*

5.3.5 Alignment with other UK government activities

This metric was analysed using evidence from the contact survey, the delivery leads workshop and the industry workshops.

Survey respondents were asked how well they thought the FFC aligned with other government initiatives (Figure 47). Around two-thirds (64%) felt that the FFC aligned strongly with other government initiatives in the UK, including a quarter (26%) who felt it did so very strongly.

Figure 47   Views of how well the Future Flight Challenge aligns with other government initiatives in the UK
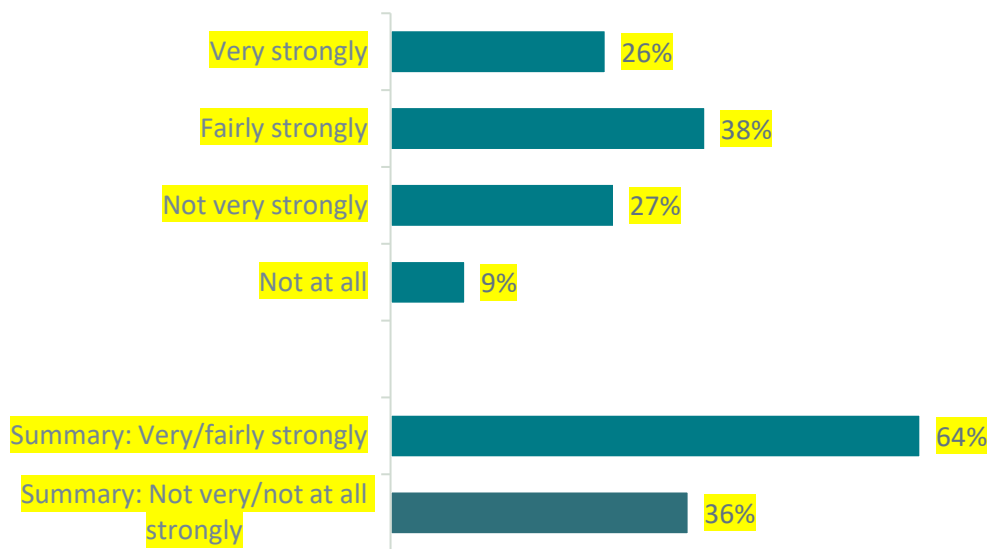
Survey respondents who had a view about how well the FFC aligned with other UK government initiatives were then asked what initiatives they were thinking about when answering the question above. The UK government initiatives most commonly considered when answering this question were Net Zero Carbon (31%) and the Aerospace Technology Institute (ATI) (20%).

Alignment with other UK government initiatives was also explored via the delivery group and industry workshops. Views around alignment of the FFC with Net Zero were mixed. Most delivery leads had no knowledge of how well the FFC aligned with Net Zero, while one delivery lead pointed out that some work had been done to understand how the FFC might be contributing to Net Zero targets. A delivery lead noted: *"I do know that this Challenge has certainly taken the advice on how to continue with Net Zero and there was some general advice given to the Challenge to go work out how much [it's] tackling Net Zero. This is the bit that we might be part of, and then this is the bit that we'll have an influence in and they have definitely used that to have a better understanding of what contribution this Challenge could make to Net Zero targets".*

Opinions from industry workshop participants were also mixed with regard to Net Zero, with some able to see a link with this initiative through an emphasis on electric and hydrogen vehicles, and others saying that there had been informal conversations around Net Zero between the FFC team and project teams but that this had not been embedded into processes such as the application for funding or the delivery of projects. One unsuccessful applicant workshop participant felt that *"[the FFC] aligns with government initiatives. It does align with the industrial strategy and the AI strategy, and it does align with Net Zero to certain extent. They were pushing electric flight in those, as well as hydrogen".*

A successful applicant workshop participant commented: *"[Net Zero] certainly wasn't in the in the submission. It's been in kind of discussions only when we're talking with people like the Future*

Flight team. It's very informal, it's not driven, it's not something that's built into the process that we've undertaken. It's something that some of us who are already in that Net Zero community will have been dealing with, but not something where Future Flight has meant that we've dealt with it necessarily".

Nonetheless, there was consensus among the delivery leads that took part in workshops that the Challenge was well aligned with initiatives related to aviation and transport, such as the Aerospace Technology Institute (ATI), the Connected Places Catapult (CPC) and the Department for Transport (DfT). One delivery lead representative, for example, highlighted regular discussions with people engaged in those departments or initiatives and attempts to align closely with different strategies.

5.4   The delivery and outcome monitoring process

This theme focuses on how delivery and outcomes are monitored.

5.4.1   Effectiveness of the delivery monitoring process

This metric was analysed using evidence from the delivery group workshop and the industry workshops.

This metric focuses on how well the delivery monitoring enables the FFC to respond to delivery or performance issues with little or no wasted time or resources.

Delivery leads explained that the monitoring process followed standard Innovate UK processes. It started with an initial meeting between the Monitoring Officers and the project team, where expected outcomes were discussed and finance and delivery schedules agreed. The Monitoring Officer also ran the project team through monitoring rules and effective project management practices, including risk management. This initial meeting was then followed by quarterly monitoring meetings between the Monitoring Officer and project team, where timelines, finances, milestones and risks were reviewed. Towards the end of the project, a closure report was produced by the Monitoring Officer, as well as projects being subject to audit reports and Challenge Director sign off. Monitoring Officers shared information from projects' quarterly reviews with the Challenge team, thus providing them with an overview of delivery.

Industry workshop participants regarded the monitoring process as helpful. They considered quarterly meetings useful for ensuring projects were on track to deliver milestones on time and to budget.

"The meetings we had with the Monitoring Officer [were] a point which helped us keep true to our plan because there was no ticking off the project saying yes, you've achieved all your deliverables and here's your grant funding. It was on us to judge our project ourselves [...] to ensure that we've delivered what we intended to deliver in the first place."

Industry workshop participant
(successful applicant)

There was evidence from industry workshop participants that the monitoring process was effective in highlighting delivery issues and ensuring consortia responded to them in a timely manner. Issues raised during monitoring meetings most often related to underspending or delays in delivering milestones. These were usually resolved by reviewing timelines and spending forecasts.

"We had partners who kept underspending and then they were re-forecasting all the money into future periods. And [the Monitoring Officer] was challenging that. [...] I think we just overestimated how much certain organisations would contribute."

Industry workshop participant (successful applicant)

A successful applicant workshop participant described: *"the only things we've had raised though, if and when we're behind in delivering milestones or anything like that. […] We usually get telling off for not putting in claims in time as well. We react by re-evaluating when we can deliver and we believe that we need to be honest with the with the MO so we talk about what's driven us to be late and we talk about how we can recover and we go from that".* Industry workshop participant (successful applicant)

Successful consortia that took part in industry workshops had positive views of their Monitoring Officers. Apart from helping with project management, Monitoring Officers were valued for their involvement with technical aspects of projects and for offering support with Innovate UK and UKRI processes.

"I think [the Monitoring Officer's] position was that it was not really his role to judge what we were producing, but I think because of his background he was quite interested so he did ask questions and, in some ways, [we were] getting feedback from him."

Industry workshop participant (successful applicant)

Another successful applicant workshop participant felt that *"it's quite good having someone allocated. Any questions [around Innovate UK processes] we'd go to him first. I think having a single point of contact or a key point of contact is pretty good […] One of the problems we had was that there was going to be a gap between our end of Phase Two [project] and the start of Phase Three. So we talked to [the Monitoring Officer] about how we could we spread the funding to cover that gap and he helped us with that".*

5.4.2 Effectiveness of the outcome monitoring process and benefits management approach

This metric was analysed using evidence from the delivery group workshop and the industry workshops.

This metric focuses on how well outcome monitoring and benefits management support the FFC in understanding whether the programme is on track to deliver its impacts.

The successful consortia that took part in the industry workshops felt that they had achieved their intended outcomes, even if some projects had underspent their funding due to COVID-19.

> "We could never fully catch up with the underspend from earlier in the project, but it didn't affect the product. So I mean from a taxpayers' point of view, you've got the same product for less money."
>
> Industry workshop participant
> (successful applicant)

Additionally, one of the consortia that took part in industry workshops explained that dissemination and exploitation had also been areas of focus of the monitoring process, with project teams being reminded of their obligations in terms of exploitation of project outcomes.

> "I think we didn't immediately think about a comms plan, but [our MO] kept reminding us of our obligations there. So when it comes to exploitation, he would bring us back to that a lot."
>
> Industry workshop participant
> (successful applicant)

As well as monitoring the outcomes of individual projects, delivery leads who took part in workshops explained that the FFC also monitored its overall outcomes more widely. This involved reviewing and reporting on the outcomes of all funded projects as well as other FFC activities on a quarterly basis against initial objectives. This quarterly review of outcomes allowed the FFC to intervene if impacts were not being delivered by supporting funded consortia and/or finding alternative activities to deliver on those impacts.

The social science activity that is being delivered in the Demonstration Phase (see Section 5.1.4) was seen to be a result of outcome and benefits monitoring, as monitoring highlighted that activity to deliver the intended impacts was lacking in this area. This finding then allowed the FFC to focus on this area in the Demonstration Phase.

5.4.3 Suggested improvements to the monitoring process

This metric was analysed using evidence from the delivery group workshop and the industry workshops.

While the monitoring process was regarded as broadly positive, industry workshop participants and delivery leads identified some improvements.

From the perspective of successful consortia, the project change request (PCR) system was seen as an impediment to project progress given the long FFC approval timelines. Participants agreed that

providing outcomes for these requests should be made a more straightforward system. Most projects were expected to need to submit a PCR given the uncertain nature of research and innovation, and the need to adapt the projects as findings emerged.

"We are still waiting for a change request to be finalised from Phase Two … it's quite frustrating and, in that sense, I would say things need to happen a bit faster because for a commercial organisation waiting for funds to be received is not the best place to be in."

"It's probably a single figure PCR, but each one pretty much was very painful to get approval. There seems to be a lot of passing between teams, it's with this team, then it's with the finance team, then it's with the awards team and then it's stuck and basically you have to escalate it to get anything finalised."

Industry workshop participants (successful applicant)

Some feedback also expressed frustration at the level of specificity that was required about uncertain aspects of budgeting which would later generate the need for a PCR to be raised. One successful applicant workshop participant described: *"… there are other lines, for example subcontracting and travel and subsistence that there's no way … that you can realistically forecast that over a two-year project and having to put the numbers together 6 to 9 months ahead of that. So the inflexibility to not be able to move even a single pound between one line there to one of the other lines. And when you do want to do that, you have to put in a PCR that takes three to six months to get turned round. It's just ridiculous".* We understand, however, that the Challenge is currently reviewing this process to bring it down to 30 days.

The successful consortia that took part in workshops would have liked Monitoring Officers to have more authority when it came to approving PCRs as they were more likely to be aware of the reasons why the PCR had been requested given their direct relationship with project teams. A successful applicant workshop participant felt that *"there should be limits e.g., several hundreds to thousands of pounds, whatever the limit is, given to the Monitoring Officers to allow them to approve simple changes on the spot, because as long as the overall grant spend is the same, there's no other impact elsewhere".*

Additionally, there was feedback both from industry workshop participants and delivery leads that the IFS portal used for monitoring could be made more user-friendly. For example, while consortium leads had access to all the financial information about a project on the IFS portal, project leads from other partner organisations did not necessarily have access to this information as it was only granted to financial contacts (who often were not involved in delivering projects). A successful applicant workshop participant commented: *"the project manager has no access or visibility of the spend profile or the forecast they put in the previous month unless they've got it saved on a separate Excel spreadsheet or something like that. Unless the project manager is the same as the financial person, which in large organisations it probably won't be. Our finance contact within our finance team, they understand the finances but they don't understand what's happening in the day-to-day life of the project".*

Similarly, project delivery leads explained that the Challenge team, Monitoring Officers and project teams did not have access to the same levels of information on the IFS portal, due to differing levels of permissions being granted. This could result in delays enacting requests submitted by project teams via the system. A delivery lead reported: *"the Monitoring Officers don't see the same things we see on our platform, and the projects use IFS and they don't get to see everything that the MO and we see and it's just very hard and we don't even have the same screens sometimes and our systems are completely different and sometimes trying to explain to them where they need to click and actually realising that something looks completely different and I'm giving them useless information can be very frustrating at times"*. Another delivery lead commented, *"It's all about ultimately built permissions and it's not always clear who has access to what and sometimes you have the best will in the world and it's quite administrative and some things can sit on an entry or somewhere and effectively just standing there when actually it's quite important for the project to have it done to get it moved forward"*.

Annex A Survey overview

The survey aimed to provide an overview of behaviours and perceptions of business and academics that have engaged with the FCC. Fieldwork took place between 27th September and 11th November 2022.

A.1   Sample methodology

The sample for the survey included:

- Those who had been successful in their application to the Challenge, including the initial Discovery stage;
- Those who had not been successful in any of their applications to the Challenge;
- Those who had started an application, but not finished or submitted it; and
- A couple of respondents who are involved in the future flight sector but did not interact with the Challenge.

Although there are likely to be more organisations engaged in the future flight sector in the UK that did not engage with the Challenge in any way, this was determined to be the fullest sample available as future flight is a new sector and is not easily distinguished from sources such as company registration data.

Contact details were shared by the FFC for each round of competitions that had taken place so far. Contact details for the two external contacts were provided by Frazer-Nash Consultancy. These were then combined and de-duplicated so that any applicants who had applied to multiple competitions were only included in the sample file once.

A census approach was used, with all contacts being invited to take part in the survey.

A.2   Sample composition

The full, de-duplicated sample for the survey consisted of 1,179 individuals. The table below shows the overall FFC application status of these individuals, where application refers to an application for a FFC competition. The profile was very much in line with that at the baseline.

Table 21 Total application status of sampled individuals

	Count of individuals	Percentage of individuals
All applications accepted	425	36%
A mix of accepted and rejected applications	149	13%
All applications rejected	373	32%
All applications not completed/submitted	228	19%
Not applicants	4	0.3%
Total	**1,179**	**100%**

As was the case at the baseline, the majority of contacts had only been named in one application to the FCC (70%). The table below shows the number of applications that individual contacts were named in (whether these were submitted or not).

Table 22 Number of applications of sampled individuals

	Count of individuals	Percentage of individuals
0 applications	4	0.3%
1 application	829	70%
2 applications	195	17%
3 or more applications	151	13%
Total	**1,179**	**100%**

In total, 197 individuals completed the survey, which represents an overall response rate of 17%, in line with the 17% achieved at the baseline.

Response rates broken down by total application status are shown below. Unlike the baseline, where those who did not complete or submit any applications were substantially less likely to respond to the survey (3% response rate), at the Interim survey the response rate has risen to 14%.

Table 23   Number of applications of sampled individuals

	Completed interviews	Interim survey response rates
All applications accepted	57	13%
A mix of accepted and rejected applications	39	26%
All applications rejected	66	18%
All applications not completed/submitted	33	14%
Not applicants	2	50%
Total	**197**	**17%**

Response rates broken down by number of applications are shown below. As was the case at the baseline, these show that those who have engaged more with the Challenge, through multiple applications, were more likely to respond to the survey.

Table 24   Number of applications of sampled individuals

	Completed interviews	Interim survey response rates
0 applications	2	50%
1 application	119	14%
2 applications	42	22%
3 or more applications	34	23%
Total	**197**	**17%**

Within the survey, respondents were asked to categorise their involvement in the future flight sector. They were asked to select, from a list, the response that they thought best describes their organisation in relation to the future flight sector. Respondents were only able to select one response.

The below figure shows how the individuals who completed the survey categorised their organisation in relation to the future flight sector. The largest group described themselves as technology developers (31%), followed by researchers (19%), service providers (13%) and technology integrators (11%). For the purposes of subgroup analysis the remaining responses have been combined into an overall 'other' category, consisting of the remaining 24% of respondents.

The profile of respondents was very similar to that seen at the baseline.

Figure 48   Involvement with future flight sector

Technology developer — Interim 31%, Baseline 30%
Researcher — Interim 19%, Baseline 20%
Service provider — Interim 13%, Baseline 12%
Technology integrator — Interim 11%, Baseline 10%
Other aviation or aerospace company — Interim 6%, Baseline 4%
Government agency — Interim 6%, Baseline 6%
Aviation support services — Interim 4%, Baseline 6%
Air traffic manager — Interim 3%, Baseline 1%
Local infrastructure provider — Interim 3%, Baseline 2%
Supply chain provider — Interim 1%, Baseline 1%
Other non-aviation or aerospace company — Interim 1%, Baseline 3%
Regulator — Interim 1%, Baseline 1%
Other — Interim 2%, Baseline 3%

■ Interim   ■ Baseline

Source: *Contact survey. A1. Which of the following best describes your organisation in relation to the future flight sector?*
Note: *Base: all respondents (Interim survey: 197, Baseline 154).*

At the interim survey, respondents in commercial businesses were asked how long their organisation has existed under all ownerships and legal statuses. As shown in Figure 49, a third (33%) had been in operation for more than 20 years, close to one in five (17%) had been in operation or between 11 and 20 years, and a similar proportion (19%) for 6 to 10 years. The remaining 32% had been in operation for up to 5 years.

Figure 49   Length of operation

Length	Percentage
1 year	5%
2 years	5%
3 years	9%
4 years	7%
5 years	6%
6-10 years	19%
11 - 20 years	17%
More than 20 years	33%
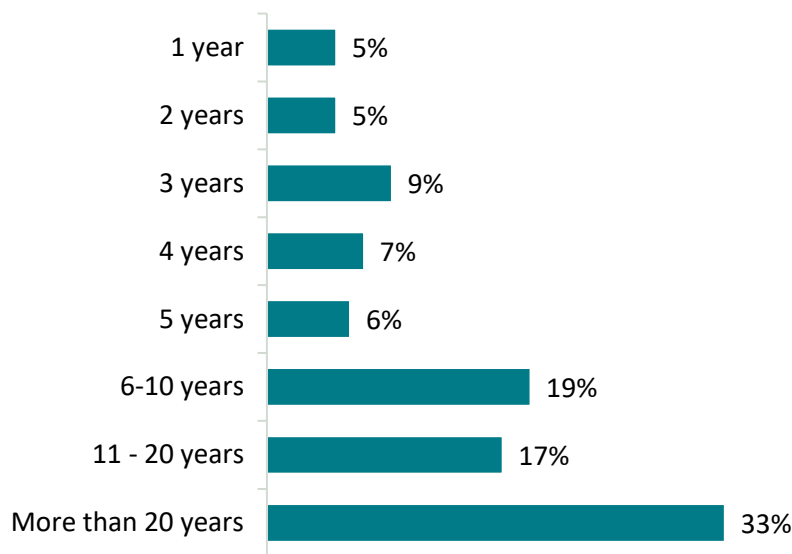
Source: Contact survey. A1A. For how many years has your organisation existed? This includes under all ownerships and legal statuses.

Note: Base: respondents in commercial businesses (Interim survey: 133).

In the interim survey, respondents were also asked which phase of the FFC their organisation had been involved with, taking into account all applications for funding, whether they were successful or not, including any applications that were started but not submitted.

Of those providing a valid response (154 respondents), two in three (66%) were involved in the Development Phase, a similar proportion (64%) were involved in the Demonstration Phase, and over half (55%) were involved in the Discovery Phase.

A.3   Sample methodology

A mixed mode approach was used for the survey, encompassing both online and telephone interviews. This mixed mode approach was employed to maximise response rates as well as to utilise the sample and resources available as much as possible.

The sample was split depending on the contact information available and the interaction with the FFC. Contacts who had only been involved in applications that had not been completed or submitted or who were only involved in the Discovery Phase were contacted by email and invited to complete the survey online. All others were contacted by phone and asked to complete the survey over the phone with interviewers. If any who were contacted by phone asked to complete the survey online, they were sent a link so that they could complete the survey in that way.

The online and telephone surveys had the same contents and the only differences were small wording tweaks to ensure the question text made sense to the respondent if it was read out by an interviewer

over the phone or if it was read on a screen by a respondent completing the online survey. 102 surveys were completed online and 95 by telephone.

The survey was designed around the evaluation framework and aimed to answer the research questions in the framework where other sources of primary or secondary information were not available.

While the survey collected a range of useful data and inputs from FFC applicants, it should be noted that there are some limitations to the achieved sample. Some questions were only asked of businesses as they referred to aspects such as turnover, other characteristics and research and development activity. As such, responses from these questions are based on 133 responses or fewer. While this number is large enough to draw conclusions at a total level, it is not sufficient to allow for subgroup analysis.

Annex B Survey instrument and topic guides

B.1   Survey

Below is the questionnaire used for the interim survey. The question text is in bold. Instructions for scripting are in red and instructions for the telephone interviewers are in blue. These instructions were not visible to survey respondents.

Screener

IF TOTAL APPLICATION STATUS IS ACCEPTED, REJECTED OR MIX OF ACCEPTED AND REJECTED

1. **S1. Were you or your organisation involved in an application for funding from the Future Flight Challenge? This could have been at any point since the first phase of the Challenge in 2019.**
SINGLE CODE
   1. Yes – CONTINUE WITH INTERVIEW

IF TOTAL APPLICATION STATUS IS ACCEPTED, REJECTED OR MIX OF ACCEPTED AND REJECTED

2. **S3. And are you able to answer questions about work that has been undertaken in this area following your application?**
SINGLE CODE
   1. Yes
   2. No

IF S3=2 (NO)

3. **S4.** CATI TEXT: **Please can you tell me who is the best person to speak to regarding the application and the work that has been undertaken in this area following the application?**
CAWI TEXT: **Please can you enter the details of the best person to speak to regarding the application and the work that has been undertaken in this area following the application.**
4. COLLECT NAME, TELEPHONE NUMBER AND EMAIL ADDRESS WHERE POSSIBLE

Background

READ OUT (ALSO SHOW FOR CAWI): The following questions will refer to the 'future flight sector'. By future flight sector we mean the development and production of technology, products and services for any aspect of the aviation system related to drones, unmanned aerial vehicles, air mobility vehicles or smaller conventional aircraft with sustainable power or autonomy. It does not cover aviation developments for larger conventional aircraft of more than 70 seats.

5. **A1. Which of the following best describes your organisation in relation to the future flight sector?**

1. Service provider (IF NECESSARY: involved in the design or provision of services using future flight technologies)
2. Technology integrator (IF NECESSARY: involved in the integration of future flight technologies, including UAS and UAM)
3. Technology developer (IF NECESSARY: involved in the design, development, manufacture, but not integration, of future flight technologies)
4. Supply chain provider (IF NECESSARY: sub-system equipment developers and providers who provide inputs to future flight sector firms)
5. Aviation support services (IF NECESSARY: such as maintenance, insurance and consultancy)
6. Other aviation or aerospace company
7. Other non-aviation or aerospace company
8. Air traffic manager (IF NECESSARY: providing passive and active ATM including supporting technology and services)
9. Local infrastructure provider (IF NECESSARY: ground infrastructure provider, including airfields, vertiports and charging)
10. Regulator (IF NECESSARY: responsible for the regulation of future flight technologies, including air vehicles and ground infrastructure)
11. Government agency (IF NECESSARY: includes national and local)
12. Researcher (IF NECESSARY: includes research institutes, universities and academics)
13. Other (please write in) EXCLUSIVE
14. Don't know EXCLUSIVE

6. **A1A. For how many years has your organisation existed? This includes under all ownerships and legal statuses.**

1. Less than one year
2. 1 year
3. 2 years
4. 3 years
5. 4 years
6. 5 years
7. 6-10 years
8. 11 – 20 years
9. More than 20 years
10. Don't know

7. **A2A. What proportion of your organisation's business is focussed on future flight technologies?**

Please give an estimation of the proportion of your business's total output that is focused on future flight technologies. Please include all sites and subsidiaries. including any work outside of the UK.

8. NUMERIC RESPONSE WITH DK OPTION. SHOW PERCENT SIGN AFTER BOX VALIDATION WHOLE NUMBERS ONLY. MIN 0, MAX 1OO

9. IF A2A=DK

A2B. Which of these bands would best describe the proportion of your organisation's business that is focussed on future flight technologies?

10. SINGLE CODE, READ OUT

1. 0%
2. 1% - 10%
3. 11% - 25%
4. 26% - 50%
5. 51% - 75%
6. 76% - 99%
7. 100%
8. Don't know

ASK ALL

11. **A3. Which of the following areas does your organisation or research group focus on in relation to the design and development of future flight technologies?**

MULTICODE, READ OUT

1. Uncrewed Aerial Systems and drones
2. Urban Air mobility
3. Autonomous aviation systems
4. Electric, hybrid-electric or hydrogen regional aircraft
5. Digital future flight infrastructure
6. Physical future flight infrastructure
7. Air traffic management
8. Regulation and governance
9. Non-future flight technologies
10. Other (please write in)

IF COMMERCIAL BUSINESS [CODES 1-9 AT A1]

12. **A4A. Which of the following best describes your organisation?**

MULTICODE, READ OUT

1. Headquartered in the UK, and only do work in the UK EXCLUSIVE
2. Headquartered in the UK, but also do work in Europe
3. Headquartered in the UK, but also do work outside of Europe
4. Headquartered outside of the UK EXCLUSIVE
5. DO NOT READ OUT Don't know EXCLUSIVE
6. DO NOT READ OUT Prefer not to say EXCLUSIVE

13. **A4B. And what other regions, other than the UK does your organisation do work in?**

MULTICODE, READ OUT

1. European Union (Excluding UK)
2. Rest of Europe (excluding EU)
3. Middle East
4. Asia
5. North America
6. South America
7. Africa
8. Australasia
9. DO NOT READ OUT Don't know
10. DO NOT READ OUT Prefer not to say

14. **A4C. What region of the UK is your [IF A4A=4; UK] headquarters in?**

SINGLE CODE, READ OUT

1. East Midlands
2. East of England
3. London
4. North East England
5. North West England
6. Northern Ireland
7. Scotland
8. South East England
9. South West England
10. Wales
11. West Midlands
12. Yorkshire and The Humber
13. DO NOT READ OUT Don't know
14. DO NOT READ OUT Prefer not to say

15. **A4D. And where does the majority of your organisation's work in the future flight sector take place in the UK?**

SINGLE CODE, READ OUT

1. East Midlands
2. East of England
3. London
4. North East England
5. North West England
6. Northern Ireland
7. Scotland
8. South East England
9. South West England
10. Wales
11. West Midlands
12. Yorkshire and The Humber
13. DO NOT READ OUT Don't know
14. DO NOT READ OUT Prefer not to say

IF COMMERCIAL BUSINESS [CODES 1-9 AT A1] AND A4A=2-4

16. **A5A. How many members of staff does your organisation currently employ globally? Please think about the number of full time equivalent employees.**
If you don't know the exact number please give an estimate.

17. NUMERIC RESPONSE WITH DK OPTION
VALIDATION – WHOLE NUMBERS ONLY, MIN 1, MAX 99,999

18. IF A5A=DK

A5B. Which of these bands would best describe the number of full-time equivalent employees at your organisation?

19. SINGLE CODE, READ OUT

1. 1-9
2. 10-19
3. 20-49
4. 50-99
5. 100-249
6. 250-499
7. 500-999
8. 1,000/4,999
9. 5,000-9,999
10. 10,000 plus
11. Don't know

20. A6A. And how many members of staff does your organisation currently employ in the UK? Please think about the number of full time equivalent employees.

If you don't know the exact number please give an estimate.

21. NUMERIC RESPONSE WITH DK OPTION

VALIDATION – WHOLE NUMBERS ONLY, MIN 1, MAX 99,999

22. IF A6A=DK

A6B. Which of these bands would best describe the number of UK full-time equivalent employees at your organisation?

23. SINGLE CODE, READ OUT

1. 1-9
2. 10-19
3. 20-49
4. 50-99
5. 100-249
6. 250-499
7. 500-999
8. 1,000/4,999
9. 5,000-9,999
10. 10,000 plus
11. Don't know

24. A6C. Which of these bands would best describe the number of UK full-time equivalent employees dedicated to R&D activities at your organisation?

SINGLE CODE, READ OUT

1. 1-9
2. 10-19
3. 20-49
4. 50-99
5. 100-249
6. 250-499
7. 500-999
8. 1,000/4,999
9. 5,000-9,999
10. 10,000 plus
11. Don't know

25.   A6D. Approximately what proportion of the full-time R&D staff at your organisation identify as female or non-binary?

SINGLE CODE, READ OUT

1. 0%
2. 1% - 10%
3. 11% - 25%
4. 26% - 50%
5. 51% - 75%
6. 76% - 99%
7. 100%
8. Don't know

26.   A7A. Which of the following bands would best describe your UK turnover for the previous financial year? Please think about all UK turnover, even if some operations are outside of the future flight sector.

SINGLE CODE, READ OUT

1. Zero
2. Less than £100,000
3. £100,000 - £499,999
4. £500,000 - £999,999
5. £1m - £4.9m
6. £5m - £9.9m
7. £10m - £24.9m
8. £25m - £49.9m
9. £50m or more
10. Don't know
11. Prefer not to say

27.   A8. Which phases of the Future Flight Challenge has your organisation been involved with? Please consider all applications for funding, whether they were successful or not, including any applications that were started but not submitted.

MULTICODE, READ OUT

1. The Discovery Phase (in late 2019 or early 2020)
2. The Development Phase (from mid-2020 to early 2022)
3. The Demonstration Phase (from late 2021 onwards)
4. None of the above [EXCLUSIVE]
5. Don't know [EXCLUSIVE]

Application process

**28.	B1. Thinking about the Future Flight Challenge overall, including the application process, how much do you agree or disagree with the following statements?**
By the application process we mean the whole process from when you started to dedicate time to the application. This may have included carrying out research into the requirement, contacting potential partners and clarifications with FFC before you began writing the application itself.

   a)	The Challenge is structured in a way that facilitates collaboration between future flight sector organisations
   b)	The Challenge is structured in a way that facilitates collaboration across different sectors
   c)	There was clear guidance about the focus of the Challenge
   d)	There were opportunities to give feed-back on policy needs of the sector
   e)	The application process was clear and easy to understand
   f)	The three-phase structure of the Challenge, from Discovery to Development and then Demonstration, is suitable for driving real-life operation demonstration of multiple novel air vehicles in challenging environments

SCALE
   1.	Strongly agree
   2.	Tend to agree
   3.	Neither agree nor disagree
   4.	Tend to disagree
   5.	Strongly disagree
   6.	Don't know

**30.	B2. Has your organisation joined or formed a consortium with other organisations for work related to future flight?**
MULTICODE
   1.	Yes, during the Discovery Phase of the FFC (in late 2019 or early 2020)
   2.	Yes, during the Development Phase of the FFC (from mid-2020 to early 2022)
   3.	Yes, during the Demonstration Phase of the FFC (from late 2021 onwards)
   4.	Yes, but not related to the FFC
   5.	No EXCLUSIVE

31. **B3. How influential was the Future Flight Challenge in the forming of this consortium?**

1. Very influential
2. Fairly influential
3. Not very influential
4. Not influential at all
5. Don't know

32. **B4. How did the Future Flight Challenge influence the forming of this consortium or consortia?**

Pease select all that apply.

1. We were introduced to the other members of the consortium by the Challenge
2. We met other members of the consortium during the Discovery Workshop in February 2020
3. We met other members of the consortium during other engagement activities run by the FFC
4. FFC gave us guidance on the types of organisations that should be included in the consortium
5. FFC provided contact details for other members of the consortium
6. Other (please specify) FIX
7. Don't know FIX

34. **B5. How much do you agree or disagree that the Discovery phase of the FFC supported the formation of consortia? The Discovery stage took place in late 2019 and early 2020.**

35. Strongly agree
36. Tend to agree
37. Neither agree nor disagree
38. Tend to disagree
39. Strongly disagree
40. Don't know

41.   B6. In what ways did the Discovery phase support the formation of consortia? Please select all that apply.

1. It bought together organisations from different sectors
2. It bought together organisations of different sizes
3. It bought together different types of organisations, such as businesses, academia, research and technology organisations and government
4. It bought together organisations that were not previously aware of each other
5. It allowed organisations with similar goals to come together
6. It encouraged organisations who would not usually consider forming consortia to do so
7. It meant consortia didn't have to over commit in early stages
8. Other (please specify) FIX
9. Don't know FIX

43.   B7. Did your consortium from the Discovery Phase go on to apply for funding in the Development or Demonstration phase competitions? The Discovery stage took place in late 2019 and early 2020. The Development Phase took place between 2020 and 2022 and the Demonstration Phase is from 2021 to 2024.

1. Yes, in the Development Phase
2. Yes, in the Demonstration Phase
3. No EXCLUSIVE

44.   B8. Why didn't your consortium go on to apply for funding in later FFC phases?

B9. How much do you agree or disagree that the structure of the FFC enabled consortia developed for the Development Phase to successfully move into the Demonstration Phase? The Development Phase took place between 2020 and 2022 and the Demonstration Phase is from 2021 to 2024.

1. Strongly agree
2. Tend to agree
3. Neither agree nor disagree
4. Tend to disagree
5. Strongly disagree
6. Don't know

47.   B9A. To what extent do you agree or disagree that feedback given by organisations in the Discovery phase was reflected in the scope of the Development Phase?
The Discovery stage took place in late 2019 and early 2020. The Development Phase took place between 2020 and 2022.

1. Strongly agree
2. Tend to agree
3. Neither agree nor disagree
4. Tend to disagree
5. Strongly disagree
6. Don't know

49.   B10. How much do you agree or disagree that the Future Flight Challenge competition process has encouraged organisations from different disciplines of the future flight sector to work together?
1. Strongly agree
2. Tend to agree
3. Neither agree nor disagree
4. Tend to disagree
5. Strongly disagree
6. Don't know

50.   B11. How well do you think the Future Flight Challenge aligns with other government initiatives in the UK?
1. Very strongly
2. Fairly strongly
3. Not very strongly
4. Not at all
5. Don't know

51.   B12. Which UK government initiatives were you thinking of when you answered the previous question?

52.   B13. To what extent did the Future Flight Roadmap or vision assist in the setting up or carrying out of future flight projects?

SINGLE CODE, REVERSE SCALE

1. A great deal
2. A fair amount
3. A little
4. Not at all
5. Don't know

53.   B14. What other, if any, centrally defined outputs from the Future Flight Challenge would have assisted in the setting up or carrying out of future flight projects?

OPEN, INCLUDE A CODE FOR NONE, INCLUDE A CODE FOR DK

Perceptions on UK progress

ASK ALL

54.   C1. CATI TEXT: **I'm now going to read out some elements of future flight technology development and support. For each, please can you tell me how you think the UK is currently performing in comparison to other countries?**

CAWI TEXT: **Below are some elements of future flight technology development and support. For each, please indicate how you think the UK is currently performing in comparison to other countries.**

55. SINGLE CODE PER ROW, RANDOMISE ROWS, READ OUT FULL SCALE ON FIRST ROW, READ OUT STATEMENTS IN FULL

ROWS

a) Private sector investment for the future flight sector
b) Government funding or investment
c) Government policy towards future flight technologies (e.g. planning rules, environmental targets)
d) Regulation of future flight technologies
e) Supply chain
f) Skills of the workforce
g) Public perceptions of future flight technologies

SCALE

1. UK is the world leader
2. UK is ahead of most countries
3. UK is ahead of some countries, but behind the world leaders
4. UK is slightly behind most countries
5. UK is a long way behind most countries
6. Don't know

56.   C2. Overall, how would you rate the UK's current reputation as a centre for innovation in future flight technology? Please use the same scale.
1. UK is the world leader
2. UK is ahead of most countries
3. UK is ahead of some countries, but behind the world leaders
4. UK is slightly behind most countries
5. UK is a long way behind most countries
6. Don't know

57.   C4. What impact, if any, do you think the Future Flight Challenge has had on the ease of securing investment in relation to development of future flight technology?
1. A large positive impact
2. A small positive impact
3. No impact
4. A small negative impact
5. A large negative impact
6. Don't know

C4A. How efficient was the CAA approval process for conducting demonstrations in the UK in 2019 at the start of the FFC?
1. Extremely efficient
2. Very efficient
3. Moderately efficient
4. Moderately inefficient
5. Very inefficient
6. Extremely inefficient
7. Don't know

C4B. Using the same scale, how efficient is the current CAA approval process for conducting demonstrations in the UK?
1. Extremely efficient
2. Very efficient
3. Moderately efficient
4. Moderately inefficient
5. Very inefficient
6. Extremely inefficient
7. Don't know

C4C. How much do you think the FFC has improved the efficiency of the CAA's demonstration approval process for FFC-funded consortia?

SINGLE CODE, REVERSE SCALE
1. FFC has increased efficiency significantly
2. FFC has increased efficiency slightly
3. FFC has not impacted efficiency
4. FFC has decreased efficiency slightly
5. FFC has decreased efficiency significantly
6. Don't know

ASK ALL

C4D. In 2019, to what extent did the CAA's demonstration approval process support future flight innovation?

SINGLE CODE, REVERSE SCALE
1. Demonstration approval was a significant barrier to innovation
2. Demonstration approval was a slight barrier to innovation
3. Demonstration approval had no impact on innovation
4. Demonstration approval slightly supported innovation
5. Demonstration approval significantly supported innovation
6. Don't know

ASK ALL

C4E. Currently, to what extent does the CAA's demonstration approval process support future flight innovation?

SINGLE CODE, REVERSE SCALE
1. Demonstration approval is a significant barrier to innovation
2. Demonstration approval is a slight barrier to innovation
3. Demonstration approval has no impact on innovation
4. Demonstration approval slightly supports innovation
5. Demonstration approval significantly supports innovation
6. Don't know

C4F. How much do you think the FFC has affected CAA demonstration approval for FFC-funded consortia, so that it better supports future flight innovation?

SINGLE CODE, REVERSE SCALE
1. FFC has had a significant positive effect
2. FFC has had a slight positive effect
3. FFC has not had an effect
4. FFC has had a slight negative effect
5. FFC has had a significant negative effect
6. Don't know

ASK ALL

C5. For each of the following, please indicate whether you think they are a barrier or enabler to the progression of future flight technology in the UK.

ROWS

    a) Private sector investment for the future flight sector

    b) Government funding or investment

    c) Government policy towards future flight technologies (e.g. planning rules, environmental targets)

    d) Regulation of future flight technologies

    e) Supply chain

    f) Skills of the workforce

    g) Public perceptions of future flight technologies

    h) The COVID-19 pandemic

    i) Brexit

    j) The pace of development of FFC technologies in other countries

    k) The size of the future flight sector workforce

    l) The costs of inputs to production

    m) Geopolitical instability, such as the war in Ukraine

    n) Local authorities' engagement

SCALE

1. Significant barrier
2. Moderate barrier
3. Slight barrier
4. No impact
5. Slight enabler
6. Moderate enabler
7. Significant enabler
8. Don't know

Current project progress

D1. For the next few questions we'd like you to think about 1 specific application for the Future Flight Challenge and the project associated with that application. For which application are you most able to answer questions about the project's progress?
SINGLE CODE
[IF PHASE_2=YES (FROM SAMPLE), SHOW LIST OF APPLICATION TITLES WHERE COMPETITION = 592 - Future flight challenge phase 2: strand 2, development OR 591 - Future flight challenge phase 2: strand 1, fast track development
IF PHASE_2=NO (FROM SAMPLE), SHOW LIST OF ALL APPLICATION TITLES FOR RESPONDENT]

ASK IF TOTAL APPLICATION STATUS IS ACCEPTED, REJECTED, MIX OF ACCEPTED OR REJECTED

58. D2. [IF 1 PROJECT: **The next few questions will ask you about your application for the Future Flight Challenge and the project associated with that application.**]
What was the outcome of that application?
59.   SINGLE CODE
1. Successful
2. Unsuccessful

ASK IF TOTAL APPLICATION STATUS IS ACCEPTED, REJECTED, MIX OF ACCEPTED OR REJECTED

D4. IF D2= SUCCESSFUL: **If your application for funding had been declined, would you have taken the project forward in any form?**
IF D2= UNSUCCESSFUL: **After your application for funding was declined, did you take the project forward in any form?**
SINGLE CODE
1. Yes
2. No
3. Don't know
4. Refused

IF D2=SUCCESSFUL OR [D2= UNSUCCESSFUL AND D4=1]
D9. At the start of your engagement with the FFC, what stage of development was the technology at in terms of Technology Readiness Level (TRL)?
SINGLE CODE, READ OUT
1. Developing basic principles or formulating the concept: TRL 1 and TRL 2
2. Developing the proof of concept or testing in laboratory conditions: TRL 3 and TRL 4
3. Being validated or tested in a real but controlled environment: TRL 5 and TRL 6
4. Being tested and scaled in an operational environment: TRL 7
5. Don't know

IF [D2=SUCCESSFUL OR [D2= UNSUCCESSFUL BUT D4=1]] AND PHASE_2=NO
D10. And what stage do you expect the technology to reach at the end of period covered by the FFC funding?
SINGLE CODE, READ OUT
1. Developing basic principles or formulating the concept: TRL 1 and TRL 2
2. Developing the proof of concept or testing in laboratory conditions: TRL 3 and TRL 4

3. Being validated or tested in a real but controlled environment: TRL 5 and TRL 6
4. Being tested and scaled in an operational environment: TRL 7
5. Fully commercialised and brought to market: TRL 8 and TRL 9
6. Don't know

D13. After your engagement with the FCC, what stage of development was the technology at in terms of TRL?
READ OUT
1. Developing basic principles or formulating the concept: TRL 1 and TRL 2
2. Developing the proof of concept or testing in laboratory conditions: TRL 3 and TRL 4
3. Being validated or tested in a real but controlled environment: TRL 5 and TRL 6
4. Being tested and scaled in an operational environment: TRL 7
5. Fully commercialised and brought to market: TRL 8 and TRL 9
6. Don't know

Collaboration

E1. IF D2=SUCCESSFUL. Outside of your FFC consortium, how many of the following types of partners are you collaborating with on future flight sector projects? Please think about all future flight sector projects that your organisation may be working on, and the total number of partners you are collaborating with across all projects, whether they have received FFC funding or not.
1. Large aviation companies (250+ employees)
2. Small or medium aviation companies (fewer than 250 employees)
3. Large non-aviation future flight sector companies (250+ employees)
4. Small or medium non-aviation future flight sector companies (fewer than 250 employees)
5. Regulators and policy makers
6. End-users
7. Researchers (research institutes, universities and academics)
8. Companies outside of the future flight sector
9. Others (please type in)
10. Don't know

E1A. You said you are collaborating with companies outside of the future flight sector. Which sectors are these companies in?
Please type your response in the box below
E2. And how many of these partners are based outside the UK?
1. Large aviation companies (250+ employees)
2. Small or medium aviation companies (fewer than 250 employees)
3. Large non-aviation future flight sector companies (250+ employees)

4. Small or medium non-aviation future flight sector companies (fewer than 250 employees)
5. Regulators and policy makers
6. End-users
7. Researchers (research institutes, universities and academics)
8. Companies outside of the future flight sector
9. Others [PULL THROUGH WRITE IN FROM E1]
10. Don't know

E3. How much do you think the Future Flight Challenge has impacted collaboration in general?
SINGLE CODE, RED OUT
1. FFC has increased collaboration significantly
2. FFC has increased collaboration slightly
3. FFC has not impacted collaboration
4. FFC has decreased collaboration slightly
5. FFC has decreased collaboration significantly
6. Don't know

IF E3=1,2,4 OR 5

E4. Of the things that the FFC has done, which have had the greatest impact on collaboration? Please give as much detail as you can
OPEN
TO BE CODED

E5. How informative do you find the following communications from the FFC?
GRID, SINGLE CODE PER ROW.
1. FFC publications (e.g. FFC Vision and Roadmap)
2. KTN introductions and newsletters
3. FFC social media posts
4. FFC personal contacts
5. FFC workshops and events for future flight sector stakeholders
6. FFC events for competition winners [SHOW TO SUCCESSFUL ONLY]

SCALE
1. 1 - Never informative
2. 2
3. 3
4. 4
5. 5 – Highly informative
6. Don't know
7. Prefer not to say

Wrap up

ASK ALL

60.   G2. Thinking about the Future Flight Challenge overall, how much do you think it has accelerated development of future flight technologies in the UK?
SINGLE CODE, READ OUT
1. Accelerated development significantly
2. Accelerated development moderately
3. Accelerated development slightly
4. Not accelerated development at all
5. Don't know

ASK ALL

61.   G3. Why do you say that?
OPEN. TO BE CODED.

Scripting error

Please note that a minor scripting error occurred at question E2. See question below. Respondents who at question E1 had said that they were collaborating with at least one partner were then asked at question E2 how many of these types of partners were based outside the UK. They were allowed to enter a number that was equal or lower to the number entered at E1 for each type of partner. However, this number validation didn't work with two specific numbers entered at E1 (10 and 20). Respondents who entered these figures were limited to enter 1 or 2 instead of 10 or 20 at E2. The validation, however, worked well for all other numbers e.g. 11 or 9, 19 or 21. Only 6 cases were affected by this issue and only one respondent complained about it. While it could be that the answers for the remaining cases at E2 were correct, we have removed the answers from these respondents at question E2 as a precaution.

So as to avid this or other issues at the next iteration of the survey, apart from the usual testing that takes place with a test link that shows the user's view of the survey, we will ensure a separate scripted not involved in this project checks the syntax of the script to ensure everything is set up correctly ahead of launching the survey.

IF TOTAL NUMBER OF PARTNERS >1
E2. And how many of these partners are based outside the UK?
NUMERICAL BOX FOR EACH ROW, WHOLE NUMBERS ONLY, MIN 0, MAX 50
ALLOW DK AND PREFER NOT TO SAY
SHOW TOTAL BOX AT BOTTOM
ONLY SHOW CODES WITH >0 AT E1

Large aviation companies (250+ employees)

62.   Small or medium aviation companies (fewer than 250 employees)

Large non-aviation future flight sector companies (250+ employees)

63.   Small or medium non-aviation future flight sector companies (fewer than 250 employees)

Regulators and policy makers

64.   End-users

Researchers (research institutes, universities and academics)

65.   Companies outside of the future flight sector

Others [PULL THROUGH WRITE IN FROM E1]

66.   Don't know

B.2　Workshop topic guide: unsuccessful applicants

Introduction and briefing (5 minutes)

Introduction:
- Moderator to introduce themselves and BMG Research
- Thank them for agreeing to take part in the workshop
- Explain about the evaluation of the Challenge and what the process evaluation focusses on
- We want to hear from successful and unsuccessful consortia
- There are no right or wrong answers
- Please respect the thoughts and opinions of others. We won't be asking you to share any commercially sensitive information, we're interested in your experiences of the Challenge and its processes
- Pease do not talk over others; you will all get a chance to speak
- You don't have to answer any questions you feel uncomfortable answering

- We aren't experts in the flight field, so please be patient with us if we ask you to explain any technical points

Purpose of the discussion: BMG, along with Frontier Economics and Frazer-Nash, have been commissioned to carry out an evaluation of the Future Flight Challenge. As part of this we're looking at the processes and set-up of the Challenge and whether there are any lessons that can be learned for future phases of the Challenge or for other similar initiatives. Other stages of our evaluation will focus on the impact of the Challenge and whether it has met its objectives.
Length: The workshop should take no more than 2 hours
Confidentiality: All information you provide will be treated confidentially, which means anything you tell us today will be completely anonymous, and no one will be able to trace the information back to you. We may use some of the things you say in our reports, but we won't reveal who said them and we'll ensure that it's not possible to work out who has said them from the quotes. This is in line with the Market Research Society Code of Conduct.
Recording: we would like to video-record the session for the purposes of accurately capturing all the information you share with us. The video will be used for analysis purposes only and will not be shared with anyone outside BMG research.

Background and introduction (10 minutes)

- First, let's start with some introductions. Please could you tell us…
  - Your name
  - The organisation you work for
  - Ask whether involved in any other FFC applications

Structure and delivery of FFC competitions (40 minutes)

To start we'd like you think about the applications process for FFC competitions. Just to remind everyone, the Challenge consists of three phases and 4 rounds of competitions:

- *[Feb 2020] Phase I (Discovery) - Funding was not available in this phase; the goal was to bring innovative organisations together and form consortia for application of funding*
- *[April 2020 – May 2022] Phase II focused on developing integrated aviation systems and underpinning technologies that enable new classes of electric or autonomous air vehicles*
  - *Phase II Strand 1 - Projects must be between 150k and 500k and we are encouraging SMEs and shorter projects.*
  - *Phase II Strand 2 - Projects must be between 500k and 10M and will likely be longer projects (e.g., 16 months).*
- *[April 2022 – Mar 2024] Phase III focused on demonstrating these technologies and innovation*
  - *Phase III Strand 1 - Projects must be between £500k and £15m and demonstrating aspects of novel air vehicles and systems.*
  - *Phase III Strand 2 - Projects must be between £500k and £4M and focused on cross-cutting technologies that enable the deployment and operation of new air vehicles.*

- Had you worked together as a consortium before submitting the FFC application? If not, how did you approach each other?
- Did you attend the Discovery Workshop in February 2020? Did this help you to form the consortium?
- Why did you choose each other as partners? Did the conditions of the competitions encourage you to seek partners that you otherwise wouldn't have?
- Was there anything in the competitions process that supported you in forming partnerships? How did it support you?

- How long did it take for your organisation to prepare your application or applications?
- Were there any aspects that took longer than you thought they would, or were more difficult? Did you have any issues? Probe for:
  - Engagement sessions
  - Finding relevant partners
  - Filling in the application
  - Submitting the application
  - Interview process
  - Being notified of the decision

- How efficient do you think the applications process is? Why do you say that?

- What is your opinion about the structure of the competitions, starting with discovery at phase 1 and then moving on to development and demonstration of technologies at phases 2 and 3?
  - Would you change this structure in any way? How?
- After submitting an application **[NAME OF PROJECT]** at Phase 2 (development phase), did you then go on and submit another application together for Phase 3 (demonstration phase)? Why/Why not?
  - **IF YES:** did the break in competitions between Phase 2 and 3 give you enough time to reconvene and prepare the new application?
  - **IF NO:** Are you collaborating in any other projects or other ways that are not related to the Challenge? Can you give us some examples?

- **IF NOT AWARE OF EACH OTHER BEFORE FFC**: Do you think that you would have formed this consortium if the FFC didn't exist? Why?
  - **IF YES:** would you have had the same type of partners in the consortium?
  - **IF YES:** would the scale of the project you applied for have been the same?

- Are you aware of the six problem statements developed by the working groups of the FFC? *IF NECESSARY: The statements:*
  - ➢ *define and highlight the key issues and restrictions to government*
  - ➢ *call on stakeholders across the aerospace and aviation industries to get involved in developing strategies to address the issues.*
  - **IF YES:** How useful, if at all, do you find these statements? Why?

- Are you aware of the system of systems approach?
- ➢ *IF NECESSARY: System of systems considers multiple independent systems in context as part of a larger, more complex system. The Future Flight Challenge (FFC) has adopted a system of systems approach to address the obstacles outlined within the roadmap. The vision is to showcase a real-life operational demonstration of multiple novel air vehicles in challenging environments. The future flight programme works in alignment with other on-going funding schemes within Government, including the Aerospace Technology Institute (ATI) programmes which are focussed directly on vehicle technologies.*
  - **IF YES:** How, if at all, has the system of systems approach help this consortium to identify problems? Can you give us an example?

Design and implementation of engagement activities (30 minutes)

- How well do you think the Challenge has encouraged collaboration between different types of organisations?
  - **PROBE FOR:**
  - Industry and academics
  - Aviation and non-aviation sector companies
  - UK and international companies
  - Small and large companies
- To what extent has the Challenge encouraged multidisciplinary working? How?
  - **IF NEEDED:** by multidisciplinary, we mean combining or involving several academic disciplines or professional specialisations.

- Apart from via competitions, are there any other ways in which ways has the Challenge encouraged collaboration between different types of organisations? How?
- In what ways (other than via your application) have you engaged with the Challenge? Probe for:
    - FFC publications (e.g. FFC Vision and Roadmap)
    - KTN introductions and newsletters
    - FFC social media posts
    - FFC personal contacts
    - FFC workshops and events for future flight sector stakeholders
    - Anything else?
- How well do you think the Challenge has engaged the industry? Are there any types of organisations/specialisations that you think have been engaged not as well as others? If so, which areas?
- How effective you do think these wider engagement activities have been in helping the Challenge to meet its objectives?
- How easy has it been to understand what the Challenge is doing and what the opportunities for you are?
    - Was it clear when the competitions would take place and what they were looking for?
    - Were the overall objectives of the Challenge clear?
- How timely were the communications from the Challenge? Probe for:
    - Notice of competitions and briefing events
    - Notice of deadlines
    - Notice of other Challenge activities

- How well do you think the Challenge aligns with other government initiatives, such as Net Zero?
    - Are the Challenge's aims complementary with other initiatives? If so, which ones?

- After not getting funding from the Challenge, were you able to secure funding from another source for this project? Where from?
- After not getting funding from the Challenge, have you taken then project forward in any way?
- Did it change from your original plan in any way?
    - PROBE FOR
    - Timescale
    - Scale
    - Number of partners

Delivery and outcome monitoring (25 minutes)

I'd now like to talk about the process of communicating application outcomes.

- Did you receive an outcome from the Challenge in regards to your application?
- Did you understand why your application was unsuccessful? Why/why not?
- Would you make any changes to the process of communicating application outcomes?

Wrap Up (5 minutes)

- Is there anything else you would like to add that we have not covered today?
- Thank and close

B.3   Workshop topic guide: successful applicants

Introduction and briefing (5 minutes)

Introduction:
- Moderator to introduce themselves and BMG Research
- Thank them for agreeing to take part in the workshop
- Explain about the evaluation of the Challenge and what the process evaluation focusses on
- There are no right or wrong answers
- Please respect the thoughts and opinions of others. We won't be asking you to share any commercially sensitive information, we're interested in your experiences of the Challenge and its processes
- Pease do not talk over others; you will all get a chance to speak
- You don't have to answer any questions you feel uncomfortable answering

- We aren't experts in the flight field, so please be patient with us if we ask you to explain any technical points

Purpose of the discussion: BMG, along with Frontier Economics and Frazer-Nash, have been commissioned to carry out an evaluation of the Future Flight Challenge. As part of this we're looking at the processes and set-up of the Challenge and whether there are any lessons that can be learned for future phases of the Challenge or for other similar initiatives. Other stages of our evaluation will focus on the impact of the Challenge and whether it has met its objectives.
Length: The workshop should take no more than 2 hours
Confidentiality: All information you provide will be treated confidentially, which means anything you tell us today will be completely anonymous, and no one will be able to trace the information back to you. We may use some of the things you say in our reports, but we won't reveal who said them and we'll ensure that it's not possible to work out who has said them from the quotes. This is in line with the Market Research Society Code of Conduct.
Recording: we would like to video-record the session for the purposes of accurately capturing all the information you share with us. The video will be used for analysis purposes only and will not be shared with anyone outside BMG research.

Background and introduction (10 minutes)

First, let's start with some introductions. Please could you tell us…
  o Your name
  o The organisation you work for [if any missing partner asked for missing partner type of org)
  o Ask whether involved in any other FFC projects (with this consortium or a different one)

Structure and delivery of FFC competitions (40 minutes)

To start we'd like to take you back to the applications process for FFC competitions. Just to remind everyone, the Challenge consists of three phases and 4 rounds of competitions:

➢ *[Feb 2020] Phase I (Discovery) - Funding was not available in this phase; the goal was to bring innovative organisations together and form consortia for application of funding*
➢ *[April 2020 – May 2022] Phase II focused on developing integrated aviation systems and underpinning technologies that enable new classes of electric or autonomous air vehicles*
  o *Phase II Strand 1 - Projects must be between 150k and 500k and we are encouraging SMEs and shorter projects.*
  o *Phase II Strand 2 - Projects must be between 500k and 10M and will likely be longer projects (e.g., 16 months).*
➢ *[April 2022 – Mar 2024] Phase III focused on demonstrating these technologies and innovation*
  o *Phase III Strand 1 - Projects must be between £500k and £15m and demonstrating aspects of novel air vehicles and systems.*
  o *Phase III Strand 2 - Projects must be between £500k and £4M and focused on cross-cutting technologies that enable the deployment and operation of new air vehicles.*

• Had you worked together before the Challenge? If not, how did you approach each other?
• Did you attend the Discovery Workshop in February 2020? Did this help you to form the consortium?
• Why did you choose each other as partners? Did the conditions of the competitions encourage you to seek partners that you otherwise wouldn't have?
• Was there anything in the competitions process that supported you in forming partnerships? How did it support you?

• How long did it take for your organisation to prepare your application or applications?
• Were there any aspects that took longer than you thought they would, or were more difficult? Did you have any issues? Probe for:
  o Engagement sessions
  o Finding relevant partners
  o Filling in the application
  o Submitting the application
  o Interview process
  o Being notified of the decision

• How efficient do you think the applications process is? Why do you say that?

- What is your opinion about the structure of the competitions, starting with discovery at phase 1 and then moving on to development and demonstration of technologies at phases 2 and 3?
    - o Would you change this structure in any way? How?
    - o Has this structure helped you achieve what you wanted to achieve with your project(s)? How?
- After completing **[NAME OF PROJECT]** at Phase 2 (development phase), did you then go on and submit another application together for Phase 3 (demonstration phase)? Why/Why not?
    - o **IF YES:** did the break in competitions between Phase 2 and 3 give you enough time to reconvene and prepare the new application?
    - o **IF NO:** Are you collaborating in any other projects or other ways that are not related to the Challenge? Can you give us some examples?

- **IF NOT AWARE OF EACH OTHER BEFORE FFC**: Do you think that you would have formed this consortium and worked on this project if the FFC didn't exist? Why?
    - o **IF YES:** would you have had the same type of partners in the consortium?
    - o **IF YES:** would the scale of the project have been the same?

- Are you aware of the six problem statements developed by the working groups of the FFC? *IF NECESSARY: The statements:*
    - ➢ *define and highlight the key issues and restrictions to government*
    - ➢ *call on stakeholders across the aerospace and aviation industries to get involved in developing strategies to address the issues.*
    - o **IF YES:** How useful, if at all, do you find these statements? Why?

- Are you aware of the system of systems approach?
- ➢ *IF NECESSARY: System of systems considers multiple independent systems in context as part of a larger, more complex system. The Future Flight Challenge (FFC) has adopted a system of systems approach to address the obstacles outlined within the roadmap. The vision is to showcase a real-life operational demonstration of multiple novel air vehicles in challenging environments. The future flight programme works in alignment with other on-going funding schemes within Government, including the Aerospace Technology Institute (ATI) programmes which are focussed directly on vehicle technologies.*
    - o **IF YES:** How, if at all, has the system of systems approach help this consortium to identify problems? Can you give us an example?

Design and implementation of engagement activities (30 minutes)

- How well do you think the Challenge has encouraged collaboration between different types of organisations?
    - o **PROBE FOR:**
    - - Industry and academics
    - - Aviation and non-aviation sector companies
    - - UK and international companies
    - - Small and large companies
- To what extent has the Challenge encouraged multidisciplinary working? How?
    - o **IF NEEDED:** by multidisciplinary, we mean combining or involving several academic disciplines or professional specialisations.

- Apart from via competitions, are there any other ways in which the Challenge has encouraged collaboration between different types of organisations? How?
- In what ways (other than via your application and project) have you engaged with the Challenge? Probe for:
    - FFC publications (e.g. FFC Vision and Roadmap)
    - KTN introductions and newsletters
    - FFC social media posts
    - FFC personal contacts
    - FFC workshops and events for future flight sector stakeholders
    - FFC events for competition winners
    - Anything else?
- How well do you think the Challenge has engaged the industry? Are there any types of organisations/specialisations that you think have been engaged not as well as others? If so, which areas?
- How effective you do think these wider engagement activities have been in helping the Challenge to meet its objectives?
- How easy has it been to understand what the Challenge is doing and what the opportunities for you are?
    - Was it clear when the competitions would take place and what they were looking for?
    - Were the overall objectives of the Challenge clear?
- How timely were the communications from the Challenge? Probe for:
    - Notice of competitions and briefing events
    - Notice of deadlines
    - Notice of other Challenge activities
-
- How well do you think the Challenge aligns with other government initiatives, such as Net Zero?
    - Are the Challenge's aims complementary with other initiatives? If so, which ones?

Delivery and outcome monitoring (25 minutes)

I'd now like to talk about the delivery and monitoring processes. This includes the quarterly meetings with your monitoring officer, kick off meetings and ongoing monitoring as well as close out reports if your project has reached that stage.

- How have you found the monitoring process?
- What benefits do you get out of the monitoring process? Probe for:
    - Help from the monitoring officer with challenges you're facing
    - Ability to determine if the project is running to schedule
    - Financial monitoring
    - Improvements to your processes or ways of doing things
- Have the quarterly meetings been helpful? If so, how?
- Has any of the monitoring changed the way that you've gone about delivering your project?
- Were any delivery or performance issues raised during monitoring? If so, how were these responded to?
- How useful has the monitoring process been in helping you to understand whether you are on track or not?
- Is there anything you would change about the monitoring process?

Wrap Up (5 minutes)

- Is there anything else you would like to add that we have not covered today?
- Thank and close

B.4   Workshop topic guide: delivery leads

Introduction and briefing (5 minutes)

Introduction:
- Moderator to introduce themselves and BMG Research
- Thank them for agreeing to take part in the workshop
- Explain about the evaluation of the Challenge and what the process evaluation focusses on
- There are no right or wrong answers
- Please respect the thoughts and opinions of others. We won't be asking you to share any commercially sensitive information, we're interested in your experiences of the Challenge and its processes
- Pease do not talk over others; you will all get a chance to speak
- You don't have to answer any questions you feel uncomfortable answering

- We aren't experts in the flight field, so please be patient with us if we ask you to explain any technical points

Purpose of the discussion: BMG, along with Frontier Economics and Frazer-Nash, have been commissioned to carry out an evaluation of the Future Flight Challenge. As part of this we're looking at the processes and set-up of the Challenge and whether there are any lessons that can be learned for future phases of the Challenge or for other similar initiatives. Other stages of our evaluation will focus on the impact of the Challenge and whether it has met its objectives.
Length: The workshop should take no more than 2 hours
Confidentiality: All information you provide will be treated confidentially. However, given the limited number of delivery leads the views that you share may be identifiable even after anonymisation. If there's something you say that you'd rather keep off records, then please do let us know. We may use some of the things you say in our reports, but we won't reveal who said them. We abide by the Market Research Society Code of Conduct and data protection laws at all times.
Recording: we would like to video-record the session for the purposes of accurately capturing all the information you share with us. The video will be used for analysis purposes only and will not be shared with anyone outside BMG research.

Background and introduction (10 minutes)

- First, let's start with some introductions. Please could you tell us…
    - Your name
    - Roles and responsibilities for delivering programme

Structure and delivery (25 minutes)

To start we'd now like to ask some questions about the structure and delivery of the Challenge.

- To what extent is the design and delivery of the programme – including the three-phase structure of competitions – enabling the programme to achieve its objectives?

- How effective are the guidance and systems used to help consortia?
    - PROBE FOR
    - Six problem statements
    - System of systems approach

- How are the different competitions within each phase aligned to complement one another and add value?
- To what extent has the design of the programme enabled consortia developed for Phase Two to move into Phase Three? How?
- Moving from Phase Two to Phase Three, was the rationale for a gate (the competition break between phases) valid? Why?

Management and governance of the FFC (30 minutes)

I'd now like to ask some questions about the management and governance of the Challenge.

- To what extent is the programme building on previous investments and interventions in the wider sector? How?

- How effective was the programme governance structure in directing the programme? Were decisions made at the right level and in a timely manner?

- Is the Challenge meeting its budgetary expectations?
    - Were there any unforeseen costs?

- To what extent is the Challenge meeting its target outputs? Were they met in an efficient and effective manner? Why/why not?

- Can you tell us how risks are identified and mitigated?
    - Is there a system in place?
    - Do you have any examples of risks that were identified and how they were mitigated?

- To what extent does the due diligence process effectively identify projects with unacceptable levels of technical or project delivery risks (including risk of applicant's financial failure)?

- Have any project failures occurred so far? **IF YES:** Why weren't these foreseen and mitigated?

- How effectively do the different activities and workstreams of the programme work together and make the programme as a whole more effective as opposed to delivering individual strands?
  - Can you provide some examples of how the different strands interact with each other?
  - Could coordination of the different stands be more effective? How?

- What would you say are the unique or innovative features of the delivery of the Challenge?

Design and implementations of engagement activities (25 minutes)

We'd now like to ask some questions about the design and implementation of engagement activities.

- To what extent has the design of the programme facilitated reaching target competition participants?
  - How has this been achieved?
  - What were the consequences and implications of these successes/failures?

- To what extent has the design of the programme facilitated engaging with wider stakeholders in the business and academic community to support the delivery of the programme?
  - How has this been achieved?

- To what extent has the Challenge encouraged multi-disciplinary working?
  - How was this done?

- How well do you think the Challenge aligns with other government initiatives, such as Net Zero?
  - Are the Challenge's aims complementary with other initiatives? If so, which ones?

Delivery and outcome monitoring (20 minutes)

For the final part of the workshop, I'd like to talk about the delivery and monitoring processes.

- How well does delivery monitoring enable the Challenge to respond to delivery or performance issues promptly and effectively?
  - Can you provide any examples of issues identified by the monitoring process and how these were addressed?

- How well does outcome monitoring enable the Challenge to understand if the programme is on track to deliver impacts?
  - What outcomes are monitored?
- Has the benefits management approach proven sufficiently timely to enable change during the programme to ensure delivery of the objectives?
  - Have any adjustments been made as a result of this approach?

- Has delivery and outcome monitoring adapted to meet changing requirements? How?

- What improvements can be made to delivery monitoring and outcome monitoring?

Wrap Up (5 minutes)

- Is there anything else you would like to add that we have not covered today?
- Thank and close

B.5   Interview topic guides

Below are the topic guides used in the semi-structured impact interviews.

Interview introduction (5 min)

My name is [ ], and I am part of the team at Frontier Economics, BMG Research and Frazer-Nash Consultancy conducting the evaluation of the Future Flight Challenge Fund.

At this stage we are carrying out an interim assessment of the impact of the Challenge so far, with a final evaluation to be carried out in 2024. Our current focus is therefore on gathering evidence of early benefits realised, and expected future benefits. We will focus on a number of different themes which we think are particularly relevant to you, but we will also be interested in your views on the impact, or potential impact, of the Challenge in other areas as well.

We are interested in exploring the impacts both for individuals, firms and organisations that have interacted with the Challenge so far, and how the Challenge is affecting the wider 'future flight' sector.

The future flight sector, as defined by the FFC, includes organisations that are developing, commercialising, producing and supporting the deployment of technologies or services related to uncrewed aerial systems (UAS), advanced air mobility (AAM) or sustainably powered (hydrogen, electric, sustainable aviation fuel (SAF)) regional conventional aircraft. The sector also incorporates the digital and physical infrastructure, systems of systems and regulatory frameworks that are necessary for the coherent development and operation of the sector.

It would be helpful to have this definition in mind when thinking about your responses.

Collaboration (5-10 min)

Discuss with: Competition participants; research and funding bodies; government; regulatory; industry

We would like to understand how the Challenge has affected collaboration within the future flight sector, and between future flight and other sectors. *[Phrasing of questions to be adjusted depending on particular audience, to address the types of collaborations they are familiar with]*

- What do you see as the most important forms of collaboration to support the growth of the future flight sector in the UK and companies in the sector? *[Prompt for collaboration within the sector and between future flight and other sectors.]*

- How well do you think collaborations are working in the sector? Are there particular areas of collaboration working well and less well? Why?

- How do you think the Future Flight Challenge has influenced collaboration so far, or will in the future? Do you have specific examples or experiences?

- Are there other bodies, groups or initiatives which seek to support collaboration in the sector or between Future Flight and other sectors? What is different about the way the Challenge affects collaboration from these in your view? *[For those with specific examples]* Do you think you would have been able to achieve the same outcomes in terms of collaboration without the Challenge?

- What would enable the Challenge to better support collaboration? What is currently preventing the Challenge from achieving more in terms of collaboration?

TRL progression (10 minutes)

Discuss with: Successful competition participants

[Check familiarity with the concept of TRLs and provide a brief explanation if needed]

- When you began the project with the Challenge, what TRL did your project begin with? *[If the project is ended]* What TRL did your project end with? *[If the project is ongoing]* Where would you say the current TRL of the project is and where do you expect it to reach at the end of the project?

- What were the main factors that affected your TRL progression (either positively or negatively)?

- To what extent did the Challenge competition contribute to [expected] changes in your TRL? What were the most important elements of the support for developing the TRL?

- If you had not been successful in the competition, how do you think your technology would have developed? Would you have been able to develop it through other routes? If so how? What would be different now, in your view?

- How could the FFC have better supported the development of your technology through this project?

Discuss with: Unsuccessful competition applicants

[Check familiarity with the concept of TRLs and provide a brief explanation if needed]

- When you applied for the project with the Challenge, what TRL did your project begin with?

- Has the project developed since your application was unsuccessful? What is the current TRL, if different?

- How have you been able to progress the technology without the support of the Challenge?

■ If you had been successful, do you think the technology would now be at a different stage of development? How/why?

Ease of conducting demonstrations (10 minutes)

Discuss with: competition participants; industry; government; regulatory

■ What is your experience with conducting future flight demonstrations in the UK and in other countries? *[For competition participants and industry:]* What types of technologies did you demonstrate?

■ Please comment on the ease of conducting demonstrations in the UK. What typically goes well? What does not go well?

■ To what extent has the Challenge affected the ease of conducting demonstrations? How/why? Are there particular aspects of the Challenge that have been particularly important? Do you have particular experiences you can cite?

■ What is different about the Challenge in terms of supporting technology demonstration compared with what went before or other initiatives you have seen to support demonstration?

■ How could the Challenge better support conducting demonstrations going forward?

Public investment (5-10 minutes)

Discuss with: competition participants; research and funding bodies; industry; government

■ How would you characterise public UK investment in future flight? Which future flight subsectors (UAS, AAM, electric regional aircraft, infrastructure, other) have received relatively more or less in public investment?

■ What are the current barriers to more public investment? What would unlock more public investment?

■ Are you familiar with public funding mechanisms in any non-UK countries? [*If yes*] How does UK public investment compare with *[other country],* in the level of funds available, in how the funds are distributed, or in types of projects that are funded?

■ How has the Challenge affected public investment in future flight? In addition to providing funding through its competitions, to what extent has the Challenge led to or influenced other public funding?

■ How do you expect the Challenge to impact on public investment in future flight in the next few years? What other factors do you think will be key determinants of this?

■ Could the Challenge better address any barriers/enablers identified?

Private investment (10 minutes)

Discuss with: competition participants; research and funding bodies; industry; government

- How would you characterise private UK investment in future flight? Which future flight subsectors (UAS, AAM, electric regional aircraft, infrastructure, other) have received relatively more or less in public investment?

- What are the current barriers to more private investment? What would unlock more private investment?

- Are you familiar with private funding opportunities in any non-UK countries? [*If yes*] How does UK private investment compare with *[other country],* in level of funds available, in how the funds are distributed, or in types of projects that are funded?

- How has the Challenge affected private investment in future flight?

- To what extent did the Challenge generate match funding that would not otherwise have been available to future flight companies?

- To what extent has there been follow-on private funding 'unlocked' by competition projects? Can you cite any specific examples from your own experience?

- How do you expect the Challenge to impact on private investment in future flight in the next few years? What other factors do you think will be key determinants of this?

- Could the Challenge better address any barriers/enablers identified?

Local authority engagement

Discuss with: devolved and local government (15 minutes)

- Please describe your experience with future flight projects. What was the role of local government?

- How do you see the role of LAs in future flight projects evolving in the future?

- What in your experience enables successful engagement with LAs around future flight? And what inhibits it?

- What has your experience been in engaging the Future Flight Challenge so far? How effective has the engagement been? What has worked well and less well?

- How has your experience compared with other bodies or organisations in this area?

- Do you have any thoughts on what would improve the effectiveness of future engagement between Local Authorities and the Challenge?

Discuss with: competition participants (5 minutes)

- Have you collaborated or engaged with LAs? If so, please describe. *[If no experience, skip this section]*

- What has been the role so far of LAs in future flight development in the UK? How do you see that role evolving in future?

- What in your experience enables successful engagement with LAs around future flight? And what inhibits it?

Discuss with: FFC (15 minutes)

- Please describe your experience engaging with LAs on future flight issues.

- What has been the role so far of LAs in future flight development in the UK? How do you see that role evolving in future?

- What in your experience enables successful engagement with LAs around future flight? And what inhibits it?

- What is the Challenge aiming to achieve in terms of LA engagement, by Autumn 2024?

- How effective do you think the Challenge has been in terms of LA engagement so far? How has/will the Challenge address the barriers and enablers?

- Since the start of the Challenge, have you seen any changes in how LAs engage on future flight issues?

Regulation

In our final Challenge evaluation in 2024, we will be assessing the FFC's contribution to accelerating the development and adoption of a robust regulatory framework that fosters the growth of the future flight sector in the UK. At this stage, we would like to assess the CAA's progress toward establishing new regulatory frameworks.

Discuss with: successful and unsuccessful competition applicants (10 minutes)

- Please describe your experience working with the CAA, between 2020 and the present.
- In your experience, which elements of working with the CAA have gone relatively more and less successfully?
- *[If applicable based on previous answer]* Have you observed any changes or trends in how the CAA collaborates with future flight companies, including changes in working arrangements, information exchanged, approval processes, or approval outcomes?
- *[Successful applicants]* Has participation in the Challenge affected your interactions with the CAA, either in in working arrangements, information exchanged, approval processes, or approval outcomes? How or why?
- *[Unsuccessful applicants]* If your Challenge application had been successful, do you think that your interactions with the CAA would have been different, either in in working arrangements, information exchanged, approval processes, or approval outcomes? How or why?
- How could the Challenge better support the development of regulatory frameworks going forward?

Discuss with: industry (10 minutes)

- Please describe your experience working with the CAA, between 2020 and the present.
- In your experience, which elements of working with the CAA have gone relatively more and less successfully?

- *[If applicable based on previous answer]* Have you observed any changes or trends in how the CAA collaborates with future flight companies, including changes in working arrangements, information exchanged, approval processes, or approval outcomes?
- To what extent has the Challenge affected the development of new regulatory frameworks? How or why?
- How could the Challenge better support the development of regulatory frameworks going forward?

Discuss with: regulators (20 min)

- Please describe [*stakeholder's organisation*]'s work toward developing new regulatory frameworks [*BSI: standards*] since 2020.
- Please describe the role of the Challenge since 2020 in supporting the development of new regulatory frameworks.
- Which elements of [*the Challenge role described*] have been more or less successful in accelerating regulatory development? How or why?
- Has the role of the Challenge in developing regulatory frameworks changed over time? How or why?
- How could the Challenge better support the development of regulatory frameworks going forward?
- What are the likely next steps in regulatory framework development, between now and 2025? What is the likely timing of [*these steps*]?

Other topics (5 minutes)

The Challenge is expected to have effects in other areas of the future flight sector, beyond those that we have discussed. In some cases, these effects might occur in the future. These areas include *[list evaluation themes not already covered]*. Can you speak to Challenge effects to date in any of these other areas?

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