

January 2023

Impact Evaluation of ESRF and European XFEL

Introduction and methodology



Version 2

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1 Introduction

The Science and Technology Facilities Council (STFC) appointed Technopolis to undertake an impact evaluation of two of the research infrastructures that it has a shareholding and interest in: the European X-ray Free-Electron Laser (European XFEL), and the European Synchrotron Radiation Facility (ESRF).

1.1 Study scope and objectives

The study has two specific aims, as set out in the study specification:

- Measure and demonstrate the impacts of the UK's investment and partnership in both facilities across the UKRI research landscape, helping provide an evidence-based understanding of the value of this UK investment
 - In the context of ESRF, the study will evaluate the UK's investment over the last ten years
 - For European XFEL, the study will evaluate the UK's involvement since 2018 when it joined
- Develop an evaluation framework which STFC can use to capture and monitor impact (particularly in research, innovation, skills, and multidisciplinary facilities) in future years

There are a number of impact areas that STFC is interested in, and which both the impact assessment and the evaluation framework should consider:

1. Research that has been evolved or enabled, including multidisciplinary research and interdisciplinary collaborations
2. Meeting strategic goals and national priorities
3. Industrial return, including contracts that UK firms have won
4. The creation of innovation pathways for the UK
5. The real-world applications of the research at the facilities.

1.2 Study activities and timeline

As outlined in Table 1 below, the study consisted of three phases. Phase 1 was completed in March 2022, culminating in the production of a scoping report that provided details of the study scope and focus, proposed initial approaches and methods to quantitatively assess impact, and outlined the key milestones for the study. Phase 2 was completed in June 2022, resulting in an evaluation framework report that drew on scoping interviews and an initial assessment of available data to set out the final methodology and timescales for the study.

Table 1 Study phases and key tasks involved

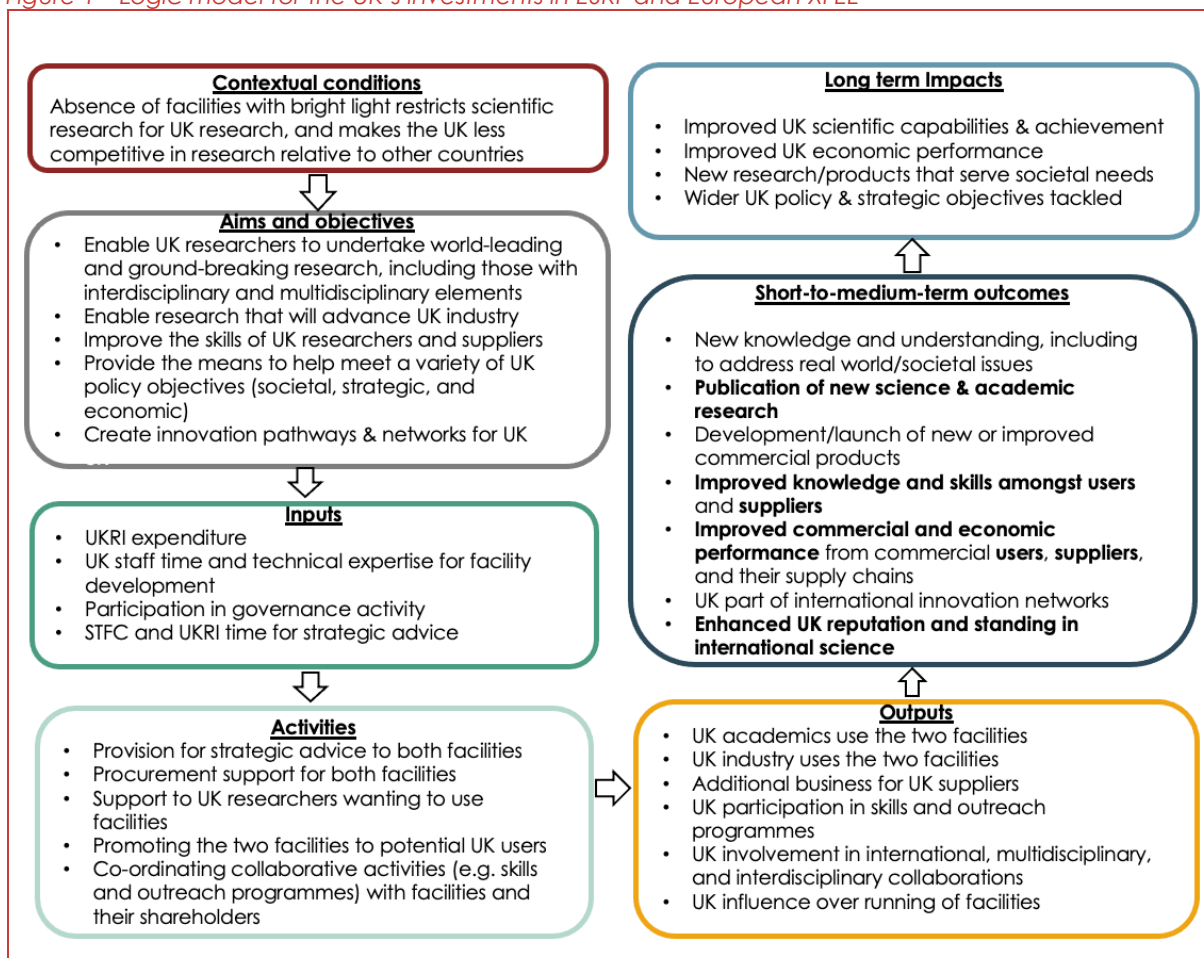
Phase 1: Scoping (completed March 2022)	Phase 2: Planning (April to June 2022)	Phase 3: Evaluation (June to November 2022)
<ul style="list-style-type: none">• Kick-off meeting• Development of Project Management Plan• Scoping report, elaborating the planned approach	<ul style="list-style-type: none">• Conducting scoping interviews with key stakeholders• Assessment of data likely to be available for the study• Developing an evaluation framework and consultation strategy• Production of an evaluation framework report	<ul style="list-style-type: none">• Online surveys• Stakeholder interviews• Publications analysis• Network analysis• Case studies• Interim report• Final report

Phase 3 represented the main period of evidence collection and analysis. This took place between June and November 2022, with progress and first findings set out within an interim report in October. The current paper, and associated reports for European XFEL and ESRF provide the final report for Phase 3. They set out the analysis and conclusions from all of the evidence collected during the study. Feedback provided on the interim report has also been taken into account in the development of these documents.

1.3 Sources of impact

To help frame our methodology, we first set out a logic model (see Figure 1) which sets out the intended workings for the UK's investments in the two facilities as a whole. We developed an initial logic model early in Phase 2, which we updated and revised following comments from the evaluation steering group (specifically around phrasing of outcomes, and the removal of feedback loops between long term impacts and contextual conditions). Our work during Phase 1 and Phase 2 found that the two facilities broadly function in a similar manner, meaning that a single logic model can apply to both. The logic model helped guide our proposed evaluation approach, helping identify the key factors that the study needed to examine. The logic model was based on inherent assumptions that UK researchers wanting to use the facility were successful in their bids, and that they had the means to access the facilities (something which was not always possible during the pandemic). It also assumed that the facilities provided infrastructure and equipment that the UK wanted in the first place, and that were relevant to their research.

Figure 1 Logic model for the UK's investments in ESRF and European XFEL



Source: Technopolis

Based on this logic model, we initially identified five principal routes to impact as follows, that formed the basis for evidence collection activities during the study:

- **Scientific and research benefits:** including the role the facilities play in advancing academic and commercial research, including through multidisciplinary and interdisciplinary research
- **Commercial and economic benefits:** including the sale of products based on research at the facilities, or the production of spin-outs from university research based at the facility
- **Skills benefits:** including R&D skills amongst users and suppliers, as well as impacts on apprentices and students
- **UK benefits from supplying the facilities:** including the additional revenue gained by firms from facility contracts and benefits to their supply chains
- **UK's international standing:** including the UK's ability to influence international science, and the facilities' role in enhancing the UK's reputation as a centre of world-leading science.

This paper sets out the methodology we have used to assess impacts in each of these areas.

During the course of the study, we also identified a further key route to impact; the UK benefiting from wider UK policy and strategic objectives being tackled. This forms one of the long term impacts that appears in the logic model. This paper also sets out how we collected evidence for this additional impact pathway too.

2 Approach to assessing impact in each pathway

The matrix below summarises the different approaches we have used to study the impact pathways stated above. As shown, a particular method or approach is often relevant to more than one impact pathway.

Table 2 Relevancy of different approaches to impact pathways being studied

	Scientific and research	Commercial and economic	Skills benefits	UK benefits to supplying the facilities	UK's international standing	UK policy and strategic goals
User survey	✓✓✓	✓✓✓	✓✓		✓	✓
Suppliers survey	✓	✓✓✓	✓✓	✓✓✓	✓	✓
Stakeholder interviews	✓✓✓	✓✓	✓✓✓	✓✓✓	✓✓✓	✓
Monitoring data analysis	✓✓		✓	✓✓		✓
Publications analysis	✓✓✓				✓✓	✓
Case studies	✓✓	✓✓	✓✓	✓✓		✓

Note: the more ticks in a box, the more relevant the approach is to the impact pathway in question

Broadly speaking, we have adopted the same methods and approaches for each facility. However, in our more detailed explanations of each method below, we highlight where approaches for the respective facilities have differed.

2.1 User survey

We ran an online survey to collect basic information about the impacts generated by a large number of users. Appendix A and Appendix C set out the questionnaires that we used. Response rates were as follows:

- We sent the **ESRF users survey** to 1,202 registered ESRF users who either had a UK work email address or a '.com' work email address (and were confirmed via internet searches to be UK-based). We received 152 responses, a 13% response rate. This is broadly in line with typical response rates for online surveys of this kind.
- We sent the **European XFEL users survey** to 109 individuals registered as UK-based users by the facility. We received 14 responses, a 13% response rate and therefore once again in line with expected rates.

2.2 Suppliers survey

The study did not have access to comprehensive data on all those that had secured contracts with European XFEL or ESRF. In consultation with STFC, we therefore decided to email all contacts in STFC's customer relationship management (CRM) tool, stating that surveys were available for those that had secured contracts with either European XFEL or ESRF (or indeed both). Survey questions are shown in Appendix B and Appendix D. Respondents were provided

with a screening question to ensure that those progressing to the main part of the survey were those that secured contracts with the facilities.

STFC shared the two surveys with 1,237 contacts, and we received four completed responses to the ESRF survey, and two to the European XFEL one. We do not know what the response rate is, because we do not know how many in the CRM database have actually secured XFEL or ESRF contracts. However, the absolute number of responses secured was disappointingly low.

In consultation with STFC, we subsequently moved to a new approach to secure additional evidence for this final report. STFC directly approached contacts that they and the facilities identified as being prominent UK contractors. This approach provided 3-4 open response questions which we invited individuals to respond to, either by email, or through a 10-minute telephone interview. STFC approached 13 companies that were known suppliers of both facilities, resulting in written feedback from two, and an interview with one. As such, the evidence base for supplier level impacts has not been as extensive as we would have hoped.

2.3 Stakeholder interviews

We conducted a series of interviews with stakeholders to better understand the full range of impacts generated by the facilities and to explore particular high impact cases (as identified through other research strands) in more depth. We also conducted interviews with policy makers and senior stakeholders of both facilities to discuss a range of identified impacts (e.g. related to the UK's international standing, and the development of innovation ecosystems).

As shown in Table 3, we completed 34 interviews, reaching 85% of our target of 40 interviews. While we believe this provides a good evidence base, we have faced particular difficulties in securing interviews with European XFEL users, and suppliers to both facilities, owing to lack of respondents to the corresponding surveys (and low numbers agreeing to participate in a follow-up interview). As noted above, we pursued alternative routes to consulting with suppliers which also led to two providing written feedback.

Table 3 Stakeholder interviews conducted

Interviewee	Organisation	Facility covered in interview	Interview group
Andrew Harrison	Diamond Light Source	ESRF	External stakeholder
John Collier	Central Laser Facility	European XFEL	External stakeholder
James Loveder	BEIS	Both	External stakeholder
Laura Woodward	STFC (Business Opportunities)	Both	STFC stakeholder
Allen Orville	Diamond Light Source	European XFEL	External stakeholder and user
Peter Hatton	University of Durham	ESRF	External stakeholder and user
Elsbeth Garman	University of Oxford	European XFEL	External stakeholder and user
Peter Lee	University of College	ESRF	User
Elsa Panciroli	Oxford University Museum of Natural History	ESRF	User
Stuart Clarke	University of Cambridge	ESRF	User

Interviewee	Organisation	Facility covered in interview	Interview group
Christopher Lucas	University of Liverpool	ESRF	User
Mark Spearing	University of Southampton	ESRF	User
Mikko Juusola	University of Sheffield	ESRF	User
Oliver Lord	University of Bristol	ESRF	User
Derren Heyes	University of Manchester	ESRF	User
Pamela Gill	University of Bristol and Natural History Museum	ESRF	User
Christian Schroder	University of Stirling	ESRF	User
Andrew Beale	University College London	ESRF	User
Stephen Armes	University of Sheffield	ESRF	User
Simon Macleod	AWE plc	ESRF	User
Felix Hofmann	University of Oxford	ESRF	User
Jon Goff	Royal Holloway	ESRF	User
William Hunter	University of Dundee	ESRF	User
Simon Jacques	Finden Ltd	ESRF	User
Tim Snow	Diamond Light Source	ESRF	User
Paul Shearing	University College London	ESRF	User
Serena Cussen	University of Sheffield	ESRF	User
Julia Weinstein	University of Sheffield	European XFEL	User
Simon Kirkman	AMF Engineering	ESRF	Supplier
Andrew Fram	RaySpec Ltd	ESRF	Supplier
Philip Taylor	Observatory Sciences Ltd	ESRF	Supplier
Justin Wark	University of Oxford	European XFEL	Supplier
Matt Wilson	STFC (Detectors Group)	Both	Supplier
Andy Ralston	Tesla Engineering	ESRF	Supplier
Phil Marston (written feedback)	Torr Scientific Ltd	European XFEL	Supplier
Edward Shrimpton (written feedback)	UHV Design	Both	Supplier

Source: Technopolis

2.4 Monitoring data analysis

We were provided with a range of data by both facilities, as set out in Table 4, which was analysed for the final report. We also supplemented this data with an analysis of Researchfish data queries on projects at the two facilities that UKRI has funded.

Table 4 Monitoring data analysed

Data type	ESRF	European XFEL
Users	<ul style="list-style-type: none"> • UK and total visits to ESRF • UK and total individual users to ESRF • UK beamtime used by scientific area 	<ul style="list-style-type: none"> • UK and total visits to European XFEL • UK and total unique users to European XFEL • UK and total users by instrument • UK and total users by scientific area
Suppliers	<ul style="list-style-type: none"> • Rate of industrial return • Total value of contracts to UK suppliers • UK suppliers receiving largest total contracts (2015 to 2021) 	<ul style="list-style-type: none"> • Industrial Liaison Office (ILO) Report 2020 <ul style="list-style-type: none"> – Main UK suppliers to facility – Organisations receiving procurement commitments of more than €50k (2018-2020) • European XFEL analysis on contracts provided

2.5 Publications analysis

Both facilities provided us with data on UK authored research publications that have cited European XFEL or ESRF. We used these to determine the countries that UK researchers have collaborated with, and the number of publications published over time. We also combined this data with that available at LENS.org to help understand the subject areas that each publication has covered, and the extent of multi and interdisciplinary collaborations occurring.

2.6 Case studies

We developed a series of detailed case studies for this report. The purpose of these is to exemplify and showcase in detail some of the major instances of impact seen at each facility. These cover a range of different impact pathways, therefore helping to demonstrate the wide-ranging impacts that the facilities generate. The case studies have a variety of units of analysis, ranging from a single user (e.g., research group, or company), a single supplier, or an entire area of research (e.g. several related research projects). These case studies appear as appendices to the final report.

In addition to case studies, we also drafted shorter half page to one page profile pieces of high impact examples. These vignettes include all the case study examples, plus some additional examples where there was insufficient information to draft full case studies but which still represented important impact examples. **Error! Reference source not found.** sets out the case studies and vignettes that we have prepared for the final report, drawing on suggestions from the evaluation Advisory Board, and others identified over the course of our research.

Table 5 Case studies and vignettes

Users	Suppliers
<ul style="list-style-type: none"> • Human Organ Atlas (ESRF) • Mary Rose conservation (ESRF) • Safety of lithium-ion batteries (ESRF) • XMaS outreach programme for school children (ESRF) • Work by UK Catalysis Hub (ESRF) • The UCL spin-out Finden (ESRF) 	<ul style="list-style-type: none"> • STFC's work on detectors (European XFEL) • FMB Oxford and D2 Instrument (European XFEL) • Lasernet Ltd and SASE3 (European XFEL) • UK participation in HiBEF consortium (European XFEL) • Tesla Engineering (ESRF) • AMF Precision Engineering (ESRF)

Users	Suppliers
<ul style="list-style-type: none"> • Serial Femtosecond crystallography (SFX) (European XFEL) • Light activated bacteria killers in water (European XFEL) 	

Below we set out the case study templates, with similar but different versions for users and suppliers. Each case study draws on multiple sources including survey evidence, follow-up interviews, findings from scoping interviews, and desk research (e.g., company or research group website, publications, and press releases).

Figure 2 User case study template

<p>Summary</p> <p>Briefly setting out who the organisation or individual is, what the nature of the work with the facility has been, and a high-level overview of the main impacts seen.</p> <p>Background</p> <p>A brief history of the user and/or their research group, including previous work they have done in the research area that they are using the facility for.</p> <p>The research project</p> <p>An overview of the work undertaken at the facility. This will set out the problem that the research is looking to address, and the role that the facility has played in enabling the research activity.</p> <p>Impacts generated</p> <p>This will bring together all the evidence collected on the case, both quantitative and qualitative, and summarise it. We will also provide commentary on the specific impacts under each relevant impact pathway.</p> <p>The importance of the facility in achieving impacts</p> <p>We will set out the centrality of having facility access in generating the impacts listed. This will also include commentary on the counterfactual, and the financial value they place on the facility.</p>
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Figure 3 Supplier case study template

Summary

Briefly setting out who the organisation or individual is, what the nature of the work for the facility has been, and a high-level overview of the main impacts seen.

Background

A brief history of the organisation, including the markets in which they have operated in the past.

Work for the facility

An overview of the work undertaken for the facility. This will include, where available, the number and value of contracts undertaken. The section will also include some commentary on how the facility contracts differ or not to previous work the organisation has done.

Impacts generated

This will bring together all the evidence collected on the case. It will state not only the quantitative effects (e.g. on turnover and employment) as indicated through the survey response, but also outline more qualitative effects (e.g. effects on markets). Again, we will also provide commentary on the specific impacts under each relevant impact pathway.

The importance of the facility in achieving impacts

We will set out the centrality of the facility contracts in generating the impacts listed. This will also include commentary on the counterfactual, and the financial value they place on having the facility as a customer.

2.7 Network analysis

To help show how far each facility has helped develop knowledge and research ecosystems, we produced a network analysis. Drawing on the evidence collected, this analysis presents a summary of the main actors, stakeholders and beneficiaries for each facility and the links and dependencies between them. For each facility, a summary diagram is presented, along with an accompanying commentary that sets out the specific nature of the links between different stakeholders in the network.

2.8 Approach to the counterfactual

Assessing the counterfactual is always difficult when examining the impact of research infrastructures such as the two facilities in question. The facilities tend to cater for relatively small and niche areas of the scientific community, meaning that there is not a large pool of well-matched non-users which could form a robust control group. An alternative counterfactual approach could have been to study the outcomes and impacts generated at other research facilities that UK researchers use, using this as a basis for deciding whether the UK is getting more out of European XFEL and ESRF than it could do otherwise. However, there are few comparable alternatives to either facility that could be used for this basis. Furthermore, our research has found that many users use alternatives alongside European XFEL and ESRF rather than instead of it. To that end, it was not practical to separate facilities into control or treatment groups given the significant overlap of users between them.

Consequently, the study has relied on self-reported additionality to help understand the counterfactual. Through primary research we have asked users and suppliers alike to comment in more qualitative terms on what difference having facility access has made to them, and what (if anything) they might have been able to achieve without the facility. This approach is

in line with other previous impact studies of research infrastructures, including Technopolis' 2021 impact study of Diamond Light Source.¹

¹ [Neil Brown, Charlotte Glass, Paul Simmonds, Cristina Rosemberg, Vivek Seth, Isabelle Boscaro-Clarke, et al. \(2021, May 26\). Socio-Economic Impact Study of Diamond Light Source. Zenodo. doi:10.5281/zenodo.4769840](https://doi.org/10.5281/zenodo.4769840)

Appendix A ESRF user survey

The Benefits the UK has derived from ESRF – Survey of scientists and engineers

Thank you for your interest in this survey, which seeks to understand your views and experiences of the benefits that the UK has derived from its membership of ESRF. Your feedback will inform a study that the policy research firm, [Technopolis](#), is undertaking for the Science and Technology Facilities Council (STFC) which looks to understand the impact that ESRF access has had to the UK.

Confidentiality and data

None of the subsequent questions in the survey are mandatory and you are able to withdraw at any time. Indeed, you are free to request the withdrawal and deletion of your submission and data at any point during the course of the study.

All data and information provided will be considered as confidential and will only be used by Technopolis for the purposes of conducting the evaluation. Any publication of results from the survey will only be in a synthesised and anonymised form in an evaluation report. The data will be presented as aggregate statistics or charts and will not be linked to individual organisations. In compliance with GDPR, Technopolis has established processes to ensure the security of the data and information that we collect and hold. You can view the company privacy policy [here](#).

We will erase your data within 6 months of the conclusion of the evaluation.

A.1 About you and your involvement with ESRF

1. Please provide the following basic information about yourself:

- Your name: [Open text]
- The name of your employer / institution: [Open text]

2. If the UK were not a member of ESRF, how likely is it that...[Matrix question]

	Very Unlikely	Unlikely	Likely	Very Likely	Don't know / not applicable
You could access the same or similar instruments elsewhere?					
You would be awarded access to another similar facility in the UK?					
You would be awarded access to another similar facility outside the UK?					
You would be able to pursue the same research through alternative means?					
You would pursue a different research question / area of research instead?					

3. Why might you choose / want to use ESRF rather than another facility? [Open]

4. Has any of your research required the use of both ESRF and any of the following together? (Tick all that apply – if you have not used ESRF in conjunction with another facility, then please leave the question blank).

- Diamond Light Source
- Other large-scale research facilities in the UK
- Other large-scale research facilities in Europe
- Other large-scale research facilities outside the UK and Europe

A.2 Supporting your work

5. To what extent has your involvement with ESRF had a positive impact on the skills and capabilities of you and your group/department, in terms of:

	No impact	Small impact	Moderate impact	Significant impact	n/a
Your ability to undertake research at facilities of this type					
Your team-working skills					
Your project management skills					
Your problem-solving skills					
Your ability to work in an international environment					

Your ability to work with other disciplines					
Student/post-doc training					

6. To what extent has ESRF impacted on your own research activities? [\[Matrix question\]](#)

	No impact	Small impact	Moderate impact	Significant impact	Not applicable / Don't know
Your understanding of your research area					
Your ability to pursue particular research questions					
The strength of your international networks and relationships					
Your career progression					
Your ability to participate in international collaborations with ESRF member states					
Your national / international reputation					
Your ability to attract further research funding					
The speed of progress in your field / discipline more widely					
The likelihood of your research being translated into other research areas or disciplines					
The commercial potential of your research					

7. Please use this space if you wish to expand upon any areas where ESRF has had a very significant impact on your activities, or if there any impact areas that have not been covered.

[\[Open text\]](#)

A.3 Outcomes of ESRF-related R&D

8. Can you point to an important scientific or technological advance that you have made personally (or been involved in), which would not have been possible if ESRF had not existed? Please briefly explain the achievement and the role of the facility in enabling this:

[\[Open text\]](#)

9. Have you / will you be preparing a REF impact case study submission based on ESRF work/findings?

- Yes – submitted for REF2014
- Yes – submitted for REF2021
- Yes – plan to submit to future REF exercise
- No / don't know

10. If possible, could you provide a link to any relevant REF cases or other published details about impacts relating to ESRF work: [\[Open text\]](#)

A.4 Support to UK Research and Innovation

11. In your view, how important has ESRF been to the following?

	Of little or no importance	Of some importance	Of great importance	Critical	Don't know
Advancing knowledge amongst the UK scientific community					
The development of technologies that have been instrumental in the UK making discoveries					
The development of the skills and capabilities of UK scientists and engineers					
Training the next generation of UK scientists and engineers					

12. Do you have any examples of world-leading or ground-breaking research that UK-based researchers have used ESRF for? [\[Open text\]](#)

A.5 Support UK research communities

13. To what extent does UK membership of / involvement in ESRF positively affect your group / department in the following ways? [\[Matrix question\]](#)

	No impact	Small impact	Moderate impact	Significant impact	Critical	Not applicable
Its existence at all						
Its size (number of staff)						
Its contact with other UK organisations						
Its ability to engage with international collaborators						
Its ability to attract highlight skilled scientists and engineers						
Its ability to attract promising undergraduate and graduate students						

A.6 Public Engagement

14. Have you or colleagues used ESRF-enabled research to support educational outreach activities?

- No - we do not conduct public outreach
- No - we do conduct public outreach, but have never used ESRF work
- Yes - to a limited extent (less than once a year)
- Yes – sometimes (at least every year)
- Yes – more often

15. If so, could you please indicate the nature and focus of these activities, and what has been the benefits to the public and your research group? [\[Open text\]](#)

A.7 Valuation

16. Overall, to you as a user, how have the costs and benefits of using ESRF compared?

- The benefits of access significantly outweigh the time and effort expended
- The benefits of access slightly outweigh the time and effort expended
- The benefits of access are broadly aligned with the time and effort expended
- The time and effort expended slightly outweigh the benefits of access
- The time and effort expended significantly outweigh the benefits of access.

In order to come forward with a monetary estimate of the value of the UK's investments in ESRF and the knowledge produced for and by its facilities, we are inviting scientists from across the disciplinary spectrum to provide a view as to the financial value of benefits. There is no intention to introduce the kind of measure suggested in the question that follows.

17. If an annual tax was needed to ensure the continued existence of ESRF in its current form (and all the benefits that flow from it), what level of tax per annum would you personally be prepared to pay?

- Nothing (£0)
- £1
- £2
- £5
- £10
- £50
- £100
- £500
- £1,000
- £5,000
- £10,000
- Don't know
- Other amount (please specify) [\[Open text box\]](#)

A.8 Final questions

18. Are there any other ways in which you (or the UK more generally) have derived benefits from ESRF, which have not been covered above? [\[Open text\]](#)
19. Are there any other comments you would like to make with regards to UK's membership to ESRF? [\[Open text\]](#)

A.9 End of Survey

20. The study team would like to follow up on selected survey responses to explore particular benefits in more depth. If you would be prepared to give a 15-20 minute telephone interview, please provide your contact details below.
- Email address [\[Open text\]](#)
 - Phone number [\[Open text\]](#)

Thank you for your time and interest in this study.

The information you have submitted will be treated in accordance with high standards of research ethics and will only be reported in non-attributable form.

Should you wish to receive any additional information or clarifications about the study, please contact the Technopolis Project Manager for this study.

Please click 'done' to submit your response and close the survey.

Appendix B ESRF suppliers survey

The Benefits the UK has derived from ESRF - Survey of Suppliers

Thank you for your interest in this survey, which seeks to understand your views and experiences of the benefits that the UK has derived from its membership of ESRF. Your feedback will inform a study that the policy research firm, [Technopolis](#), is undertaking for the Science and Technology Facilities Council (STFC) which looks to understand the impact that European XFEL/ESRF access has had to the UK.

The questionnaire is aimed at organisations that have successfully bid for ESRF contracts.

Confidentiality and data

None of the subsequent questions in the survey are mandatory and you are able to withdraw at any time. Indeed, you are free to request the withdrawal and deletion of your submission and data at any point during the course of the study (email: vivek.seth@technopolis-group.com).

All data and information provided will be considered as confidential and will only be used by Technopolis for the purposes of conducting the evaluation. Any publication of results from the survey will only be in a synthesised and anonymised form in an evaluation report. The data will be presented as aggregate statistics or charts and will not be linked to individual organisations. In compliance with GDPR, Technopolis has established processes to ensure the security of the data and information that we collect and hold. You can view the company privacy policy [here](#).

We will erase your data within 6 months of the conclusion of the evaluation.

B.1 About you and your involvement with European XFEL

1. Have you previously been awarded a contract to provide ESRF with goods or services?

- Yes (progress to Q2)
- No (terminate survey)
- Don't know (terminate survey)

2. Please provide the following basic information about yourself:

- Your name: [Open text]
- The name of your employer / institution: [Open text]

3. Approximately, what proportion of your organisation's staff is based in the UK?

- 100%
- 75-99%
- 50-74%
- 25-49%
- 1-24%
- 0%
- Don't know

4. Which of the following sectors does your organisation mainly operate in?

- Education, health and social work
- Electricity, gas and water supply
- Software and control systems
- Professional services (Insurance, accounting...)
- Aerospace
- Precision manufacture
- Defence
- Precision metrology
- Engineering consultancy
- Other (please specify) [Open text]

B.2 Bidding for ESRF contracts

5. To what extent were you motivated to bid for ESRF contracts for the following reasons? [Not at all, to a small extent, to a large extent]

- We had completed design studies / preparation work and would be competitively placed
- Financial / commercial reasons
- Access to research groups to build future collaborations
- To support internal R&D

- For reputational benefits
- To develop internal skills
- The possibility of further future contracts with ESRF
- The possibility of further future contracts with other research facilities
- Other (please specify)

B.3 ESRF contracts

6. Please estimate the following*:

- The total number of contracts ever awarded to your organisation by ESRF: [\[Open text\]](#)
- The total value of these contracts to your organisation (please indicate currency): [\[Open text\]](#)

*The information you provide will remain in **confidence** and will only be used by Technopolis as part of calculations for the current study. It will not be shared more widely.

We realise that you may not have precise figures to hand, but would appreciate if you could **provide a best estimate** for each of the questions below, if possible. If you would prefer not to disclose this information, please proceed to the next section.

7. Please select the categories that best reflect your ESRF contracts [\[Drop down menus to select 'Primary and 'Secondary'\]](#)

- Supply: Civil engineering, building and technical services
- Supply: Electrical engineering and magnets
- Supply: Electronics and radio frequency
- Supply: Information technology / software
- Supply: Mechanical engineering and raw materials
- Supply: Vacuum and low temperature
- Supply: Particle and photon detectors
- Supply: Optics and photonics
- Supply: Gases, chemicals, radiation and waste equipment
- Supply: Health, safety and environment
- Supply: Transport, handling and vehicles
- Supply: Office supply, furniture, communication and training
- Services: Temporary labour contracts
- Services: Service contracts
- Services: Maintenance contracts
- Services: Works contracts
- Don't know
- 'Other', please specify. [\[Open text\]](#)

B.4 Effects of ESRF contracts within your organisation

8. To what extent have your past ESRF contracts resulted in improvements to any of the following areas within your organisation?

	No impact	Small impact	Moderate impact	Significant impact	Critical
Your in-house knowledge and expertise					
Your in-house skills and capabilities					
Your ability to attract and retain talent					
Your capacity to innovate					
Your efficiency or productivity					
Your ability to work successfully with public research institutes					
Your connections or partnerships with academic institutions					
Staff satisfaction					

B.5 Innovation and Socio-Economic Benefits

9. Have your ESRF Contracts led to any of the following innovation-related benefits? [\[Select multiple\]](#)

- Improvements (non-patented) to existing products
- Improvements (non-patented) to existing services
- New patent applications
- New licence agreements
- The launch of new products or services
- The launch of new processes
- The launch of new start-ups
- Further developing products services for ESRF for use in other applications
- None of the above

10. Please feel free to provide further details on any options you have selected (e.g. details on patent applications submitted, details on any new/improved products etc).

[\[Open text\]](#)

B.6 Commercial Information

The following questions ask for commercial information about your organisation. Again, the information you provide will remain in confidence and will only be used by Technopolis as part of calculations for the current study. It will not be shared more widely.

We realise that you may not have precise figures to hand, but would appreciate if you could provide a best estimate for each of the questions below, if possible. Otherwise, please proceed to the next section.

11. Please provide the following (historical) information:

- The first year in which you were a ESRF supplier: [\[Open text\]](#)
- Your approximate annual turnover in the year preceding this (please indicate currency): [\[Open text\]](#)
- Your approximate number of employees (FTE) in that same year: [\[Open text\]](#)

12. Please also provide the following (current) information: [\[Open text\]](#)

- Your approximate annual turnover for the latest full financial year: [\[Open text\]](#)
- Your approximate number of employees (FTE) in that same year: [\[Open text\]](#)

13. If we imagine a scenario where you had never had an ESRF contract, how different would your turnover and number of employees look compared to now:

	Select one
Your annual turnover (for the latest full financial year)	<ul style="list-style-type: none"> • Turnover would be higher without the contracts • Turnover would be unchanged • Turnover would be 1-20% lower • Turnover would be 21-40% lower • Turnover would be 41-60% lower • Turnover would be 61-80% lower • Turnover would be 81-99% lower • The company would not exist • Don't know
Your number of employees (FTE) in that same year	<ul style="list-style-type: none"> • Employment would be higher without the contracts • Employment would be unchanged • Employment would be 1-20% lower • Employment would be 21-40% lower • Employment would be 41-60% lower • Employment would be 61-80% lower • Employment would be 81-99% lower • The company would not exist • Don't know

14. Hypothetically, if your business did not exist, what share of your current market do you believe would likely be... (please estimate a % in each case, totalling 100%)

- Taken/filled by existing UK-based competitors? [\[Open text\]](#)
- Taken/filled by existing international competitors? [\[Open text\]](#)

- Not taken or filled by any competitors? [\[Open text\]](#)

B.7 Commercial Benefits

15. To what extent have your past ESRF contracts contributed to the realisation of any of the following wider commercial benefits?

	Not at all	To a small extent	To a moderate extent	To a large extent
Access to new markets within the UK (e.g. national laboratories, universities)				
Access to new markets overseas (e.g. other international research institutes)				
The price-performance of your products or services				
The saleability of your products or services				
Increase in sales income (beyond the ESRF contracts themselves)				
Increase in profitability				
Increase in employment				
Increase in market share				
Increase in international competitiveness				
Increase in reputation and global brand value				

16. Hypothetically, what might have happened commercially had you not been able to make those ESRF-related sales? [\[Open text\]](#)

17. Are there any other ways in which you have derived benefits from working with ESRF, which have not been covered above? [\[Open text\]](#)

B.8 Willingness to Accept

18. Overall, to you as a supplier, how have the costs and benefits of bidding to European XFEL/ESRF compared?

- Benefits significantly outweigh the costs
- Benefits slightly outweigh the costs
- Benefits are broadly aligned with the costs
- Costs slightly outweigh the benefits
- Costs significantly outweigh the benefits

In order to come forward with a monetary estimate of the value of the UK's investments in ESRF, we are asking various groups to provide a view as to the financial value of the benefits that

ESRF brings to them. There is no intention to introduce the kind of measure suggested in the question that follows.

19. What would be the minimum amount that your organisation would be willing to accept, as an annual payment, as compensation for not being able to bid for any further ESRF Contracts'? [Multiple choice]

- None
- £50
- £100
- £200
- £500
- £1,000
- £5k
- £20k
- £50k
- £100k
- £250k
- Other (please specify) [Open text]

B.9 Final Questions

20. Do you anticipate tendering for ESRF contracts again in the future? [Multiple choice]

- Yes, definitely
- Yes, possibly
- No
- Don't know

21. If you answered no above, then please can you explain why? [Open text]

22. Do you have any other comments or reflections on your view on European XFEL/ESRF contracts not covered above? [Open text]

23. The study team would like to follow up on selected survey responses to explore particular aspects of responses in more depth.

If you would be prepared to give a 15-minute telephone interview, please provide your contact details below.

- Email address: [Open text]
- Phone number: [Open text]

B.10 End of Survey

Thank you kindly for your time and interest in this study.

The information you have submitted will be treated in accordance with high standards of research ethics and will only be reported in non-attributable form.

Should you wish to receive any additional information or clarifications about the study, please contact the Technopolis Project Manager for this study Vivek Seth (vivek.seth@technopolis-group.com).

Please click 'done' to submit your response and close the survey.

Appendix C European XFEL users survey

The Benefits the UK has derived from European XFEL – Survey of scientists and engineers

Thank you for your interest in this survey, which seeks to understand your views and experiences of the benefits that the UK has derived from its membership of European XFEL. Your feedback will inform a study that the policy research firm, [Technopolis](#), is undertaking for the Science and Technology Facilities Council (STFC) which looks to understand the impact that European XFEL access has had to the UK.

Confidentiality and data

None of the subsequent questions in the survey are mandatory and you are able to withdraw at any time. Indeed, you are free to request the withdrawal and deletion of your submission and data at any point during the course of the study (email: vivek.seth@technopolis-group.com).

All data and information provided will be considered as confidential and will only be used by Technopolis for the purposes of conducting the evaluation. Any publication of results from the survey will only be in a synthesised and anonymised form in an evaluation report. The data will be presented as aggregate statistics or charts and will not be linked to individual organisations. In compliance with GDPR, Technopolis has established processes to ensure the security of the data and information that we collect and hold. You can view the company privacy policy [here](#).

We will erase your data within 6 months of the conclusion of the evaluation.

C.1 About you and your involvement with European XFEL

1. Please provide the following basic information about yourself:

- Your name: [\[Open text\]](#)
- The name of your employer / institution: [\[Open text\]](#)

2. If the UK were not a member of European XFEL, how likely is it that...[\[Matrix question\]](#)

	Very Unlikely	Unlikely	Likely	Very Likely	Don't know / not applicable
You could access the same or similar instruments elsewhere?					
You would be awarded access to another similar facility in the UK?					
You would be awarded access to another similar facility outside the UK?					
You would be able to pursue the same research through alternative means?					
You would pursue a different research question / area of research instead?					

3. Why might you choose / want to use European XFEL rather than another facility?

[\[Open\]](#)

4. Has any of your research required the use of both European XFEL and any of the following together? (Tick all that apply – if you have not used European XFEL in conjunction with another facility, then please leave the question blank).

- Diamond Light Source
- Central Laser Facility (CLF)
- Other large-scale research facilities in the UK
- Other large-scale research facilities in Europe
- Other large-scale research facilities outside the UK and Europe

C.2 Supporting your work

5. To what extent has your involvement with European XFEL had a positive impact on the skills and capabilities of you and your group/department, in terms of:

	No impact	Small impact	Moderate impact	Significant impact	n/a
Your ability to undertake research at facilities of this type					
Your team-working skills					
Your project management skills					
Your problem-solving skills					
Your ability to work in an international environment					

Your ability to work with other disciplines					
Student/post-doc training					

6. To what extent has European XFEL impacted on your own research activities? [\[Matrix question\]](#)

	No impact	Small impact	Moderate impact	Significant impact	Not applicable / Don't know
Your understanding of your research area					
Your ability to pursue particular research questions					
The strength of your international networks and relationships					
Your career progression					
Your ability to participate in international collaborations with European XFEL member states					
Your national / international reputation					
Your ability to attract further research funding					
The speed of progress in your field / discipline more widely					
The likelihood of your research being translated into other research areas or disciplines					
The commercial potential of your research					

7. Please use this space if you wish to expand upon any areas where European XFEL has had a very significant impact on your activities, or if there any impact areas that have not been covered.

[\[Open text\]](#)

C.3 Outcomes of European XFEL-related R&D

8. Can you point to an important scientific or technological advance that you have made personally (or been involved in), which would not have been possible if European XFEL had not existed? Please briefly explain the achievement and the role of the facility in enabling this:

[\[Open text\]](#)

9. Have you / will you be preparing a REF impact case study submission based on European XFEL work/findings?

- Yes – submitted for REF2014
- Yes – submitted for REF2021
- Yes – plan to submit to future REF exercise

- No / don't know

10. If possible, could you provide a link to any relevant REF cases or other published details about impacts relating to European XFEL work: [\[Open text\]](#)

C.4 Support to UK Research and Innovation

11. In your view, how important has European XFEL been to the following?

	Of little or no importance	Of some importance	Of great importance	Critical	Don't know
Advancing knowledge amongst the UK scientific community					
The development of technologies that have been instrumental in the UK making discoveries					
The development of the skills and capabilities of UK scientists and engineers					
Training the next generation of UK scientists and engineers					

12. Do you have any examples of world-leading or ground—breaking research that other UK-based researchers have used European XFEL for? [\[Open text\]](#)

C.5 Supporting UK research communities

13. To what extent does UK membership of / involvement in European XFEL positively affect your group / department in the following ways? [\[Matrix question\]](#)

	No impact	Small impact	Moderate impact	Significant impact	Critical	Not applicable
Its existence at all						
Its size (number of staff)						
Its contact with other UK organisations						
Its ability to engage with international collaborators						
Its ability to attract highly skilled scientists and engineers						
Its ability to attract promising undergraduate and graduate students						

C.6 Public Engagement

14. Have you or colleagues used European XFEL-enabled research to support educational outreach activities?

- No - we do not conduct public outreach
- No - we do conduct public outreach, but have never used European XFEL work
- Yes - to a limited extent (less than once a year)
- Yes – sometimes (at least every year)
- Yes – more often

15. If so, could you please indicate the nature and focus of these activities, and what has been the benefits to the public and your research group? [\[Open text\]](#)

C.7 Valuation

16. Overall, to you as a user, how have the costs and benefits of using European XFEL compared?

- Benefits significantly outweigh the costs
- Benefits slightly outweigh the costs
- Benefits are broadly aligned with the costs
- Costly slightly outweigh the benefits
- Costs significantly outweigh the benefits

In order to come forward with a monetary estimate of the value of the UK's investments in European XFEL and the knowledge produced for and by its facilities, we are inviting scientists from across the disciplinary spectrum to provide a view as to the financial value of benefits. There is no intention to introduce the kind of measure suggested in the question that follows.

17. If an annual tax was needed to ensure the continued existence of European XFEL in its current form (and all the benefits that flow from it), what level of tax per annum would you personally be prepared to pay?

- Nothing (£0)
- £1
- £2
- £5
- £10
- £50
- £100
- £500
- £1,000
- £5,000
- £10,000

- Don't know
- Other amount (please specify) [\[Open text box\]](#)

C.8 Final questions

18. Are there any other ways in which you (or the UK more generally) have derived benefits from European XFEL, which have not been covered above? [\[Open text\]](#)
19. Are there any other comments you would like to make with regards to UK's membership to European XFEL? [\[Open text\]](#)

C.9 End of Survey

20. The study team would like to follow up on selected survey responses to explore particular benefits in more depth. If you would be prepared to give a 15-20 minute telephone interview, please provide your contact details below.
- Email address [\[Open text\]](#)
 - Phone number [\[Open text\]](#)

Thank you for your time and interest in this study.

The information you have submitted will be treated in accordance with high standards of research ethics and will only be reported in non-attributable form.

Should you wish to receive any additional information or clarifications about the study, please contact the Technopolis Project Manager for this study.

Please click 'done' to submit your response and close the survey.

Appendix D European XFEL suppliers survey

The Benefits the UK has derived from European XFEL - Survey of Suppliers

Thank you for your interest in this survey, which seeks to understand your views and experiences of the benefits that the UK has derived from its membership of European XFEL. Your feedback will inform a study that the policy research firm, [Technopolis](#), is undertaking for the Science and Technology Facilities Council (STFC) which looks to understand the impact that European XFEL/ESRF access has had to the UK.

The questionnaire is aimed at organisations that have successfully bid for European XFEL.

Confidentiality and data

None of the subsequent questions in the survey are mandatory and you are able to withdraw at any time. Indeed, you are free to request the withdrawal and deletion of your submission and data at any point during the course of the study.

All data and information provided will be considered as confidential and will only be used by Technopolis for the purposes of conducting the evaluation. Any publication of results from the survey will only be in a synthesised and anonymised form in an evaluation report. The data will be presented as aggregate statistics or charts and will not be linked to individual organisations. In compliance with GDPR, Technopolis has established processes to ensure the security of the data and information that we collect and hold. You can view the company privacy policy [here](#).

We will erase your data within 6 months of the conclusion of the evaluation.

D.1 About you and your organisation

1. Have you previously been awarded a contract to provide European XFEL with goods or services?
 - Yes (Proceed to Q2)
 - No (Terminate survey)
 - Don't know (Terminate survey)

2. Please provide the following basic information about yourself:
 - Your name: [\[Open text\]](#)
 - The name of your employer / institution: [\[Open text\]](#)

3. Approximately, what proportion of your organisation's staff is based in the UK?
 - 100%
 - 75-99%
 - 50-74%
 - 25-49%
 - 1-24%
 - 0%
 - Don't know

4. Which of the following sectors does your organisation mainly operate in?
 - Education, health and social work
 - Electricity, gas and water supply
 - Software and control systems
 - Professional services (Insurance, accounting...)
 - Aerospace
 - Precision manufacture
 - Defence
 - Precision metrology
 - Engineering consultancy
 - Other (please specify) [\[Open text\]](#)

D.1 Bidding for European contracts

5. To what extent were you motivated to bid for European XFEL contracts for the following reasons? [\[Not at all, to a small extent, to a large extent\]](#)
 - We had completed design studies / preparation work and would be competitively placed
 - Financial / commercial reasons
 - Access to research groups to build future collaborations
 - To support internal R&D

- For reputational benefits
- To develop internal skills
- The possibility of further future contracts with European XFEL
- The possibility of further future contracts with other research facilities
- Other (please specify)

D.1 European XFEL contracts

6. Please estimate the following*:

- The total number of contracts ever awarded to your organisation by European XFEL: [\[Open text\]](#)
- The total value of these contracts to your organisation (please indicate currency): [\[Open text\]](#)

*The information you provide will remain in **confidence** and will only be used by Technopolis as part of calculations for the current study. It will not be shared more widely.

We realise that you may not have precise figures to hand, but would appreciate if you could **provide a best estimate** for each of the questions below, if possible. If you would prefer not to disclose this information, please proceed to the next section.

7. Please select the categories that best reflect your European XFEL contracts [\[Drop down menus to select 'Primary and 'Secondary'\]](#)

- Civil engineering, building and technical services
- Controls, handling and transport
- Electrical engineering and magnets
- Electronics
- Engineering supplies
- Information and communication technologies
- Instrumentation
- Land & office equipment and supplies
- Materials
- Mechanical engineering
- Microwave and radio frequency
- Optics and photonics
- Radiation, chemicals, gases, waste
- Services
- Vacuum and low temperature
- Other (please specify)

D.1 Effects of European XFEL contracts within your organisation

8. To what extent have your past European XFEL Contracts resulted in improvements to any of the following areas within your organisation?

	No impact	Small impact	Moderate impact	Significant impact	Critical
Your in-house knowledge and expertise					
Your in-house skills and capabilities					
Your ability to attract and retain talent					
Your capacity to innovate					
Your efficiency or productivity					
Your ability to work successfully with public research institutes					
Your connections or partnerships with academic institutions					
Staff satisfaction					

D.1 Innovation and Socio-Economic Benefits

9. Have your European XFEL Contracts led to any of the following innovation-related benefits?
[Select multiple]

- Improvements (non-patented) to existing products
- Improvements (non-patented) to existing services
- New patent applications
- New licence agreements
- The launch of new products or services
- The launch of new processes
- The launch of new start-ups
- Further developing products services for European XFEL for use in other applications
- None of the above

10. Please feel free to provide further details on any options you have selected (e.g. details on patent applications submitted, details on any new/improved products etc).

[Open text]

D.2 Commercial Information

The following questions ask for commercial information about your organisation. Again, the information you provide will remain in confidence and will only be used by Technopolis as part of calculations for the current study. It will not be shared more widely.

We realise that you may not have precise figures to hand, but would appreciate if you could provide a best estimate for each of the questions below, if possible. Otherwise, please proceed to the next section.

11. Please provide the following (historical) information:

- The first year in which you were a European XFEL supplier: [\[Open text\]](#)
- Your approximate annual turnover in the year preceding this (please indicate currency): [\[Open text\]](#)
- Your approximate number of employees (FTE) in that same year: [\[Open text\]](#)

12. Please also provide the following (current) information: [\[Open text\]](#)

- Your approximate annual turnover for the latest full financial year: [\[Open text\]](#)
- Your approximate number of employees (FTE) in that same year: [\[Open text\]](#)

13. If we imagine a scenario where you had never had an European XFEL contract, how different would your turnover and number of employees look compared to now:

	Select one
Your annual turnover (for the latest full financial year)	<ul style="list-style-type: none"> • Turnover would be higher without the contracts • Turnover would be unchanged • Turnover would be 1-20% lower • Turnover would be 21-40% lower • Turnover would be 41-60% lower • Turnover would be 61-80% lower • Turnover would be 81-99% lower • The company would not exist • Don't know
Your number of employees (FTE) in that same year	<ul style="list-style-type: none"> • Employment would be higher without the contracts • Employment would be unchanged • Employment would be 1-20% lower • Employment would be 21-40% lower • Employment would be 41-60% lower • Employment would be 61-80% lower • Employment would be 81-99% lower • The company would not exist • Don't know

14. Hypothetically, if your business did not exist, what share of your current market do you believe would likely be... (please estimate a % in each case, totalling 100%)

- Taken/filled by existing UK-based competitors? [\[Open text\]](#)
- Taken/filled by existing international competitors? [\[Open text\]](#)

- Not taken or filled by any competitors? [\[Open text\]](#)

D.3 Commercial Benefits

15. To what extent have your past European XFEL contracts contributed to the realisation of any of the following wider commercial benefits?

	Not at all	To a small extent	To a moderate extent	To a large extent
Access to new markets within the UK (e.g. national laboratories, universities)				
Access to new markets overseas (e.g. other international research institutes)				
The price-performance of your products or services				
The saleability of your products or services				
Increase in sales income (beyond the European XFEL contracts themselves)				
Increase in profitability				
Increase in employment				
Increase in market share				
Increase in international competitiveness				
Increase in reputation and global brand value				

16. Hypothetically, what might have happened commercially had you not been able to make those European XFEL -related sales? [\[Open text\]](#)

17. Are there any other ways in which you have derived benefits from working with ESRF, which have not been covered above? [\[Open text\]](#)

D.4 Willingness to Accept

18. Overall, to you as a supplier, how have the costs and benefits of bidding to European XFEL/ESRF compared?

- Benefits significantly outweigh the costs
- Benefits slightly outweigh the costs
- Benefits are broadly aligned with the costs
- Costs slightly outweigh the benefits
- Costs significantly outweigh the benefits

In order to come forward with a monetary estimate of the value of the UK's investments in European XFEL, we are asking various groups to provide a view as to the financial value of the

benefits that European XFEL brings to them. There is no intention to introduce the kind of measure suggested in the question that follows.

19. What would be the minimum amount that your organisation would be willing to accept, as an annual payment, as compensation for not being able to bid for any further European XFEL contracts? [Multiple choice]

- None
- £50
- £100
- £200
- £500
- £1,000
- £5k
- £20k
- £50k
- £100k
- £250k
- Other (please specify) [Open text]

D.5 Final Questions

20. Do you anticipate tendering for European XFEL contracts again in the future? [Multiple choice]

- Yes, definitely
- Yes, possibly
- No
- Don't know

21. If you answered no above, then please can you explain why? [Open text]

22. Do you have any other comments or reflections on your view on European XFEL/ESRF contracts not covered above? [Open text]

23. The study team would like to follow up on selected survey responses to explore particular aspects of responses in more depth.

If you would be prepared to give a 15-minute telephone interview, please provide your contact details below.

- Email address: [Open text]
- Phone number: [Open text]

D.6 End of Survey

Thank you kindly for your time and interest in this study.

The information you have submitted will be treated in accordance with high standards of research ethics and will only be reported in non-attributable form.

Should you wish to receive any additional information or clarifications about the study, please contact the Technopolis Project Manager for this study.

Please click 'done' to submit your response and close the survey.

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