UKRI-3008 Appendix A

Specification for

Socio-economic impact of Mathematical Sciences Research Funded by EPSRC over the last 10 years, and programme evaluation for the Additional Funding Programme for Mathematical Sciences

Contents

1 Introduction

1.1 Background

The mathematical sciences underpin scientific, technical, and social advances that improve health and raise living standards. For example, Genetic analysis relies on statistical methodologies, allowing improvements in human, animal, and plant health; Machine learning, artificial intelligence and data science are dependent on mathematics to find patterns in complex datasets.

Mathematics is increasingly leveraged by those economies intending to compete internationally by enabling, amongst others, digital, biomedical, and environmental innovation to generate greater social and economic benefits[1] but the requirement for government and industry to provide solutions to increasing complex and more data intensive problems requires a significant boost in funding for mathematical sciences to secure the UK's internationally leading position. Furthermore, as noted by the Bond Review[1], mathematicians of the future will need additional skills to fully equip them to engage in an impactful way across a wide range of fields.

The UK government, through UK Research and Innovation's (UKRI's) Engineering and Physical Sciences Research Council (EPSRC), currently supports fundamental mathematical sciences research investing in the three strands: people, projects, and research infrastructures (the institutes). EPSRC each year invests approximately £24 million in fellowships and research grants and approximately £18 million in approximately 190 new PhD students in mathematical sciences. The Royal Society fellowship schemes are also open to mathematicians with a small number of fellowships being awarded each year. The current budget for research investment in fundamental science has not enabled any growth of support in capability and capacity within this discipline area over the last 5 years. The outcome of this current level of investment is that the UK delivers a world average level of research output in mathematics based on 2016 research publication data. The quality of the outputs based on citation data identified in the same report ranks the UK well above world average. Given the fundamental nature of this research, it has not benefitted significantly in the major new programmes that have provided a welcome uplift to UKRI investment such as the Industrial Strategy Challenge Fund and the Strategic Priorities Fund.

[1] The Era of Mathematics (Bond Review) 2018

In January 2020, the UK government announced an additional programme of investment in the mathematical sciences, and an investment of £124M was allocated between 2020 and March 2023.[2] The *Additional Funding Programme for Mathematical Sciences* is focused on increasing the level of discovery-led mathematical science in the UK. The expected outcomes are an increased level of internationally competitive mathematical sciences in the UK, with the follow-on impact of increasing the provision of skilled individuals and foundational knowledge to the UK economy in the long term. A 2012 study[3] identified that 10% of jobs in the UK were based on mathematics. A 2018 report - *Era of Mathematics*[1] - identified areas such as cybersecurity, data analytics, uncertainty modelling, optimisation modelling for productivity gains, all of which will need increased levels of foundational mathematical thinking to secure and retain the UK's internationally leading position. This investment will underpin the governmental Department for Science, Innovation & Technology (DSIT) priority areas of AI, big data, security, and health, aligns with the Government's Industrial Strategy pillars of ideas and people, as well as aligning to the EPSRC and UKRI delivery plans in supporting discovery research and skill development.

The purpose of this investment is to increase both the volume of high-quality Mathematical Sciences research activity being undertaken in UK academia and the number of people trained at PhD level over the next 5 years to underpin growth in the UK economy and deliver benefits to society.

The benefits of the *Additional Funding Programme for Mathematical Sciences,* that have been identified by the outline business case and derived from the logic models outputs and outcomes are described below:

- A Vibrant diverse academic base in mathematical sciences throughout UK
- Continued UK reputation as a global leader in mathematical sciences attracting people and businesses globally to work and invest in the UK
- Mathematical sciences research outcomes available to be used by other research and innovation domains
- UK national expertise available for the security and defence sector
- An enhanced number of people with state-of-the art mathematical sciences knowledge in business, public sector and third sector to contribute to new products and processes, increased productivity, efficiency and better decision and policy making

[2] Boost for UK science with unlimited visa offer to world's brightest and best
[3] Measuring the Economic Benefits of Mathematical Science Research in the UK

Similar to more traditional infrastructure found in other disciplines (e.g., laboratories, analytical facilities), mathematical sciences institutes are key infrastructure to the community, bringing mathematicians together to deliver world leading research. The INI and the ICMS are currently funded by EPSRC at £2.5 million per year and deliver a key role in convening mathematicians from around the globe (from academia, industry, and public sector) to take part in a range of different research programmes focused on different areas of mathematics. HIMR is funded by Government Communications Headquarters (GCHQ) to engage the academic community in fundamental research of relevance to security. EPSRC does not currently directly support HIMR which works across several UK universities but will start to do so through this investment. These institutes are key assets to the UK mathematics research portfolio alongside the strong university base and can be considered as an international window for attracting international collaborators to the UK and showcasing the UK capabilities.

EPSRC plans to continue the baseline funding for mathematical sciences at the current rate, subject to UKRI budget allocations. This baseline will continue alongside and the new funding to be provided by the Additional Funding Programme for Mathematical Sciences will be in addition to this.

1.2 Requirement

EPSRC wishes to conduct two parallel but connected evaluations: a baseline evaluation, including an impact analysis and a landscape analysis, of the research that it has been funded under the Mathematical Sciences theme over the past 10 years (2012-2022), and a programme evaluation tied to the *Additional Funding Programme for Mathematical Sciences*.

- **Baseline Evaluation:**

For the impact evaluation of the research EPSRC has funded under the Mathematical Sciences theme over the past 10 years (2012-2022), the baseline study should identify the current UK mathematical sciences landscape and quantify the economic impact from the Mathematical Sciences research funded by EPSRC. The baseline will enable EPSRC to understand the funding landscape for mathematical sciences, the international standing of UK mathematical sciences, skill-base and research strengths (high-level) at this time, and the impact the past 10 years has had in building that current position. Part of the role of the baseline evaluation will also be reviewing the M&E framework and logic model on which maths funding should be evaluated; setting the M&E methodology on which both these evaluations are conducted (as well providing some recommendations for future post programme monitoring and evaluation activities*).*

The impact evaluation baseline will:

- Focus on quantifying the economic impact from the Mathematical Sciences research funded by EPSRC (which is primarily low Technology Readiness Level, TRL, basic/fundamental research) evidenced by a Return on Investment (ROI) figure.
- Document the wider and spill-over benefits arising from the funded research.
- Produce robust case studies of impact from the investments.

The landscape analysis will:

- Provide an understanding of the Mathematical Sciences landscape of the past 10 years.
- Frame the evidence within the context of importance of Mathematical Sciences to the UK and globally.

- **Programme evaluation for the *Additional Funding Programme for Mathematical Sciences:***

Alongside the baseline, the programme evaluation activity undertaken for this exercise will provide the evidence of the impact of the investment, as well as contribute to the programme evaluation, allowing EPSRC to assess the value for money of the investment and to understand the impact of its activity on the UK's knowledge, the economy and society. It will also inform ongoing and future improvements of programme design and delivery.

The findings from the evaluation will be used to inform decisions and actions throughout, EPSRC, UKRI and government. Primarily, the findings will be used over the life of the Programme to:

- inform and fine tune future plans to efficiently enhance impact within the mathematics theme.
- Inform decisions across EPSRC/UKRI to better the overall planning, governance, and execution of other programmes.
- inform DSIT' future plans, interventions, and execution of programmes.
- enable lessons learnt and for informed conclusions to be drawn about the impact (forecast and actual) of the programme.

The programme evaluation will:

- Assess success as defined by the objectives of the commissioned projects and activities (at mid- and end-stages)
- Assess the aggregate picture at mid- and end-stages
- Assess the overall success and achievement of the programme and potential realisation of the expected outcomes / longer term impacts and benefits.

For both the baseline evaluation and the programme evaluation, we are particularly interested in the study to evidence how the EPSRC investment makes a difference in terms of supporting the provision of mathematically skilled people to the wider UK workforce (including academia), for example in enhancing the number of mathematicians in business, the public sector and the third sector. In addition, the study should provide evidence of how the investments provide competitive advantage, innovative products, knowledge flow to innovation for example through, Intellectual Property (IP), patents, links to users of the research (businesses and government bodies) etc.

The information gathered through this exercise will help EPSRC build the evidence base to support bids for future funding in this area and to highlight successes from past investments.

The Supplier should have a team that understands the challenges of evaluating low TRL research investments and to have the expertise to conduct the various analysis required to answer the breadth of the questions to uncover impacts from the investments. We do understand that this might involve partnership with organisations where specific expertise might lie. In such cases, we would expect the Supplier to contract as the lead supplier, and to ensure programme and delivery structures to be such that there is a central point of contact and ownership to avoid multiple channels of communications and management. This is to ensure that the study runs smoothly and does not create unnecessary burden on EPSRC.

2 Aims & Objectives

2.1 Deliverables

EPSRC seeks to commission an independent evaluation for the programme that will involve, as outlined in the previous section, a baseline, and an end of programme evaluation.

An example structure that should outline the different deliverables is presented below.

Preparatory stage – where confirmation of the precise scope of the project is sought, logistics are agreed as well as governance arrangements and data collection methodologies and case studies discussions take place. Expected risks and associated mitigations should be identified, as well as stakeholders to consult and a reiteration of the study framework.

Deliverable 1: Scoping stage (Information Review and Data Collection) – this stage should involve a review of existing secondary data sources, including official data as well as databases that the Supplier has access to, including, where appropriate:

- Internal Data supplied by EPSRC/UKRI
- The Office of National Statistics
- Central Statistics Office of Ireland
- The Scottish Government
- HM Revenue and Customs
- Department for Business, Innovation and Skills
- OECD, WTO, Eurostat and UN
- MINT, Perfect Information and other financial databases

This review of available data will then contribute to the first deliverable, which will be a scoping report to include:

- finalising the methodology of analysis for the baseline and programme evaluation including the data to be used and the approach for collecting further data
- a finalised project management timeline
- an associated and finalised M&E framework for the baseline, end of programme evaluation, and some recommendations for future post programme monitoring and evaluation activities (including a review of the logic model/theory of change for baseline and additional maths funding see Annex B).

The evaluations will also examine how well the processes and programme performed and what improvements could be introduced. The relevant parties will be expected to develop plans to implement any recommendations. One consideration for any M&E process is to achieve a balance between adequate reporting and transparency, whilst not becoming overly burdensome; therefore, the baseline activity, will also be tasked with examining which questions are relevant across the programme lifecycle and merit inclusion.

Deliverable 2: This will be to produce interim report for the Baselining evaluation – this stage should involve overviewing the evidence and an initial draft of the final report, which includes the conclusions provided by the analysis so far. This will be used as a review point to reflect on methodology, review the conclusions so far drawn and agree the next steps in the analysis. The baselining interim report will include aspects of;

- **Economic and Data Analysis** – this will involve the estimation of the 'narrow' economic impacts of mathematical science research in the UK to include direct, indirect, and induced effects.
- **Non/Less Quantifiable Impacts and Case Studies** – the quantitative analysis will be augmented by qualitative insights derived from secondary research and case study analysis to inform our understanding of 'broader' economic impacts – such as longer-term commercialisation of research.
- **Policy Analysis and Synthesis** – this will draw out the insights and key messages of the analysis and answer the "so what?" question.

Deliverable 3: Produce initial review of the Programme evaluation for the *Additional Funding Programme for Mathematical Sciences.* This will include initial findings associated with the end of programme evaluation, with an assessment of progress against the objectives of the research funding programme. This will form the basis of a 'informal mid-term review' which will inform the strategy for the programme funding; being used to inform decisions and actions at different levels (programme level, UKRI level and for wider DSIT consideration).

Deliverable 4: Produce final report for baselining evaluation – this stage should involve the finalisation of the analysis and publication of the report on the impact of the research EPSRC has funded under the Mathematical Sciences theme over the past 10 years (2012-2022). This will identify the current UK mathematical sciences landscape and quantify the economic impact from the Mathematical Sciences research funded by EPSRC.

Deliverable 5: Produce final report for the Programme evaluation for the *Additional Funding Programme for Mathematical Sciences*, timing of this final report will coincide with the end of funding in March 2025, to use any funding data associated with this. This report will provide the evidence of the impact of the investment and overview the programme evaluation, allowing EPSRC to assess the value for money of the investment and to understand the impact of its activity on the UK's knowledge, the economy and society.

Throughout the study the Supplier will liaise regularly (through meetings) with the EPSRC to keep it appraised of progress, and will present to the Programme Advisory Board at the completion of each stage for comment, sign-off and associated payment.

In answering the key questions for the deliverables the Supplier will advise of the best approach and agree this with EPSRC. Some of the lines of enquiry (not limited to) are:

Economic impact

What has the overall economic impact of EPSRC funded Mathematical Sciences research been, for example:

- What is the Return on Investment (ROI) from EPSRC's investment in Mathematical Sciences research?
- What is the effect of the investment on leverage and further funding?
- What is the Impact on supporting innovations, including new products/processes, patents and spinouts arising from the EPSRC portfolio?
- What has the effect of the research knowledge arising out of these investments been on cost saving/efficiency?
- What are the quantifiable benefits of the Mathematical Sciences research to future solutions in different economic sectors?

Impact on research

What has the impact of research in Mathematical Sciences been, for example:

- What are the demonstrable strengths in EPSRC funded Mathematical Sciences research? How have the past investments led to growth in research for current and future socio-economic solutions?
- What is the impact of EPSRC-funded Mathematical Sciences research on different disciplines and sectors (type of research and problem solving in different areas)?
- What engagement, collaboration and further funding has there been with different stakeholders in EPSRC funded Mathematical Sciences research (specially looking at key features and impact from the critical mass investments)?
- What has been the impact on enabling research in different disciplines/sectors (new users, research communities and lines of enquiry)?

- What has the impact been on advancing research in the areas of importance to UK Mathematical Sciences and/or enabling growth of new areas of research?

- What has been the impact of different EPSRC funding mechanisms (e.g., CDTs, Programme Grants, Standard Mode)? What features of the schemes allow for realisation of this impact?

Wider Impact

- What is the impact, or potential impact, of EPSRC funded Mathematical Sciences research on health, society, and the environment?

We envisage the use of data visualisation, analysis, narrative and case studies to demonstrate the impacts covering qualitative as well as quantified benefits wherever possible. Case studies should have information that will be useful for different audiences including Treasury/Government, business/investors, and the public. Some aspects that the case studies could bring out (not limited to) are:

- How has the people pipeline of trained mathematicians (across the breadth of the UK) been further strengthened, and what evidence is there of the positive outcomes of this investment in talent?

- What are the areas of fundamental research that have contributed to the growth of Mathematical Sciences enabling the impact highlighted in the case study?

- What was the role of collaborations in enabling the impact?

- What evidence is there that EPSRC-funded research has led to benefits to the end users, for example to businesses etc. in terms of cost savings, improvement of processes, maximizing their productivity, etc.?

- Which sectors have benefitted from the research that has been enabled by EPSRC funding and how?

- What is the novelty of the research that led to the impact?

- How does the impact from the research align with broader societal and governmental challenges?

- What would have happened in absence of EPSRC funding?

- What is the economic value or the quantified benefit of the impact that was enabled by the research?

- Why was the investment by EPSRC crucial/timely?

Expected outputs include, but are not limited to:

- Return on Investment figure for EPSRC's investment in Mathematical Sciences research over the last 10 years.
- A narrative detailing both qualitative and quantified benefits and impact of the investment over the last 10 years.
- A narrative detailing the current UK mathematical sciences landscape and the evolution over the past 10 years.
- 5 Case Studies, with at least two demonstrating the impact of investing in the provision of mathematically trained people, at least one demonstrating societal, health or environmental benefits, and one demonstrating the benefits of the Institute critical mass investments.

In answering the key questions for the programme evaluation, some of the lines of enquiry (not limited to) are:

Economic impact

Has the *Additional Funding Programme for Mathematical Sciences* increased the number of people with state-of-the art mathematical sciences knowledge in business, public sector and third sector enabling them to contribute to new products and processes, increased productivity, efficiency and better decision and policy making, for example:

- Is there yet any Return on Investment (ROI) from the *Additional Funding Programme for Mathematical Sciences*?
- To what extent has the programme produced (or is likely to produce) economic benefits in terms of employment, products and services, cost savings, efficiency etc.?
- To what extent has the programme contributed to growth of new businesses and improving business success?
- What is the Impact on supporting innovations, including new products/processes, patents and spinouts arising from the EPSRC portfolio?
- What is the effect of the programme on leverage and further funding?
- What has the effect of the research knowledge arising out of these investments been on cost saving/efficiency?
- What are the quantifiable benefits of the programme to future solutions in different economic sectors?

- To what extent has the programme contributed to private and inward investment in the UK?

- To what extent has the programme built on existing strengths in research and innovation to deliver benefits for their local economy?

- To what extent has the programme supported innovation-led regional growth?

Impact on research and research environment

To what extent and how has the programme contributed to the aim of achieving a vibrant diverse academic base in mathematical sciences throughout UK, for example:

- To what extent has the programme attracted high calibre individuals?

- To what extent has the programme been successful in increasing capability in Mathematical sciences research?

- To what extent has the programme enabled diversity in Mathematical sciences research?

- To what extent has the programme contributed to high end skills in public private and third sectors?

What has the research impact of the programme been, for example:

- What are the demonstrable strengths in EPSRC funded Mathematical Sciences research? How has the programme led to growth in research for current and future socio-economic solutions?

- What is the impact of the programme on different disciplines and sectors (type of research and problem solving in different areas)?[4]

- What engagement, collaboration and further funding has there been with different stakeholders in the programme (specially looking at key features and impact from the critical mass investments)?

- What has been the impact on enabling research in different disciplines/sectors (new users, research communities and lines of enquiry)?

- What has the impact been on advancing research in the areas of importance to UK Mathematical Sciences and/or enabling growth of new areas of research?

[4] The programme logic model can be found in Annex B

Has the investment enabled the continued UK reputation as a global leader in mathematical sciences, attracting people and businesses globally to work and invest in the UK, for example:

- How successful has the programme been in establishing and enhancing UK's research leadership in the area?
- How successful has the programme been in fostering collaborations between diverse groups (users, disciplines, policy makers, international and others)?
- To what extent has the programme successfully linked with users for example businesses and other users of its outputs and outcomes?
- To what extent has the programme enhanced local collaborations involving research and innovation?

Wider Impact

- What is the impact, or potential impact, of EPSRC funded Mathematical Sciences research on health, society, and the environment?
- To what extent the outcomes can be attributed to the Additional Funding Programme for Mathematical Sciences over EPSRC's core activity?
- Has the investment enabled and grown the UK national expertise available for the security and defence sector?
- Why was the investment in the Additional Funding Programme for Mathematical Sciences was crucial/timely?
- To what extent has the investment made mathematical sciences research outcomes available to be used by other research and innovation domains, for example:
- To what extent is the programme strengthening and building collaborations?
- What new relationships and collaborations are developing?

We envisage the use of data visualisation, analysis, narrative and case studies to demonstrate the impacts covering qualitative as well as quantified benefits wherever possible. Case studies should have information that will be useful for different audiences including Treasury/Government, business/investors, and the public. Some aspects that the case studies could bring out (not limited to) are:

- How has the people pipeline of trained mathematicians (across the breadth of the UK) been further strengthened, and what evidence is there of the positive outcomes of this investment in talent?

- What are the areas of fundamental research that have contributed to the growth of Mathematical Sciences enabling the impact highlighted in the case study?
- What was the role of collaborations in enabling the impact?
- What evidence is there that EPSRC-funded research has led to benefits to the end users, for example to businesses etc. in terms of cost savings, improvement of processes, maximizing their productivity, etc.?
- Which sectors have benefitted from the research that has been enabled by EPSRC funding and how?
- What is the novelty of the research that led to the impact?
- How does the impact from the research align with broader societal and governmental challenges?
- What would have happened in absence of EPSRC funding?
- What is the economic value or the quantified benefit of the impact that was enabled by the research?

Expected outputs include, but are not limited to:

- Return on Investment figure (either realised or likely in the future) for EPSRC's investment in Mathematical Sciences in relation to the *Additional Funding Programme for Mathematical Sciences* investment.
- A narrative detailing both qualitative and quantified benefits and impact of the *Additional Funding Programme for Mathematical Sciences*.

For each strand of the programme (PhD Studentships, Fellowships, Small Grants, Large Grants, and Institutes) at least three case studies, with at least one of each of these demonstrating the impact and benefits in relation to people aspects of the investments.

2.2 Objectives

Evaluation Objectives and Expectations

The Supplier must be able to deliver all elements of the deliverables in section 2.1 to achieve the following objectives (Further specifics are clarified in the relevant sections throughout the document):

- **Baseline for EPSRC funded- Mathematical Sciences Research over the last 10 years,**

The **UK ecosystem baseline exercise - Deliverables 1, 2 and 4 - July 2024 for Baseline and Feb 2024 for interim report** will provide a snapshot of the current UK mathematical sciences landscape and identify impacts that have been delivered in the last 10 years of EPSRC investment Mathematical Sciences research in the UK. It will include an evaluation of the socio-economic impacts that have been delivered by EPSRC's investment in Mathematical Science research over the last 10 years including a return-on-investment figure. Baselining will include finalisation of the monitoring and evaluation plan/framework.

- ***Additional Funding Programme for Mathematical Sciences*** **End of Programme Review (Y5)**

The ***Initial review of the Programme evaluation for the Additional Funding Programme*** *(**Deliverables 1 & 3)*** **- Interim review February 2024 -** initial review of the Programme evaluation for the Additional Funding Programme for Mathematical Sciences. This will include initial findings associated with the end of programme evaluation, with an assessment of progress against the objectives of the research funding programme. This will form the basis of a 'informal mid-term review' which will inform the strategy for the programme funding; being used to inform decisions and actions at different levels (programme level, UKRI level and for wider DSIT consideration).

The ***End of Programme Evaluation*** **- Deliverable 5 – July 2025** will review the overall programme against the programme objectives and expected outputs and the progress towards and potential for realisation of the expected programme outcomes and longer-term impacts, as assessed at the end of the programme.

3 Background to the Requirement

Mathematical Sciences is one of the key themes in EPSRC, where significant investments are made through several mechanisms to build UK's research leadership and capability in diverse and cutting-edge research – both within the Mathematical Sciences remit as well as to underpin a multitude of other disciplines.

The mechanisms include funding ideas generated by the research communities through individual investigator(s) led projects, EPSRC addressing specific needs through targeted strategic calls, and critical mass investments such as hubs and/or centres that are large investments bringing community and users together enabling a portfolio of people and projects in an organised manner to address specific challenges. Besides these there is also significant investment in skills and training for example through Centres for Doctoral training and Doctoral training partnerships to provide high quality doctoral training to students. EPSRC has funded more than six hundred individual investments in the Mathematical Sciences theme over the past 10 years through these mechanisms. The investment spans more than thirty research areas and has a combined investment value of over £248m currently invested in the landscape.

The research covered by these investments generate knowledge that benefit key economic sectors such as Aerospace, Automotive, Pharmaceuticals, Construction, Healthcare, Information and Technology, Electronics, Food and Beverages, Energy, and others. Economic impact is realised throughout these sectors though job creation, inward investment, the generation of new companies and commercialisation of the knowledge generated. Outside of the economic impact in these key economic sectors, impact of the research can be found across knowledge (e.g., scientific advances), society (e.g., policy, international development), people (e.g., trained/upskilled people).

Following the Prime Ministerial announcement in early 2020 about the *Additional Funding Programme for Mathematical Sciences*, it is timely to evaluate the EPSRC's investments in Mathematical Sciences over the past 10 years to assess what difference this investment will have. Furthermore, moving forward it will be critical to assess the impact of *Additional Funding Programme for Mathematical Sciences* and the wider Mathematical Sciences portfolio as well as to gather evidence that feeds into the case for Mathematical Sciences investment.

Over the past 10 years EPSRC has made investments of varying sizes and complexities to tackle, and further research, through the Mathematical Sciences theme. The awards are spread across over seventy Higher Educational organisations. Examples of projects funded by EPSRC and some of the outcomes can be viewed in Gateway to Research portal https://gtr.ukri.org/ by using appropriate search terms and filters.

4 Scope

4.1 Data and other information provided by EPSRC to help the study

- A set of funded research grants data for investments in Mathematical Sciences which will include title, awarded institution name, award value, partners on grants, their contributions, principal investigator (PI) name and a brief summary of the project.

- Outcomes data submitted by the PI in Researchfish against those grants that include narrative impact, key findings and any information provided on the following:
    - Collaborations and partnerships
    - Further funding
    - Engagement activities
    - Influence on policy
    - Research tools and methods
    - Research databases and models
    - Intellectual property and licensing
    - Medical products, interventions and clinical trials
    - Artistic and creative products
    - Software and technical products
    - Spinouts
    - Awards and recognition
    - Other outputs and knowledge
    - Use of facilities and resources
    - Secondments, placements and internships

  It should be noted that the quality of this data is highly dependent on the degree to which the PI completes the annual submissions.

- Any annual reports submitted to EPSRC in addition to the Researchfish data.

- A set REF case studies overviews from the 2021 REF exercise for those submitted that have received EPSRC support.

We anticipate the need for further collection of information especially those that will help capture the wider impacts and help with the economic impact/ROI calculations.

4.2 Interaction with Supplier

We expect the Supplier to work closely with EPSRC, the nominated EPSRC project officer, and the established evaluation advisory board to review the approaches and methods by which the questions posed in the study could be answered. Regular updates should be provided to the EPSRC project officer and the Additional Funding Programme Programme Board though online/email updates; these should include access to topic guides and other research material used to gather primary information. The Supplier will be expected to present the methodology to the steering board at the project inception meeting as well as present key findings at set intervals to the steering board to ensure that the project delivers a robust evaluation. The Supplier would be expected to act on any advice provided by the steering board that is within the scope of the evaluation.

4.3 Deliverables

- UK baseline of the Mathematical Sciences research ecosystem in the UK and impact evaluation - **interim deliverables 1, 2 and 4 (section 2.1)**
- End of programme review - **interim deliverable 1, 3 & 5 (section 2.1)**
- An ROI for EPSRC funded research in Mathematical Sciences, both over the last 10 years of investment and for the *Additional Funding Programme for Mathematical Sciences*.
    - An explanation of the methodology used for the ROI calculations (Assumptions and data to be provided to EPSRC as part of deliverables).
- A final report based on study findings, including the estimation of economic benefits of EPSRC funded Mathematical Sciences research (Returns on Investment, this includes the figures as well as a complete narrative on how these were obtained). This report should include an executive summary which can be distributed separately, as a standalone, for communications purposes.
- Case studies depicting the economic, scientific, and wider impact of EPSRC investments in Mathematical Sciences research. This should include:
    - For the baselining, at least two demonstrating the impact of investing in people, at least one demonstrating societal, health or environmental benefits, and one demonstrating the benefits of the Institute critical mass investments.

  - For the *Additional Funding Programme for Mathematical Sciences*, at least three case studies for each strand (PhD Studentships, Fellowships, Small Grants, Large Grants, and Institutes, with at least one of each of these demonstrating the impact and benefits in relation to people aspects of the investments.

- Datasets gathered as a result of the exercise (with reference to economic modelling and assumptions used for future reference by Government analysts).

- Other qualitative outputs generated.

- Any model or modelling tools used to estimate socio-economic impacts, including data sets utilised.

Some questions that should be considered for the impact and evaluation review deliverables can be seen below:

  - To what extent and how has the programme contributed to the aim of achieving a vibrant diverse academic base in mathematical sciences throughout UK?

  - Has the investment enabled the continued UK reputation as a global leader in mathematical sciences, attracting people and businesses globally to work and invest in the UK?

  - To what extent has the investment made mathematical sciences research outcomes available to be used by other research and innovation domains?

  - Has the *Additional Funding Programme for Mathematical Sciences* increased the number of people with state-of-the art mathematical sciences knowledge in business, public sector and third sector enabling them to contribute to new products and processes, increased productivity, efficiency and better decision and policy making?

  - Has the investment enabled and grown the UK national expertise available for the security and defence sector?

Like the plan in general, the framework and the questions above are presented as a starting point. We therefore expect that the plan and framework are evolved on a quarterly basis through further discussions with the steering board and EPSRC.

5 Requirement

EPSRC wishes to understand the socio-economic impact from the research in Mathematical Sciences that it has funded in the last 10 years, and a programme evaluation for the *Additional Funding Programme for Mathematical Sciences*. In particular the study wants to determine ROI of the publicly funded research investments, their impact on advancement and competitiveness of research and research led innovations alongside the value that it brings in terms of societal, environmental and health benefits. EPSRC particularly wishes to understand the impact EPSRC investment has made in terms of supporting the provision of the mathematical sciences talent pipeline and its impact on the wider UK society and economy. Alongside this, a baselining exercise and several evaluations, as outlined above, are expected.

The Supplier shall have appropriate methodologies in place for how the baseline, economic impact assessment and the evaluations will be undertaken, analysed and presented. The same applies to any analysis and the individual case studies.

The economic return should be calculated using a methodology that is compliant with Treasury Green Book and Magenta Book guidance (see more on methodology below), bearing in mind the challenges of quantifying benefits and impacts from fundamental research. The Supplier will be provided grants (input applications) and Researchfish (outcomes) data for projects identified within the portfolio of Mathematical Sciences research, should this be required. EPSRC would expect the Researchfish and grants data to provide the basis for analysing collaboration, leverage, and other outcomes from the portfolio, with any gaps in the information filled through secondary research methodologies (desk research, literature reviews, interviews, surveys etc.). In addition to the above, the expectation is to have case studies from each focus area of the critical mass investments (current if running for over three years, as well as completed). In addition to information from critical mass investments, the individual case studies should also include information from investments in the particular area made through other mechanisms for example investigator led projects, strategic initiatives, etc. The case studies should take a holistic view of the benefits arising in the area but aim to provide information on the mechanisms which enabled for example highlight benefits from the critical mass investments or individual projects as the case may be.

The Supplier shall implement appropriate methods (i.e., the sampling approach) and tools (i.e., face to face, phone interview, etc.). It is envisaged that each case study would develop their own impact narrative with clear range estimates on returns on investment / quantifiable benefits (where possible), to demonstrate the impact of EPSRC investment in Mathematical Sciences initiatives.

5.1 Methodology

EPSRC is eager to understand the socio-economic impact of EPSRC-funded research in Mathematical Sciences and expect the study to highlight demonstrable and quantifiable impacts. We understand that an assessment of economic impact might attempt to make a qualified quantifiable assessment of the economic value of the outputs that have been achieved by the projects and expect this to include an assessment of cost effectiveness i.e., the benefits relative to the costs of the projects.

The Supplier is expected to propose methodologies and plans of how they are going to progress and deliver this study addressing the challenges of impact assessment from investments in fundamental and low TRL applied research. *The Return-on-Investment calculations in particular should be based on robust assumptions and sound economic principles. The overall evaluation should follow government guidance on evaluations as outlined in the Magenta Book which is a complementary guidance to the H.M.Treasury Green Book.*

The study should clearly outline any assumptions that are used on any estimation. EPSRC would like to see these considerations in the proposal. Given the nature of the study there will be an expectation of relying on estimates drawn from the wider literature, the expectation is that proposals would highlight why these are the best and represent robust estimates in order to help the study draw quantifiable conclusions. Additionally, the Supplier should consider the challenges and limitations for the evaluation and propose measures to address these where it is feasible.

The case studies should be developed through in-depth exploration and analysis of evidence and where possible should include quantifiable information. Case studies should be developed such that it can be used for a variety of audience such as policy makers, government departments i.e., Treasury and DSIT, Ministers, general public and others.

Given the complex nature of the Mathematical Sciences sector that the *Additional Funding for Mathematical Sciences Programme* is aiming to impact, this evaluation will need a robust and fit for purpose evaluation methodology that takes care of all the complexities and subtleties of attribution, etc. The challenge will be to devise a concise methodology that will precisely evaluate the tangible and intangible aspects of the impact that the programme had on the UK.

It is anticipated a variety of methods will be used. The Supplier is expected to identify and justify the most appropriate method(s) and propose approaches to best evidencing attribution and the programme's contribution to the sector(s). The Supplier is expected to demonstrate how they shall be going about creating a proper baseline for the proposed evaluation.

Given the bespoke and complex nature of the Mathematical Sciences research landscape in the UK, the Supplier must be able to establish a credible baseline within the given constraints that must correctly reflect the landscape 'as is' in the absence of the *Additional Funding Programme for Mathematical Sciences* intervention.

The Supplier shall have appropriate methods for capturing and presenting this for projects that have already commenced under this programme, i.e., collecting data retrospectively, especially for those that have not put in place the appropriate data collection protocols.

It will not be possible to rely on programme administrative data to construct a baseline, therefore external data sources will also be required The Supplier shall identify and define the population for this aspect of the work.

6 Timetable

Completion date: Final completion July 2025

6.1 Table of Critical interim deliverables

Milestone	Deliverable	Date	Payment
1	Scoping report **(deliverable 1)**	30 September 2023	N/A
2	Interim report for Baseline evaluation and Interim report/mid-term review for Programme Evaluation **(deliverables 2 & 3)**	29 February 2024	**25% of contract payment** upon acceptance of report
3	Baseline Evaluation Report **(deliverable 4)**	31 July 2024	**25% of contract payment** upon acceptance of report
4	Programme Evaluation **(deliverable 5)**	31 July 2025	**50% of contract payment** upon acceptance of report

Milestones and deliverables will be discussed at the inception meeting and the outline plan revised accordingly within the first deliverable – the scoping report. It is envisaged the Supplier will work closely with EPSRC and the project advisory board to deliver and evolve the study as it progresses.

After the completion of each stage the EPSRC reserves the right to terminate the contract on grounds of performance and/or budget.

7 Social Value

The Supplier will be expected to align to the principles, obligations and aspirations set out in the Social Value Act (2012)[5]. The Supplier shall identify and deliver on Social Value initiatives as identified and agreed. The Supplier will be responsible for recording and reporting performance against agreed Social Value scorecards.

Based on the Social Value Model[6], UKRI have identified "**fighting climate change**" and "**tackling economic inequality**" as the Key Themes most relevant to this Contract. Information about the Key Themes is presented in the table below:

7.1 Table of Social Value Key Themes

Key Themes		
Theme:	**Fighting climate change**	**Tackling Economic Inequality**
Policy Outcome:	Effective stewardship of the environment	Create new businesses, new jobs and new skills.
Delivery Objectives (Activities that):	Deliver additional environmental benefits in the performance of the contract including working towards net zero greenhouse gas emissions. Influence staff, suppliers, customers and communities through the delivery of the contract to support environmental protection and improvement.	Create opportunities for entrepreneurship and help new, small organisations to grow, supporting economic growth and business creation. Create employment opportunities particularly for those who face barriers to employment and/or who are located in deprived areas. Create employment and training opportunities, particularly for people in industries with known skills shortages or in high growth sectors. Support educational attainment relevant to the contract, including training schemes that address skills gaps and result in recognised qualifications. Influence staff, suppliers, customers and communities through the delivery of the contract to support employment and skills opportunities in high growth sectors.

[5] Public Services (Social Value) Act 2012 (legislation.gov.uk)
[6] Procurement Policy Note 06/20 – taking account of social value in the award of central government contracts - GOV.UK (www.gov.uk)

Reporting Metrics:	May include: • Number of people-hours spent protecting and improving the environment under the contract, by UK region. • Number of green spaces created under the contract, by UK region. Annual: • Reduction in emissions of greenhouse gases arising from the performance of the contract, measured in metric tonnes carbon dioxide equivalents (MTCDE). • Reduction in water use arising from the performance of the contract, measured in litres. • Reduction in waste to landfill arising from the performance of the contract, measured in metric tonnes.	Number of full-time equivalent (FTE) employment opportunities created under the contract, by UK region. Number of apprenticeship opportunities (Level 2, 3, and 4+) created or retained under the contract, by UK region. Number of training opportunities (Level 2, 3, and 4+) created or retained under the contract, other than apprentices, by UK region. Number of people-hours of learning interventions delivered under the contract, by UK region.

Annex B: *Additional Funding Programme for Mathematical Sciences* Logic Model