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Department for
Science,
Innovation
& Technology

Research and analysis

DSIT Areas of Research Interest 2024

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Foreword

Dr Dave Smith, National Technology Adviser.

The Department for Science, Innovation and Technology (DSIT) was founded on 7 February 2023 by the Prime Minister to deliver on the government's ambition to be a global science, innovation and technology powerhouse.

DSIT's mission is to drive stronger growth, create jobs and encourage bold discoveries, cementing the UK's place as a science and technology superpower by 2030. The department will:

- Back UK science, technology and innovation and boost investment in the UK's most exciting technologies and sectors of the future, to grow the economy, provide societal benefit especially in health and create high value jobs.
- Tackle global challenges through international influence and partnerships to secure our future resilience and security.
- Improve lives by championing responsible innovation in the digital economy and public services.

Our collective mission will have a profound impact on the lives of people not only within our country but also across the globe.

The science and technology landscape is vast and complex - we require the strongest research and data to underpin our policy making. Following the creation of DSIT, this first publication of the departmental Areas of Research

Interest (ARI) document is an important step to support this requirement and DSIT's wider ambitions.

The work of DSIT is underpinned by world class evidence, analysis and research and we need the breadth of UK talent to help us add to it and keep it fresh. I am therefore delighted to have this opportunity to broaden and deepen its network of researchers and experts from across academia, industry. I encourage experts with relevant expertise to connect with the department to enhance DSIT's existing evidence base and strengthen further UK science and technology policy.

Dr Dave Smith, National Technology Adviser (NTA)

Introduction

The Department for Science, Innovation and Technology (DSIT) focuses on positioning the UK at the forefront of global scientific and technological advancement to deliver its mission: stronger growth, better jobs, and bold discoveries. It utilises the UK's strong foundations of world-class research, a thriving technology scene and global networks of collaboration to create a golden thread from outstanding basic science to innovations that change lives and sustain economic growth. It directs R&D, talent programmes, regulation and physical and digital infrastructure to support the UK's economy, security, public services and wider government priorities. To achieve this, the department must draw upon the highest quality science, research, and evidence to support policy and decision making.

The department's current high level priority outcomes are to:

- Optimise public R&D investment to support areas of relative UK strength and increase the level of private R&D to make our economy the most innovative in the world.
- Promote a diverse research and innovation system that connects discovery to new companies, growth and jobs – including by delivering world-class physical and digital infrastructure (such as gigabit broadband), making the UK the best place to start and grow a technology business and developing and attracting top talent.
- Put our public services – including the NHS and schools – at the forefront of innovation, championing new ways of working and the development of in-house STEM capability to improve outcomes for people.
- Strengthen international collaboration on science and technology in line with the Integrated Review, and ensure our researchers are able to continue to work with leading scientists in Europe and around the world.

- Deliver key legislative and regulatory reforms to drive competition and promote innovation, including the Data Protection and Digital Information Bill, the Digital Markets, Competition and Consumer Bill and our pro-innovation approach to regulating AI.
- Implement the Online Safety Act to keep British people, especially children, safe online.

DSIT aims to be evidence and data driven in its approach, drawing on a wide range of research and technical knowledge and building strong links with the science and research community. Ensuring that, as new trends, technologies, and potential risks develop, the department is aware of and can quickly make use of research advances.

What are ARIs?

The Areas of Research Interest (ARI) document highlights topics where DSIT is keen to develop and enrich its evidence. The purpose of the DSIT ARI publication is to promote collaboration across government and the wider scientific community. The ARI is not intended to constrain any research that is undertaken but to provide guidance about the topics where further research may be most likely to have a positive impact on DSIT policy. Further objectives of the ARI include:

- developing a network of researchers and experts from across academia, industry and the wider research community around departmental research interests.
- welcoming the submission of evidence that aligns with identified research topics to help build the evidence base and stimulate future collaboration.
- fostering a culture of using research and innovation within the department that sustains a continuous dialogue with external expertise.
- communicating departmental research interests to other government departments (OGDs) to allow cross-cutting themes to be identified and foster work around them.

DSIT recognises the value brought by engagement between the department and external experts and is keen to acknowledge this, where appropriate.

What is the scope of DSIT ARIs?

This ARI document articulates the key evidence needs of the department, collating some of our current research areas alongside longer term topics. Most

will be framed for departmental delivery outcomes needed in the next 2-5 years, although some areas of research interest have longer term trajectories. The document is a summary of topics and areas where DSIT officials have identified the scope and value of further research.

The ARI is neither exhaustive nor definitive and is intended to facilitate conversations with the wider research community. DSIT has evidence on all the topics raised in this document. The depth and strength of the evidence varies across the topics and DSIT is keen to strengthen its understanding of these policy issues. The ARI does not cover all of the department's research endeavours. DSIT remains interested in research that is outside the areas outlined, which may still be relevant to DSIT policy or delivery.

We hope that this document will help those applying to funding bodies by enabling proposals for new research to draw a direct line to DSIT's ARI and thus strengthen the case for the possible public impact of the research. We intend to update this ARI document at regular intervals. Further information on how to connect to DSIT is contained in the Section on Working with Us.

Evidence needs by policy area

Structure of DSIT

DSIT has two policy Director General (DG) led groups:

- Digital Technologies and Telecoms Group (DTG), focussing on delivering the government's ambitious digital and technology agenda, and
- Science Innovation and Growth Group (SIG) in DSIT is a key player in the UK government's efforts to promote science, technology, and business growth across the economy. SIG's approach to R&D investment across government helps to maximize investments in delivering on government priorities. The Group has been instrumental, and continues to make headway, in supporting the government's ambitious goals, from space to life sciences, and from quantum computing to engineering biology.

Under these DG led groups there are a number of Directorates to drive forward the department's priorities. Also included in these ARIs is Building Digital UK (BDUK) which is an executive agency, sponsored by the Department for Science, Innovation and Technology.

How to read the ARIs

This section is organised by DG group, with each constituent directorate then included alphabetically. For each policy area there is a brief summary and overview of their activities. Critical policy issues, evidence needs and questions have then been listed to capture the directorate's key topics of research interest. DSIT would encourage researchers to reflect on how their research activities and outputs might best contribute to these policy challenges.

DSIT welcomes and encourages a diversity of perspectives and viewpoints. The challenges raised by the ARIs cannot be clearly mapped to disciplines, methods or research traditions. Rather DSIT encourages researchers to develop new perspectives and understandings to allow the department to tackle these challenges

Digital Technology and Telecoms Group

Artificial Intelligence

Artificial Intelligence (AI) is the fastest growing deep technology in the world, with huge potential to rewrite the rules of entire industries, drive substantial economic growth and transform all areas of life. The UK is a global superpower in AI and is well placed to lead the world over the next decade as a genuine research and innovation powerhouse, a hive of global talent and a progressive regulatory and business environment. The department believes that AI will play a central part in delivering and enabling the goal of the UK becoming a science and technology superpower by 2030. To that end, significant work is being done to develop a comprehensive evidence base. We aim to further our understanding of global AI risks, the efficacy of AI safety mitigations, the impacts of AI in the economy and society, and the applicability of AI in public sector services, especially in the civil service as a workplace.

Key DSIT objectives for AI

The UK government is committed to being a global AI leader. We will keep pace with its constant evolution, harness its potential to enhance our lives, be a thought leader on its safe employment, and foster the tech talent and skills in the UK needed to support our aims. The National AI Strategy (https://www.gov.uk/government/publications/national-ai-strategy) provides a three-pillar structure to deliver this (but does not limit the varied extent of work happening across government):

- **Pillar One**: Invest and plan for the long-term needs of the AI ecosystem
  DSIT is responsible for ensuring that the critical enablers are in place and that the UK is attracting and retaining AI businesses, building a vibrant AI sector
- **Pillar Two**: Support the transition to an AI-enabled economy, reaching all sectors and regions
  DSIT sets the standards and overall ambition, supporting departments in diffusing AI throughout their sectors
- **Pillar Three**: Ensure the UK gets the national and international governance of AI technologies right
  DSIT is responsible for putting in place guardrails to drive safe, responsible AI innovation.

DSIT AI strategic approach

Our strategic approach to managing AI underpins all three of those pillars in the National AI Strategy. We divide them into five areas:

Boosting UK capability

- Ensure the UK is a great place to build AI
- Build UK strategic advantage, analyse ecosystem/supply chain
- Develop the UK's talent and skills base
- Develop the technical infrastructure to allow home-grown innovation
- Enable frontier AI R&D

Regulating effectively

- Establish an effective framework for regulating AI which drives safe, responsible innovation
- ·   Ensure our regulators have the capabilities and powers they need and coordinate effectively

Identifying, assessing and mitigating risks

- Conducting research on specific risks and effective mitigations across Central AI Risk Function (CAIRF) and the AI Safety institute (AISI).
- Leading cross Whitehall coordination to implement mitigations effectively

Driving international cooperation

- Ensuring that we are setting the direction internationally

Setting the direction across Whitehall

- Setting DSIT AI strategy and driving AI thought leadership across Whitehall
- Maintaining and sharing a coherent AI narrative

- Managing UK HMG engagement on AI

In the [National AI Strategy, (https://www.gov.uk/government/publications/national-ai-strategy)](https://www.gov.uk/government/publications/national-ai-strategy) the government made commitments to enrich our understanding of AI as it impacts the economy and society more broadly. Additionally, we recently launched a steering board chaired by the heads of both the government analysis and scientific functions, to ensure cohesive cross government approaches to understanding AI impacts. An overview of the high-level questions we are asking in this regard are outlined in the section below.

Some priority work we are currently developing to meet these commitments include:

- **An analysis of the AI White Paper consultation to feed into the formal consultation response**. This will allow us to take on feedback from the public and various key players in sectors across the economy, and better tailor policy interventions to support strategic AI aims.
- Establishing the **AI Safety Institute** to advance the world's knowledge of AI safety by carefully examining, evaluating, and testing new frontier AI systems. The Institute will conduct fundamental research on how to keep people safe in the face of fast and unpredictable progress in AI, improving our understanding of the capabilities and risks of AI systems.
- **A monitoring and evaluation framework for AI regulatory interventions** in tandem with the AI regulatory white paper. This will develop our understanding of key metrics to monitor with regards to AI governance and ecosystem impacts.
- **Research into the AI sector and supply**. Updating the AI Sector Study to establish a consistent and comparable set of economic indicators for the AI sector in terms of producers and suppliers. This study helps us to best understand where the AI sector needs support, to grow the sovereign capability of the UK in AI, in alignment with strategic priorities.
- **The development of a cross-economy national AI risk register**. Developed in tandem with a responsibility register that garnered cross Whitehall agreement on which departments hold which risks with regards to AI. The risk register will provide a single source of truth on AI risks which regulators, government departments, and external groups can use to prioritise further action.
- **Further research into Compute and the best ways to leverage compute to support the AI sector**. This will be key to informing our response to the future of compute review, and maximising the £1 billion+ investments in state-of-the-art compute.

Critical policy issues, evidence needs and questions
1. The impact of AI on the UK labour market

As AI technology advances, it may be possible to continue to automate an increasing number of human tasks. A research interest would be to understand the task breakdown of the UK labour market by sector and geography. Building on this, some scenario modelling (i.e. under different levels of AI capability) could be undertaken to test the extent to which jobs are likely to be lost.

- Occupations: What are the characteristics of occupations that put them more at risk of replacement/change or give them a comparative advantage? Over what time frame will they be impacted?
- Sectors: Which sectors are more likely to benefit from AI and which are more at risk from the downsides?
- Inequalities: What is the likelihood of impacts on different demographic groups and how that will affect equality of opportunity? Will this exacerbate/mitigate existing inequalities in the workforce?
- Indicators: What are the rapid indicators of AI impact on the labour market?
- Productivity: What are the possible direct and indirect productivity impacts of AI?
- Wages: What would be the impact of AI deployment at work on wages and costs for employees and employers?
- Market power: How will labour demand and supply elasticities change?

2. AI impacts on productivity and growth

- Macro productivity: To what extent does AI impact national productivity?
- Micro productivity: To what extent does AI impact firm level productivity?
- Quality or quantity: Does AI enable the delivery of better outputs and increased quality from firms and businesses?
- How should the UK position itself in terms of the global AI market? What sort of AI businesses should we particularly be looking to attract?

3. Other impacts of AI on economy and society

- What will the future of AI look like within the UK, and how can we monitor our progress towards the many possible scenarios?
- How will AI impact competition and innovation?
- What patterns are we likely to see in AI diffusion and adoption throughout the economy?
- How can we better understand the barriers to AI adoption?
- To what extent are the potential risks posed by highly capable AI systems a barrier to economy-wide adoption, and how could progress in AI safety overcome these barriers? How can we ensure that the UK population has the right AI skills for life and work?
- How can we ensure public attitudes to AI are positive, and maximise trust in safe AI?

- How will AI impact societal outcomes, especially regarding inequality, health and the environment?
- How will AI impact societal cohesion, including through trust in institutions and the government and through factionalism?

4. UK capabilities

- R&D: In which areas of AI R&D is the UK strongest? What are the most significant AI R&D opportunities for the UK? Which government interventions are most effective for boosting UK AI R&D (relative to such goals as economic growth, productivity and security)?
- Skills: How do we make sure the right skills are available to maintain a world-leading position in AI? And how do we ensure the labour force has the right skills to support individual opportunities?
- Talent: What is the role of international AI talent in UK prosperity? What are the AI talent flows into and out of the UK?
- Compute: What are the latent needs of the UK's AI ecosystem for compute resource?
- AI sector: What are the key opportunities for HMG to intervene that will support the growth of the UK AI sector?
- International comparisons: How do UK capabilities compare to international leaders (such as the US, China, France, South Korea, Singapore, Israel)? How do these governments' interventions and capabilities policies compare to the UK's?

5. How AI can be used to bring productivity gains to the public sector offering

- How can we ensure AI increases public sector productivity?
- Will investment in AI lead to reduced public sector costs in the long run?
- Will adoption of AI in key delivery departments contribute to more efficient and effective public services?
- What is needed to enable the public sector to adopt AI?
- How do we ensure that AI adoption in the public sector is safe?

6. How can we meaningfully assess the risks posed by AI and prepare for them?

- How can we ensure use of AI is ethical?
- How can we reduce bias when using AI?
- What risk assessment methods are best suited to risks from AI?
- Which data sources or key indicators should we be watching that may indicate major changes in the risk assessment, or new risks hitherto unidentified arising?

- What are the possible scenarios for various AI risks 1, 3, 5, 10 and more years from now?
- How can we attribute the role that AI had in causing a particular harm, rather than something else?
- What human systems are resilient to impacts from AI and which are less so?
- To what extent do AI companies face sufficient incentives to invest in risk measurement, prevention and mitigation?
- How can we apply the defence in depth approach to preparing for risks from AI?
- How can we best stress test the UK's playbooks for different risks becoming crises in an ongoing way?
- Which risks from AI are the most urgent to mitigate?

Building Digital UK

Building Digital UK (BDUK) is an executive agency of DSIT with a mission to ensure that homes and businesses across the UK can access fast and reliable digital connectivity.

We are responsible for the rollout of gigabit-capable broadband and the expansion of mobile coverage in hard-to-reach areas of the UK. Delivering our mission is a team effort across government, industry, local councils, devolved administrations, regulators, consumer groups and citizens. We work with these partners to ensure that people can access the reliable digital connectivity that can transform their lives.

The fast, reliable connections delivered by our programmes will level up mostly rural and remote communities across the UK, as well as tackling pockets of poor connectivity in urban areas. Closing this digital divide will enable people across the country, wherever they live and work, to grasp the opportunities that connectivity brings. Our work will:

- Create and support thousands of high-paid, high-skilled jobs. The digital connectivity we are delivering will also give people greater flexibility to work from any location, increasing employment opportunities in rural and remote locations. Innovators and wealth creators will be able to start-up and run a business of any size from anywhere in the UK, and then manage their business on the go.
- Provide people from remote areas with greater access to online services, including remote GP appointments, learning and training opportunities, and local government services.
- Enhance people's home life, with the ability to stream movies, TV and video games in higher quality onto multiple devices at the same time, with no

slowdowns in speed. Better connectivity also allows for more internet-connected smart appliances.

- Enable more people to stay connected, shop online and stream entertainment on the go, wherever they are in the UK, thanks to improved mobile coverage.

> BDUK wishes to develop a stronger evidence base around the **telecoms market** and how it functions at a national level. In these markets, BDUK is interested in increasing understanding of **infrastructure planning and decision making**, as well as how **infrastructure maintenance** can be ensured in the long term.
>
> BDUK would like more insight into the barriers to **delivery of gigabit and mobile roll-out across the UK** and what **technological innovations** may assist in this. **International comparisons** for gigabit and mobile connectivity roll out would also be beneficial.
>
> Cutting across all programmes, BDUK wants to understand more about the **impacts of fixed and mobile connectivity**, specifically how greater connectivity benefits businesses, residents and public sector organisations. In addition, BDUK also needs more evidence on the **behavioural changes** connectivity makes to **residents and businesses** which have been connected, and the wider impacts this may have. Lastly, BDUK is interested in more evidence on the **environmental impact** of its work.

Critical policy issues, evidence needs and questions

1. Telecoms market

- What incentivises and supports sharing of knowledge to promote sector-wide best practice in a competitive market place?
- To what extent can investment in the market be predicted? What factors incentivise and disincentivise investment into a supplier or subcontractor?
- To what extent would future market consolidation affect the different actors within the market and the performance of the market as a whole?
- What factors in the market increase the likelihood of future market consolidation and what barriers exist that decrease this likelihood? Why would an actor in the market pursue integration of another firm's network and why would they not?
- How would future market consolidation impact connectivity for businesses, public sector organisations and residential premises on different networks? What recommendations should be made to the UK government to prepare for these scenarios?

- To what extent is the market and actors within it able to withstand economic shocks?
- How would a retrenchment of the telecoms market affect: (i) market structure and market behaviour, (ii) outcomes for delivery, (iii) the general public?
- What is the financial capability of the broadband altnet market and how may this change over the next decade?
- What is the financial capability of the broadband subcontractor market and how may this change over the next decade?
- How is the broadband subcontractor market being affected by our programmes in terms of (i) supply and demand of services, (ii) quality of services, and (iii) accountability?
- What are some of the supply chain issues and risks associated with fibre deployment in the next 10 years? To what extent is the UK able to self-sufficiently, domestically produce, fibre and ducting for the needs of the market and to what extent is it reliant on imports?
- How will the mobile market be affected by reaching 95% coverage of the UK and increasing competitiveness across regions of the UK by 2030?

2. Infrastructure planning and decision making

- What are the key factors that influence a supplier's decision to include or exclude premises in area build plans? Are there ways to predict or model this behaviour within an area?
- What are the factors which lead to urban premises not having FTTP connectivity?
- To what extent is tactical blocking of fibre connectivity an issue within the market and which methods are most effective at overcoming it or accounting for it in strategic decision making?
- To what extent is overbuild an issue within the market and what characteristics make it a more or less favourable delivery decision for suppliers?
- To what extent are the networks being built adding to the resilience of national infrastructure?
- To what extent are network providers effectively planning their networks to ensure delays and additional cost are avoided?
- How do network providers differ in the surveying methods used and what efficiencies do particular methods have?
- How are approaches to delivery differing across regions in the UK and are different approaches needed to aid later delivery?
- To what extent are the decisions being made by network suppliers in where to build equitable both at the beginning of and during delivery (specifically considering the impact of descoping premises from delivery)?
- What other factors beyond cost to build affect the commerciality of a premise? And how may this change up to 2030?

- How do network providers, internet service providers and mobile connectivity providers plan and consider the risks of climate change within the UK to the longevity of infrastructure? Are their considerations and plans sufficient for the expected extent of climate change?

3. Infrastructure maintenance

- How might future extreme weather, such as flooding and storms, heatwaves, and wildfires, affect the reliability and durability of: (i) underground fibre ducting; (ii) overhead cabling; (iii) mobile masts; (iv) hybrid wireless solutions such as satellite connectivity; (v) system wide vulnerabilities?
- To what extent can efficiency in maintenance be gained by utilising existing public sector resources and assets to preserve or maintain our networks?
- To what extent is the market and actors within it able to withstand environmental and climate shocks to deliver a continuous and reliable service?

4. Delivery efficiency and management

- What are the barriers to delivery of fibre-to-the-premises across the UK? What possible solutions exist to these barriers?
- What are the barriers to delivery of full mobile coverage across the UK? What possible solutions exist to these barriers?
- How do delays to delivery impact: (i) the organisation delivering the network (ii) other actors in the telecom market (iii) the premises being delivered to (business and residential)? How does this impact vary based on the length of delay?
- What datasets, like streetworks data, could be used to verify open market review (OMR) plans of suppliers?
- How best can local context be incorporated into data received to understand how local events and human and natural geographical features of the area affect the speed of build and risks of delivery?
- How can Quality of Service data be quantified and measured as a consistent metric across BDUK delivery?

5. Technology usage and innovation

- What is the current forecast of non-fibre based technology (including anything capable of delivering speeds above superfast but below gigabit [30Mbps - 1Gbps], or speeds which exceeds gigabit [>1Gbps]) and its role in delivering broadband connectivity to homes and businesses where fibre is not feasible? What is the lifespan and redundancies of these technologies?
- What is the potential for future technologies in delivering mobile connectivity more efficiently and effectively than contemporary technologies e.g. low earth orbit satellite technology? What are the advantages and disadvantages of these technologies, including their feasibility and possible barriers to implementation?

- How does technology usage affect competitiveness in the market, for example delivery rates and value for money? How does this differ across technologies and organisations?

- What impact will the copper switch off have on the resilience for networks and their usage? How might it impact public sector service providers, such as care homes, emergency services and other NHS sites? How aware are customers that the copper switch off is taking place and what risks come from this for the market?

- How might Artificial Intelligence tools such as language models be useful in: i) processing delivery data ii) increasing understanding of geospatial areas and associated risks of delivery?

6. International comparisons

- How have other countries delivered gigabit connectivity in difficult areas? This includes (i) urban areas, such as cobble streets, (ii) and rural areas characterised by difficult terrain or where existing infrastructure is lacking?

- How does the growth in gigabit-capable connectivity in the UK compare to other countries? In particular, how does the UK compare to France, Spain, the United States, South Korea? What factors contribute to this? What can the UK learn from gigabit roll-out in other countries with similar geographies/populations/characteristics such as New Zealand?

- How does the UK compare to other countries in respect to 4G mobile coverage? In particular, how does the UK compare to G7 and EU countries? What factors contribute to this? What can the UK learn from 4G mobile roll-out in other countries?

7. Impacts and usage of improved fixed connectivity

- How does the benefits of connectivity change for the end user when there is an increase from superfast to gigabit compared to a change from sub-superfast to gigabit and sub-superfast to superfast?

- What benefits of increased connectivity can still be achieved at sub-gigabit speeds which are still above ultrafast (300-999 mbps)? How do the benefits compare at different levels; for example, what are the benefits at 600 mbps versus 700 mbps? How do these differences in benefits change over time?

- How does improved fixed and mobile connectivity impact the different utilities services and networks within the UK?

- For how long will gigabit capable speeds be sufficient for (i) residential premises; (ii) business premises; (iii) public sector organisations?

- What will gigabit capable speeds not be sufficient for, and will this interact with overall network capacity and/or government ambitions? Does this differ for other characteristics of connectivity such as bandwidth and latency?

- What are the benefits of connectivity that fibre, cable and other fixed technologies deliver in terms of their improved quality of service to the end user? How can this be understood in terms of its economic impacts?

- How has gigabit connectivity and the digital harmonisation, or moving a variety of services onto one system, of local public services affected; (i) how they're delivered, (ii) how they're used, (iii) future coverage within that local area, (iv) technological innovation within that local authority?
- What are some of the barriers local authorities experience in using gigabit connectivity and extracting the most value from digitally harmonised services?
- To what extent is wide-spread connectivity contributing to a growth in digital citizenship? How can we determine what is attributable to BDUK's interventions and monetise their benefits?
- What risks does digital first public services/digital citizenship pose to the digitally excluded?

8. Impacts and usage of improved mobile connectivity

- How can benefits of 4G mobile connectivity be monetised for areas where very few people live? Are there international examples, such as national parks from across the world, that are comparable?
- What is the interaction between mobile and fixed connectivity? What is the role of 4G mobile connectivity in people's online access compared to broadband/fixed access? Are there certain benefits or disbenefits which are only achieved with both mobile and fixed connectivity?
- Could 4G mobile connectivity be enough, especially for extremely isolated populations that would be extremely costly to connect with fibre? For how long could 4G coverage be sufficient instead of broadband for (i) a residential premise; (ii) a business premise? To what extent is there demand in these communities for broadband connectivity?
- What benefits do consumers gain from offering a wider selection of mobile providers through the expansion of mobile connectivity in areas with partial coverage?
- How does introducing 4G mobile coverage to areas which previously had no coverage impact the entire area? How does it affect the local industries and does it allow for new emergent industries? How does it impact local ways of life, tourism, educational facilities, safety for residents and visitors, and leisure activities? Are there international case studies of this happening?
- What kind of methods exist for tracking data usage from tourists or transient visitors to an area where 4G mobile connectivity has recently been installed? How can this be used to monetise and evaluate the socio-economic benefits of installing 4G mobile connectivity?
- How does the upgrade in mobile connectivity from 4G to 5G impact end users, both positively and negatively? Additionally, what changes in usage does this upgrade cause for both residential and business users? How can the impact of this uplift be monetised?
- To what extent are individuals without landline based connectivity at greater risk of exclusion?

- How does the mobile network landscape differ by quality and capacity across the UK for rural and urban areas? Additionally, how does this differ for transport specific contexts?

9. Residential and business behaviour change

- How might wide-spread take-up of gigabit connectivity affect an individual's daily life? What impact might it have on; (i) spending/saving habits, (ii) occupation, (iii) location of residence, (iv) education, (v) health (including wellbeing)? How does this differ for different demographic groups?
- How might wide-spread take-up of 4G mobile connectivity affect an individual's daily life? What impact might it have on; (i) spending/saving habits, (ii) occupation, (iii) location of residence, (iv) education, (v) health (including wellbeing)? How does this differ for different demographic groups?
- How does wide-spread take-up of gigabit connectivity affect businesses on a local and national level? What impact might it have on (i) productivity, including Business-to-Business transactions [for further relevant questions on productivity see Digital Infrastructure section 1], (ii) competition, (iii) economic performance, (iv) human capital? How does this differ for different business sectors?
- How does wide-spread take-up of 4G mobile connectivity affect businesses on a local and national level? What impact might it have on (i) productivity, (ii) competition, (iii) economic performance, (iv) human capital? How does this differ for different business sectors?
- What are some of the emergent technologies which will increase the need for gigabit connectivity for (i) residential premises; (ii) business premises?
- What are some of the key drivers and enablers for take-up of gigabit-speed connectivity for (i) residential premises; (ii) business premises? [question of relevance to Digital Infrastructure, as seen in their section 1]

10. Environmental impact

- What is the full carbon life cycle of fibre? How does this differ where different machineries and processes are used? Are there possible emissions savings that could be made across the lifecycle? What are the ways in which these savings could be implemented or influenced by BDUK or other actors in the market?
- How long does it take for the CO_2eq emissions from the production, shipping, installation and use of fibre to result in a net emission saving over use of copper?
- How do low or no emission power methods for 4G mobile masts, such as wind, solar, hydrogen, and other methods, compare to diesel generation powering in terms of ;(i) viability, (ii) reliability, (iii) durability, (iv) cost to operate?
- How does access to a gigabit connection affect CO_2eq emissions for; (i) a household, (ii) a business, (iii) a public sector organisation?

- To what extent does increased connectivity increase teleworking? How does this change in teleworking impact emissions from commuting and business travel?
- How does increased data usage affect power consumption at server and data centres?
- What is the overall impact of gigabit connectivity and 4G mobile connectivity on the government's target to achieve net zero by 2050?
- What are some of the emergent environmental and ecological benefits of fixed and 4G mobile connectivity? For example, could 4G mobile connectivity help rewilding and biodiversity projects by aiding in wildlife tracking? Could increased fixed connectivity support greater use of sensors with IOT, for example, to track water quality? How significant of an impact would this be?
- What is the overall impact of telecoms on biodiversity within the UK? This includes; (i) domestic manufacturing, (ii) shipping, (iii) installation, (iv) maintenance (v) passive existence of infrastructure?
- How can BDUK determine and understand what biodiversity impacts are attributable to our interventions?
- What will be the environmental impact of the copper switch-off and recovery of copper wiring? This includes the emissions used to recover the copper wiring, and the emissions savings from reduced need to mine and refine copper?
- What examples of environmental added value from other government funded infrastructure projects are there, either domestically or internationally? How could these help BDUK support government environmental goals, like those associated with tree planting and peatland restoration, alongside its primary target of fixed and mobile connectivity? How can we learn from these projects in terms of improving environmental reporting particularly regarding the supply chain for these projects?

Cyber Security and Digital Identity (CSDI)

The Cyber Security and Digital Identity (CSDI) directorate is leading departmental policies to make the UK the safest place to live and work online. As part of the government's [National Cyber Strategy (https://www.gov.uk/government/publications/national-cyber-strategy-2022)](https://www.gov.uk/government/publications/national-cyber-strategy-2022), the directorate works to make the digital economy secure for people and businesses by driving improved cyber risk management across the economy, setting cyber security standards, designing risk out of the system, and growing our cyber capability.

We are also enabling the secure and trusted adoption of digital identity technology so people can prove their identity online and unlock the full benefits of our digital economy. Both these pieces of work are part of DSIT's mission to

increase economic growth and develop an economy which is creative, innovative and works for everyone.

DSIT works with the National Cyber Security Centre (NCSC) to support the objectives in the National Cyber Strategy. DSIT leads on two of the strategy's five pillars (Pillar 1: UK Cyber Ecosystem, and Pillar 3: Technology Advantage), and supports on a third (Pillar 2: Cyber Resilience). We work with the NCSC, other government departments and industry partners to deliver a range of interventions:

- On standards, we develop and deliver cyber security standards, such as codes of practice for minimum security requirements in connected technologies and in organisations. These include the Cyber Essentials certification scheme, guidelines for secure AI system development, the Code of Practice for Consumer IoT Security which now forms the basis of the relevant ETSI standard, the Code of practice for app store operators and app developers and the Board Toolkit;

- On regulation, we are implementing the Product Security and Telecommunications Infrastructure Act to ensure that connected devices available to UK consumers meet minimum security standards, and we are updating the Security of Network and Information Systems Regulations (NIS Regulations) to support regulators to ensure that our critical national infrastructure is resilient against cyber threats;

- To professionalise the cyber workforce we have established the UK Cyber Security Council to set standards. To encourage more people to follow a pathway into the cyber workforce we deliver programmes like Cyber Explorers and Upskill in Cyber;

- To develop the cyber ecosystem we deliver programmes like Cyber Runway to help cyber firms grow and innovate, the Cyber Academic Startup Accelerator Programme to help commercialise academic innovation and the UKC3 programme to build the ecosystem across all regions of the UK.

As well as evaluating and optimising these cyber interventions, the directorate spends a significant amount of time identifying where further government action is needed and seeking industry views on priority areas such as IoT security and the governance of cyber risk.

In order to ensure the UK is well protected now and in the future we need to build upon our existing knowledge of **cyber security risks and the resilience of software supply chains** and are working to identify which mitigations the government can leverage to ensure the UK is well protected now and in the future.

We're also assessing the **impact of these mitigations** in driving enhanced security measures. A key area of research interest therefore is **understanding the consequences of requiring higher levels of cyber security** for products and digital services sold in the UK. Strengthening this

evidence base will help shape and inform future policy work around the regulation of products and business requirements for cyber security.

Some technologies are critical to cyberspace. To build and sustain a competitive edge in cyber-related technologies we need a coordinated, rigorous and consistent approach to identify and analyse critical areas of science and technology and prioritise national effort. CSDI is interested in being able to **better anticipate the science and technology developments most vital to UK cyber power and in analysing the cyber opportunities and risks related to those developments**.

It is crucial to ensure that digital identity solutions are both secure and inclusive. The directorate seeks to gather further evidence on how best to enable more inclusive digital identity services whilst maintaining robust security measures. Digital identity solutions enable a person to prove something about themselves for the purposes of a transaction, an eligibility check or accessing services. This includes verifying a person's age when purchasing age regulated products, when undertaking pre-employment checks or opening a bank account. The government is not mandating a specific approach, but instead has committed to setting outcomes-based standards in the form of the [UK digital identity & attributes trust framework (https://www.gov.uk/government/publications/uk-digital-identity-and-attributes-trust-framework-beta-version/uk-digital-identity-and-attributes-trust-framework-beta-version)](https://www.gov.uk/government/publications/uk-digital-identity-and-attributes-trust-framework-beta-version/uk-digital-identity-and-attributes-trust-framework-beta-version). Organisations that adhere to these standards and agree to oversight from the Office for Digital Identities and Attributes (OfDIA) will receive a trust mark, so that businesses and individuals can be confident that their digital identity solution is safe and secure.

Critical policy issues, evidence needs and questions

1. Efficacy of cyber interventions

- What cyber interventions that DSIT or NCSC runs are the most effective at reducing cyber incidents and improving cyber resilience? How effective are the NIS Regulations at securing operators of essential services in the UK? How effective is carrying out each of the 10 Steps to Cyber Security at reducing cyber risk?

- Are regulatory measures more effective at reducing cyber security incidents / breaches than non-regulatory measures? What other measures could be introduced to improve the adoption of cyber security measures - how and at what cost? How is this best measured?

- How could interventions be improved to reduce cyber risks posed by organisations and the economy? Do some interventions work better for some sectors, sizes or maturities of a company? How can we best visualise this and classify? Does organisational structure play a role in how effective certain interventions are? Is there a need for different types of intervention for different sectors and structures?

- What behavioural and attitudinal considerations can be mapped in this area and how do we encourage good behaviours across organisations?
- What are the most cost-effective interventions for improving an organisation's cyber security risk or network of interventions? How well do current government interventions support these?
- What are the systemic links between the growth of the UK cyber sector and the efficacy of cyber interventions? Does growth of the cyber sector have an inverse relationship with the impact of interventions? What are the reinforcement and control loops in this system?
- What are the barriers and opportunities for external investment in UK cyber sector companies? To what extent are these specific to cyber versus reflecting the UK investment landscape overall? What can be done to encourage investors to look at cyber companies based outside London and the South East?

How can we measure the efficacy of DSIT's growth, innovation and skills interventions in growing a thriving and innovative domestic cyber sector and a growing talent pool of cyber professionals?

2. Adoption of cyber security

- What cyber interventions that DSIT or NCSC runs are most likely to be adopted and what is the positive impact of these? What drivers exist for the adoption of these? What are the barriers to adoption? Do sectors with more stringent regulatory measures see higher adoption of cyber security principles than non-regulatory driven protocols? What other non-UK government frameworks matter most to organisations?
- What are the most appropriate measures for adoption? What do different measures look like for cost effectiveness, availability of information or resource, ease of implementation, prospect of mitigated data/financial losses due to cyber breaches?
- How could incentives for cyber security adoption and change, to reduce cyber risk, be posed to organisations? Is there a need for different types of incentivisation for different sectors or differing sizes of organisations?
- What evidence is there for not embedding adequate cyber security in highly commercialised or direct-to-consumer tech? What evidence is there on cyber security not being embedded adequately in sectors with lower regulation?
- Are there different hierarchies, professional groups or user types and behaviours that aid or block cyber security implementation? How do we best understand this both quantitatively and qualitatively?
- What is the most effective measure for cyber security upskilling and embedding that the UK government promotes or could promote?
- How can diversity in the cyber security workforce be improved? What can be done to have immediate impact and what should be done to affect long-term change?

- How can organisations be encouraged or incentivised to take on more entry level cyber security roles, including apprenticeships?
- What are the systemic linkages between the cyber security skills shortage and other government cyber interventions?
- In what ways can cyber security effectively share the UK technology talent pool with other priority industries?
- How are cyber security careers perceived and how is this changing over time? What can be done to mitigate negative perceptions of cyber security careers?
- How might automation, machine learning/AI change the way in which cyber security services are currently delivered? Do these changes lead to a reduction or even an increase in demand for cyber security skills, products and services
- How effective is UK government messaging and guidance on adopting cyber security? Do some messages land better than others? Why? With whom?
- Which businesses or sectors consistently have lower cybersecurity adoption rates and is this affected by regulation levels in those sectors?
- What are the economic incentives that drive cyber security?

3. Economic consideration of cyber security practices

- How does cyber security impact the price or competitiveness of a product or service? Does greater cyber security increase the price of goods and services? How much of a difference does it make to the price of products and services? If they internalise these costs, how much is the cost to the manufacturer/supplier? Are more secure products and services out competing competitors due to being more secure or are cheaper alternatives (with less security) more competitive in the marketplace? Does greater security of UK products lead to them outcompeting other brands on the international stage? Are UK products considered premium products internationally due to greater security by design? Does security provide a competitive advantage both within the UK market and internationally?
- What are the costs associated with higher levels of cyber security services or regulated businesses (e.g. those under NIS regulation), in regards to products and services? Who pays for these costs? If they are passed onto the consumer then how is this incorporated into the product or service? How can price differentials be clearly identified?
- What can the current evidence and available economic data tell us regarding price modelling, taking into account global supply chains where relevant?
- What is the trade-off of cost compared to security that companies are seeing? Could the cost of security cause businesses to minimise or abstain from effective security protocols and codes of practice that are produced by governments, regulators and international organisations/bodies? If so, what could be done to mitigate this risk?
- How can government intervention best foster and encourage innovation that becomes globally foundational to securely operating digital systems? What is

the cyber equivalent of the three-point belt? How do we maximise the chances that the UK cyber ecosystem begets such an invention?

4. Cyber security of technologies and services

- What are the critical emerging technologies on the 5, 10, and 15-year horizon which have the potential to change cyberspace or impact on the UK's cyber-power and strategic advantage? What novel critical applications of existing technologies could have the potential to transform cyberspace? How should emerging technologies be prioritised for cyber security research?

- What is the most effective method for incentivising responsible technology design, in terms of cyber security? What are the barriers or blockers for using secure by design principles for cyber security of emerging connected technologies? Where have we seen successes in adopting secure by design principles for connected technologies? Is there a gold-standard or case study where security of a product has been considered during early inception? Has that led to greater security of the product and fewer breaches?

- How can connected technologies can be secured when liability and responsibility of product security is unclear, due to convergence of technologies and systems. I.e., taking a system-of-systems approach, how can holistic and robust cyber security be ensured? What is the series of measures required to safeguard the whole system? For example, a taxonomy of cyber security risks and threats from the research phase through to product development, deployment and embedding with other technologies and systems. How could the UK produce a world-leading approach to securing emerging technologies through an end-to-end process?

- What are the most common connected technology convergence points we will see realised in the UK in the next 5-10 years? What are the applications of these converged connected technologies? Which sectors will be most impacted? Will there be an increased cyber attack surface for converged technologies? How can the cyber security of converged technologies be managed?

- Does the cyber security of AI models need to follow any novel principles that aren't set out under existing policy and technology security principles? If so, what are these measures and how do the differ from what exists? How do the vulnerabilities/risk of AI model security differ from existing cyber threats?

- Does deploying AI models in an existing process or system increase the attack surface of the host system? If so, how can this be mitigated? Who would be the owners for securing against those vulnerabilities and, where this is unclear, should organisations be sharing knowledge and security ownership, across the technology stack and system of deployment? Analyse and examine the full extent and range of cyber security risks to the UK economy in software development, distribution and supply chains. Identify what risks to the UK's cyber resilience are introduced through software supply chains by software vendors and users? Which are the highest profile risks? We are interested in B2B/enterprise software rather than consumer software but including: operational technology, IT and cloud and on-premise.

- Where are the biggest risks from - developers, vendors, customers? Where could government intervention help to improve the cyber resilience of software supply chains? Explore case studies of different contexts, for example: (i) most recent significant attacks, incidents and exploited vulnerabilities and their causes and (ii) statistics on attacks, breaches and prevalence of software vulnerabilities. What are the biggest/most urgent software supply chain risks to the UK economy (that companies face)?

- What could the government and/or industry do to help improve the cyber resilience of software supply chains?

- How can we build agility into software policy to ensure policy remains dynamic?

- What do we foresee as future risks in this space and how might we best futureproof the UK?

- What measures and prioritisation tools can be used to better evaluate and target cyber risks with government interventions?

5. Importance of inclusion for digital identity solutions

- How inclusive is the evolving digital identity ecosystem? What are the barriers to inclusion within the system? What are the benefits of digital identity to individuals and businesses? How can we ensure the UK's digital identity ecosystem is secure? Within the current market which groups are disproportionately affected or are more likely to become left behind as digital identity solutions become more widespread? What are some of the consequences of having excluded groups? Are there differences across different sectors or use cases? How can we build trust in digital identity solutions?

- How can governance and standards frameworks encourage greater inclusion and security across the ecosystem? What would a good framework for measuring inclusion in digital identity markets look like? How can we minimise security and privacy risks within digital identity solutions?

- If digital identity solutions become more widespread, what are the impacts this could have on marginalised groups? What further interventions could be implemented to improve access for these groups?

Data Policy (DP)

The Data Policy (DP) directorate exists to drive forward policies to build a world-leading data economy; unlock the power of data across government, the wider economy and society, all while maintaining trust and confidence in its use. The generation and use of data drives innovation, supports trade, improves public safety and bolsters national security capabilities. DP's aim is to make the UK the world's number one data destination: an open, welcoming and secure beacon for companies from all over the world to use and share data to innovate

and grow their businesses, and a place where data is shared and used to make life better for people across the UK.

The [National Data Strategy (https://www.gov.uk/government/publications/uk-national-data-strategy/national-data-strategy)](https://www.gov.uk/government/publications/uk-national-data-strategy/national-data-strategy) (NDS) sets out and defines the core pillars for unlocking the power of data and the priority areas of action for the government. The directorate's key policy areas are defined by the individual missions of the NDS, focussing on Missions one, two, four and five. Mission three is owned by the Cabinet Office.

- Mission one - unlocking the value of data across the economy
- Mission two - securing a pro-growth and trusted data regime
- Mission three - transforming government's use of data to drive efficiency and improve public services
- Mission four - ensuring the security and resilience of the infrastructure on which data relies
- Mission five - championing the international flow of data

In order to achieve these missions, DP must build upon the research and evidence that informs its knowledge base and underpins its policies. Below articulates the directorate's critical policy issues and questions identified in response to the NDS missions. Key focus areas include **defining and monitoring the data ecosystem and economy, generating evidence for intervention and understanding the impacts of policies**.

DSIT is committed to **improving data sharing**. The [NDS Mission 1 Policy Framework (https://www.gov.uk/government/publications/national-data-strategy-mission-1-policy-framework-unlocking-the-value-of-data-across-the-economy/national-data-strategy-mission-1-policy-framework-unlocking-the-value-of-data-across-the-economy)](https://www.gov.uk/government/publications/national-data-strategy-mission-1-policy-framework-unlocking-the-value-of-data-across-the-economy/national-data-strategy-mission-1-policy-framework-unlocking-the-value-of-data-across-the-economy) outlines the principles for intervention and priority areas for action for unlocking data value. Addressing the barriers to optimal data use and reuse is an important area of interest.

The government has held a consultation on reforms to the UK's **data protection regime**. The approach for data protection change is set out in the documentation for a [new data direction (https://www.gov.uk/government/consultations/data-a-new-direction/outcome/data-a-new-direction-government-response-to-consultation#about-the-consultation)](https://www.gov.uk/government/consultations/data-a-new-direction/outcome/data-a-new-direction-government-response-to-consultation#about-the-consultation). DP is working to ensure that UK [GDPR (https://www.gov.uk/data-protection)](https://www.gov.uk/data-protection), the ICO and other parts of the data protection regime are fit for purpose. Evidence relating to **privacy and trust** in data and data use and the impacts of **data regulation** would help to address some of the directorate's key questions.

DP wants to broaden its understanding of **data infrastructure** and strengthen its evidence base on data centres, cyber security and resilience. The environmental impacts of data use is a key area of research interest.

It is important to advance our knowledge of international data flows and how they shape and influence the global data system. Addressing the evidence gap on the value of data flows as well as the volume of data is of key interest.

Critical policy issues, evidence needs and questions
Mission one - increasing data sharing
Mission two - ensuring data protection is fit for purpose

1. Market failures in the data market

- What are barriers to data sharing in general and for businesses and scientific/research institutions in particular?
- What are the barriers to accessing public sector data in particular.
- How should government approach public sector valuation to encourage further utilisation of datasets. What are some effective models to provide access to sensitive public datasets for research purposes.

2. Drivers of data use

- What impact did data regulations (linking to data prospects consultation (https://www.gov.uk/government/consultations/data-a-new-direction/outcome/data-a-new-direction-government-response-to-consultation) and Impact Assessments (https://bills.parliament.uk/bills/3322/publications)) have on data sharing? What should we expect from the Government's proposed changes?
- What are the potential cases and market failures Privacy Enhancing Technologies (PET) might help to resolve? What are the potential barriers to their adoption? What are some of the most adopted PETs in use in the UK?
- What is the nature of the relationship between data and productivity? How does this influence business motivation to share/use data?
- Data as a rival and nonrival economic good: Is there evidence that data privacy laws centred around individuals' rights might hinder realising collective benefits? What are the potential remedies and interventions to resolve that?

3. Data protection

- What are the direct and indirect costs to different sizes of organisations of adopting and navigating data protection regulations?
- What is the relationship of citizens and individuals with their data, and how do they behave online? What drives and encourages them to share data and what doesn't? How might upcoming changes in data legislation effect citizens' willingness to share data.
- What is the opinion of Internet users on cookie pop up banners. How would they prefer to be informed and aware of cookie usage, what is the right

balance between that and a frictionless online experience.

4. Research and innovation

- What role does cloud and computing play in enabling efficient research? Are there any current market failures that the government should be seeking to remedy and how could it intervene?
- What is the relationship between research led innovation and commercialisation in the UK? What are the determinants of this relationship? What are the tools required for research to lead to innovation? What are the barriers, if any.

5. Competition

- How competitive are data markets? What are the drivers behind concentration in some areas? What are the barriers to enabling more competition?
- How can the government facilitate data-driven innovation and boost competitiveness in data intensive sectors without adversely disrupting markets and investment in data capabilities?

Mission four - data infrastructure

6. Data infrastructure

- How secure and resilient is data infrastructure (DI) in the UK? Which systems in the sector should be designated Critical National Infrastructure (CNI) and how? What are the risks (social and economic) to the UK of less-than-ideal levels of security and resilience?
- What are the costs of cloud and data centre outages to businesses? Is there scope for government intervention to provide transparency or prevention for any issues in this space?
- How much capacity do UK centres have, and is it sufficient for domestic uses? How much reliance is there on data centres abroad? How might technological advances such as in the field of AI affect future demand for data centre processing power and can the sector cope with such changes?
- What is the state of trust in digital environments and applications (including data-processing applications such as AI)? How does this influence use of and investment in data infrastructure?
- What are the trade-offs between data access, openness and security? How should we consider and measure the pros/cons, risks and opportunities of restrictions on international flows of data, such as the impact of trade restrictions? How do we identify the appropriate balance between a healthy, competitive market with ensuring that rules are in place to ensure the safety and resilience of the data infrastructure and its users?

Mission five - international data flows

7. Data flows

- Can global data flows be mapped? What is the relationship between the volume and value of data flows?

- Is there a way we can extrapolate the value of data flows based on the volume of exchanges? What is the link between international data flows and trade?

- What is the impact of data security measures on international data flows?

- How confident and aware are UK citizens and businesses about the domestic data protection regime vis-à-vis those used in other countries? Are there any such concerns preventing them from sharing data internationally?

- What are the benefits of securing data adequacy with the rest of the world? What is the added value of data adequacy, especially to small and medium firms, in comparison to using alternative transfer mechanisms such as standard contractual clauses? Do businesses use such contractual clauses even where data bridge (adequacy) agreements are in place, and if so why.

- Are there any benefits to data localisation - economic, security, scientific and tech leadership? What are the costs?

Digital Economy Unit

The Digital Economy Unit aims to provide coherence across the digital policy space. The directorate focuses on the investment, people, ideas, emerging technologies immersive worlds, and regulation needed for the digital economy to grow and flourish. It also brings together the conversation with the biggest technology players across government and takes on tactical pieces of work which can define tomorrow's, increasingly digital, economy and society. The objectives are:

- To foster an environment in which technology can fuel economic growth, such as supporting businesses to scale and invest in the UK;

- Promoting emerging technologies such as Blockchain and virtual worlds;

- Making sure that the market frameworks that regulate the digital economy are fit for purpose;

- Harnessing the power of digital innovation for the benefit of UK businesses and consumers.

The Digital Economy Unit (DEU) wants to probe and develop evidence on **the adoption and potential impact of emerging technologies digital regulation on consumer choice, and the impacts of the new pro-competition digital markets regime**. Already, through the Plan for Digital Regulation (https://www.gov.uk/government/publications/digital-regulation-driving-growth-and-unlocking-innovation/digital-regulation-driving-growth-and-unlocking-

innovation), the government launched a conversation about how to set the right rules for governing the digital economy.

The Directorate is committed to **monitoring and evaluations** to inform progress against specific policy measures and the Plan for Digital Regulation. The current key objectives in this regard are delivering:

- An outcomes monitoring framework (https://www.gov.uk/government/publications/digital-regulation-driving-growth-and-unlocking-innovation/plan-for-digital-regulation-outcomes-monitoring-framework-2023) to **monitor trends on key areas of the digital ecosystem** that the government is seeking to influence, through regulation alongside broader policy measures.
- Developing and implementing a **monitoring and evaluation plan** for the new pro-competition regime for digital markets.
- Evaluations of specific governance, regulatory or spending measures.
- Research projects to provide an **overarching view of impacts and learning** on regulatory measures' implementation.

The directorate is also interested in forward looking /exploratory research that can inform policy design:

- Research projects on **consumer choice in the digital environment**.
- **Digital workforce** - understanding how to develop **workforces** to ensure we have the skills needed for the UK now, and in the future. This includes considerations around **recruitment, retention and progression**; and tackling diversity issues in digital and technology jobs. It is vital for the UK to ensure that our workforces are skilled and representative of the population as a whole, so that our systems are designed and built for the needs of everyone.
- **Digital ecosystems in UK regions** - building on from the Assessing the UK's regional digital ecosystems (https://www.gov.uk/government/publications/assessing-the-uks-regional-digital-ecosystems) research published 1.in 2021. DEU would like to develop evidence on what could be the most efficient solutions in addressing the differing maturity of local ecosystems between, and within, UK regions.
- Identifying **emerging technologies** - monitoring their adoption amongst both the business and general population, understanding their potential impact, any competition implications, and how government can support their development.
- **Digital Economy** – improving how we define and measure the digital economy, ensuring that it remains relevant, with digital being a fast-changing area.

Critical policy issues, evidence needs and questions

1. Digital exclusion and workforce diversity

- Creation of a definition for digital exclusion that is used across government and industry.
- What digital facilities do UK citizens need to have access to in order to take part in education, work, and social life?
- Which groups are vulnerable to which types of digital exclusion?
- What are the barriers preventing equity of access to digital services, including accessing online government services; and how does this change for different groups?

2. Workforce skills and pipeline

- Analyse and evaluate the pathways into digital and technology jobs, identifying the barriers to recruitment, retention and progression, and how this differs in underrepresented groups. How do we define and understand these roles? How can talent be retained within the UK's universities and the wider educational sector?
- What are the areas of supply shortage (personnel and skills) and how do we improve and fill these gaps? What works internationally?
- What solutions, and scale of solutions, can improve recruitment, retention and progression in the digital and technology workforce? What are the main forces at play?
- What solutions, and scale of solutions, can improve the upskilling of digital skills capabilities, and wider digitisation, of UK businesses? How can we incentivise the private sector to play their role in upskilling the UK labour market?
- What are our long term and future digital skills needs? How do we visualise these skills and workforce needs across sectors considering UK dynamics? What does the global landscape look like in this space?
- What productivity benefits can businesses expect from investing in tech upskilling?

3. Tackling diversity issues in tech leadership/founders and across digital occupations at all levels

- How do we define digital skills and occupations, ensuring this keeps pace with the fast-changing sector?
- How do we improve representation and diversity of the digital workforce? How do we better understand the challenges and opportunities for inclusion across different social groups, taking into account: ethnicity, gender, age, disability status, regional difference? How do we make policies that support equitable progression and reward across the sector?
- Where are the opportunities to break down barriers, tap into unrealised opportunities and ensure that those building our digital and technological solutions are representative and cognisant of UK societal needs as a whole?

- What is the cost of lack of diversity both in the digital sector and in digital and technology jobs? What are the potential impacts and benefits of a more diverse digital workforce?

- What solutions, and scale of solutions, should be implemented to increase diversity (i.e. depending on demographic groups/ intersectionality considerations)? What works for different groups? Which are expected to gain maximum impact? What needs to be improved in the working environment and working culture?

- What are the barriers faced by founders from diverse backgrounds in accessing finance? How does this vary across different social groups (e.g. ethnicity, gender, age, neurodiversity, disability status)?

- What solutions, introduced at what scales, would increase the access to finance for founders from diverse backgrounds? (i.e. depending on demographic groups/ intersectionality considerations)? What works for different groups? Which are expected to gain maximum impact?

4. Consumer choice online

- What are the potential harms and wellbeing risks that can impact consumers? How do we best measure and quantify these harms taking into account different online markets? How do different markets and tools engage in terms of reach and impact on individuals, for example to what extent does advertising follow and adversely impact consumers?

- What regulatory solutions could be efficiently deployed to mitigate harmful practices for digital consumers online? How do we measure their effectiveness?

- What research and social experimentation can quantify harms and impacts of harmful online practices with a view to develop best practice principles and regulation?

5. The digital sector and its impact on society

- What are the (aggregate) impacts of current digital regulations implemented by the UK government? What are the best/potential measures that can evaluate impacts? What could a best practice monitoring and evaluation framework look like?

- What does the current digital ecosystem look like and what could be the impact of future digital regulation and policy changes directly or indirectly? What are the trade-offs and gaps to consider in maximising growth and minimising harm in these areas?

6. Measuring the growth of the digital economy and sector

- How does the UK compare to other digital economies and how can we robustly measure this?

- How do we best measure the growth of the tech sector within the digital economy?

7. Digital ecosystems in UK regions

- Building on from the Assessing the UK's regional digital ecosystems (https://www.gov.uk/government/publications/assessing-the-uks-regional-digital-ecosystems) research published by DSIT, what could be the most efficient solutions in addressing the differing maturity of local ecosystems between, and within, UK regions?

- Analyse and evaluate regional growth using "internet economy (https://assets.cambridge.org/97805218/55914/frontmatter/9780521855914_frontmatter.pdf)" principles. What are the interventions that can be made and the impact of place-based vs people-based interventions?

- What are the barriers faced by founders outside of London and the South East in accessing finance, talent and support?

- What are the most effective business support practices to accelerate the growth of tech startups and scaleups?
  How should business support practices such as accelerators be designed to maximise their impact on tech startups and scaleups?

- What solutions, and scale of solutions, should be implemented to reduce these barriers, in order to drive growth in the digital sector across all regions of the UK?

- What are the future scoping research questions and work needed to better understand and drive digital regional growth?

Digital Infrastructure

The Digital Infrastructure (DI) directorate leads on policies that promote telecoms infrastructure investment and protect national security, whilst running innovative pilot programmes for the next generation of technology. Having a world-leading sustainable telecoms infrastructure is a priority for the government and underpins DSIT's objective to make the UK the best digital economy in the world and drive digital transformation.

High quality telecoms networks are crucial for unlocking opportunities, driving productivity improvements and bolstering economic growth: facilitating new ways of working, reducing the costs of doing business, increasing the size of markets by making it easier for firms and consumers to interact - in turn driving economies of scale and improving competition. We have a mission to put the UK at the forefront of global scientific and technological advancement. Future telecoms is one of the five critical technologies identified in the published Science and Technology Framework (https://www.gov.uk/government/publications/uk-science-and-technology-framework).

The UK is recognised as having a globally influential position in telecoms, but the picture for the future is one that might be different to today. For example:

standalone 5G promises radically different capabilities and services and developments in Wi-Fi; next generation satellite networks have the potential to offer competing or complementary connectivity solutions and the uptake of the Internet of Things (IoT) offers new opportunities for all. 6G is expected to take us further. DSIT wants the UK to be an attractive home where these platforms can flourish and maximise economic and social benefits while ensuring a digitally secure future UK infrastructure. Research that enables us to undertake investments that maximise these benefits and to estimate the size of the benefits, as well as their distribution, is vital.

For the **deployment of current and future technologies**, DI wishes to develop a stronger evidence base around the benefits of and barriers to their deployment, with a focus on the adoption of **5G and open network infrastructure** to build the resilience of networks and support innovation. DI needs to develop models and techniques to understand efficient **spectrum allocation** and understand the issues surrounding the use of **specific spectrum bands**.

DI needs to better understand the trends around **technological convergence, future demand for digital connectivity, regulation around access to the internet** and **emerging cloud services** and their impact on security.

DI wishes to complement its understanding of current technology deployment with research into the work driving future technologies to develop and increase the **UK's future capabilities**.

All of this needs to be underpinned by further research into the **security and resilience of UK networks**, addressing future developments and threats, gaining insight into the value of security interventions and barriers to investment in security.

Critical research and policy issues, evidence needs and questions

1. High capacity fixed and wireless networks adoption

- In what ways does the UK mobile market differ from international markets as a result of having a higher than average number of mobile service providers? For example, how does this impact levels of investment, pricing of services, regulation, and competitiveness in the market?

- To what extent will mobile market consolidation impact: (i) mobile coverage, (ii) consumer choice, (iii) consumer behaviour? How might the government or regulatory body need to prepare or intervene?

- What international evidence is there of the productivity benefits from high capacity fixed and wireless networks? At what point are these changes noticeable to consumers and businesses?

- To what extent are market sectors or verticals, such as transport, logistics, utilities, health and social care (including critical national infrastructure) likely to require access to high specification connectivity (e.g. high capacity, high reliability, low latency)? What are the commercial models for any required new investment likely to be and are there likely to be areas of market failure?

- Identifying the distribution of productivity benefits from telecoms infrastructure investment (fixed and wireless): (i) to what extent can, or has, telecoms investment reduce(d) the difference in productivity between areas of the UK? (ii) what is the impact of telecoms infrastructure on the differences in productivity between firms within sectors (e.g. can it help address the issue of 'long-tail' of low productivity firms)? And how do the productivity impacts differ between different industries? (iii) what are the barriers to scaling up wireless enterprise applications for growth and how are they changing? (iv) How do productivity impacts vary across public mobile networks, private mobile networks (e.g. private 5G) and fixed networks including the role of Wi-Fi? For further relevant questions on productivity see BDUK section 9.

- What are the current telecoms supply chain/RAN market concentration risks and how are they evolving? What has been/will be the impact of the economic and geopolitical risks on achieving greater market diversity. How could future technological trends affect market concentration risks in telecoms supply chains?

- What are the potential opportunities and issues associated with the development and deployment of open telecoms solutions such as Open RAN, and how should government intervention be targeted to utilise or mitigate these? How is Open RAN adoption progressing and what is the likely trajectory? What are the barriers to adoption and acceptance of open architectures for 5G deployment and how are they changing? What are the economic benefits associated with this?

- Estimating the willingness to pay for access to high-capacity telecoms networks: (i) what behavioural factors may hinder business and residential consumers from taking up new services and what factors drive them? (ii) what policy interventions might address these?

- How can small cell technology support the delivery of mobile coverage and capacity across the UK? What are the advantages and limitations of incorporating this technology into delivery strategies?

- What will be the role of terrestrial and non-terrestrial (satellite and intermediate platforms) in delivering high quality mobile coverage and capacity across different regions of the UK? What regulatory changes will be needed, including on spectrum management?

- What are the advantages, disadvantages, and limitations in using non-terrestrial technology to support the expansion of mobile coverage across the UK?

- What changes should we expect to see in the next decade both domestically and internationally in regard to the technological, commercial, and regulatory landscapes of the mobile market?

- To what extent can existing rail and roadside infrastructure be used to support or deliver expanded mobile coverage across the UK? What innovative business models might promote improved coverage in road and rail corridors?
- How important is rail coverage versus road coverage, and are there industry targets to provide improved rail coverage?
- What are the impacts of 5G on users' day-to-day lives? How will people and businesses use this connectivity?
- What is the industry view on the potential of and the requirements for 6G? How far will 6G take us?

2. Spectrum allocation and management mechanisms

- Given the expected changes in future network deployments and upcoming consideration of spectrum bands: (i) what are the most efficient methods of allocating spectrum to maximise social and economic benefits? (ii) is the current framework of market mechanisms (auctions, trading, Administered Incentive Pricing (AIP) based licence fees) likely to continue maximising social benefits or will they need updating?
- Evaluate current spectrum annual licence fees: (i) do they effectively promote efficient allocation and use of spectrum? (ii) do they materially inhibit operator ability to invest in network upgrades? (iii) What lessons can be drawn from international practice, particularly on how charging for spectrum and network investment and coverage interact?
- How effective have market mechanisms been in enabling efficient and effective use of spectrum, compared to the objectives when they were introduced? How do the UK's spectrum allocation mechanisms compare to the rest of the world? What best practices for allocation can be adopted in the UK?
- Given the focus towards higher frequency bands and increasing competing demand from new and incumbent users, is a different model accommodating shared use of spectrum needed? What is the best mechanism for promoting shared use of spectrum?
- What future strategy for shared spectrum can drive coverage and scale up private/enterprise networks?
- How might AI contribute to future spectrum regulation/management?

3. Specific spectrum bands

- There are legitimate but competing demands for access to the Upper 6GHz band by proponents of Wi-Fi and mobile services both internationally and in the UK. What are the advantages/disadvantages to the UK of an allocation favouring mobile or Wi-Fi compared to a hybrid option, which enables access but with limitations to both services?
- What are the economic trade-offs of achieving capacity improvements in mobile networks over the coming decade? How does achieving this

exclusively through increased use of spectrum compare to network densification? In comparing strengths and weaknesses, what might be an optimal combination of both?

- Given that Wi-Fi is the go-to access method between fibre to the premises (and Gigabit capability) and user devices: (i) identify options for future evolution of Wi-Fi technologies and network architecture in premises (domestic and business) that will match the data capacity of fibre? (ii) what are the spectrum implications and options for transitioning to the desirable spectrum requirements (e.g. using spectrum above 50 GHz or LiFi).

- Given changing TV viewer habits (online vs terrestrial TV), how can the use of the remaining Digital Terrestrial Television (DTT) spectrum be optimised? What is the potential of incentivising more spectrally efficient technology (e.g. Digital Video Broadcasting — Second Generation Terrestrial or 'DVB-T2') and enabling increased access for mobile services while facilitating a sustainable future for DTT (albeit with a reduced set of channels). Note: this work will need to be coordinated with DCMS and its planned DTT viewing and policy reviews.

4. Technological convergence

- What are the key factors and incentives that are driving technological convergence in digital networks and their barriers? How are these changing?

- What priority areas should the UK be targeting in key convergence areas to support growth of UK supply-side market share? Where is there a clear UK competitive advantage?

- What is the correlation between adopting improved connectivity and wider digitalisation and what new use cases will improve connectivity allow?

- Do firms that adopt one frontier technology, such as 5G, also adopt other cutting-edge technologies?

- What are the empirical trends in previous technology adoption cycles, and to what extent can they be used as proxies to predict future trends and rates of adoption?

- How can government funding be used most effectively to support future adoption of important technologies?

5. Technological neutrality and open internet

- What impact do open internet regulations have on the efficient deployment and use of full fibre and 5G networks to meet the growing connectivity demand? How do changes in these regulations impact network investments, deployment and use - e.g. impact on traffic growth, traffic management, costs for ISPs and requirements of new use cases?

- To what extent does innovation and competition between companies promote network technology evolution and interoperability (e.g. between systems, equipment, etc)? For further relevant questions on market competition and cooperation see BDUK section 2.

- What are the potential unintended consequences of digital technology (5G, ORAN, Fibre, etc) policies and to what extent could the market mitigate them?

6. Cloud services

- In what way(s) will the development of cloud services impact telecoms networks? What are the opportunities and the challenges?
- What security and competition challenges are expected to arise from the development and adoption of cloud services in telecoms networks?

**&. Future technologies and UK capability

- What is the potential for future technologies in delivering mobile connectivity more efficiently and effectively than contemporary technologies e.g. low earth orbit satellite technology? What are the advantages and disadvantages of these technologies?
- Evaluate the technologies that will drive terabit networks: supporting the development of next-gen fibre technology, leveraging opto-electronics, encoding and graphene expertise to deploy a terabit network.
- Evaluate the technologies that will drive clean networks/power efficiency: harnessing semiconductors and AI to drive more efficient telecom radios and network optimisation.
- Evaluate the technologies that will drive smart networks: evidencing the utilisation of the UK's lead in AI and Edge technology to develop self-organising, secure and highly optimised network software.
- Given current gigabit deployment and capabilities, what is the economic case for private sector investments into future network technologies?
- Which of the future technologies will the UK have a comparative advantage in or face particular challenges in regard to global competition? How can the UK build strategic advantage in key technologies and how can the benefits be measured?
- Identify factors which inhibit UK telecoms research and development in terms of: (i) skills and talents (education, jobs), (ii) R&D (lack of IP knowledge, facilities), (iii) investment (private sector / venture capital), (iv) coordination, (v) market dynamics (barriers to entry, commercialisation, international policies and subsidies).
- Identify the policy intervention options for mitigating barriers to UK capability, including analysis of how policy could stimulate or support (e.g. research and publications, start ups, investments, commercialisation). What can we learn from other countries' approaches, or what are the ecosystem benefits we can emulate from the practice of leading international companies?
- Which areas of research on the uses of next generation networks may need policy interventions (e.g. Internet of Things and Artificial Intelligence)? This may include driving strong take-up of fibre and 5G/6G, encouraging the

adoption of the products and services, and increasing Willingness to Pay and supporting industry to make the necessary investments?

- How can the UK build its potential to transform research into intellectual property (IP) and products/services and to commercialise to increase its global market share?

- What new skills/professions are likely to emerge as a result of future telecoms technologies and how can the UK be best placed to exploit them?

- To what extent are telecommunications companies investing in research and development to devise and implement alternative ways, to traditional telecoms mast structures, of expanding wide area mobile coverage across the UK? Low altitude balloons; repeaters etc.

- Where are the opportunities for international collaboration to increase the UK's role and influence over the development of next generation telecommunications technologies - including advanced 5G and beyond?

8. Network security and resilience

- Evaluate the security and resilience opportunities and risks of the technologies (as listed above) that will drive terabit networks, clean networks and smart networks.

- What is the economic value of security and resilience within telecoms networks for the UK?

- What are the major security and resilience issues that may arise from future telecoms networks?

- What is the economic opportunity from growing UK commercial ecosystems of telecoms security/resilience solutions? What should the UK prioritise supporting as part of the next generation of telecoms solutions?

- What are the suitable metrics for quantifying the costs and benefits of telecoms security and resilience policies?

- In what ways do security interventions (under the Telecommunications (Security) Act (https://www.legislation.gov.uk/ukpga/2021/31/enacted) 2021) in the telecoms market have an impact on investment within the sector? How is this broken down, in a quantitative manner, by fixed and mobile infrastructure?

- What are the barriers to improving security and resilience of telecoms infrastructure? Identify and compare incentives for greater levels of investment in security and resilience measures.

- Illustrate what a strong telecoms security and resilience sector will look like in the next 5-10 years: Include what challenges future networks face and identify how best these can be mitigated. Additionally, how will new technology, market changes and shifts in the geopolitical environment impact security and resilience in the telecoms sector. How are changes in the value chain for 'telecoms' driving market dynamics and how is that likely to change.

- How can the expected benefits of policies to increase the security and resilience of telecoms networks be quantified?

- What is the value of subsea communications cables to the UK economy, and should the UK seek to attract or incentivise the expansion of the subsea cable network?
- How does the UK's approach to telecoms resilience compare to other countries approaches? This includes power resilience of the telecoms network.

9. Further questions affecting the telecoms sector

- To what extent is the market and actors within it able to withstand economic shocks?
- How will future public services rely on digital infrastructure and what adjustments will be required?
- What technologies will have the biggest impact on demand for data? Is growth in data exponential, linear or decreasing?
- What is telecom's role in achieving net zero and the impact of changing climate? To what extend is telecoms a driver of energy efficiency within and across sectors?
- How will climate change/energy insecurity impact the UK's telecoms networks? To what extent are our networks (directly or indirectly) vulnerable to climate change e.g. voltage instability during heat waves? For further relevant questions on network resilience see BDUK section 3.
- Are telecoms networks a net contributor or mitigator of GHG emissions, and will their net emissions grow or shrink in the future?
- What broader science/tech sectors have the most spillovers with the telecoms sector?
- What are the most relevant potential changes in the external security and resilience risk environment?
- How do changes in technology usage and market structure change the risks faced?
- What are the direct benefits from increases in connectivity?

International and economic security

The International Directorate works to maximise UK security and prosperity through international partnerships and influence as well as policies on trade and governance. The directorate manages significant bilateral and multilateral partnerships with countries and institutions to advocate for UK interests. This spans from leading for the UK on the digital and tech elements of the G7 and G20 to engaging with technical bodies which allow us to exert influence over global internet governance and digital technical standards. The teams work to negotiate pioneering trade agreements on digital and telecoms issues that shape our future relationship with the world and scrutinise foreign acquisitions

and investment in these sectors – from AI to semiconductors – promoting growth and protecting British interests.

In addition to coordinating cross-departmental international work, there are three core areas of focus:

i) The International Strategy Team provides a critical function to support domestic priorities and maximise global influence, including working to build a global enabling environment for digital and technology.

ii) The Economic Security Unit identifies where economic interactions may pose national security risk for the UK, developing and implementing policies to prevent and mitigate that risk, and generating UK strengths in critical sectors for strategic advantage. The team leads on semiconductor policy and is responsible for delivering the National Semiconductor Strategy.

iii) The Digital Standards, Internet Governance and Trade Team combines international engagement with global internet governance and digital standards bodies with digital trade policy. The team enhances our ability to ensure that UK values and priorities are embedded in the development of new technologies and helps protect our global vision of a free, open and secure internet, while lowering cross-border barriers and opening new opportunities for businesses.

> The International directorate is interested in understanding **how the UK's standing in the world in the digital and tech sectors might look in the future. Horizon scanning and the trends of internet fragmentation, technology security, and the economic opportunities in digital change** are of great interest. We are interested in understanding how businesses and other countries are responding to the changing geopolitical environment, particularly around the steps they are taking to safeguard critical technologies and promote growth in these key sectors. How can the UK remain economically competitive, technologically resilient and technologically secure? This is of particular interest in the context of semiconductors, where we are seeking to understand the right balance between supporting economic growth and protecting our national security. The **impact of global digital standards and regulation and protecting the multistakeholder global internet** is a priority for our international teams and research in this field would be of interest. One of the UK's three priorities in digital standards is better incorporation into UK research and innovation. Research to support delivery of this objective is of interest.
>
> Net Zero and **global aims to reduce carbon emissions** is important to DSIT and fully understanding and measuring the impact of new digital technologies would be of interest.

Critical policy issues, evidence needs and questions

1. International trends and competition: the international digital technology landscape change over the coming decades

- What are the digital technology trends that the UK government should be considering in the long term?
- What is the nature of international investment in science and tech related R&D?
- Comparative studies on international strategic advantages now and in the future.
- Horizon scanning on the scenarios for digital and tech dominance over the near- and medium-term future.
- What factors drive fragmentation and consolidation, respectively, in internet architecture and the international digital space?
- What does research say about digital sectors or countries that pose the greatest risk of disruption to international cooperation over the use and governance of digital technology?

2. The UK maintaining and improving its strategic advantage in select sectors internationally

- What does research tell us about the impact of interventions that the government has put in place to strengthen the UK's capabilities in digital and emerging technologies, and about possible future trajectories?
- How should the UK mitigate the risks associated with emerging technologies, while taking advantage of the opportunities?
- What does evidence suggest about how the UK could prepare for future trends?
- How should the UK engage on digital policy with developing countries?
- How can the UK foster international influence in digital policy, and what should the priorities be for cooperation over such policy?

3. Global digital standards and regulation: the effects of different digital standards and regulations, and how to use these for the benefit of the UK.

- How should global digital technical standards be understood and used, and how can we understand their costs and benefits? How do we work with global companies on this from a UK perspective?
- How can the UK support firms to optimise the benefits of digital technical standards development? How can expertise of UK industry be better harnessed by government?
- What are the opportunities to influence global digital standards?
- How can we better join up digital standards with UK research and innovation sectors to ensure that digital standards are a valued element of the innovation lifecycle in the UK?

4. Global internet governance: the importance of global technical and governance layers (not the content layer) of the global internet to the UK's security, economy and values.

- What are the risks to UK interests if the industry led, multi stakeholder nature of the global internet is weakened in favour of greater state- or multilateral control?

5. Net Zero: the positive and negative impacts of digital sectors and emerging technologies on the climate, and how policy can be used to achieve Net Zero objectives.

- How can international governance, emerging technologies (including climate tech) and digital agreements be used to achieve Net Zero and support environmental sustainability?
- What are the environmental effects of emerging technologies?
- Are some countries further ahead, and by what degree, in climate tech resilience than others?

6. National and Economic Security

- Which technologies are going to be important for economic and national security over the next 10 years?
- How can the UK use its S&T strengths to protect national security?
- What are the key determinants of economic security?
- A taxonomy of economic and national security risks with likelihood impact assessments to determine relative severity.
- What are the policy levers available in S&T to support and protect economic and national security How effective are they?

7. Semiconductors

- How can the UK retain and expand its strategic advantage in relation to semiconductor IP, design, R&D and compound and advanced materials?
- What incentives need to be put in place to ensure that the UK semiconductor industry remains competitive?
- How can the UK effectively assess and mitigate semiconductor supply chain vulnerabilities?

Security and Online Harms (SOH)

The Security and Online Harms (SOH) Directorate works on a wide range of online safety initiatives, which span actions such as taking forward the Online

Safety Bill through to tackling disinformation online, promoting media literacy, and supporting innovation in the safety tech sector.

Although there is already material evidence on the types of serious harms individuals encounter online, there still remain a number of emerging harms, where the evidence base is still yet to mature (e.g. epilepsy trolling, online animal abuse). SOH would like to close this significant gap in understanding the **impact of encountering different types of serious harms online and understanding the best approaches to measuring the impact of the Online Safety legislation**.

SOH highlights the importance of **media literacy** in the digital age and asks for further studies to uncover barriers to engagement as well as the effectiveness of DSIT programmes. This issue closely relates to **Counter-Disinformation** interventions, which requires evidence for its effect on bystanders, topic specific disinformation and what tools can be used to combat this issue.

Research on **safety technology** would greatly develop SOH's understanding of the relationship that DSIT online safety objectives have with the technology market today. A primary focus lands on improving **Age Assurance (AA)** measures. This includes ensuring transparency and assessing opportunities for the sector.

Critical policy issues, evidence needs and questions

1. Measuring the prevalence of online harms and understanding the impact of the Online Safety Legislation

- What types of harmful content exist online, and what is the impact to children's offline behaviour?

- What novel research approaches can be deployed to help effectively measure the impact of online harm beyond typical quantitative survey methods? How could these be used to measure the wider impacts of Online Safety Legislation?

- In terms of horizon scanning, how do we best develop approaches to identifying new types of harm online, or new and emergent platforms of technologies (e.g. virtual reality) where online harm can manifest?

2. Developing Media Literacy across the UK

- What interventions are effective at building strong media literacy capabilities in UK citizens (including building resilience to harms such as misinformation and disinformation)? Are there examples of interventions from other countries that could inform the UK's approach?

- What barriers, if any, impact the media literacy sector's delivery of effective and wide-reaching media literacy activities? What are the potential

intervention opportunities for government in this space?

- What evaluation methods/ tools can be used to measure the impact of media literacy interventions on citizens' attitudes and behaviours online in a robust way?

3. Understanding and reducing online disinformation and misinformation

- What are the direct impacts of the harms of online mis/disinformation and what types of online mis/disinformation are most harmful? How do these impact individuals, wider society and the democratic process (whether physical, psychological health, civil unrest, UK security, elections)?
- What are the long-term outcomes of exposure to online mis/disinformation for the individual and society?
- How do online bystanders respond to viewing perceived online mis/disinformation (e.g. report, share, ignore), and how could their behaviours be influenced?
- How does mis/disinformation spread between social media platforms, particularly primary and secondary platforms? How can it be identified and contained?
- To what extent are the types and trends of harmful online mis/disinformation consistent between larger and smaller platforms?
- What are the most effective policies and approaches taken by platforms to counter disinformation?
- What are the potential risks or unintended consequences of counter-disinformation interventions?
- What is the overlap between inauthentic content and mis/disinformation and, what role is inauthentic content playing in wider mis/disinformation narratives?
- In what ways will AI exacerbate the spread of mis/disinformation and is mis/disinformation spread by AI likely to be more effective in influencing UK audiences?
- What are the economics underlying the spread of mis/disinformation (i.e., what is the scale and nature of the for profit mis/disinformation)?
- How would a shift towards interoperable / decentralised social media (aka 'the fediverse') alter how disinformation spreads, and the ability to be able to address it?

4. The effects of (generative) AI on online harms and trust in information?

- AI will democratise access to capabilities that used to be expensive or hard to access, and create new capabilities that didn't previously exist. As barriers (e.g. technical skills, access to specialist equipment) are reduced, AI use will increase. What is the prevalence of AI generated content online?
- Which harmful online uses of AI are likely to increase? What could be the impact of AI-generated content on attitudes, beliefs, behaviours or psychological wellbeing?

- One expected impact of AI will be on trust in information. How might AI reduce public trust in information available online? Do UK citizens trust AI-generated online content?
- How will AI affect existing kinds of harmful online content (e.g. online abuse, scams) and what new kinds of online harmful content might it give rise to?
- How will the use of generative AI to create 'deepfakes' that manipulate people's likeness (face, body, voice) evolve? What is the psychological impact of being deepfaked, and what harmful uses (e.g. intimate image abuse, fraud, reputational damage) will develop and increase?
- What risk is there that generative AI evolves such that the content it generates can avoid detection faster than tools can be developed to detect it? How can international and industry collaboration limit this risk?
- How can different actors (e.g. governments, tech companies, social media platforms, individuals etc.) mitigate these harms?
- How could media literacy be used to build audiences' resilience to these harms?
- In which channels is harmful Gen-AI content most prevalent, how does it spread, and how can friction be introduced to these channels?
- How can AI be used to identify harmful content?

5. Growth and investment in safety technology

- Evaluate the growth trajectory of the UK safety technology market, and the extent to which market growth supports DSIT online safety and prosperity objectives.
- Evaluate current growth barriers or opportunities, understand where action is needed (by the government or others) to address these barriers, and understand the impact of any interventions.
- Evaluate the extent to which the emerging regulatory landscape and the implementation of relevant regulation can be harnessed as a driver to support growth.
- Further understand investment, export and domestic market access for safety tech products and services in the UK and beyond.

6. Understanding opportunities in the Age Assurance (AA) sector

- What is the prevalence and associated costs of Age Assurance technology/ solutions across industry?
- What are the current approaches to measuring the accuracy of Age Assurance technologies/ solutions?
- How is the use of Age Assurance technologies for the child online safety sector likely to change over the next 5 and 10 years?
- What emerging and external factors present a risk to the sector's ability to develop effective solutions? What are the risks around Age Assurance technology and how might they be mitigated?

Science, Innovation and Growth

Geospatial Commission

The Geospatial Commission aims to unlock the significant economic, social and environmental opportunities offered by location data. In June 2023, we published the [UK Geospatial Strategy 2030 (https://www.gov.uk/government/publications/uk-geospatial-strategy-2030)](https://www.gov.uk/government/publications/uk-geospatial-strategy-2030) setting out the government's plan to drive greater use of innovative location data and technology across the economy.

Geospatial applications and services have become an intrinsic part of everyday life, enabling routine activities and improving individual consumer experiences from instant journey planners to ever faster delivery of goods. The insights that these services provide are vital for businesses and the delivery of public services.

The potential of location data is enhanced by enabling technologies, such as artificial intelligence (AI) and cloud computing, which have caused disruption and opened up huge new capabilities. To make the most of these enabling technologies it will be essential to overcome limiting factors, such as a lack of awareness and skills.

The 2030 UK Geospatial Strategy sets out three key missions to position the UK to drive technological innovation:

Mission 1 - embrace enabling technologies to accelerate geospatial innovation

Mission 2 - drive greater use of geospatial applications and insights across the economy

Mission 3 - build confidence in the future geospatial ecosystem

The Geospatial Commission has a mandate to research, initiate, drive and deliver changes by working in partnership with others. This means we:

- Provide strategic oversight of the geospatial ecosystem in the UK, setting geospatial strategy, policy and standards
- Hold the budget for the public sector's largest investment in location data, the Public Sector Geospatial Agreement (PSGA)
- Make targeted investments in projects that accelerate innovation and adoption of location data, applications and services

Our key focus areas, detailed in our critical policy issues and questions below, are as follows:

- How **emerging and developing technologies are likely to impact the future UK geospatial ecosystem**, and how best to track its adoption and use in the economy.
- Further developing our **understanding and methodology for valuing location data**, applications and services to the economy and society.
- **Building confidence in the geospatial ecosystem** – including understanding changing public attitudes and growing the future pipeline of geospatial skills.

Critical policy issues, evidence needs and questions
Mission 1

1. Embrace enabling technologies to accelerate geospatial innovation

- What new and emerging technologies (including cloud, Artificial Intelligence, Machine Learning, and Augmented Reality/Virtual Reality) will impact geospatial skills and innovation, and access to geospatial data in the future, and how could the UK leverage these technologies?
- How can we better understand novel uses or applications of AI in the geospatial ecosystem, such as in the analysis of Earth Observation and Population Movement data, 3D visualisation, and climate modelling?
- What are the opportunities of emerging technologies (quantum and AI) to revolutionise our ability to map underground assets?
- How can we better understand the integrity (i.e. accuracy, completeness, and consistency) and use of Population Movement data?
- How are new and emerging geospatial technologies supporting market growth and wider economic, social and environmental value?

Mission 2

2. Drive greater use of geospatial applications and insights across the economy

- How can we further improve our understanding of location data characteristics that bring social, economic and environmental value? How does value change when combined with other types of data?
- What are the factors that constitute making data "authoritative", especially in an increasingly dynamic and digital data economy?
- What are the most appropriate models for improving access to location data held at both the national and local level that maintains sustainable access to the data?

- What land use change is needed to meet the UK's policy objectives, targets and legal obligations, and where in the UK are there opportunities for multifunctional land use (as well as where are the potential areas for conflict)?
- How can the UK academic sector and policy makers improve connections between those who understand and use analysis and land use decision makers who would benefit from these insights?
- What is the feasibility, desirability and viability for developing a comprehensive taxonomy for land use that meets the needs of UK land use decision making?

Mission 3

3. Build confidence in the future geospatial ecosystem

- How might the growth in innovative uses of location data impact public attitudes on the responsible use of location data, for example population movement data?
- How career pathways for geospatial skills are changing, and which new skills the geospatial workforce needs?
- How can we better understand trends in geospatial investment internationally, including into the capture of data (such as satellite, aerial imaging and surveying programmes) and the development of geospatial applications?

Government Office for Life Sciences

The Office for Life Sciences (OLS) directorate is part of the Department of Health and Social Care and the Department for Science, Innovation and Technology, and champions research, innovation, and the use of technology to transform health and care service.

> The analysis team is responsible for two datasets on life sciences activity in the UK and how it compares with other countries. One of its publications, the Bioscience and health technology sector statistics (https://www.gov.uk/government/statistics/bioscience-and-health-technology-sector-statistics-2021/bioscience-and-health-technology-sector-statistics-2021), is an **official statistic** and captures a detailed breakdown of where life sciences activity occurs in the UK, as well as key economic indicators such as employment and turnover. The analysis team is also responsible for publishing the Life sciences competitiveness indicators (https://www.gov.uk/government/publications/life-sciences-sector-data-2023/life-sciences-competitiveness-indicators-2023), a publication which tracks UK performance against international comparators. These two publications

form the bulk of the evidence base that supports OLS policy making and key facts and figures for stakeholders. One of the ambitions of the team is to **expand** the range of data collected on activity in the sector to encompass a broader range of economic indicators, including Gross Value Added, R&D spending, Wages, and workforce statistics, among others.

In addition to this critical evidence base, OLS is also interested in key research questions and evidence to support the development of policy for the **Life Sciences Missions**, a set of disease and intervention areas identified in the Life Sciences Vision as key areas of intervention to help the NHS to solve some of the biggest healthcare problems of our generation. These range from establishing a strong evidence base on incidence and its regional distribution to identifying potential innovative technologies that could address them. Additionally, the analysis team is also very interested in deepening our understanding of the economic impact and possibilities of the broad area of **genomics**, as well as understanding the economic impacts and societal benefits that accrue from conducting **clinical trials** and other forms of R&D in the life sciences.

On the regulatory front, OLS would like to expand its understanding of the main **regulatory barriers to the approval and roll-out of new, innovative technologies**, as well as understanding the costs and benefits associated with these regulations. We have a limited evidence base for some products but would like to expand that understanding to be better able to assess the impact of specific regulatory interventions. We would also like to have more comprehensive data on the introduction and adoption of these technologies across the country and through the NHS.

On the **investment** front, we are particularly interested in building a more comprehensive evidence base on the determinants of investment in both manufacturing and R&D facilities, and how elements of both the commercial and business environment affects company location and investment decisions.

Finally, we are very interested in developing a more comprehensive understanding of the **manufacturing landscape** in the UK, from being able to interrogate the pipeline of new products and innovations in development, to establishing the UK's manufacturing capabilities for health and supply chain resilience, as well as understanding key challenges faced by companies in terms of access to skilled workers and finance across the country.

Critical policy issues, evidence needs and questions
1. Sectoral data: company level data on activity in the life sciences sector and international comparators

- Detailed company and sector level data to enable estimates of gross value added and labour productivity.
- Detailed data on R&D spending at the company and sector level.
- Detailed company data on workforce composition and compensation.
- Detailed company data on tangible and intangible assets, as well as use of materials, to produce estimates of both labour productivity and total factor productivity.
- Detailed company data on sales to the NHS.
- Detailed data on companies that specialise in the provision of AI services in life sciences.
- Detailed company data on both current expenditure and investment in AI.
- Estimates of the potential market size for AI-related services in the life sciences sector.
- More detailed and reliable data on all the relevant indicators included in our publication.
- Explore other databases that could expand our coverage of the various elements of the life sciences ecosystem.
- Data on indicators relevant for international comparisons in genomics.

2. Healthcare Missions (Cancer, Ageing, Dementia, Mental Health, Respiratory Disease, Obesity, Vaccines, Addiction)

- Evidence on the burden of disease associated with each of these disease areas, including both mortality data and quality of life adjustments.
- Evidence on inequality of the impact of the diseases across different population groups.
- Evidence on inequality of access to and benefit from treatments.
- Evidence on the prevalence of long-term conditions associated with the disease areas covered by the healthcare missions (cancer, ageing, dementia, mental health, respiratory disease, obesity, addiction). Further, we would like to understand what links exist between these disease areas: whether there are mutual risk factors or whether any of these disease areas are a risk factor for another.
- A usable forward look on new technologies (including medicines, devices, therapeutics, precision medicine tools and approaches to drug development) in development.
- Estimates of the returns to R&D spending in these disease areas.
- Evidence on whether reductions in excess adiposity improve patient outcomes and prevent the incidence of developing secondary disease or multiple long-term conditions.

3. Genomics

- Evidence on the potential impact of genomics on new therapeutics and interventions.

- Evidence of the potential impact of genomics on the productivity of the pharmaceutical sector.
- Estimates of the economic impact and contribution of genomic activities, including returns to R&D spending.

4. Clinical trials

- Evidence on the economic impact of clinical trials and cost.
- Evidence on the main barriers to conducting clinical trial activity.

5. NHS Innovation, Uptake and Access

- Reliable estimates of the relative productivity of the different factors in the health production function for the NHS.
- Estimates of the benefit and impact of introducing new technologies and therapeutics to the NHS.
- Detailed data on the dates of regulatory approval and cost-effectiveness appraisal of medicines and medical technologies.
- Detailed data on uptake and access of medicines and medical technologies at the level of each commissioning unit.
- Detailed data on the price per QALY associated with each medicine and medical technology purchased by the NHS.
- We would like to understand the relationship between drug launch/supply of new drugs and the broader commercial environment, including price regulation and other cost control measures.
- Evidence on whether the commercial environment has a material impact on launch prioritisation for new drugs.

6. Investment - business environment

- We would like to understand the extent to which the planning system limits investment activity in the sector.
- We would like to understand the extent to which capital allowance rules and the overall corporate tax burden affects investment decisions in the sector.
- We would like to understand the impact of operational costs (such as energy or materials along the supply chain) on the decision to locate and/or increase investment activity in the UK.

7. Investment - commercial environment

- How are decisions on investment and location of manufacturing facilities affected by the broader commercial environment and, in particular, price regulation and other cost control measures?
- How are decisions on investment and location of R&D facilities affected by the broader commercial environment and, in particular, price regulation and other cost control measures.?

- We would like to understand how clinical trial activity is affected by the broader commercial environment and, in particular, price regulation and other cost control measures.
- We would further like to understand whether there is any evidence for co-location of R&D and manufacturing activity and whether this depends on the stage of the R&D conducted on site.
- We would like to better understand the overall determinants of investment and location decisions, including how board sentiment might override other financial considerations.

8. Manufacturing activity

- Manufacturing Innovation: We would like to have a more comprehensive forward look for new drugs, devices, or other therapeutics to identify potential innovations faster.
- Health resilience: More comprehensive data on capacity and capabilities for companies in the sector to better identify areas of concern with respect to supply vulnerabilities.
- Supply chain resilience: more comprehensive evidence on the supply chain relationships between companies in the UK and those in other countries, as well as evidence on the potential impact of supply chain restrictions.

9. Skills

- Evidence and data on the current composition of the workforce in the sector.
- Evidence on the skills shortage, including quantitative assessments of the skills gap in terms of numbers of workers for different professions and levels of qualification.
- Evidence on the gap between the skills required by employers in the sector and those currently provided through various forms of education and training.

10. Access to finance

- Data on the number of companies that fail to secure funding in the UK but successfully access capital in the US.
- More comprehensive evidence on the determinants of funding for early-stage companies, and on what stage companies struggle to secure funding the most.
- Evidence on the determinants of foreign investment on UK start-ups.
- Data on risk-adjusted returns on UK start-ups relative to other countries.

11. Real estate

- Evidence on the impact of the planning system on the cost of establishing manufacturing and R&D activity.

12. Net zero

- Evidence and data on the climate impact of life sciences activity.

International Research and Innovation

The International Research and Innovation Analysis team (IRIA) works on DSIT's portfolio of international collaboration interventions and provides advice on the international research landscape to policymakers across government. We work with stakeholders in DSIT, FCDO and other government departments as well as wider stakeholders such as the Met Office and GO Science. We also support a network of science and innovation advisers based in UK embassies.

We provide analytical support to the International Science Partnerships Fund (ISPF), a new programme allowing UK researchers and innovators to collaborate with international partners on multidisciplinary projects. We also work on existing UK research and innovation collaboration funds which are reaching the end of delivery. These include ODA interventions (Global Collaboration Research Fund, Newton) and non-ODA funds (e.g. the Fund for International Collaboration, delivered by UKRI).

International collaboration in research and innovation (R&I) leads to better science and beneficial economic impacts. The UK is looking to optimise the value of international research & innovation partnerships with countries around the world. Our team provides the evidence base to ensure that the UK is making the best decisions about how to collaborate internationally.

> IRIA aims to build an evidence base useful for monitoring the effectiveness of UK international research collaboration, determining the value-for-money of international R&I interventions and comparing the UK with other countries. We support a wide range of programmes as well as building an evidence base that can be used for new interventions. This includes government plans to protect and support UK science, research, technology and innovation (SRTI) sectors, should association to Horizon Europe on fair and appropriate terms not be possible.
>
> We are interested in assessing the value delivered from **infrastructure which supports research and innovation**, such as laboratories or institution headquarters. An example of this is the project to relocate the European Centre for Medium-Range Weather Forecasts (ECMWF) to the University of Readings' campus.

Critical policy issues, evidence needs and questions
1. Reputation and Influence

Science diplomacy is a strategic goal of UK research and innovation collaboration. Analysing the impact of R&I on the UK's overseas reputation and influence on other actors requires operationalised definitions, metrics which can be tracked over time and evaluative methods that allow interventions to be compared. Where data exists to track outcomes contributing to reputation and influence, such metrics should be adopted. However, there may be a need for new or additional data collection. For example, to address the following questions:

- What does reputation and influence mean for international R&I?
- What activities and outcomes contribute to improving reputation and influence?
- How do investments in R&I (e.g. infrastructure, partnerships) contribute to reputation and influence?
- What data and metrics exist which could measure reputation and influence benefits?
- What evaluation methods are appropriate for comparing reputation and influence impacts across programmes?

2. Monetising international R&I impacts

We seek to provide monetised estimates of the impact of international R&I, especially international collaboration in R&I. This is salient for collaboration between more economically developed countries (or HMG non-ODA interventions) but is also relevant for collaboration between the UK and less economically developed countries (or HMG ODA interventions). We are also interested in being able to quantify ODA outcomes which cannot be appropriately monetised. The aim is to build an evidence base comparable to domestic impacts of R&I, for example by addressing questions including:

- What outcomes of international R&I could be monetised?
- What activities – from government or other actors – contribute to monetised outcomes?
- What data and metrics exist which could be used to estimate the return on R&I activities?
- What new data could be collected to estimate rates of return on international R&I?
- Where ODA intervention outcomes cannot be monetised, can they be quantified?

3. International R&I talent

We are interested in establishing how UK researchers and institutions work with overseas partners and in the R&I ecosystems of other countries. The corresponding section of this document from Science, Research & Innovation (section 3.9) covers how international talent is attracted to work in the UK and

the impact of those researchers on the UK. There is further interest in other aspects of this including:

- How are R&I professionals from the UK received overseas?
- What impact do UK research professionals and academics have overseas?
- Can any of these impacts be monetised?

4. Understanding local impacts of international R&I

DSIT has a good understanding of the lead recipients of funding from its R&I collaboration programmes (GCRF, FIC and Newton). However, we would like to understand more about the onward flows of money. We are interested in the extent to which funding from international R&I remains in the UK and the geographical distribution of R&I funding and impacts within the country. Questions include:

- Which institutions and actors are engaged in international R&I within the UK?
- How is international R&I activity distributed across the UK at a sub-regional level?
- Does international R&I activity in UK universities incentivise the creation of local clusters or agglomerations of business and research organisations? Are there concrete examples of this? What are the causal factors?
- How does international R&I activity affect the local economy?

Science, research and innovation

The Science Research and Innovation Directorate (SRID) has a central role in reforming UK RDI to deliver the government's ambitions to become a Science and Technology Superpower by 2030 and to capitalise on the UK's strengths in RDI to drive growth and productivity and increase the UK's strategic advantage.

SRID seeks to meet the following objectives:

1. Maximise the economic, social and research benefits of public and private RDI, ensuring they are experienced right across the UK. Setting strategic direction for the UK research and innovation system to ensure it delivers world class research and supports innovation across the economy. Ensuring the system is a diverse, resilient, and investible organisational landscape.
2. Invest effectively in the foundations of the RDI system, including discovery research, talent, infrastructure, that support UK plc and achieve HMG priorities, and the organisations that deliver this (e.g., UKRI, National Academies, Public Sector Research Establishments, ARIA).
3. Create the conditions that incentivise public and private investment in innovation across the UK, supported by increasing public investment in RDI.

SRID works collaboratively with other government departments, non-departmental bodies and other RDI partners and funders to meet the government's science ambitions.

SRID evidence aims to ensure that DSIT's significant RDI budget is invested effectively and that we understand its impact and value for money. The Science, Technology and Innovation Analysis Team (STIA), the analytical team supporting SRID, develop the evidence base via internal analysis, cross-Whitehall collaboration and externally commissioned research projects. STIA work closely with other analytical teams in DSIT and DSIT's partner organisations.

STIA continuously work to improve our approach and methods of **valuing RDI investment** to fully showcase and evidence its value to the UK. We are also interested in developing new real-time performance monitoring tools to allow for more agile decision-making and significantly improve our **Monitoring and Evaluation (M&E)** capabilities. Improving our methodology for **measuring economic, social and research benefits of RDI** is also our priority.

SRID and STIA want to develop a stronger evidence base of **the foundations of the Research Development and Innovation (RDI) system** including how to: 1) grow the **RDI workforce** by improving the domestic pipeline, attracting and retaining the most talented RDI workers and supporting diverse, dynamic and creative careers 2) develop strong and sustainable **RDI institutions** that foster innovation 3) identify and capitalise on **RDI clusters** in the UK to support the **levelling up** agenda.

We also aim to develop a better understanding of how RDI policy can best drive economic growth, better jobs and discoveries. We aim to do this through identifying the best methods for measuring adoption and diffusion of innovation as well as **drivers and barriers to innovation** to create conditions for an increased investment in innovation.

Critical policy issues, evidence needs and questions
1. Strategic RDI research

This strand of research and evidence contributes to informing answers to cross-cutting questions about the HMG RDI portfolio, its impact on the society and its role in driving economic growth. It focuses on macro-scale questions to support a healthy, balanced, and effective RDI system.

- Optimisation of the RDI system: What is the 'optimal' balance for public investment across the RDI landscape, including (but not limited to) the balance of funding by research type (basic, applied, experimental and innovation)? What are options for change and what is their impact on the RDI system?
- Optimisation of strategy and priority setting institutions and governance in the RDI system: Do we have the right institutional model for strategy and priority

setting at all levels across the UK RDI system to deliver the ambitions of the Science and Technology framework?

- Effective funding models: What funding models are most effective and for what type of research (e.g., tightly controlled spending versus flexibility)?
- Promoting collaboration: What works in incentivising knowledge transfer and collaboration between research institutions and businesses/industry?

2. RDI investment appraisal

Maximising the value from record levels of public RDI investment is key to increasing private sector investment in RDI and driving UK economic growth. This can only be done by understanding the impact of our RDI programmes and the marginal value of additional investment in the different parts of our science and technology landscape.

- New methodologies for valuing the impact of RDI programmes: What new methodologies exist for valuing the impact of individual RDI programmes? Are there ways to accurately estimate programme-specific spillovers or indirect impacts?
- Marginal value of RDI: What is the marginal value of RDI in a programme? Many different research projects are funded in open research calls - how does the average value of these research projects compare to the marginal value of the last research project chosen?

3. RDI trends

Tracking trends and patterns in RDI helps to ensure that the Department stays up to date with key indicators of UK's performance and its competitiveness in the global landscape of Science and Technology.

- Increased private sector investment in RDI: How does increase in public investment affect levels of privately funded RDI? Can we measure this either in aggregate or for individual programmes?
- R&D Tax Credits: What impact will tax credit changes have in attracting private R&D investment?
- Competitive Advantage: How does the UK RDI performance compare internationally? Which sectors need the most support?

Competitive Advantage: What would a robust and impartial set of international comparators for RDI performance look like that measures the quality rather than quantity of research performed? Are there more nuanced measures of quality than traditional statistics?

4. RDI Monitoring & Evaluation

High quality M&E for all government RDI investments allow us to understand whether programmes are on track to achieve intended outcomes and to identify the impact of the intervention. M&E is also used to track progress against

departmental priorities such as stimulating private sector RDI investment and levelling up.

- Real time performance monitoring: How can DSIT promote and introduce real time data monitoring, to track the delivery and performance of RDI programmes inflight?
- Promoting robust M&E: How do we ensure that robust M&E practices are integrated into all future RDI investment decisions, whilst targeting the priority impact areas of the Department?
- Findings from M&E across RDI programmes: How are DSIT's RDI programmes contributing to goals such as promoting RDI private sector leverage and job creations?
- Evaluation methods for RDI programmes: What new methods and approaches are emerging to understand the short-term and long-term impact of public sector RDI investments?
- Indicators for monitoring progress towards goals: What are the most appropriate indicators to measure progress in RDI programmes and projects?

5. UK RDI talent and skills[footnote 1]

A skilled and qualified workforce is critical for effective RDI activity. The following research questions will help DSIT build a strong evidence base of how to foster a large, varied base of skilled, technical and entrepreneurial talent.

- Establishing competitive advantage in attracting international talent to the UK: How best to attract and retain international RDI workers and talent? What factors work as enablers and barriers to attracting talented researchers and innovators? How do those factors vary for different types of RDI workers (e.g., occupations, disciplines, etc.)? What is the impact of the current visa regime on the RDI workforce and attracting and retaining global talent?
- Dynamic and inclusive RDI careers – What works in improving sectoral mobility, inclusion and productivity of research teams? How does working culture differ across different sectors, disciplines and regions?
- Agile and responsive skills system: What changes in the skills system are required to meet government ambitions to support and grow critical technologies set out in the Science and Technology Framework? How can we future proof the workforce by giving them the right skills to fully embrace AI and its potential?
- Value of investing in talent: What is the short-term and long-term value (including monetary value) of UK RDI talent schemes and investing in PhD students including international talent?

6. RDI and Levelling Up

RDI investment is key to generating productivity gains at the local and national level, thus supporting RDI outside the Greater South East is crucial to achieving

government's Levelling Up ambitions. DSIT's evidence building in this area of research interest will ensure that policymakers across central and local government have a robust evidence base and understanding of the strengths and opportunities across the UK.

- Innovation clusters: Where are UK RDI clusters and what are the associated skills and investment in these clusters?
- Local benefits/patterns: What is the local impact of different RDI interventions?
- RDI outside of the Greater South East: How can the government boost RDI outside of the Greater South East to boost productivity, pay, jobs and living standards? Also, how can the UK attract RDI investment in these clusters from private actors?

7. RDI institutions and system

Building understanding of the varied institutions within the UK RDI system and the factors affecting the operation of these institutions, such as bureaucracy and financial sustainability, is key to ensuring effectiveness of the system.

- Ensuring the UK has the right diversity in the Science & Technology (S&T) landscape: How can the UK RDI system be mapped thematically and usefully (systems mapping as well as geographical mapping)? What have previous attempts achieved and how? How can gaps in the system be identified?
- Financial sustainability of research: What impact would various changes to the long-standing approaches to research funding have on research sustainability?
- Spin-outs and finance eco-system: How can the current system for university spin-outs be improved to nurture the next generation of globally competitive Science & Technology companies?
- Reduced bureaucracy of research and innovation funding: What approaches work to reduce 'unnecessary' bureaucracy in government funded RDI programmes?

8. Innovation

Innovation is critical for economic growth. The following research questions will help DSIT build a strong evidence base of how to drive innovation in all sectors and regions of the UK and maximise the benefits of innovation by boosting its adoption in firms and the public sector.

- Innovation drivers and barriers: How can innovation support be better tailored to different types of firms and the specific barriers they face? To what extent is innovation in firms persistent and what factors influence this?
- The geography of innovation: How does proximity to research and innovation infrastructure (i.e., PSREs, Research Council Institutes, Catapults, etc.) affect innovation activity in businesses, research organisations and

universities? How can this infrastructure be used to support the growth of clusters of R&D excellence across the - UK?

- Innovation diffusion and adoption: How can we measure and understand the adoption and diffusion of new ideas and technologies across regions and sectors? How can we support more widespread adoption of existing and new innovations?
- Role of public and non-profit institutions: To what extent do public and non-profit institutions facilitate innovation and its commercialisation in firms and universities? How can we effectively measure and incentivise innovation in public and non-profit institutions?

9. Metascience

This is less a particular evidence gap and more an interest in a certain way of addressing the gap. High quality M&E and data analysis on government programmes can inform many of the questions listed above. Another complimentary form of evidence comes from conducting live controlled experiments on the funding system. We are interested in a broad set of topics and methods termed 'metascience', the application of scientific methods (including live controlled experimentation) to the social practice of science itself. To support this, government is creating a new metascience unit. The unit will be jointly run across DSIT and UKRI, with an initial funding commitment of £10 million. The unit will deliver a competitive grant programme funding academic research into a broad range of topics relating to research productivity and integrity; and will also conduct experiments to test and robustly evaluate the effectiveness of changes in the funding processes delivered by UKRI.

Space

The Space Directorate aims to build an evidence base useful for monitoring the effectiveness and value-for-money of UK government interventions, for benchmarking the UK space sector against competitor countries, for understanding the role of space products and services in the wider economy and for tracking innovation and discovery. Our research interests are focused around the Four Pillars, as set out in the National Space Strategy.

DSIT sits within a wider ecosystem of institutions with an interest in space research.

A non-exhaustive list includes:

- UK Space Agency (UKSA)
- Department for Environment, Food and Rural Affairs (DEFRA)
- Department for Transport (DfT)

- Defence Science and Technology Laboratory (DSTL)
- HM Customs and Excise (HMRC)
- Ministry of Defence (MoD)
- Met Office
- Satellite Applications Catapult
- Ordnance Survey
- NHS
- Rail Safety and Standards Board (RSSB)
- UK Research and Innovation (UKRI)

The Space Academics Network, the Space Partnership and the Space Clusters also work to support, promote and coordinate research in space. Within this ecosystem DSIT's focus is on the implementation, monitoring and evaluation of the ambitions set out in the National Space Strategy.

We are considering whether, and if so how, to convene a College of Experts on space, and would welcome views on the matter.

Critical policy issues, evidence needs and questions

1. Unlocking growth in the UK space sector

- Studying the relative competitiveness of the UK space sector in an international context. How do UK space sector companies compare to international rivals?
- What are the areas of weakness, what are the areas of strength?
- How is the space sector likely to grow and change, and what will that mean for the UK space sector?
- What enables UK space sector companies to thrive – and what stops them from thriving?
- What is the role of government in this context?
- What is the evidence for the effectiveness of UK intervention in the space sector?
- Looking at skills across the space sector – what is needed, what is being provided, identifying shortages and developing proposals for addressing those shortages. Strengthening our understanding of what attracts graduates towards/ drives them away from choosing to work in the space sector. What is the role of government in this context?

2. Collaborating internationally

- How to make the UK a partner of choice in space activities?
- How best to draw on collaborative research and innovation, international opportunities, and global talent to be resilient and competitive?

- How to increase bilateral and multilateral partnerships with other spacefaring nations, forging the best relationships to achieve our goals in space?
- How to assess the costs and benefits of existing international collaborations?

3. Growing the UK as a science and technology superpower

- How can government effectively champion UK-led space science, exploration and innovation which expands our horizons and inspires the next generation?
- How can we leverage our world-class researchers, education, businesses and facilities to build the UK as a science and technology superpower, and in doing so, helping to achieve our goals in space?
- What are the areas of strength and weakness in UK space science and technology?
- Horizon scanning assessments of the future landscape for space.
- What are plausible scenarios and what role could/should the UK play in them?

4. Developing resilient space capabilities and services

- Building a stronger overall picture of the space sector. Mapping and explaining how the sector works, how its constituent parts intermesh, how the UK space sector is connected to the rest of the world, how academia and industry interconnect.
- How do we measure and understand space? What is the role of government in this context?
- Investigating the impact of the space sector on wider UK economy and society. What services are provided by the space sector?
- How does the space sector underpin our critical national infrastructure and our society?
- How is the space sector changing our society? What will this look like in the future? What is the role of government in this context?
- Estimating the climate change impact of the space sector, across the entire value chain. Analysing and proposing methods and mechanisms to reduce this impact. Estimating how space sector products (e.g., earth observation) can support broader climate change mitigation and adaptation efforts. What is the role of government in this context?

Technologies and innovative regulation

Technology strategy and security

This DSIT policy team works on policy to promote 'deep technologies', meaning technologies based on significant scientific or engineering advances, which

typically emerge from the research base. The team has a particular interest in engineering biology, robotics, advanced materials, and cyber physical systems (including digital twins.) In addition, the team engages in work on the convergence between technologies, and undertakes horizon scanning to consider nascent technologies and tech trends.

The team is interested in research and insights on the lifecycle of a technology from idea through research to reaching the market and scaling. The needs of "Deep Tech" companies are of particular interest, these can be characterised as businesses with high tech innovation or pursuing significant scientific advances. Compared with some other technology businesses such as in software and Fintech, these businesses may face additional barriers in raising funding due to the longer development cycles and additional product risk.

Office for Quantum

The Office for Quantum is delivering the UK's National Quantum Strategy (https://www.gov.uk/government/publications/national-quantum-strategy). The team identify and realise the opportunities of the nascent quantum sector for the benefit of UK prosperity, security and global influence.

Pro-Innovation Regulation

The Pro-Innovation Regulation Team works within and outside the Department to promote and enable a pro-innovation regulatory environment in the UK. Innovation-friendly regulation plays a critical role to encourage and translate R&D investment into real-world, marketable products and services that could, in the future, be scaled across domestic and international markets to the advantage of the UK economy.

The 2019 report, Regulation for the Fourth Industrial Revolution (https://www.gov.uk/government/publications/regulation-for-the-fourth-industrial-revolution/regulation-for-the-fourth-industrial-revolution), set out the government's plan to maintain our world-leading regulatory system in this period of rapid technological change.

At Autumn Statement 2022, the Chancellor announced a programme of work (https://www.gov.uk/government/collections/pro-innovation-regulation-of-technologies-review) to advise how the UK can better regulate emerging technologies, enabling their rapid and safe introduction. This Review, led by Sir Patrick Vallance and subsequently by Dame Angela McLean, consists of a series of reports on how regulation can support key areas of growth.

Most recently, the UK Science and Technology Framework (https://www.gov.uk/government/publications/uk-science-and-technology-framework) set out ten key actions to enable the UK to become the most innovative economy in the world, which included encouraging a regulatory environment that supports innovation.

Appreciating that not only is each regulator different, but the markets and innovations are different as well, we have developed a blend of approaches to ensure regulation is pro-innovation, stimulates science and technology demand in UK and international markets and attracts investment while representing UK values and safeguarding citizens:

- Maximising independent expert advice on regulatory reform for new and emerging technologies.
- Grant funding to encourage regulatory experimentation among regulators and local authorities.
- Connecting regulators on innovation.
- Convening partners on standards.

Technology Strategy

As the team has a broad remit, there are a range of different areas of evidence needs. These are likely to be areas of ongoing enquiry, as we seek to keep abreast of market and technological developments. We are also interested in the interaction of these issues e.g. with systems approaches.

Evidence challenges

One of the main challenges we have is that SIC codes do not readily permit us to do analysis of technology sectors, so we need to use specialist datasets, bespoke studies or natural language processing to enable us to collect data on the issues.

We work with technology experts to define classifying methods.

How Evidence is Used

We already have databases on business activity and equity funding in the team, with access to other datasets across the department on research activity, exports, skills, patents, IP, etc. We are nevertheless always interested in hearing about new data developments in this space.

We also have evidence from commissioned studies, and call for evidence responses.

Pro-Innovation Regulation

How evidence is used

The Pro-Innovation Regulation team wants to strengthen its evidence base to better support all parts of the policy cycle:

- Understanding the current health of regulatory and standards frameworks would help develop the rationale for our team's work.
- Understanding the barriers / opportunities faced by regulators, policy makers and standard-setting agencies would help the team target its efforts.
- Understanding 'what works' in terms of approaches to supporting innovation through regulation and standards would help the team develop interventions that have impact.
- Evaluating existing government policies would help demonstrate 'value for money'.
- Improving our research methods would help us generate better evidence in the future.

Scope of policy interests

The 'Pro-Innovation Regulation' policy area:

- Takes a very strategic cross-cutting interest in regulation. We are primarily interested in the UK regulatory system as a whole. But we are interested in regulation / standards in relation to particular technologies / sectors as well, particularly where it reveals more generalisable insights.
- Takes a very broad view of the definition of innovation. We are involved in very early-stage technologies (like quantum computing and fusion energy production) through to technologies which are already reaching markets (like drones and neurotechnology).
- Recognises the diversity of organisations that are involved in innovation – including academic researchers, start-ups, scale ups and established large firms.
- Recognises that regulatory opportunities and challenges are not unique to the UK. We are therefore open to learning from international experiences and examples of good practice.
- Is primarily interested in the role of regulation / standards in supporting innovation. But we are also interested in how regulators / standards bodies can use data / technology to support their work (e.g. in making the regulatory environment easier to navigate or enabling more effective risk-based compliance).

Evidence challenges

We are interested in all kinds of evidence (qualitative or quantitative) which are relevant to our research questions. But we recognise that it can be challenging to generate quantitative evidence in our policy area:

- It often doesn't lend itself to experimental methods. Because regulation is a system-level intervention, opportunities to use Randomised Control Trials are limited.

- Large-sample survey methods have been used in the past (e.g. UK Innovation Survey) to understand innovators perceptions but these have limited coverage of emerging technologies.
- Measuring the impact of government policies is also challenging because of the long time - horizons involved and the difficulties in separating the impacts of regulation from other policies (e.g. investment, skills).

As such, much of the existing research in this field is qualitative (case studies, in-depth interviews) and evaluation is typically theory-based.

Critical policy issues, evidence needs and questions
Technology Strategy and Pro-Innovation Regulation

1. Technology companies and investors in the UK

- We need to understand who the UK technology companies are, who owns them and who invests in them.

2. Equity finance and Foreign Direct Investment

- Providing sufficient scale up capital for fast growing tech and deep tech companies is always a very important topic, as part of the global race for leadership.
- Understanding gaps in finance, whether in particular sectors, for particular people (e.g., women) or compared with overseas is always of interest.

3. Skills / talent pipeline

- We need to understand the type and volume of new entrants required to meet the needs of growing sectors, and where these people might come from.

4. Commercialisation Infrastructure

- Sometimes there can be a lack of certain specialised facilities or infrastructure that is a barrier to technology companies scaling up within the UK.

5. Supply chains / value chains / exports

- We are interested in which companies we might collaborate with in order to give the UK a leading role within global value chains.
- We are interested in understanding situations where we are heavily reliant on a particular country in order to source key components.

6. International comparisons

- We are always interested in comparing the situation and activity in the UK to what is happening in our global partners and competitors.
- We are interested in estimates of the size of the future market for particular technologies.

7. Pro-Innovation Regulation

- In what ways is the UK regulatory environment helping / hindering the plans and activities of innovators? Is it becoming more friendly or less friendly to innovators over time? Methodologically, what is the best way of measuring the health of the UK regulatory environment over time?
- What role do technical standards play in supporting or hindering innovation? How can regulation and standards play complimentary roles in creating an agile governance framework? Are there successful case studies we can draw lessons from?
- What are innovators perceptions of regulations and standards in relation to innovation? Do perceptions vary depending on the type of innovator (e.g. start-up vs large firm) or depending on the stage of innovation (e.g. low vs high TRL)?
- How can we scan the regulatory horizon to identify opportunities to improve the regulatory environment? What role can regulators play in helping government identify areas of regulation in need of reform (and what information could they provide)? As new technologies develop, how can we more effectively anticipate and 'roadmap' the need for regulation and/or standardisation? How can we estimate what/when risks will occur (based on TRL) and when regulation is needed?
- How can the UK design a flexible anticipatory approach to regulation while ensuring protection to consumers and environment? What are the ethical aspects of regulating future technology and how can these be incorporated into an anticipatory regulatory framework? Are there successful case studies we can draw lessons from?
- What is the proper role for public engagement and communication as part of a wider regulatory process? What is regulators' accountability to the public with respect to innovation? What are the practical ways of doing public engagement in agile way?
- What approaches do regulators currently use to support innovators? How effective are these approaches? What are the underlying barriers stopping regulators from doing more to enable innovation (Capability, Opportunity and/or Motivation)? What opportunities are there for government to work with regulators to support innovation? How can grant funding be targeted at those regulator initiatives which will have the most impact on innovation?
- How can we better understand the risks and rewards of various regulatory approaches, such as sandboxes, and design a system that balances the two? What types of data sharing between regulators and businesses would enable greater innovative activity in the UK?

- How have UK and non-UK regulators and public authorities introduced emerging technologies in their regulatory work? What constitutes best practice in the use of emerging technologies by regulators to improve the efficiency or effectiveness of regulation? What are the barriers to regulators taking up new and emerging technologies to make their regulatory practices more efficient and effective?

- How can networks and communities of practice be used to support knowledge sharing and foster collaboration amongst regulators? How can strategic coordination and partnership help unlock the value of standards for innovation? How can regulators work with Freeports to overcome the regulatory challenges of developing, testing and applying new ideas and technologies?

- How can we foster a Pro-Innovation culture among regulators and policymakers, and encourage / enable them to fully factor the needs of innovators / innovation in their work at the earliest stages? What would enable different parts of the institutional landscape to work together collaboratively and across traditional organisational boundaries? How can the use of performance reporting and metrics by regulators be used to drive their support for innovators?

- How can government better assess the impact of regulatory reform proposals on innovation when producing Impact Assessments? Is it realistic to quantify impacts on innovation?

- What impact are the governments 'Pro-Innovation regulation' policies having (including the Regulatory Horizons Council (https://www.gov.uk/government/groups/regulatory-horizons-council-rhc) and Regulators Pioneer Fund (https://www.gov.uk/government/publications/projects-selected-for-the-regulators-pioneer-fund/projects-selected-for-the-regulators-pioneer-fund-2022)) and how can we better evaluate such policies in the future? Can we create an evaluation system specifically designed to help businesses and regulators monitor and evaluate the impacts of different regulatory approaches to create a coherent consistent library from which lessons can be learnt?

- Are international regulatory frameworks and technical standards currently helping or hindering UK innovators in achieving scale? How do key stakeholders rate our regulatory system compared to international competitors? How active / influential has the UK been in shaping international efforts to establish regulations and standards? Have UK industry and government built new capabilities / coalitions, effective in shaping global technical standards?

- How can 'systems science' be used by government and regulators to improve their understanding, making their policies better targeted and more effective? How can 'behavioural science' be used to influence the behaviour of key stakeholders (regulators, businesses and/or policymakers) to achieve better policy outcomes?

- What are the big strategic questions in relation to 'Pro-Innovation Regulation' that the government should be focused on? Do regulatory mandates and remits need to change and if so how, as markets and the economy continue

to shift? Is sector-focused regulation struggling to cope with changing markets, and how should it interact with horizontal regulation? Should innovation be made an explicit part of regulators' remit, without diluting their responsibility for consumer safety? How far should regulation be used to create new markets or shape existing ones?

Working with us

The DSIT ARI will be uploaded onto the ARI Database (ari.org.uk (https://ari.org.uk/)) as single lines describing the topic of interest.

DSIT welcomes the opportunity to extend its networks as widely as possible and is keen to ensure it reaches a diverse range of stakeholders. The department is happy to receive general expressions of interest and more detailed submissions from experts, at all career stages, who are interested in collaborating with DSIT and becoming part of its extended research networks. We are keen to engage researchers in a wide range of activities from submitting evidence, participating in events such as roundtables or working on research development with the department.

If you are keen to register your interest in working and connecting with DSIT and/or submitting evidence, then please complete the DSIT-ARI Evidence survey here (https://dsit.qualtrics.com/jfe/form/SV_cDfmK2OukVAnirs).

Appendix A contains a template of the survey. You should look at this prior to logging, in order that you have had an opportunity to prepare the information you will supply, particularly if you are submitting evidence. In addition, where you are not able to access the link for any reason, then we recommend that you send an email to csa@dsit.gov.uk structured in the format set out in the survey.

There is a data protection privacy notice at Appendix B, which explains in detail how we process your data.

The first page of the survey aids DSIT in understanding your expertise and your policy interests. If you are interested in being on DSIT's network list exclusively, please fill in just the first page. In addition, this contains a section to provide any information on potential future collaborations you would like to initiate discussions on. The second page of the survey is a mechanism that allows you to submit structured evidence that meets the evidence needs described in the ARI and which seeks to develop the DSIT's knowledge and evidence base. If you do have research evidence relevant to DSIT, including all forms of research, then please complete the full survey as an initial starting point for DSIT to engage with your work. It is possible to provide evidence that speaks to more than one policy area/question. Further information on submitting evidence is below.

To help DSIT manage the high volume of evidence it can receive, it is helpful for you to submit this in a structured way through the survey link provided and to keep in mind the following advice when completing the survey. DSIT is keen to receive evidence in structured formats so that it can easily direct the information and then absorb key aspects of your work. DSIT needs to understand the policy area your findings are most likely to be applicable to, your research aims and approach, your key findings and whether these are generalisable, scalable or transferable to different contexts. Where studies do evidence the benefits of a policy intervention or where they indicate that a policy has not met its intended aspirations the department is keen to receive this data. DSIT wants to know 'what works' in different contexts, the details of an approach and at what costs where known. DSIT wants to understand impacts and potential in all policy areas in terms of meeting needs for individuals, industry, cultural and civil society organisations, and society more broadly.

Please also reach out to DSIT through the survey should there be ongoing or recently started research that may feed into our policy evidence needs. DSIT is keen to talk through research design at an early stage. There are people in the Chief Scientific Adviser's Team, who are keen to assist.

DSIT will be seeking to better acknowledge all those who do contribute to its policy development through the submission of research evidence. This structured approach to collecting evidence will assist in this aspiration. Whilst DSIT may not be able to respond immediately to everyone directly, this does not mean that your submission has not been noted or your contributions have not been taken into account.

For more **general queries** about research and science please email the Chief Scientific Adviser's Team at csa@dsit.gov.uk.

Appendix A: DSIT ARI Survey

If you are keen to register your interest in working and connecting with DSIT and/or submit evidence, then please complete the DSIT ARI survey. Appendix A contains the template of the survey. Appendix B contains the data protection privacy notice associated with this survey. It is advisable to look at this information prior to logging in at the link, in order that you have had an opportunity to prepare the information you will supply. In addition, where you are not able to access the link for any reason, then we recommend that you send an email csa@dsit.gov.uk structured in the format set out in the survey. The privacy notice explains in detail how we will process your data.

Survey text in full:

The latest version of the DSIT areas of research interest (ARI) have been published online. These provide information on aspects of departmental work

where we would like to strengthen our evidence base. If you are interested in becoming part of a DSIT science network, attending events, undertaking research or providing links to existing research then please complete this survey.

To register your interest in networking with DSIT, please complete the first page of the survey, which seeks to capture information about your background and interests. We are keen to understand your expertise. Please note that we are keen to ensure we are engaging with a wide range of stakeholders in the development of our evidence base. Please note that you will need to move through all pages to get to the final submission button but need not complete the information on page two unless you do have evidence to submit.

If you are in a position to provide relevant evidence from an existing piece of research, then please complete the survey as a whole. Where you are able to provide evidence from more than one piece of research, then you should complete separate survey submissions for each piece of research. Having completed a first survey submission, you should sign in again to the survey and on page 1 provide your name and email and indicate this is a further submission. We will then be able to link your submissions. If any personal data has changed since previous submissions, then please update the relevant fields on page 1. You should then provide information on your new evidence submission by completing page 2.

All information will be retained securely in line with data protection law. Before completing the survey, please refer to the full privacy notice provided at Appendix B so that you are properly informed as to how your data will be managed.

Our intention is to build up our science networks and external engagement ensuring that we do deliver evidence based policy. If you do have any queries about the survey or DSIT science systems more broadly, then please email the Chief Scientific Adviser's Team at: csa@dsit.gov.uk.

Survey start

Page 1 of the survey to register interest in being part of DSIT science networks

1. Name:
2. Email:
3. Please indicate if this is your first evidence submission to DSIT via this survey tool.

If this is a follow up submission, then having completed your name and email, if all details on this first page remain the same then you should proceed to the second page of the survey.

- Yes, this is my first evidence submission via this survey
- No, this is a follow up evidence submission completed via this survey

1. Organisation:
2. Job role:
3. Career stage:

- Doctoral student
- Under 5 years in DSIT relevant academia, industry or other employment contexts
- 5-10 years in DSIT relevant academia, industry or other employment contexts
- 10-20 years in DSIT relevant academia, industry or other employment contexts
- More than 20 years in DSIT relevant academia, industry or other employment contexts

1. Please provide a summary of your expertise (max. 100 words). You may wish to add a link to an online professional profile and/or your publications list.
2. How did you find out about the areas of research interest (please tick all that apply)?

- I engage with areas of research interest documents from across government departments
- I regularly provide evidence which informs public policy
- The Department for Digital, Culture, Media and Sport (DCMS) College of Experts
- UK Research and Innovation (UKRI)
- Universities Policy Engagement Network (UPEN)
- Other academic networks
- Social media
- Other (please specify)

1. Areas of policy interest (please tick all that apply).

- Artificial Intelligence
- Building Digital UK
- Cyber Security and Digital Identity
- Data Policy
- Digital Economy Unit
- Digital Infrastructure
- International and Economic Security
- Security and Online Harms

- Geospatial Commission
- Government Office for Life Sciences
- International Research and Innovation
- Space
- Technologies and Innovative Regulation

1. Indicate how you would be keen to engage with DSIT (please tick all that apply).

- Attending events including focus groups and roundtable discussions
- Providing evidence briefings to DSIT
- Collaborating on new research
- Other (please specify below in question 11)

1. If you would like to propose a new research collaboration then please briefly set out your proposal below (max. 100 words).
2. Do you have any views on what you think should be the DSIT horizon scanning science priorities? (max. 50 words)
3. These ARI are intended to communicate some of our immediate research priorities. Did you find these a helpful tool for engaging with DSIT?

- Yes
- No
- Somewhat
- Not sure

1. Was there anything you would change about their formatting? (max. 100 words)

Page 2 of the survey for evidence submissions

1. Indicate the area of policy interest which your evidence base relates to (please tick all that apply).

- Cross cutting policy
- Artificial Intelligence
- Building Digital UK
- Cyber Security and Digital Identity
- Data Policy
- Digital Economy Unit
- Digital Infrastructure
- International and Economic Security
- Security and Online Harms
- Science, Innovation and Growth

- Geospatial Commission
- Government Office for Life Sciences
- International Research and Innovation
- Space
- Technologies and Innovative Regulation

1. Please indicate the specific policy evidence needs you are seeking to address, linking it to the areas of research interest document where possible (max. 50 words).
2. Please provide an overview of your research (max. 300 words). You may wish to include a link to any articles, data sets and online web pages detailing the research.
3. Please set out any highlight findings for policy and or practice (max. 100 words).
4. Please add any further information you wish to provide (max. 200 words).

Thank you for taking the time to complete this survey. If you have more than one evidence submission you wish to make then please can you complete a second submission, providing your name and email on page one, with the second page then completed again.

Survey end.

Appendix B: DSIT ARI survey privacy notice

Department for Science, Innovation and Technology: Privacy Notice for Areas of Research Interest Evidence Gathering

Who is collecting my data?

The Department for Science, Innovation and Technology (DSIT) focuses on positioning the UK at the forefront of global scientific and technological advancement. It utilises the UK's strong foundations of world-class research, a thriving technology scene and global networks of collaboration to create a golden thread from outstanding basic science to innovations that change lives and sustain economic growth. It directs R&D, talent programmes, physical and digital infrastructure and regulation to support the UK's economy, security, public services and wider government priorities. We help to give the UK a unique advantage on the global stage, striving for economic success. In order to do this, it is important that we build a robust evidence base to help inform our policy development. As part of this process we are reaching out through our published Areas of Research Interest (ARI) to grow our networks and develop our evidence base. Within this context, DSIT are the data protection controller. "DSIT", "we" and "us" indicate the controller for the personal information we

process, unless otherwise stated. Responsibility for leading on the ARI process sits within the Chief Scientific Adviser's Team in DSIT.

Purpose of this privacy notice

This notice sets out how we will use your personal data as part of our legal obligations with regards to Data Protection. It is provided to meet the obligations as set out in Article 13 of UK General Data Protection Regulation (UK GDPR) (this sets out the information we have to provide where the data is received directly from the data subject) and the Data Protection Act 2018 (DPA). The government's [personal information charter (https://www.gov.uk/government/organisations/department-for-science-innovation-and-technology/about/personal-information-charter)](https://www.gov.uk/government/organisations/department-for-science-innovation-and-technology/about/personal-information-charter) explains how we deal with your information. It also explains how you can ask to view, change or remove your information from our records.

What is personal data?

Personal data is any information relating to an identified or identifiable natural living person, otherwise known as a 'data subject'. A data subject is someone who can be recognised, directly or indirectly, by information such as a name, an identification number, location data, an online identifier, or data relating to their physical, physiological, genetic, mental, economic, cultural, or social identity. These types of identifying information are known as 'personal data'. Data protection law applies to the processing of personal data, including its collection, use and storage.

What personal data do we collect?

Most of the personal information we collect and process is provided to us directly by you on a voluntary basis. This includes:

- Personal identifiers, contacts and characteristics (for example, name and contact details)
- Employment data
- Research interests
- Research evidence as provided

How will we use your data?

We use personal information for a wide range of purposes, to enable us to carry out our functions as a government department. Within this context we are gathering data for use by the Chief Scientific Adviser's Team and more widely by colleagues across DSIT, for example our policy and analysis teams. We are using your data to develop our science networks and strengthen our evidence base.

What is the legal basis for processing my data?

Our legal reason for collecting or processing this personal data is to perform a public task (to carry out a public function or exercise powers set out in law, or to perform a specific task in the public interest that is set out in law). The lawful basis that we rely on to process your personal data will determine which of the following rights are available to you. Much of the processing we do in DSIT will be necessary to meet our legal obligations or to perform a public task. If we hold personal data about you in different parts of DSIT for different purposes, then the legal basis we rely on in each case may not be the same.

What will happen if I do not provide this data?

We are asking you to provide data in a structure format to engage in our research networks and to submit research evidence. All of the questions are optional and you should only supply data you feel comfortable in submitting to us.

Who will your data be shared with?

You are submitting this data by a survey submission or email to the Chief Scientific Adviser's Team based in DSIT. The Chief Scientific Adviser's Team will regularly review the data you submit and log it creating a listing of network contacts.

Personal data uploaded through our survey is hosted in the UK by Qualtrics whose services are contracted for with DSIT. We will regularly download data from the survey site. Access to the Qualtrics survey is limited to the DSIT Chief Scientific Adviser's Team.

Access to the Team's email inbox is limited to this Team. However, once initially logged, the Team will then share your submission with relevant colleagues across DSIT, including but not limited to policy and analysis teams.

If we do work on cross cutting research with other government departments or to evidence a case for funding to the Treasury, then your research may form part of our evidence base. However, we will not share your contact data outside of DSIT without your explicit permission.

How long will my data be held for?

Our network data will be reviewed annually. We will send out an email to all registered stakeholders as a reminder that you are on our network lists. The email will remind you to let us know if you wish your name to be removed from these lists. If we do not hear from you, then we will retain your name on our network lists. If we receive a bounce back from an email account, then we will also remove your details. Over longer periods of time we will refresh our network lists and at these points you will need to more specifically opt into the list.

In terms of the evidence you supply, we may be working on complex policy questions for very long periods of time. We will retain the evidence you have supplied for as long as we feel it may be relevant to policy development or where it is a part of the underpinning rationale for a policy decision we have taken.

Will my data be used for automated decision making or profiling?

We will not use your data for any automated decision making.

Will my data be transferred outside the UK and if it is how will it be protected?

We will not send your personal data beyond the European Economic Area.

What are your data protection rights?

You have rights over your personal data under the UK General Data Protection Regulation (UK GDPR) and the Data Protection Act 2018 (DPA 2018). The Information Commissioner's Office (ICO) is the supervisory authority for data protection legislation, and maintains a full explanation of these rights on their website (https://ico.org.uk/for-organisations/accountability-framework/individuals-rights/) . DSIT will ensure that we uphold your rights when processing your personal data.

How do I complain?

The contact details for the Data Protection Officer (DPO) at DSIT are:

DSIT Data Protection Officer
Department for Science, Innovation and Technology
1 Victoria Street
London
SW1H 0ET

If you're unhappy with the way we have handled your personal data and want to make a complaint, please write to the department's Data Protection Officer. You can contact the department's Data Protection Officer using the details above.

How to contact the Information Commissioner's Office

If you believe that your personal data has been misused or mishandled, you may make a complaint to the Information Commissioner, who is an independent regulator. You may also contact them to seek independent advice about data protection, privacy and data sharing.

Information Commissioner's Office
Wycliffe House
Water Lane

Wilmslow
Cheshire
SK9 5AF

Website: www.ico.org.uk (http://www.ico.org.uk/)
Telephone: 0303 123 1113
Email: casework@ico.org.uk

Any complaint to the Information Commissioner is without prejudice to your
right to seek redress through the courts.

Changes to our privacy notice

We may make changes to this privacy policy. In that case, the 'last updated'
date at the bottom of this page will also change. Any changes to this privacy
policy will apply to you and your data immediately.

If these changes affect how your personal data is processed, DSIT will take
reasonable steps to let you know.

This notice was last updated on 24/11/2023.

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1. Note that SRID focuses on the domestic RDI workforce and international RDI
   workers in the UK. Research questions relating to overseas collaboration and
   UK RDI workforce abroad is covered under International Research and
   Innovation.

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