British Geological Survey

BGS DIGITAL STRATEGY 2020-2025

Creating a digital-first geological survey

Executive summary

The British Geological Survey (BGS) are proud to deliver our first digital strategy.

The strategy enables us to create a digital-first geological survey that will support our scientific research and our role as the UK's premier provider of objective and authoritative scientific data, information and knowledge to help society to understand our Earth. We will support the UK Government in achieving its net zero target as well as the UN's Sustainable Development Goals (SDGs) in the UK and overseas, making communities safer and more resilient to natural disasters.

Our vision is to create a digital-first geoscience organisation linking people, data, equipment and technology to make new inferences about the world around us.

The digital revolution is changing how geoscience is carried out, how information is shared and how people engage with the world around them, accelerating the process of scientific discovery. This digital strategy sets out how the BGS will respond to the digital revolution and how we will ensure data and technology are at the heart of everything that we do. Our most valuable assets, after our staff, are our data holdings, which are fundamental to our future research. We will invest in our skills, resources and technical capabilities to drive our digital transformation and accelerate geoscientific discovery. We will transform how we conduct our business and scientific activities to fully exploit the opportunities of new digital technologies and their effects across society in a planned and prioritised way.

The BGS has a strong track record of producing innovative technological solutions to geoscience problems and early adoption of emerging technology. We have many success stories, including providing online access to over one million borehole logs and the development of bespoke data products and geoscience visualisation technology. Academia, industry and the public sector present many opportunities for our data and information.

To take full advantage of this wealth of opportunities, we have identified nine challenges that we need to focus on in the next five years. In addressing these challenges, we will be able to make our past part of our future by digitising our analogue collections, making data available for analysis using machine learning and data science techniques. We will link our information systems together, improving data flow from ingestion to service delivery, and transform how we work both within the BGS and with the wider UK and global communities.

To make progress in these areas and deliver an ambitious digital transformation programme we have identified six key areas for focus:

- leadership
- skills
- infrastructure
- data
- discovery and adoption
- products and services

Within each area there are enabling activities, including developing our digital skills, supporting innovation and digitising our national collections; these will drive our future programmes and provide the basis on which we will measure our performance.

Introduction

The BGS is a data-rich organisation. As technology rapidly develops, we must harness our potential to gather, combine and disseminate data in the most effective ways possible.

We released our refreshed Science Strategy *Gateway to the Earth,* in 2019. The strategy focuses on solving three science challenge areas:

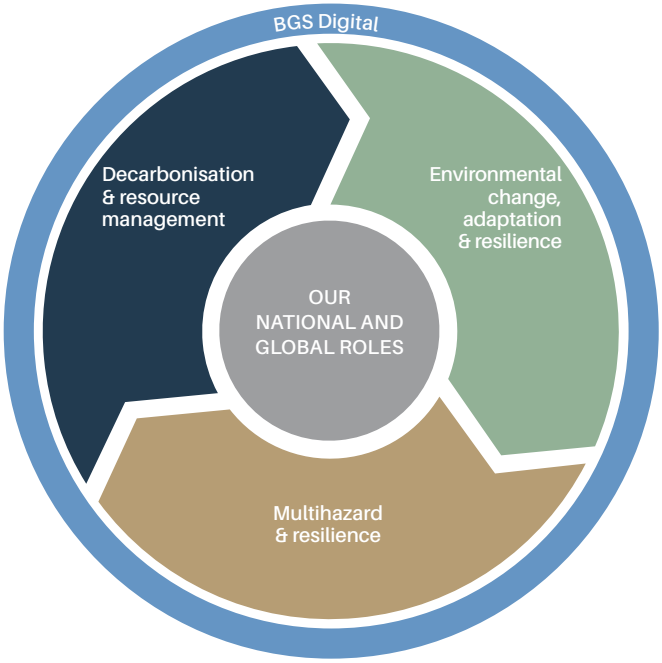
- decarbonisation and resource management
- environmental change, adaptation
- resilience and multihazards and resilience.

Underpinning all three challenge areas and core to the BGS's goals is 'BGS Digital', with its objective of driving digital transformation across the organisation. This will include maximising the opportunities to better measure and describe the underground; using increased computing power for storage and visualisation, and developing artificial intelligence for forecasting and prediction.

Embracing new technology across the BGS will be crucial. We will invest in technologies to change our operating systems and to create a new cyber infrastructure. This will include an integrated information system feeding into a global geoscience cloud, revolutionising data provision, forecasting and prediction, and supporting the science challenge areas. We will also develop new methods of delivering data to our customers and stakeholders to improve their user experience, including new insights into data and data tailored for business societal and environmental solutions.

BGS Digital vision

Our vision is to create a digital-first geoscience organisation linking people, data, equipment and technology to make new inferences about the world around us.



BGS Digital mission

Our mission is to respond to the digital revolution and put data and technology at the heart of the BGS. We will do this by investing in our skills, resources and technical capabilities to drive our digital transformation and accelerate geoscience discovery. We will develop internal and external user-focused solutions and broker digital partnerships on a national and global scale.

BGS Digital form and function

BGS Digital will lead our digital, data and technology functions. The BGS has a strong track record of producing innovative technological solutions to geoscience problems and early adoption of emerging technology. We will continue to manage, use, draw insights from and make accessible a vast array of datasets, computational capabilities, innovation platforms and digital assets. The pace and level of complexity at which we operate continues to accelerate and new paradigms and capabilities are providing benefits to both the BGS and our partners.

BGS Digital will also lead our digital transformation. The digital revolution is changing how geoscience is done, how information is shared and how people engage with the world around them, accelerating the process of scientific discovery. We will use digital technologies to create new and improve existing processes, culture and user experiences to meet the changing requirements of all users of geoscientific data and information.

The BGS's most valuable assets, after its staff, are its data holdings, which are fundamental to future research. We will continue to embrace change and re-invent how we make our data and expertise available to scientists and the private and public sectors, both in the UK and worldwide.

BGS Digital will continue to maintain and update our platforms, skills and approaches to realise the potential offered by the digital age. We will transform how we conduct our business and scientific activities to fully exploit the opportunities of new digital technologies and their effects across society in a planned and prioritised way.

Functions of BGS Digital

BGS Digital is structured into five areas (Figure 1), each contributing specific functions to enable BGS Digital to deliver its vision and mission.

Challenges and opportunities

There are many opportunities and challenges that the scientific community needs to address in the next 5–10 years. Technology will play a critical role. The most significant are:

- Big data: ever-increasing availability of data, particularly from sensors, requires managing new orders of magnitude of information.
- FAIR data: findable, accessible, interoperable and reusable (FAIR) data that is trusted in a way that suits our stakeholders' needs.
- Emerging technology: the appearance of new and rapidly evolving technologies generates opportunities for new scientific discovery.
- Scientific e-infrastructure: demand for integration with the broader European and international scientific community, from collaboration to sharing of data and digital capability, is increasing.

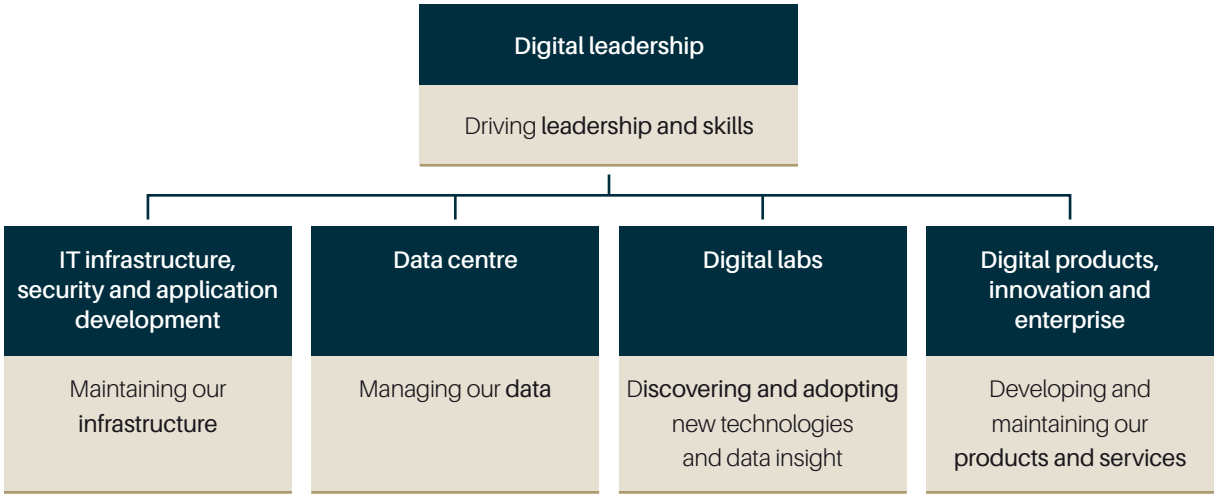


Figure 1 The five functional areas of BGS Digital.

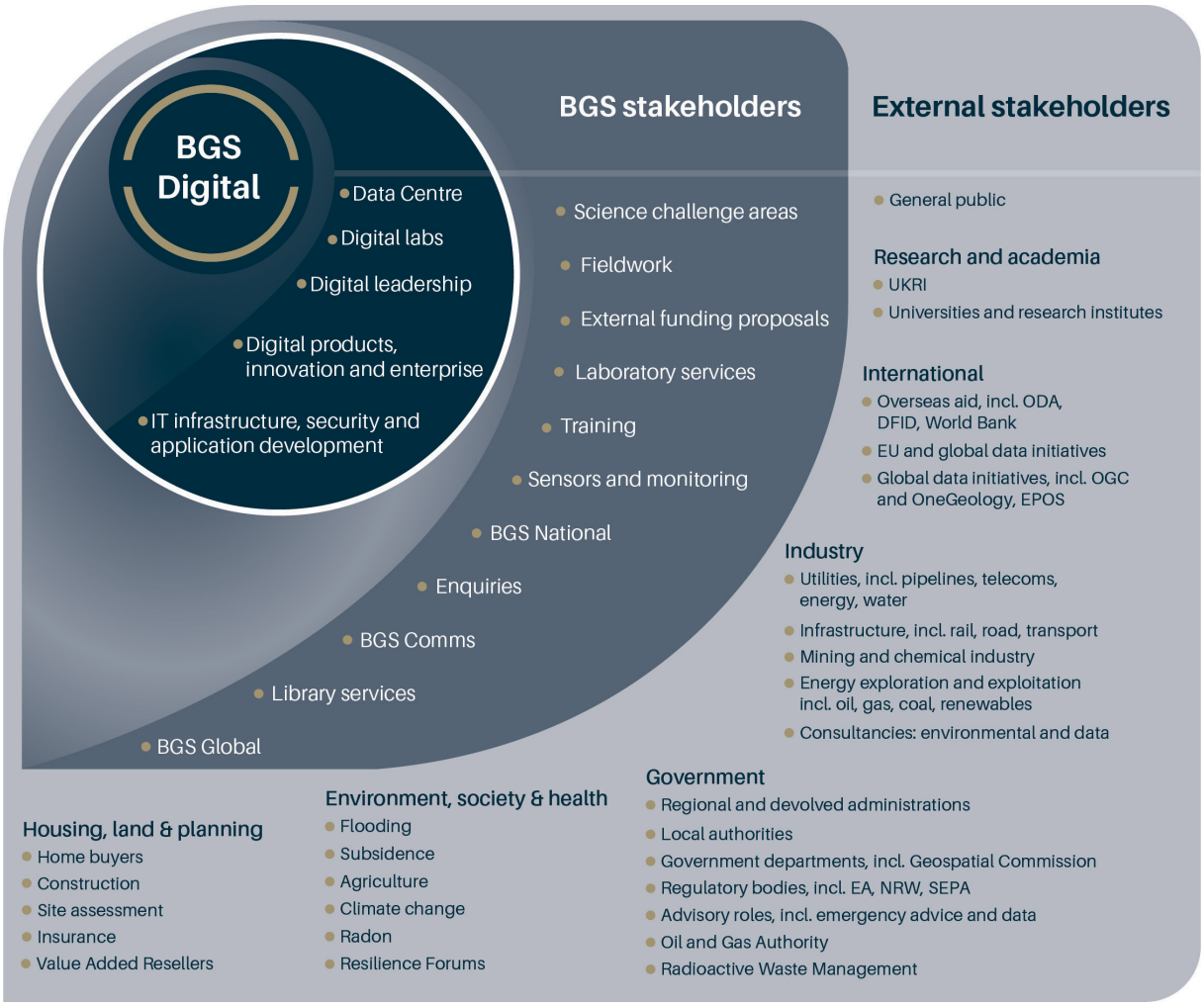


Figure 2 The breadth and scope of BGS Digital stakeholders.

- Cyber threat: the growing threat of cyber-attacks and the implementation of cyber resilience standards require improvement in the management and mitigation of security threats in order to protect our digital estate.
- Open source: increasingly vibrant, innovative open-source code, software and platforms will enable diverse digital opportunities.
- Efficiency: budget pressures continue to create tension between business-as-usual and opportunistic experimentation, requiring new approaches to organisational investment and a
- need for consolidation and simplification of BGS digital systems to improve efficiency.
- Flexibility: demands of work are changing and, for the BGS, the diverse needs of people both within the office and in the field require increasing flexibility for staff to be effective.

Using these opportunities, we will:

- make our past part of our future by digitising our analogue collections and making data available for analysis using machine learning and data science techniques
- link our information systems together, improving data flow from ingestion to service delivery
- transform how we work within the BGS and with the wider UK and global communities

Critical success factors

We have identified some critical success factors to ensure the implementation of our digital transformation agenda. These will provide clear direction and help achieve our digital vision alongside our strategic science goals.

Alongside the critical success factors are twelve 'enabling activities for digital transformation' and a set of outcomes with which we expect to deliver a step change. The critical success factors and enabling activities will drive our business, plan for our digital transformation and provide the basis on which we will measure our performance.

The critical success factors and enabling activities outlined in Table 1 are areas where we will make substantive and measurable changes in the next five years.

Table 1 Areas for change in the next five years.

Critical success factors	Enabling activities
Leadership	Digital leadership team
	Engagement
Skills	Valuing and developing digital skills
	Digital toolkit and virtual workplace
Infrastructure	Digital security
	Digital infrastructure
Data	Digitisation of our national collections
	Data Governance
Discover and adopt	Emerging technologies
	Digital insight
Products and services	Serving the digital economy
	Supporting innovation

Leadership

Digital leadership team

The BGS has invested in a digital leadership team to understand and address cultural issues, uniting the entire organisation behind a clearly articulated digital agenda.

The team is led by the chief digital officer (CDO), who has been appointed at executive level to provide strategic leadership and oversee the digital transformation. The team will:

- ensure a high level of data governance
- enable fast decision making
- increase productivity
- reduce 'silos'
- develop a user-centred focus and collaborative ethos to BGS digital research and innovation

Strategy

Under the direction of the CDO, the digital leadership team will be responsible for the implementation of the BGS Digital Strategy. In a fast-paced and ever-evolving digital environment, it will:

- continually monitor progress against objectives
- identify opportunities
- adapt to take advantage of the latest technologies

Governance

The digital leadership team will provide collective governance to enable strategic decision making, the targeting of resources and the prioritisation of projects and investments. In order to develop new products and services, the team will identify overly manual processes that can be replaced by automated or semi-automated alternatives and develop exit strategies for any existing services that cost more to support than they generate in reputational or financial value.

Engagement

The digital transformation programme will underpin and support the entire organisation in achieving scientific and business goals. We will work across the organisation to understand and support wider business needs to create a climate of collaboration with all three science challenge areas, plus national and international programme.

Digital champions

With such a diversity of expertise and experience across the BGS, there is a requirement to communicate clearly and with a consistent message. We will appoint digital champions to represent the organisation's data, applications, processes and skills and provide a point of contact to share knowledge. They will establish grassroots-led mechanisms, a bottom-up approach to development with a framework to enable this, to identify, evaluate and support innovative, new processes that will boost productivity and effectiveness across the BGS.

Empowering BGS digital culture

We will further support colleagues through a mixture of engagement methods, including digital-focused events and workshops to promote staff capabilities, share knowledge and inspire innovative ideas. By communicating the latest digital and technological developments to a wide audience, we intend to broaden our impact, encouraging uptake, efficiencies and use of latest techniques, and embed digital workstreams and technologies in all parts of the organisation.

Skills

Valuing and developing digital skills

Our employees are our most valuable resource. Developing our digital talent will be key to the success of our digital transformation. We will continue to invest in improving our digital skill set, whether this is through 'upskilling' existing employees or accessing the best talent. Our objective will be to create a digital mindset throughout the BGS.

Digital Academy

The BGS will need strong digital leaders who can deliver change so that our research, innovation and business services can benefit from the many improvements that modern technology has to offer. To this end, we will set up a virtual BGS 'Digital Academy' for our employees. The Digital Academy will employ a blended learning approach, including online and in-person training, and provide opportunities for sabbaticals and apprenticeships.

Professional development

In addition to the Digital Academy, we will develop a programme to share knowledge and best practice, connecting our partners across the public and private sectors . We will foster an environment of horizon scanning to look at future opportunities and continual professional development for our staff that will encourage innovation and inform the continual evolution of skills expectations.

Digital toolkit

The distinction between on-site and off- site working is being eroded. BGS staff are already able to work remotely through a virtualised working environment. There is an increasing need to access big data repositories, open-source tools and applications, with software providers already enriching their offerings on the cloud. Our digital workplace will be optimised to allow users to take advantage of these resources in this ever-evolving environment. Required software and data will be accessible and available for collaboration with colleagues, with training provided to maximise the effectiveness of the systems.

Virtual workplace

We will employ multiple cloud-based platforms with the required functionality and scalable capacity to support a wide range of business activities from any location.

When considering additional tools and functionality, their compatibility with existing infrastructure will be enforced to ensure that systems and processes are interoperable wherever practical. We will use a remotely accessible portal to direct staff towards the location of digital and analogue information. This will be actively maintained to ensure accurate content.

Collaborative tools

We are witnessing a paradigm shift in collaboration methods and tools, allowing people to co-create information and knowledge, instantly message each other and share and edit documents. We will invest in tools, training, platforms and services to enable users to work and collaborate anywhere, anytime, with fit-for-purpose security. This will optimise their work experience and productivity.

The digital workplace will be adaptive and flexible in order to incorporate new types of users, new behaviours and new technologies.

Infrastructure

Digital security

Keeping our organisation safe from cyber-attack is a top priority. We work to ensure that we have the right systems and technology in place to respond and recover quickly to continue operations as normal. We will continue to build a strong security-awareness culture and implement appropriate controls and safeguards. Continued investment in this area will ensure that our security environment meets both cyber resilience standards and our own business requirements.

Tools to boost cyber security, resilience and trust

We will move towards a 'cyber security by design' approach when developing new applications, ensuring that security plays an integral part in our software development approaches. We will develop a secure digital ecosystem, including a fit-for-purpose testing environment and a software package management system, that is sufficiently flexible to allow developers and scientists to use open-source tools to provide adaptable, low-cost development. We will have clear and structured pathways to operate successful applications through the creation of an authorising environment that will ensure our development approaches are of the highest quality.

Digital infrastructure

A stable, high-performing and well-supported digital infrastructure will enable us to produce world-leading geoscience research.

The traditional role of IT infrastructure is being rapidly reshaped by the demands put upon it by emerging technologies and increasing volumes of data. With a digital landscape focused on user experience, we will ensure that our digital infrastructure supports us and our partners in providing a trusted, reliable and affordable digital service.

Stable, modern network

BGS digital infrastructure will offer both internal and external users a stable, consumer- grade experience with easy discovery and 'click-to-consume' services that can scale to meet demand. We will invest in a flexible, hybrid infrastructure to support the shift towards software-as-a-service facilities, open-source technology and software, and online code repositories. Taking advantage of the opportunities that cloud services offer will ensure that our infrastructure can support organisational needs both now and in the future.

FOCUS: digital security

BGS already has a high level of digital security across its network. We continue to maintain and advance excellence in this field, enabling staff to work flexibly and securely around the globe.

Safe access to high-powered computing and services has helped science research over the last two decades and will continue to support and enable novel systems and techniques in the future. Our IT infrastructure continues to be shaped by the demands put upon it by new digital technologies and increasing volumes of data. For example, there has been a shift towards software as a service, increasingly open-source technology and online code repositories, which has resulted in a well-developed and flexible infrastructure.

Enterprise architecture

In order to align our data, technology and processes with our research and business goals, we will develop an enterprise architecture that links current processes and systems to the infrastructure that supports them. We will enhance our enterprise architecture to address business needs more efficiently and move to a hybrid infrastructure system that can provide, deploy and manage services on demand. Our digital infrastructure will expand to include new capabilities dominated by the end-to-end themes of automation and orchestration.

Dependencies on computer storage and networking services will be separated out and replaced by composed environments that can be assembled, reconfigured and broken apart at will to enable a more agile working environment and a simplified estate.

Samples and Archives

Data

600 km of core from over 22 500 wells and boreholes

Three million palaeontology and **three million** mineralogy and petrology specimens

135 000 high-resolution online core images

7500 types of fossil, all imaged, many with 3D digital models

Ten million borehole records

One of the **"big three"** UK geoscience libraries

The largest UK geoscience records archive with over **20 km** of shelving

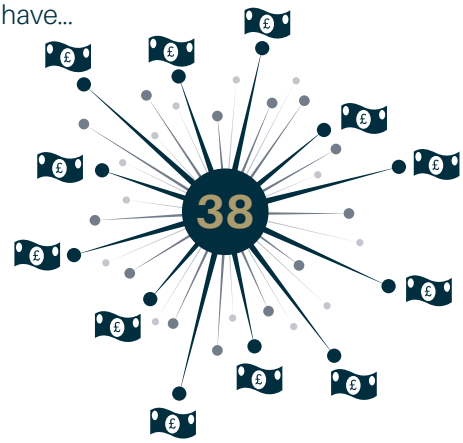
271 km of offshore core digitally imaged and available for download

We issue over **200** new data licences each year

At present, we have over **1000** different organisations accessing data via a BGS data agreement (including digital, academic and data exploration licences, and Letter of Undertaking).

We have **65** datasets approved for commercial use

We have...



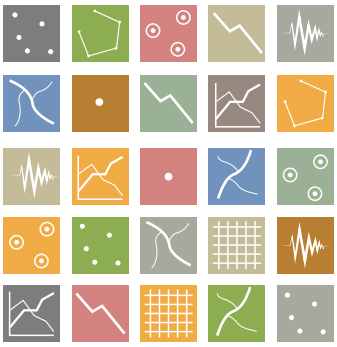
...data reselling partners who are authorised to sell data to third parties

Two Licensed software Intellectual Property Rights

We make around...

...a year through data licensing

Data access



25 datasets available to download under the OGL

We provide free online access to over **one million** borehole logs...

...with over **ten million** borehole records accessed

Over **70** web services available

documents in the publications viewer, covering the period 1835–2010

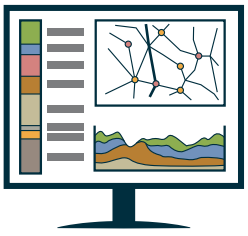
Over **80** WMS feeds delivering free-to-view data

12 000–13 000 visitors per month to the onshore GeoIndex

data layers

Over **7000** BGS maps published in OpenGeoScience

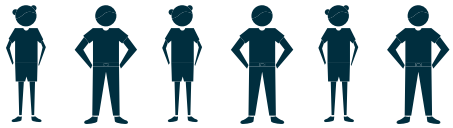
Over **900** downloads of Groundhog Desktop geological software per year across all industry sectors, in academia and from all continents



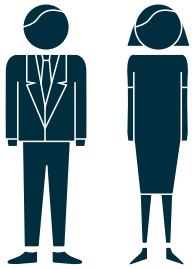
Networks

Working with over **15** private sector customers...

...and over **15** universities and institutes nationally



Average of **6** students and apprentices



130 technical and science staff

30 support staff

Working with **13** European and international projects and consortiums

App stats

iGeology

total downloads: **372 750**
Downloaded in **134** countries
1000 users per week

mySoil

total downloads: **113 700**
2440 submissions

iGeology 3D

total downloads: **53 760**

myVolcano

total downloads: **1000**
700 volcano/ash observations submitted

Data

Digitisation of our national collections

We have amassed an enormous amount of globally significant data, collections and information from the geoscience community. The range and quantity of these data and collections have continued to expand over the past 200 years, along with the need for resources to support preservation and global access. Consequently, geoscience data and collections are often an underused resource awaiting scientists, engineers, educators and policymakers who can consolidate, link and exploit the information to better help society use its natural resources responsibly and manage environmental change.

BGS digital collections programme

The BGS has been digitising records for many years and we already have a multitude of digitised collections and metadata catalogues served by a range of online applications and web services.

To accelerate our progress, we will set up a digital collections programme to prioritise and make our most important data records and collections available. These data will be made available through a consistent suite of application program interface (APIs) and well-maintained applications that are easy to find and use; they will also provide aggregated searches and data linkages across all our resources, e.g. specific lithological or stratigraphical units.

We will continue to exploit emerging technologies to deepen engagement with the collections, including text-mining techniques and provision of labelled data for machine learning models. We will create a virtual forum where we share our expertise and collections with the virtual community, helping our users to understand and exploit scientific or commercial opportunities.

National core research centre and store

The BGS Core Store, housed within the National Geological Repository (NGR), was originally constructed in 1985 with extensions added in 2001 and 2010. The current store is now full, with temporary storage likely to be filled by 2021.

We will look to develop a state-of-the-art centre with improved inspection bays. This will include X-ray CT scanners and portable mass spectrometers to allow for non-destructive imaging and analysis of our most valuable core.

Data governance

Alongside our analogue records, we hold geoscientific data from a variety of sources including public, private and research sectors. This collection of geoscientific data is held in the National Geoscience Data Centre (NGDC) and helps make the BGS the authoritative source of geological and geo-environmental data for the UK.

We professionally manage these data and make them accessible and (to differing degrees) interoperable for the longer term as evidence of existing scientific projects or programmes, as well as encouraging future re-use and therefore economic gain for the UK.

Accessible, discoverable, reusable and trusted data

As scientific data are increasingly peer- reviewed, amalgamated across discipline boundaries and re-used, there needs to be a high level of trust and confidence in our management and preservation of national data assets. We will continue to demonstrate professional management and compliance by adhering to CoreTrustSeal standards that underline our commitment to the 'TRUST' and 'FAIR' principles of data management. We will consolidate our position as global leaders in data management by actively promoting best practice and sharing knowledge.

Data governance framework

We will continue to develop and improve our data governance through the development of a data governance framework, so that the overall management integrity and security of our data are maintained to ensure integrated, data-driven decision making.

The data governance framework will consider the entirety of the organisation's data assets, be they scientific, operational or business intelligence. It will be enhanced to ensure the processes established and undertaken are 'fit-for-purpose' to maximise effective data management, consider ethics and minimise the risks from poor data quality, policies or approaches.

FOCUS: National Geoscience Data Centre

The National Geoscience Data Centre (NGDC), managed by the BGS, is the authoritative source of geological and geo-environmental data for the UK. It is a NERC-funded environmental data centre that holds data from scientists working in the UK and around the world.

The NGDC is responsible for maintaining environmental data and making them available to all users, not just NERC researchers but others from science, commerce, government and education as well as the general public. Its primary objective is to ensure that scientific data generated through NERC-supported activities are properly managed to ensure their long-term availability.

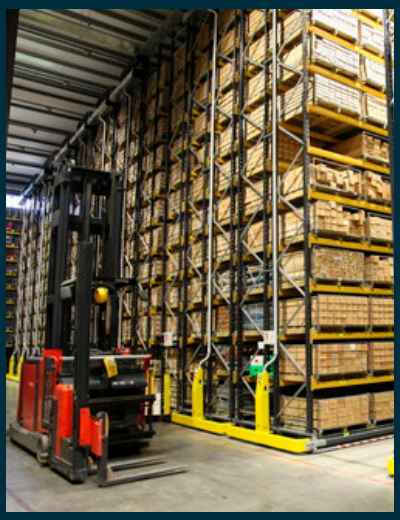
This service is governed by a board and an agreed service level agreement outlining the services and functions expected for use by the environmental community.

FOCUS: National Geological Repository and Core Store

The BGS is a data-rich organisation with over 400 datasets in its care, including environmental monitoring data, digital databases, physical collections (borehole core, rocks, minerals and fossils), records and archives.

Our National Geological Repository collections include:

- Over 350 km of drill-core and 4.5 million samples of cuttings from approximately 8000 wells
- Offshore sea-bed sediment and core samples
- Biostratigraphical collections of over three million specimens
- Over 250 km of cores, samples and cuttings from over 15 000 boreholes



Discover and adopt

Emerging technologies

The 'fourth industrial revolution' is characterised by a range of new technologies that are fusing together the physical, digital and biological worlds. These include:

- artificial intelligence (AI)
- virtual reality (VR)
- the internet of things (IoT)
- high-speed 5G
- edge computing
- ubiquitous networks of sensors

For geoscience, this explosion of new data sources, analytical technologies and observing systems is resulting in streams of data that can be translated into game-changing understanding through the development of new platforms to curate and combine diverse datasets. New analytical tools and empirical techniques, such as AI, deep learning and machine learning, will extract new information and insight. New decision-support applications will make information increasingly accessible to scientific communities.

Early assessment of emerging technology

We will develop a 'pipeline' of emerging technologies, augmented by future scanning and gap analysis. These will be strategically assessed against defined criteria so significant technologies can be prioritised for implementation whilst less relevant, or insufficiently mature, technologies are deprecated.

BGS Digital's scientists, in partnership with other scientists from across the organisation, will be given time and space for innovation and testing of technologies through low-cost, low-commitment projects that can be adopted or abandoned quickly. These projects will be monitored to ensure that only viable solutions and products are pursued beyond the evaluation stage.

Timeliness of investment in technologies

Knowing when to invest is critical to effective technological implementation. Following initial assessment, the scale of technology and the risks of adoption will be considered at each stage to ensure that resources invested are commensurate with the likely opportunity. We will quantify the organisational dependency on each technology and identify effects related to its implementation, focusing on scientific and business viability along with skills requirements.

Digital insight

'Digital insight' is our ability to analyse multiple large, complex datasets, enabling us to unlock unused knowledge from our data holdings to make new scientific discoveries, enable novel innovations and drive new opportunities for our diverse range of stakeholders. We will do this by generating more big data outputs from our analytical facilities and observatory networks.

Digital insights group

We will develop a digital insights group, whose focus will be to turn data, including big data, into insight. The group will work with the three science challenge areas, operational and business departments and digital champions to develop case studies for new technologies and help drive future research initiatives.

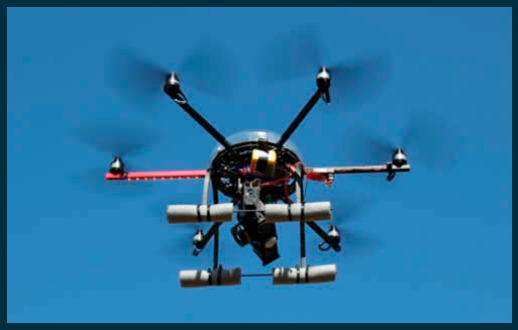
These functions will encourage evidence-based decision making throughout the BGS, support continued strategy development and use data to identify opportunities. It will be forward looking and experimental, business and research focused, collaborative and independent.

Collaborative, open and reproducible research process

To make the research process more collaborative, open and reproducible, we will develop digital science laboratories that are accessible to both BGS scientists and their collaborators. This virtual space will provide a place to experiment with new technologies and find new ways to use the information and data that we provide.

FOCUS: Monitoring data

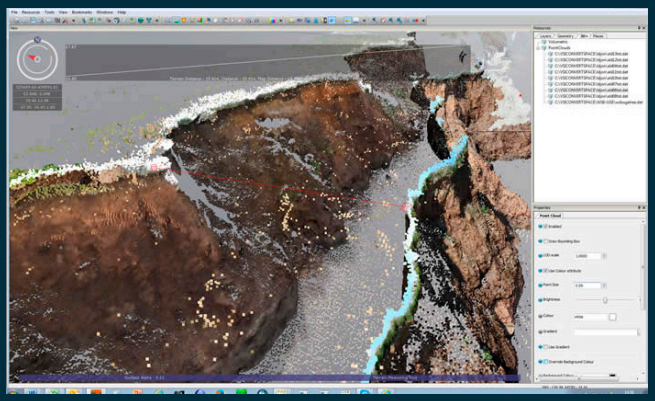
Real-time monitoring of environmental phenomena is an expanding area of interest for both the BGS and wider research communities. We collect data from sensors located throughout the UK, and beyond, capturing a wide range of environmental metrics. We have invested in technology and skills that allow future research strands to capitalise on these streamed resources.



FOCUS: geoscience visualisation

Geoscience visualisation is a fast-growing area and we are one of the world leaders in its application and development. These technologies enable geoscientists to visualise data in 3D and provide a mechanism for effective communication of BGS science.

We have developed several dedicated visualisation solutions that are able to more easily convey complex geological understanding, uncertainty and risk, as well as specific solutions for exploration, mining and virtual fieldwork.



Products and services

Serving the digital economy

We are living through a period of enormous technological change. Emerging geospatial technologies are offering exciting opportunities to deliver economic growth and increased productivity for the UK. The BGS is becoming increasingly instrumental in supporting a wider, multi-agency provision of information, knowledge and data to address industrial and societal needs, most importantly in dealing with our changing environment.

Encouraging uptake

We will continue to make our collections of data publicly available, providing outputs as open data where possible and via a 'freemium' model for our premium products and services. This balanced approach will ensure a sustainable platform to support the development of datasets and services while making our data as widely accessible as possible.

Stakeholder needs

We will continue to develop and support services to enable government, business and the public to benefit from the national repository archive of data and knowledge. To better understand the needs of all our stakeholders, we will expand our business analysis and user experience expertise to build a stakeholder-first approach, identifying core sectors and their needs and streamlining the internal processes and external services that support them. Using design thinking and user experience principles, we will ensure that the products we create meet the needs of our users.

Investment in datasets, products and services

We will continue to maintain and develop our most valuable datasets, products and services, and develop an investment plan for outputs with significant reputational, societal or economic impact. Understanding our position in the value chain of the UK digital economy, we will identify where we can unlock most value and deliver outputs fully aligned to our science strategy and public role. We will develop more robust maintenance strategies for data outputs and managed exit strategies for products no longer aligned to our core strategy or stakeholder needs.

We will review the support systems behind our products and upgrade them to address requirements for data discoverability, quality assurance, security and interoperability. We will demonstrate the benefits of our streamlined processes measure and customer satisfaction.

Supporting innovation

Digital solutions are already dramatically changing the way we operate as a society. Data and technology are key drivers of innovation and we will continue to look for opportunities that exploit our skills, data and services. We will increasingly focus on co-designed solutions that deliver step changes to our stakeholders' business, societal or policy needs. We will also remove barriers to innovation and provide support to promote the exploitation of our digital assets by third parties.

Encouraging and equipping digital innovators

Through research infrastructure programmes such as the European Plate Observing System (EPOS) and continued development of our strategic data partnerships, the BGS will provide leadership in digital geoscience innovation in the UK. We will make skills, expertise and knowledge available to the wider community through outreach and sectoral engagement. We will engage with external innovation programmes to help with the uptake of BGS data and set up an innovation hub in partnership with national and local institutions.

The innovation hub will stimulate the uptake of environmental data and subsurface information via training, support, focused collaboration and open competition. It will provide end-to-end support for all who want to work with environmental geospatial data as well as access to specialist scientists and technologists.

We will review our current systems for supporting our commercial clients in a challenging, online environment by developing more streamlined services and investigating alternative business models. We will create sector and product champions focused on outcomes in this critical revenue stream.

Technologies that support our innovation process

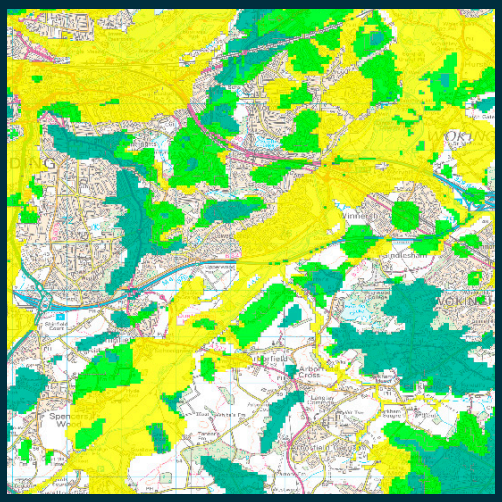
The BGS has increasingly deployed agile and lean management practices, optimising efficiency, in our digital innovation process to streamline processes and shorten product lifecycles. We will continue in our premise of 'innovation = problem X solution X delivery', using techniques focused on producing minimal viable products developed through co-designing solutions with our user communities. We will adopt digital techniques for simulating and prototyping new products and services and enhance design and user experience.

We will invest in systems that provide better access to all data, products and services and expand our outputs with increased use of APIs and dashboards. We will invest in systems that provide better business metrics to understand how our stakeholders are interacting with our expanding digital portfolio and improve monitoring of our successes (and failures) and measure the effect our work has.

FOCUS: data products

The BGS produces a wide range of data products that align to government policy and stakeholder needs. These include geological map data and engineering properties and geohazards datasets. Our products are supported by stakeholder focus groups, identification of gaps in current knowledge and policy assessments.

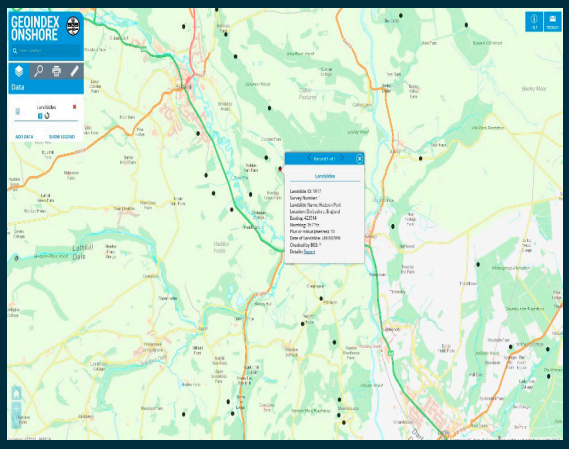
Our products and services help to improve understanding and communication of the impact of geo-environmental properties and hazards in Great Britain, thereby improving society's resilience and enabling people, businesses, and the government to make better-informed decisions.



FOCUS: OpenGeoscience

OpenGeoscience is the BGS's home for open data. It has been at the forefront of web delivery for 10 years, providing a wide range of freely available geoscience information, and will continue to form the basis for future data delivery and access.

OpenGeoscience includes a variety of free to view or download resources, including access to 1:50 000-scale geological data, over a million borehole logs, scanned versions of our map catalogue, access to our photo library and a host of web services and apps.



Defining success

Measuring success

The criteria in Table 2 represent how we will measure success. These will enable us to know how well we have delivered our digital strategy. Some measures are already in place; in other, newly formed areas we will develop mechanisms for measurement in due course.

Table 2 Success measurement criteria.

Critical success factor	What success looks like	Measures
Leadership	• Clearly articulated digital programme • Enhanced digital culture	• Higher levels of engagement of BGS staff in digital technologies and data • Improved monitoring of progress on strategic initiatives • Engaged digital champions from science challenge areas • Focused events to enhance and develop digital culture
Skills	• Digital workplace enabling BGS staff to harness technologies • New ways of working that will drive high-impact science	• Higher levels of digital skill competency across organisation • Improved flexible working connectivity • More staff awareness of the services on offer from BGS Digital
Digital infrastructure	• Stable • Reliable • High performing • Flexible • Secure • Well-supported	• System uptime • Number of security incidents • Increasing infrastructure and licencing efficiency • Internal satisfaction with BGS IT services • Reduction in the number of redundant products and services not decommissioned
Data	• Increased use of BGS data and information archives by BGS staff and the wider scientific community	• Increase in machine-readable data • Increase in available data downloaded directly from website • Number of analogue records digitised • Improved core warehousing and research facilities • Promotion of accessible, discoverable, reusable and trusted data • Improved corporate data governance
Discover and adopt	• Scientific discovery enabled through the exploitation of existing and new data	• Reduced manual wrangling of data • More decisions informed by data insights • Increased awareness of the strategic value of data and emerging technologies • Number of high-potential emerging technologies assessed and adopted • Digital insights group set up and operating
Products and services	• More diverse stakeholder community supported with data products and services to address industrial and societal needs	• Increase in the number of digital geoscience innovations reaching user communities through process improvements • Increased levels of automation in product and service development • Increased uptake of BGS data services and digital products • Improve working partnerships with our digital innovation partners • Increased user satisfaction

British Geological Survey

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