



Annual Report

2022





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2022



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Foreword



As a member of the ELIXIR Industry Advisory Committee (IAC) since its creation in 2015, I have had the privilege to follow ELIXIR activities and witness its progress over the years. ELIXIR's IAC tries to make useful recommendations on how to promote ELIXIR's valuable bioinformatics services and resources to meet the challenges and needs of the diverse and ever-changing life sciences industries. We strongly believe in the ELIXIR-industry partnership as an instrument to drive innovation. This is clearly illustrated by ELIXIR's contributions to the European life sciences innovation ecosystem and by its adoption of open science recommendations from multiple stakeholders.

The strategic position of ELIXIR in the bioinformatics community in 2022, along with its strong stakeholder relationships, has attracted interest from new countries like Croatia and from leading edge European initiatives like GAIA-X and EuroHPC. In addition, ELIXIR Communities are constantly adapting to cater for emerging areas such as systems biology, single-cell omics and biodiversity, and we are very excited to see what the European Genomic Data Infrastructure project is going to bring.

ELIXIR is very aware of the benefits of engaging with industry, and therefore, it absorbs and implements our recommendations swiftly. Examples of actions taken by ELIXIR are the creation of networks of experts and the vast training offerings designed to develop specific professional skills. This is in addition to the development of internationally validated standards for data, services

and infrastructures, and the provision of coordinated access to sustainable core data resources that is essential for business continuity. The IAC recognises ELIXIR as a key player in the pan-European implementation of local and national initiatives and in the creation of a cross-cutting collaboration between academia and industry.

The fast and efficient response of ELIXIR to the pandemic continued in 2022, clearly demonstrating its agility and capacity to react at speed. ELIXIR's plethora of tools, data, standards, training and services was offered to science and healthcare communities in the fight against the SARS-CoV-2 pathogen, and in the process, creating a new focus for ELIXIR on infectious diseases.

We believe that ELIXIR's purpose, identity and values will contribute to the alignment of ELIXIR Nodes with a shared vision and sense of belonging, and also bring ELIXIR closer to industry culture and practices, creating further common grounds for action. I look forward to further supporting ELIXIR in their industry endeavours, and I am confident the ongoing work performed by ELIXIR across its Nodes, Communities and Platforms will continue to enable a bright future for the life sciences industries at large.

Natalia Jiménez Lozano

Chair of ELIXIR Industry
Advisory Committee (2022)

Benzos, France

February 2022

A handwritten signature in blue ink that reads "Natalia". The signature is fluid and cursive, with a long horizontal flourish extending to the right.

Preface



In 2022 we were able to gather together again, sometimes tentatively, sometimes as if we had never been interrupted at all. Opening the All Hands Meeting in June was an emotional experience, it was a relief and a joy to see the ELIXIR community able to enjoy face-to-face interaction again.

During 2022, ELIXIR's focus on research data management came to fruition, with the maturing and flowering of resources such as RDMkit, the FAIR Cookbook, FAIRsharing.org and the Data Stewardship Wizard. The FAIRplus project finished on a high, plans for a new Research Data Management Community were formed and a collaboration blossomed with the NIH's Office for Data Science Strategy.

Groups of experts form the foundational backbone of ELIXIR and nurturing the development of people and connections has remained a strong focus. The Executive Masters in Management of Research Infrastructures (EMMRI) ran for a fifth time, with each cohort featuring strong representation from ELIXIR. Our community events were phenomenally successful, with our annual BioHackathon standing out in terms of participant enthusiasm and the production of concrete results in such a short period of time.

2022 brought with it new EU-funded projects, notably the European Genomic Data Infrastructure (GDI) project, which is building the infrastructure to realise the ambition of the 1+Million Genomes (1+MG) initiative. ELIXIR continues to develop its biodiversity portfolio, with strong involvement in the Biodiversity Genomics Europe (BGE) and Agroserv projects and advanced plans for a new Biodiversity Community.

Much effort was directed towards the development of our next five-year Scientific Programme, which will start in 2024. We concluded our in-depth consultation process and drew together all the strands and discussions into a coherent strategy document which will guide our delivery planning. Finally, 2022 was a year of growth for ELIXIR with Croatia formally committing to joining our community.

Looking ahead to 2023, we will continue our focus on people with the delivery of the ELIXIR Training Programme in Management (ELITMa), building operational and management expertise in ELIXIR Nodes. Following the successful launch of the Federated European Genome-phenome Archive (FEGA) we will push on with the rollout of the federated infrastructure to enable data access whilst respecting national data sharing regulations.

We foresee that ELIXIR will continue its expansion in 2023, with advanced discussions with new member states underway. And with the 2024-2028 Scientific Programme launch growing ever closer, the coming year is one for us all to pull together to make our plans for the coming years the best they can be.

Niklas Blomberg

ELIXIR Director

Cambridge, UK

March 2022



ELIXIR in 2022



DRIVING PROJECTS FORWARD

14

ONGOING
EU-FUNDED
PROJECTS

7

NEW
PROJECTS

In 2022, the portfolio of EU projects involving the ELIXIR Hub comprised 7 new projects and 14 ongoing projects, 7 in a coordination or co-ordination role (starred):

AgroServ

*B₁MG

BiCIKL

Biodiversity Genomics Europe

*BY-COVID

canSERV

CINECA

European Joint Programme on Rare Diseases

*ELIXIR-CONVERGE

*EOSC₄Cancer

EOSC Future

*EOSC-Life

eTRANSAFE

EUCAIM

EU-STANDS₄PM

*FAIRplus

*European Genomic Data Infrastructure

Healthdata@EU Pilot

HealthyCloud

ISIDORE

PathOS

PROPHET

RltrainPlus

Has started coordinating one new project:

EUROPEAN GENOMIC DATA
INFRASTRUCTURE (GDI)

€40M

to realise the 1+MG initiative's ambition of creating a data infrastructure to enable secure access to genomic and corresponding clinical data across Europe.

Has started co-coordinating one new project with the Barcelona Supercomputing Center (BSC)

EOSC₄CANCER

€8M

to make cancer data accessible and enhance federated and interoperable systems for securely identifying, sharing, processing and reusing FAIR data across borders.

And has finished one EU project

FAIRplus – developed tools and guidelines for making life science data FAIR (Findable, Accessible, Interoperable, Reusable) with 21 partners from academia and industry.

Funded 27 new Commissioned Services with a total investment of

€5.2M

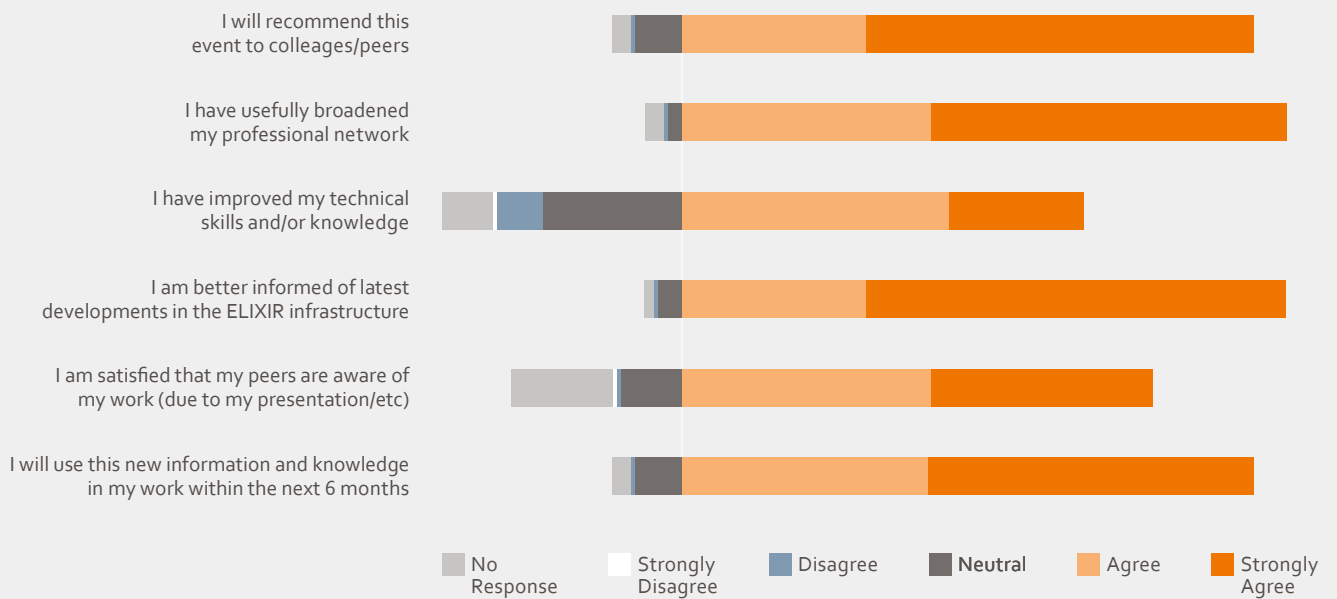
Planned the new ELIXIR Scientific Programme 2024-2028

Held a series of consultation events planning and developing the Programme

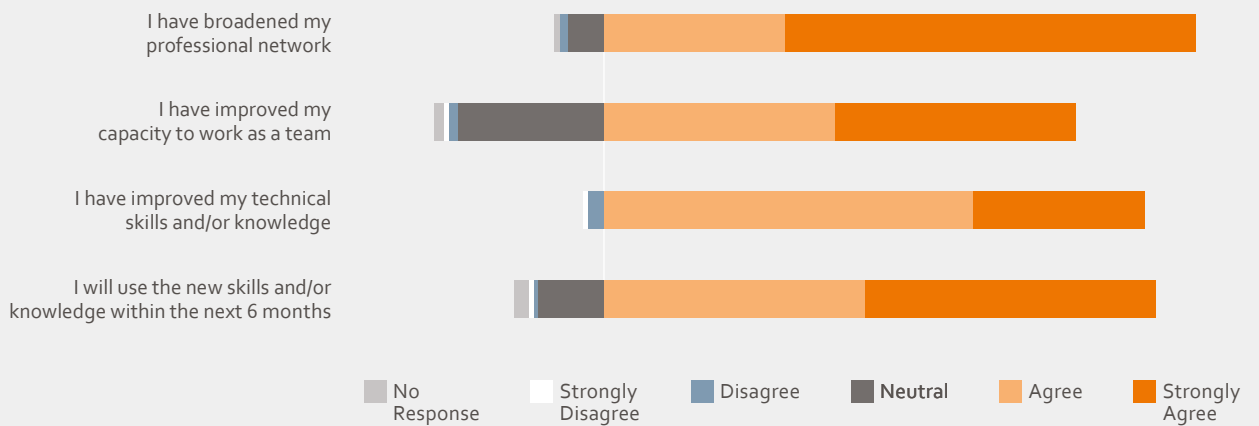


HOSTED HIGH
IMPACT EVENTS

All Hands meeting 2022



BioHackathon Europe 2022



Our EU grants

To drive forward our goals in the field of bioinformatics and provide services to the scientific community, ELIXIR participates in several EU-funded projects. These enable ELIXIR to collaborate with key European and global initiatives, industry partners and other research infrastructures.

FAIRplus

FAIRplus

In 2022, the ELIXIR coordinated Innovative Health Initiative (IHI) project, FAIRplus, came to an end:

TIMELINE January 2019 - December 2022

BUDGET €8.23M

WEBSITE <https://fairplus-project.eu>

The FAIRplus consortium set out on their journey in January 2019 to develop a framework for making life science data FAIR (Findable, Accessible, Interoperable, Reusable). The project has successfully developed many FAIR resources and tools in the past three years, including the FAIR Cookbook, the Dataset Maturity Model, the FAIR Wizard, a series of Innovation and SME Forum and the FAIRplus Fellowship Programme.

The FAIR Cookbook is an online open resource for the life sciences with recipes to help researchers make and keep data FAIR. By the end of the project, the FAIR Cookbook included more than 70 recipes contributed by over 90 authors. The Cookbook is now incorporated into Node service delivery plans, and it is embedded in the ELIXIR Interoperability Platform.

It has strong links to the RDMkit and is recommended in research data management guidelines on the ELIXIR website and by the European Commission.

The FAIR Wizard uses FAIRification resources developed by the FAIRplus project and other platforms, suggests FAIRification materials based on the FAIRification requirements, and designs FAIRification solutions for data owners, data stewards and anyone involved in FAIRification.

The FAIR Dataset Maturity Model¹ guides FAIR maturity decision-making by targeting data management investment towards the capabilities that most effectively improve data discovery, accessibility, interoperability and reusability, and by establishing success metrics for evaluating how FAIR data assets are both before and after investment.

To foster an innovation ecosystem in FAIR open data, the FAIRplus project organised three Innovation and SME Fora. With more than 400 participants representing both industry and academia, the Fora have powered the discussion on FAIR knowledge and the future use and societal benefit of FAIR principles.

To contribute towards changing

and sustaining change in the data management culture, a one-year fellowship programme was established to educate the next generation of experts for further FAIRification of data sets within IHI projects, European Federation of Pharmaceutical Industries and Associations (EFPIA) partners and beyond². The 15 fellows improved the FAIR levels of their own data sets, used and contributed to the FAIR Cookbook and learned how to apply the maturity model. After completing the programme, the fellows had the confidence to lead, advise and initiate FAIR data processes in their respective companies and organisations. The FAIR fellowship e-learning materials are available for reuse through the ELIXIR training materials platform TeSS³.

Collaboration with other projects was a key feature of the FAIRplus project. During the project period, the FAIRplus squad teams, consisting of experts working in universities and pharmaceutical companies, actively worked to FAIRify data sets from other large IHI projects, such as RESOLUTE, eTOX and APPROACH. In total, the FAIRplus project published seven case studies highlighting the application of the FAIR Cookbook and work in FAIRifying IHI project data.

¹ <https://fairplus.github.io/Data-Maturity>

² <https://fairplus-project.eu/get-involved/fellowship>

³ <https://tess.elixir-europe.org/materials/fairplus-fellowship-programme>



European Genomic Data Infrastructure (GDI)

In 2022, ELIXIR started coordinating one new project:

TIMELINE November 2022 - October 2026

BUDGET €40M co-funding (50/50)

WEBSITE <https://gdi.onemilliongenomes.eu>

The European Genomic Data Infrastructure (GDI) project launched in Brussels on 17 November 2022. The new €40 million project, coordinated by ELIXIR, is jointly funded by the European Commission under the Digital Europe Programme, and through co-funding from participating Member States.

The project involves a consortium of partners from 20 European countries and will facilitate a cross-border federated network of national

genome collections for biomedical research and personalised medicine.

The aim of the GDI project is to realise the 1+MG initiative's ambition of creating a data infrastructure to enable secure access to genomics and corresponding clinical data across Europe. This will create unparalleled opportunities for transnational and multi-stakeholder advances in personalised medicine for common, rare and infectious diseases.



EOSC4Cancer

In 2022, ELIXIR began involvement in one new project with Barcelona Supercomputing Center (BSC):

TIMELINE September 2022 - February 2025

BUDGET €8M

WEBSITE <https://eosc4cancer.eu>

EOSC4Cancer will make diverse types of cancer data accessible: genomics, imaging, medical, clinical, environmental and socio-economic. It will use and enhance federated and interoperable systems for securely identifying, sharing, processing and reusing FAIR data across borders and offer them via community-driven analysis environments.

The resulting well-curated data sets will be essential input for reproducible and robust analytics and

computational methods, including machine learning and artificial intelligence. EOSC4Cancer's five use cases will cover the patient journey from cancer prevention to diagnosis to treatment, laying the foundation of data trajectories and workflows for future European Cancer Mission projects.

ELIXIR and the European Health Data Space

In October 2022, a new European Health Data Space (EHDS) project (HealthData@EU pilot) was launched with the aim of addressing the challenges of access to health data throughout the EU, and to open new perspectives to research and innovation. ELIXIR coordinates the B1MG project which supports the 1+MG initiative by delivering the blueprint for the infrastructure that will interoperate with the EHDS.

ELIXIR's involvement in the European Health Data Space (EHDS) pilot

- ELIXIR drives a colorectal cancer data use case with the aim of ensuring synergies from conception between the EHDS and the genomics infrastructure.

ELIXIR projects that work closely with and contribute to EHDS



Our progress against strategic objectives

As defined in the Scientific Programme for 2019-2023, ELIXIR has five strategic objectives. These cascade down to the more specific objectives in ELIXIR Platforms, Communities and in scientific and technical collaborations with ELIXIR partners.

1

ELIXIR will operate a portfolio of integrated services that meet the data needs of life scientists at a European scale

DATA
PLATFORM

P. **30**

INTEROPERABILITY
PLATFORM

P. **32**

TOOLS
PLATFORM

P. **33**

COMPUTE
PLATFORM

P. **35**

TRAINING
PLATFORM

P. **37**

2

ELIXIR Communities will drive service uptake, support standards development, and connect ELIXIR's experts in life science disciplines

ELIXIR
COMMUNITIES

P. **39**

3

ELIXIR Core Data Resources will be the global standard for bioinformatics resource management and the foundation for an international funding and life cycle management strategy that secures the long-term sustainability of those resources

DATA PLATFORM

P.30

GLOBAL BIODATA COALITION COLLABORATION

P.55

4

ELIXIR will be the recognised and trusted life science foundation of the European Open Science Cloud

DATA PLATFORM

P.30

INTEROPERABILITY PLATFORM

P.32

TOOLS PLATFORM

P.33

COMPUTE PLATFORM

P.35

EOSC FOCUS GROUP

P.47

5

All ELIXIR Nodes will connect life science users in academia and industry to our open, federated service network

ELIXIR NODES

P.17

BIOHACKATHON EUROPE

P.50

DEMONSTRATING ELIXIR'S IMPACT

P.52

ENABLING AND SUPPORTING INDUSTRY COLLABORATION

P.56

Our Services

ELIXIR Services

ELIXIR coordinates the provision of life science services, developed and managed across Europe by ELIXIR Nodes. These services are available to researchers around the world and support efficient manipulation, analysis, storage and exchange of life science data.

The portfolio of ELIXIR services is organised into five technical Platforms: Data, Tools, Compute, Interoperability and Training. Additionally, selected services are part of three key services collections: ELIXIR Core Data Resources, ELIXIR Deposition Databases and ELIXIR Recommended Interoperability Resources.

Selected ELIXIR Services:

The content and usage of a number of key ELIXIR services and resources in 2022

Life Science Login (previous known as ELIXIR AAI)

- Over 13,300 logins per month
- 143 ELIXIR AAI services integrated with Life Science Login
- Integrated 146 production services in total and an additional 161 in testing
- More than 9,600 users

FAIRsharing

- 1,986 databases
- 163 policies
- 1,647 standards
- 3,526 organisations involved

ELIXIR TeSS

- 104 content providers
- 26 training workflows
- 1,903 training materials

BioContainers

- 10,954 tools

BioTools

- 27,736 entries
- 474,698 annotations
- 6,421 users

ELIXIR Nodes continued to expand their portfolio of services in 2022



*some services are in more than one Platform

5

MULTI-NODE SERVICES

31

COMPUTE PLATFORM

154

DATA PLATFORM

279

TOOLS PLATFORM

55

INTEROPERABILITY PLATFORM

31

TRAINING PLATFORM

ELIXIR Commissioned Services

ELIXIR Commissioned Services are funded through the ELIXIR budget to drive the integration of services operated by the ELIXIR Nodes. They are proposed and managed by a particular Platform or Community, agreed with the ELIXIR Heads of Nodes Committee, and approved by the ELIXIR Board.

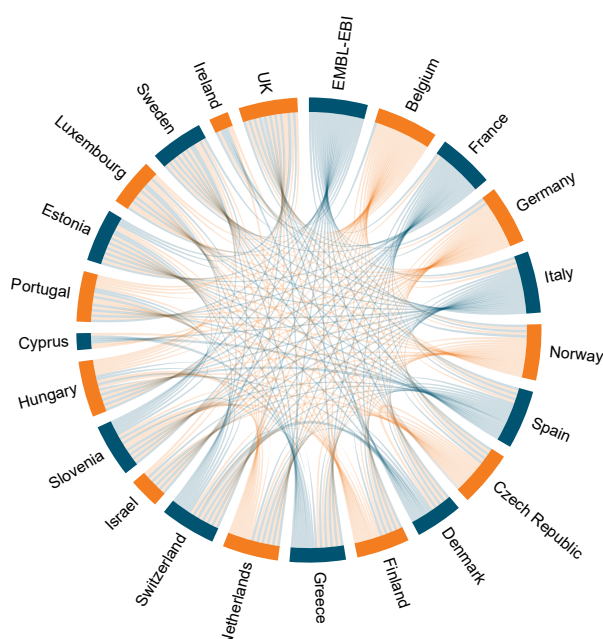
The Commissioned Services are the main instrument to achieve the strategic objectives of the Scientific Programme for 2019-2023. Commissioned Services are divided into seven different categories: Platform tasks, Community Implementation Studies, Community-led Implementation Studies, Strategic Implementation Studies, Infrastructure Services, Staff Exchange Programme and ELIXIR Industry Engagement.

In 2022, a total of 44 Commissioned Services were active, engaging activity from across all ELIXIR Nodes. 27 of these projects were new and launched in 2022:

- APICURON integration with curation databases
- ELIXIR Beacon Implementation Study 2022/23
- ELIXIR Beacon Infrastructure Service Plan
- Bioschemas Coordinator AAI engagement
- ELIXIR Hybrid Cloud
- Container Orchestration
- Community and Data Management network engagement
- Data Integration
- Scalable Curation
- Administration and support for Core Data Resource (CDR), Deposition Database (EDD) portfolio and Community Data Resources
- Alignment of the Interoperability Platform FAIR Service Architecture Framework with the Data Platform, Communities, and ELIXIR Projects
- An ELIXIR Interoperability Platform KnowledgeHub
- Packaging, containerisation & deployment
- Performance benchmarking & technical monitoring
- The bio.tools registry and the EDAM ontology
- The Federated EGA framework: supporting sensitive data management across the ELIXIR Nodes
- Food and Nutrition Community: Microbiome-diet-health
- Scalable extraction of human genetic and phenotypic data from peer-reviewed literature
- Curation of lipid pathways by domain experts to generate open access biology resources
- ELIXIR Rare Disease Community services and international collaborations
- Integrating epitranscriptomic data into the ELIXIR ecosystem
- TeSS - the ELIXIR training portal
- Scalable curation of TF-TG interactions via integration of NLP and VSM
- Training toolkit
- Consolidating quality and impact of the TeSS training resources

Each Commissioned Service is led by a team of experts from one or more ELIXIR Nodes, drawing on their national scientific priorities and expertise. Their collaborative nature also enables newly established Nodes to take part in ELIXIR activities and quickly integrate their national communities into ELIXIR.

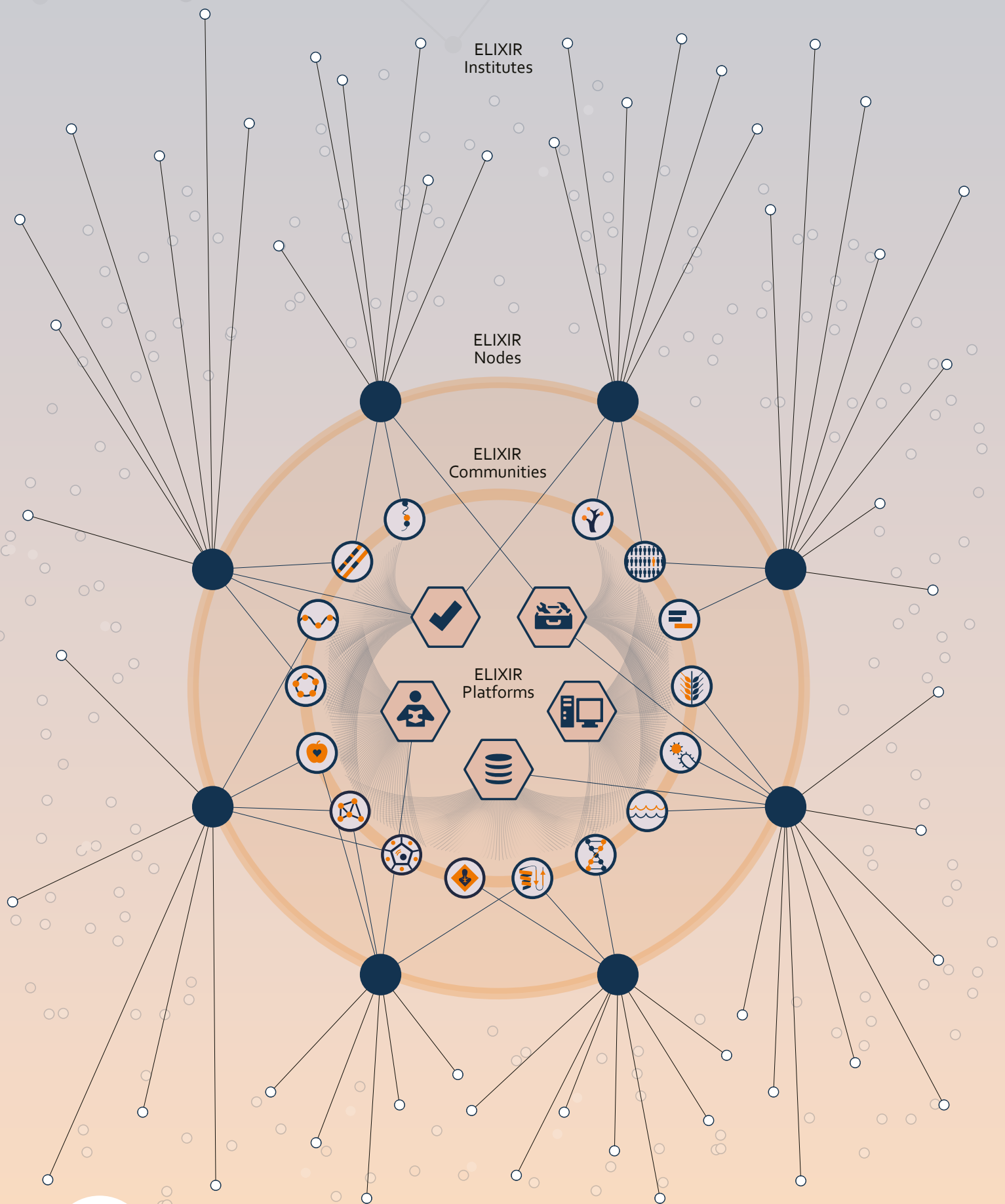
Connection between ELIXIR Nodes facilitated by ELIXIR Commissioned Services in 2022



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COMMISSIONED
SERVICES RAN DURING 2022

Our Core Structure

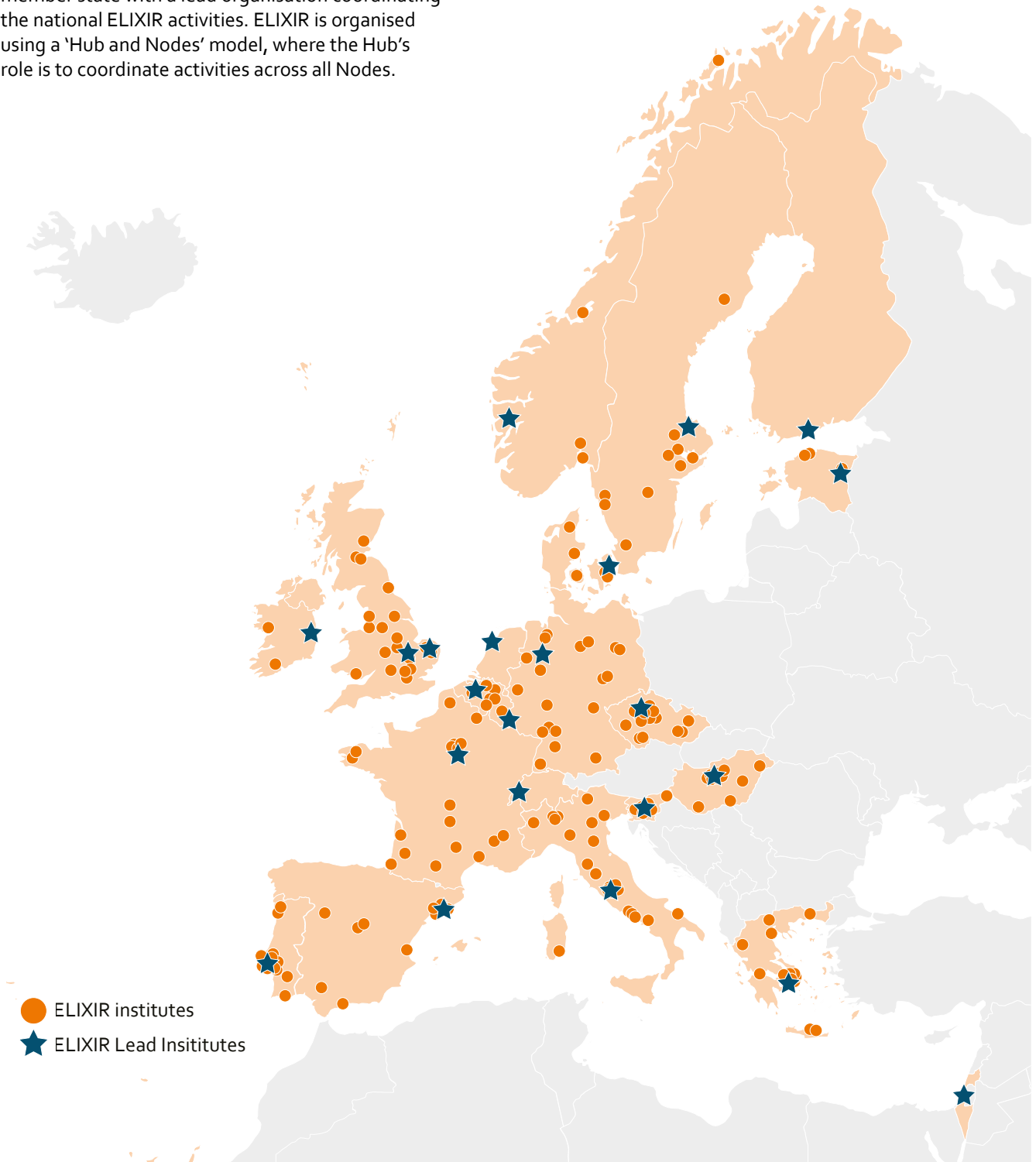


ELIXIR Nodes

Each Member State of ELIXIR establishes a Node. A Node is a network of organisations that work within a member state with a lead organisation coordinating the national ELIXIR activities. ELIXIR is organised using a 'Hub and Nodes' model, where the Hub's role is to coordinate activities across all Nodes.

Strategic
Objective

5





ELIXIR Belgium

LEAD INSTITUTE VIB

WEBSITE www.elixir-belgium.org

- Awarded a €7.8 million grant for 2023-2026 from the Research Foundation Flanders (FWO) to continue operating the ELIXIR Belgium Node and provide services to life science researchers
- The new grant supports the coordination of a Belgian sensitive data infrastructure enabling federated learning
- Initiated the Belgian Genome Biobank project, funded by FWO, to create a genomic resource of the Flemish/Belgian population in a secure environment
- Secured funding in three Horizon Europe projects (EuroScienceGateway, AgroServ, deCYPher) and one Digital Europe project (European Genomic Data Infrastructure)
- Started four Strategic and one Community-led ELIXIR Implementation Studies
- Organised 18 training courses for a total of 289 participants
- Launched a new website outlining Node activities, services, training courses and events
- Set up a Node LinkedIn page and designed brochures describing Node services
- Organised the Node's national ELIXIR meeting *FAIR data for life sciences research* and co-organised the *Empowering Biodiversity Research Conference 2022*
- Contributed to the ELIXIR data management ecosystem and the emerging ELIXIR Data Management Community
- Added eight additional services to the Node's portfolio: ENA Data Submission Toolbox, RDMkit, ELIXIR Toolkit Theme, WorkflowHub, RO-Crate Toolbox, iRefIndex, OLIDA and ORVAL⁴.



ELIXIR Czech Republic

LEAD INSTITUTE Institute of Organic Chemistry and Biochemistry of the CAS

WEBSITE www.elixir-czech.cz

- Data Stewardship Wizard (DSW) achieved a high EU-wide adoption and became 'the ELIXIR data management planning solution' together with RDMkit
- ELIXIR AAI has been transformed into the Life Science Login
- Life Science Login was successfully developed within the EOSC-Life project and serves the European biomedical community
- Assisted in the preparation of Czech Republic national Open Science Strategy 2022+
- Supported the setup of COVID-19 genomic surveillance in the Czech Republic
- Released five new ELIXIR Czech Republic services: WatNA⁵, AlphaCharges⁶, Jumpcount⁷, Marrow Donor Registry Simulator⁸ and AHOJ⁹
- Published 56 articles in 2022, received 1,394 citations in the period 2019-2022
- Organised 20 training events and workshops with a total of approximately 900 participants
- Carried out seven Implementation Studies
- Took part in a Staff Exchange with ELIXIR Switzerland, *Towards analysis of SMiLE-seq raw data*, with the ultimate goal of identification of binding sites of the poorly characterised transcription factors.

⁴ <https://www.elixir-belgium.org/services>

⁵ <https://watna.datmos.org>

⁶ <https://alphacharges.ncbr.muni.cz>

⁷ <https://jumpcount.cz>

⁸ <https://cdfs-mdrsimulator.zcu.cz>

⁹ <http://apoholo.cz>



ELIXIR Denmark

LEAD INSTITUTE Center for Biological Sequence Analysis,
Technical University of Denmark

WEBSITE www.elixir-denmark.org

- Appointed Professor Lars Juhl Jensen from the University of Copenhagen as the new Head of Node
- Contributed to COVID-19 Health Genetics Initiative and facilitated data upload to the COVID-19 Data Platform
- Participated in ELIXIR Czech Republic Scientific Advisory Board
- A Node institution, Danish National Genome Center¹⁰, became a participant in the European Genomic Data Infrastructure (GDI) project
- Consolidated the bio.tools registry with more than 27,000 software tools, synchronised the registry with other ELIXIR services like OpenEBench and Galaxy, resulting in the sandbox version of the Tools Platform Ecosystem¹¹
- 3,500 new software tools added to the bio.tools registry, bringing the total to 27,000 tools and more than 6,000 contributors
- Collaborated with ELIXIR Communities, including 3D-BioInfo, Human Copy Number Variation, Intrinsically Disordered Proteins, Proteomics and Rare Diseases, to provide specialised pages for the promotion of their most popular tools and services¹²
- Involved in the Proteomics Community's Implementation Study, *Increasing the translational value of public proteomics datasets: Automatic metadata-driven reanalysis in cloud infrastructures*, and contributed four scalable workflows for the automatic re-analysis of public proteomics data
- Participated in BioHackathon Europe 2022 with project, *Scientific and technical enhancement of bioinformatics software metadata using the Tools Ecosystem open infrastructure*, as part of the Implementation Study.



EMBL-EBI

WEBSITE www.ebi.ac.uk

- The DeepMind AlphaFold system for predicting previously unknown 3D structures was trained on data resources jointly delivered by EMBL-EBI
- AlphaFold, hosted by EMBL-EBI as AlphaFold-DB and integrated across many services offered by EMBL-EBI, included 214,684,311 predicted structure with 48 complete proteomes available for bulk download
- AlphaFoldDB had accumulated over 500,000 users in 190 countries in the first year of operation
- Played a key role in Federated EGA, which officially launched in 2022 with the signing of the first legal agreements with inaugural Nodes in Sweden, Norway, Germany, Finland and Spain
- Led activities of the Proteomics Standards Initiative (PSI), the organisation in charge of developing open data standards in proteomics
- In collaboration with the Consortium for Top-Down Proteomics, the PSI released the ProForma 2.0 notation, providing a standard way to represent combinations of protein sequences plus protein modifications
- Led ELIXIR Proteomics Community, which received very positive feedback from reviewers.

¹⁰ <https://eng.ngc.dk>

¹¹ <https://github.com/bio-tools/content-sandbox>

¹² <https://bio.tools/communities>



ELIXIR Estonia

LEAD INSTITUTE University of Tartu

WEBSITE elixir.ut.ee

- Appointed Hedi Peterson as Head of Node, replacing Jaak Vilo
- Hosted the ELIXIR Board meeting in Tallinn in April 2022
- Contributed to the new front-end of ELIXIR TeSS
- Participated in three Implementation Studies and four Platform tasks
- Held 11 training events, mainly focused on data management
- Continuously supported national COVID-19 prevalence study and SARS-CoV-2 sequencing project with data management, analysis and visualisation expertise
- Started running the 1+MG mirror group for Estonia
- Secured funding for the European Genomic Data Infrastructure (GDI) project.



ELIXIR Finland

LEAD INSTITUTE CSC - IT Center for Science

WEBSITE www.elixir-finland.org

- Offered 247 person months employment to 62 experts
- Launched a set of sensitive data services for research¹³
- Achieved national sensitive data processing environment certification based on Findata.fi (Health Data Access Body) specification
- Signed the Federated EGA contract and achieved readiness for technical service launch
- Collaborated on 24 European and Commissioned Service projects with more than 20 corresponding full time equivalent staff
- Contributed to the successful initiation of the European Genomic Data Infrastructure (GDI) project and started as the co-lead of pillar II with ELIXIR Sweden
- Expanded user of Life Science Login technology (REMS) to Australian Biocommons and Australian Access Federation
- Delivered the 1+MG Cancer proof of concept
- Co-led the Compute Platform
- Co-led the Single-Cell Omics Community and Federated Human Data Community.

¹³ <https://research.csc.fi/sensitive-data>



ELIXIR France

LEAD INSTITUTE IFB-Core

WEBSITE www.france-bioinformatique.fr

- Appointed by the French Ministry of Research as Reference Center for the data management in Life Sciences
- Appointed by the French network of research facilities in life sciences and agronomy¹⁴ to support the development of their data management strategy through training
- Joined as a partner in four Horizon Europe projects: EOSC₄Cancer, AgroServ, GDI and PHENET
- Co-led the Microbiome Community
- Upscaled the delivery of FAIR data training
- Contributed to tools ecosystem governance and technical development¹⁵
- Completed refactoring of the continuous integration infrastructure for containers
- Created an EDAM quality control package called Caséologue¹⁶ in collaboration with ELIXIR Norway
- Analysed EDAM coverage and links between bio.tools and Workflowhub¹⁷
- Organised an online ELIXIR Training Platform Workshop with the Belgian and Swiss Nodes, focusing on enhancing TeSS using Bioschemas profiles.
- Published a pre-print, *Plant data exchange and standard interoperability*¹⁸, on BioHackXiv as a result of Biohackathon Europe 2022
- The international immunogenetics information system (IMGT)¹⁹ has implemented a knowledge graph (IMGT-KG), enriched two of its databases (IMGT/mAb-DB and MGT/GENE-DB) and enlarged its industrial collaboration portfolio.



ELIXIR Germany

LEAD INSTITUTE Bielefeld University

WEBSITE www.denbi.de/elixir-de

- The Node was incorporated, via the Forschungszentrum Jülich GmbH, as a member of the Helmholtz Association of German Research Centers
- The new Institute for Bio- and Geosciences IBG-5 at Forschungszentrum Jülich GmbH, located at the Bielefeld branch, was established for the continuation of de.NBI/ELIXIR Germany
- A continuation plan for the Node was developed and agreed
- Offered 104 services to the life science community
- Delivered 31 training courses with more than 600 participants
- Acquired more than 2,200 de.NBI Cloud users and supported over 700 projects
- Organised the 5th de.NBI Cloud User Meeting²⁰
- Published an advertising brochure for Development and Operation of the Federated de.NBI Cloud²¹
- Organised the first Biohackathon Germany²² with more than 130 participants
- Led the de.NBI Industrial Forum²³ comprising 36 companies
- from Germany, Luxembourg, Switzerland and Austria
- Organised the 3rd Annual Industrial Forum Meeting 2022²⁴
- Co-led ELIXIR Platforms: Data, Compute and Tools
- Co-led ELIXIR Communities: Galaxy, Proteomics, Plant Sciences, Metabolomics, Marine Metagenomics and Single Cell Omics
- Organised the third joint Bayer AG and de.NBI/ELIXIR Germany online conference: Women in Data Science - Perspectives in Industry and Academia²⁵.

¹⁴ <https://www.ibisa.net/>

¹⁵ <https://github.com/bio-tools/content>

¹⁶ <https://github.com/edamontology/caseologue>

¹⁷ <https://github.com/bio-tools/biohackathon2022>

¹⁸ Arend, D., Beier, S., Bouri, I., et al. (2022, December 19). BioHackEU22 Project 22: Plant data exchange and standard interoperability. <https://doi.org/10.37044/osf.io/c724r>

¹⁹ <https://www.imgt.org>

²⁰ <https://www.denbi.de/de-nbi-events-archive/1495-5th-de-nbi-cloud-user-meeting>

²¹ https://www.denbi.de/images/Downloads/deNBI_Cloud_Brochure_web.pdf

²² <https://www.denbi.de/de-nbi-events-archive/1454-biohackathon-germany>

²³ <https://www.denbi.de/industrial-forum>

²⁴ <https://www.denbi.de/de-nbi-events-archive/1492-3rd-annual-industrial-forum-meeting-2022>

²⁵ <https://www.denbi.de/women-in-data-science/women-in-data-sciences-2022>



ELIXIR Greece

LEAD INSTITUTE Biomedical Sciences Research Centre (BSRC) 'Alexander Fleming'

WEBSITE www.elixir-greece.org

- Evaluated as the only research infrastructure with emphasised priority for support among all 28 Greece national research infrastructures²⁶
- Organised national All Hands meeting including a Federated EGA workshop
- Co-led the Metabolomics Community
- Involved in the Intrinsically Disordered Proteins²⁷, Microbial Biotechnology, Single-Cell Omics and Systems Biology²⁸ Communities and engaged in the creation of the Biodiversity Community Implementation Study
- Co-led the Machine Learning and FAIR Training Focus Groups, and member of the steering committee of the RDA Focus Group
- Co-led the Machine Learning Strategic Implementation Study
- Participated in the EOSC₄Cancer project as work package lead
- Co-led two projects at the BioHackathon Europe 2022: *Lesson for the Software Management Plan* and *Mapping the Omic Wastewater Surveillance Ecosystem*
- Co-led the ELIXIR wastewater surveillance working group and the Compute Platform container orchestration Programme task
- Co-led the software management plan and the associated software management wizard model
- Elected new national Officers' Board in November 2022 and established the position of Industrial Liaison Officers.



ELIXIR Hungary

LEAD INSTITUTE Institute of Enzymology, Research Centre of Natural Sciences, Hungarian Academy of Sciences (RCNS HAS)

WEBSITE elixir-hungary.org

- Organised a national bioinformatics conference in collaboration with the Hungarian Bioinformatics Society
- Participated in five Commissioned Services
- Prepared a nationwide booklet of bioinformatic resources and databases
- Organised 12 training courses by the University of Debrecen, ELTE University, University of Pecs and Semmelweis University
- Participated in the BY-COVID project
- Benefited from 59 PhD students belonging to ELIXIR Hungary research groups
- Launched a new central bioinformatics resource²⁹ containing ELIXIR Hungary information, web resources, databases, ongoing projects and PhD opportunities
- Published 198 papers
- Viktoria Lakatos joined ELIXIR Hungary as Node Secretary.

²⁶ European Commission, Directorate-General for Research and Innovation, Support to Greece for policies developing research infrastructures and the R&I ecosystem : final report, Publications Office of the European Union, 2022, <https://data.europa.eu/doi/10.2777/1972551>

²⁷ Quaglia F, Mészáros B, Salladini E, et al., DisProt in 2022: improved quality and accessibility of protein intrinsic disorder annotation, *Nucleic Acids Research*, Volume 50, Issue D1, 7 January 2022, Pages D480–D487, <https://doi.org/10.1093/nar/gkab1082>

²⁸ Martins dos Santos V, Anton M, Szomolay B et al., Systems Biology in ELIXIR: modelling in the spotlight. *F1000Research* 2022, 11(ELIXIR):1265, <https://doi.org/10.12688/f1000research.126734.1>

²⁹ <https://www.bioinformatics.hu>



ELIXIR Ireland

LEAD INSTITUTE University College Dublin, National University of Ireland

WEBSITE <https://www.ucd.ie/sbi>

- Joined the European Genomic Data Infrastructure (GDI) project and the 1+Million Genomes Initiative³⁰
- Established the role of ELIXIR Deputy Technical Coordinator based at University College Cork and the role of Bioconductor Community Manager at University of Limerick
- Participated in ELIXIR Commissioned Services for machine learning (University of Dublin) and for single-cell analysis (University of Limerick)
- Delivered training courses and one-on-one engagements for data management planning, sequence alignment and phylogenetics
- Participated in the development of the ELIXIR Food and Nutrition Community white paper and the emerging Biodiversity Community
- Hosted the annual ELIXIR Intrinsically Disordered Protein Community meeting in August 2022 at University College Dublin
- Participated in the preparation of the National Strategy for Accelerating Genetic and Genomic Medicine in Ireland³¹
- Working on expanding the Irish Node network to include University of Limerick (UL) and Royal College of Surgeons in Ireland (RCSI).



ELIXIR Israel

LEAD INSTITUTE Weizmann Institute of Science (WIS)

WEBSITE <https://en.huji.ac.il>

- Organised the first meeting of the Israel Node steering committee
- Participated in the Programme committee of the BioHackathon Europe 2022
- Organised an ELIXIR activities exposure event for the Israel community with 277 participants
- Engaged in four ELIXIR Communities: 3D-Bioinfo, Galaxy, Metabolomics and Single-Cell Omics
- Participated in four Commissioned Services
- Developed and delivered a single-cell training course
- Participated in Training Platform activities
- Participated and presented Israel activities in the BY-COVID event, *National-level experiences of pathogen-related data sharing in pandemic times and beyond*³²
- Participated in three modules of the EMMRI Masters programme as part of the ELIXIR team
- Initiated impact assessment activities.

³⁰ <https://digital-strategy.ec.europa.eu/en/news/1-million-genomes-initiative-ireland-and-france-join-eu-initiative-genetic-data-sharing-research>

³¹ <http://www.hse.ie>

³² <https://by-covid.org/news-events/pathogen-data-sharing>



ELIXIR Italy

LEAD INSTITUTE CNR Institute of Biomembrane and Bioenergetics

WEBSITE <https://elixir-italy.org>

- Obtained a €18M consolidation grant over three years through a national recovery and resilience plan (NextGenerationEU) call for research infrastructure development
- Commenced the expansion of ELIXIR Italy's Compute Platform IT capacity
- The national node of the Infrastructure for System Biology Europe (ISBE-IT) started an integration process within ELIXIR Italy
- Participated in ELIXIR Communities: IDP, Galaxy, Metabolomics, Rare Disease, Human Data, Proteomics, Systems Biology, 3D-BioInfo and Marine Metagenomics
- Commenced the recruitment of a full-time project manager taking over the role of Node Coordinator
- Joined the European Genomic Data Infrastructure (GDI) project to build human data infrastructure in Italy and become a national Federated EGA Node
- Joined the EuroScienceGateway project to strengthen the Pulsar Network and implement a national usegalaxy.it Galaxy instance
- Maintained over 65 services (excluding training) included in the ELIXIR Service Delivery Plan
- Began the implementation of national impact assessment activities
- Hosted 12 international training events, including an advanced training course in bioinformatics with lectures and hands-on activities totalling 166 hours
- Collaborated with industry in eight bioinformatics mini-courses tailored to the training needs of pharmaceutical companies
- Carried out public outreach activities by demonstrating how to use bioinformatics resources in the classroom to high school teachers.



ELIXIR Luxembourg

LEAD INSTITUTE Luxembourg Centre for Systems Biomedicine

WEBSITE elixir-luxembourg.org

- Provided the sustainability solution to the multi-party international project, IMI-ABIRISK³³
- Co-led the ELIXIR Health Data Focus Group
- Participated in the establishment of the Single-Cell Omics Community and the Systems Biology Community
- Led pillar I of the newly initiated European Genomic Data Infrastructure (GDI) project
- Participated in the European Health Data Space Pilot as a consortium member
- Co-led two projects at the BioHackathon Europe 2022: *Infrastructure for synthetic health data* and *The what and how in data management: Improving connectivity between RDMkit and FAIR Cookbook*
- Co-organised the translational medicine 2022 Community of Special Interest Group (COSI) satellite meeting at the ISMB conference 2022
- Hosted seven local training events, including newly developed training on power analysis and missing data
- Contributed to training in the wider ELIXIR network, including ELIXIR course certification, FAIR training materials and the Train-the-Trainer programme
- Contributed to the FAIR Cookbook and RDMkit content development by joining the editorial boards, hosting face-to-face events and contributing to manuscripts
- Supported the setup of the Luxembourg National COVID-19 Data Portal
- Finished the first version of the Node's data hosting service end-to-end solution.

33 <https://www.imi.europa.eu/projects-results/project-factsheets/abirisk>



ELIXIR Netherlands

LEAD INSTITUTE Dutch Techcentre for Life Sciences (DTL) - Health-RI

WEBSITE www.dtls.nl/elixir-nl

- Deepened the partnership with Health-RI, which will host ELIXIR Netherlands starting 2023
- Strengthened collaboration with the Dutch nodes of BBMRI and EATRIS
- Health-RI is the second largest beneficiary in the European Genomic Data Infrastructure (GDI) project and leader of the use case work package in EOSC₄Cancer
- Formed the Thematic Digital Competence Center for Life Sciences and Health to connect Dutch researchers and research infrastructures
- Launched the Netherlands resources page on RDMkit
- Achieved major progress on FAIR tools such as FAIR digital objects, FAIR implementation profiles, the FAIR Data Cube and the Data Stewardship Wizard
- Acquired a Dutch Research Council (NWO) open science grant for BridgeDb, an ELIXIR Recommended Interoperability Resource
- Co-led the ELIXIR-CONVERGE training work package and organised training on FAIR data stewardship
- Contributed to BioHackathon Europe 2022 projects on learning paths, a FAIR training handbook, machine learning and synthetic data
- Organised training on Galaxy (Smörgåsbord event) and started the microGalaxy community for microbial analysis in Galaxy
- Organised the kickoff of the ELIXIR Food and Nutrition Community
- Co-led the ELIXIR Systems Biology Community
- Executed several sustainability activities in the Node Impact Implementation Study
- Organised four meetings of the Data Stewards Interest Group
- Co-led the EOSC Association Task Force: Data Stewardship Curricula and Career Paths
- Co-organised the annual Health-RI and BioSB conferences and a national FAIR Data Day.



ELIXIR Norway

LEAD INSTITUTE University of Bergen

WEBSITE www.elixir.no

- Kicked-off the national ELIXIR₃ grant³⁴, which will run until 2026, representing the third funding cycle from the Research Council of Norway
- Appointed Sushma Grellscheid as Head of Node, replacing Inge Jonassen
- Launched the Norwegian node of Federated EGA
- Joined the European Genomic Data Infrastructure (GDI) project
- Improved collaboration and interaction with the national authorities of health, including the national 1+MG working groups
- Started an European Economic Area-funded collaborative project with the Romanian Society of Bioinformatics to support the initiation of the Romanian node of Federated EGA
- Joined the EBP-Nor, EOSC₄Cancer and EuroScienceGateway projects
- Hosted the first meeting of the Norwegian biodiversity community
- Established a national community, beyond ELIXIR Norway, for life science research data management through monthly meetings
- Highlighted as an open science infrastructure example by the Research Council of Norway
- Mentioned in several governmental reports³⁵, policies³⁶ and evaluations³⁷ regarding the FAIRification of data and state of the art data infrastructures.
- Part of the national committee appointed by the Research Council of Norway to advise the Ministry of Research on how to invest in and organise infrastructures for FAIR research data
- Launched ELIXIR Norway's second call for services
- Organised 12 training events on FAIR data management and bioinformatics analysis
- Contributed to four Focus Groups, six Implementation Studies, five Platform tasks and two Staff Exchange Programmes.

³⁴ <https://elixir.no/news/78/63/Continued-funding-to-ELIXIR-Norway>

³⁵ <https://www.forskningradet.no/siteassets/publikasjoner/2022/rapport-fra-datainfrastrukturutvalget-2022.pdf>

³⁶ <https://www.regjeringen.no/contentassets/coab0380265445e58508c36e51e5561b/no/pdfs/strategi-for-persontilpasset-medisin.pdf>

³⁷ <https://www.openscience.no/media/3582/download?inline>



ELIXIR Portugal

LEAD INSTITUTE Instituto de Engenharia de Sistemas e Computadores (INESCD-ID)

WEBSITE www.elixir-portugal.org

- Gained a new associate, UCIBIO³⁸, making ELIXIR Portugal/BioData.pt a non-for-profit private association of 13 research and innovation organisations
- Recruited a new project manager, taking over the role of Node Coordinator
- Welcomed the first cohort of 24 trainee data stewards for life sciences in Portugal in collaboration with ELIXIR Netherlands, Sweden and Greece and many Portuguese organisations³⁹
- Co-led tasks in ELIXIR-CONVERGE: the organisation of data management/data stewardship hackathons; and the initiation of the ELIXIR training programme in management (ELITMa)
- Participated in AgroServ and the European Genomic Data Infrastructure (GDI) projects
- Participated in the Beacon study, and the Federated Human Data Community and Plant Science Community Implementation Study, *Increasing Plant data findability and reuse beyond ELIXIR*
- Co-led Training Platform task 2.3, *Design and delivery of training collections tailored to ELIXIR Communities' needs*
- Participated in the Implementation Study, *Impact evaluation at Node-level - getting it done*
- Hosted the Technical Meeting of BioData.pt Association, the first national All Hands and the Node Scientific Advisory Board Assessment
- Held a monthly webinar series BioData.pt Talks: 3D BioTalks
- Actively involved in several ELIXIR Communities, Platforms and Focus Groups
- Contributed expertise and resources to the publication of 13 articles
- Initiated two Staff Exchange Programs: *Open access tools for effective management of ELIXIR Nodes based on collaborative work developed in ELIXIR-CONVERGE, RITRAIN, RltrainPlus and EMMRI* (with 12 ELIXIR Nodes); and *ELIXIR Portugal as a case-study for the deployment of Local EGA/Beacon v2 instances* (with 3 ELIXIR Nodes)
- Hired the first data steward for life sciences in Portugal to support the implementation of data management policies and best practices for open science at the Instituto Gulbenkian de Ciência (IGC).



ELIXIR Slovenia

LEAD INSTITUTE University of Ljubljana

WEBSITE www.elixir-slovenia.org

- Increased the number of ELIXIR Slovenia core staff to seven
- Expanded the Node's research infrastructure services⁴⁰ to include SLURM based HPC compute (CPU and GPU) services using Docker and Singularity containers and storage services for national genomic data archive
- Improved the high-throughput wet lab equipment of two ELIXIR Slovenia laboratories: the Central next generation sequencing laboratory in Maribor and the Laboratory for single cell analysis in Ljubljana
- Improved procedure for ordering, booking and reporting ELIXIR Slovenia tools and services using an *Order a service* page at on the Node website⁴¹
- Integrated the Slovenian systems biology community (former ISBE.si) into the ELIXIR Slovenia Node
- Co-lead the ELIXIR Systems Biology Community
- Created a collaboration with ELIXIR Estonia on new national Galaxy service⁴²
- Organised 24 training events and courses about the use of the infrastructure for data management, including training hackathons
- Co-organised several training events with other ELIXIR Nodes
- Catalogued all training materials in the ELIXIR Slovenia eLearning Platform (EeLP)⁴³
- Updated the Slovenia Data Steward Wizard⁴⁴.

³⁸ <https://ucibio.pt>

³⁹ <http://ready4biodatamanagement.biodata.pt/courses.html#dataStewards>

⁴⁰ <https://elixir-slovenia.org>

⁴¹ <https://elixir-slovenia.org/order-a-service>

⁴² <https://galaxy.elixir-hpc.si>

⁴³ <https://elixir.mf.uni-lj.si>

⁴⁴ <https://elixir-si.ds-wizard.org>



LEAD INSTITUTE Spanish National Bioinformatics Institute - INB

WEBSITE www.inb-elixir.es

- Established the Spanish Federated EGA node (es-FEGA)
- Led the Beacon project
- Released and adopted Beacon V2, including text-mining extraction and partial manual curation of results by DisGeNET, according to the open-source discovery protocol GA4GH Beacon API
- Took part in ELIXIR Platforms, Communities and Focus Groups, including the leadership of the ELIXIR Tools Platform, the Rare Diseases, the Federated Human Data and the Biodiversity Communities and the Cancer Data Focus Group
- Contributed to 11 Implementation Studies
- Continued contributing to the precision medicine infrastructure associated with Science and Technology (IMPACT), including coordinating the data science pillar (IMPACT-Data)
- Released two demonstrators on how to build a federated ecosystem enabling distributed analysis via Galaxy and using GA4GH Passports and visas technologies
- Maintained the TransBioNet collaborations with the Human Copy Number Variation Community and CIBERER⁴⁵, providing connections with the genomics pillar (IMPACT-Genómica)
- Participated in projects for advancing the use and reuse of biomedical data for research purposes, including EOSC-Life⁴⁶, EJP RD⁴⁷, euCanShare⁴⁸ and CINECA⁴⁹.
- Led projects, such as PerMedCoE⁵⁰, HealthyCloud⁵¹, EOSC4Cancer⁵², EUCANCan⁵³, CGI-Clinics⁵⁴, EASI-Genomics⁵⁵
- Played an active role in European Genomic Data Infrastructure (GDI) project as the designated Spanish representative (CNAG-CRG) and pillar III leads (BSC)
- Involved in different European and international initiatives, for example, leading 1+MG initiative working groups and mirror groups, IRDiRC and GA4GH
- Contributed to establishing the Gaia-X Spanish hub and co-led the technology area within the health working group
- Bioinfo4Women initiative, a sex and gender bias project, continued in BioHackathon Europe 2022 and deepened collaboration with de.NBI Women in Data Science initiative and ELIXIR activities
- Organised the European Conference on Computational Biology (ECCB202) including an outreach webinar to connect with Latin American bioinformatics communities and the colocated ELIXIR Innovation and SME Forum: Data-driven innovation in healthcare diagnostics
- Organised the Federated EGA celebration symposium and presentation of the inaugural FEGA nodes within the tenth GA4GH plenary in Barcelona, Spain.

45 <https://www.ciberer.es/en>

46 <https://www.eosc-life.eu>

47 <https://www.ejprarediseases.org>

48 <http://www.eucanshare.eu>

49 <https://www.cineca-project.eu>

50 <https://permedcoe.eu>

51 <https://healthycloud.eu>

52 <https://eosc4cancer.eu>

53 <https://eucancom.com>

54 <https://www.cgiclinics.eu>

55 <https://www.easi-genomics.eu>



ELIXIR Sweden

LEAD INSTITUTE NBIS — National Bioinformatics Infrastructure Sweden

WEBSITE www.nbis.se

- Provided data management support to over 350 projects and held consultations with 293 principal investigators
- Increased NBIS/ELIXIR Sweden staff to 120
- Added a new ELIXIR Sweden service: Metabolic Atlas
- Participated in the European Genomic Data Infrastructure (GDI) project, co-leading a pillar and leading a work package
- Participated in the EUCAIM project on European cancer image data and the PHENET project on plant phenotyping
- Completed the infrastructure for secure image upload to controlled repositories with ELIXIR Finland in the IMI-funded BIGPICTURE project, with large-scale operations to start in February 2023
- Organised 19 National Bioinformatics Infrastructure Sweden (NBIS) courses with approximately 400 participants and collaborated on an additional 24 training events
- Led the creation of a European data stewards expert network within ELIXIR-CONVERGE
- Organised the online international summer school RaukR - Advanced R for Bioinformatics, summer course
- Participated in four Implementation Studies
- Developed a workflow for metabolomics, MetaboIGNITER, gaining attention beyond ELIXIR and used by groups in the US, Australia and the World Health Organization's cancer agency
- Engaged in seven Communities and six Focus Groups
- Joined the Federated EGA and are ready for service launch.



ELIXIR Switzerland

LEAD INSTITUTE SIB Swiss Institute of Bioinformatics

WEBSITE www.sib.swiss

- Welcomed a new Executive Director, Christophe Dessimoz, and bade farewell to Ron Appel and Christine Durinx
- Three SIB knowledge bases (Rhea, UniProt and STRING) were recognised as critical for life science worldwide as part of the Global Core Biodata Resources
- Welcomed new resources in the SIB portfolio of leading open science databases and software tools: ASAP, Cellosaurus, Glyco@Expiry and Nextstrain
- Submitted the SwissBioData ecosystem proposal, a national infrastructure to foster the sharing and reuse of life science research data, to the Swiss Research Infrastructure Roadmap 2023
- Launched the BioMedIT.ch portal supporting the national infrastructure to connect researchers to health data and boost personalised health research
- Co-led the training work package of the Implementation Study of the new ELIXIR Single-Cell Omics Community
- Launched a webpage showing how the life science infrastructure and data science expertise at SIB contribute to a better world and a stronger Switzerland⁵⁶
- Issued SIB Remarkable Outputs 2021, the yearly showcase of achievements by SIB scientists of particular interest for the global bioinformatics community
- Held an internal scientific conference, SIB Days – the Swiss Bioinformatics Summit.

⁵⁶ <https://impact.sib.swiss>



ELIXIR UK

LEAD INSTITUTE The Earlham Institute

WEBSITE elixiruknode.org

- Expanded to 23 national members after adding University of Exeter and the Open University
- Added five services: BRepertoire, Cafe Variome, Missense 3D, RDMkit and Variant Validator
- Created roadmaps for CyverseUK and the Health Informatics Centre
- Established the ELIXIR UK DaSH Data Stewardship fellowship funded by a national award
- Twenty-four fellows from 17 organisations advocated for ELIXIR's RDM activities and developed FAIR RDM training content, including RDMbites videos registered in TeSS and linked to RDMkit
- Held the third UK Conference on Bioinformatics and Computational Biology
- Co-led (with Health Data Research UK) a five-year programme on federated analytics across Trusted Research Environments using ELIXIR's Beacons, RO-Crates and workflow technology
- Transferred FAIR expertise to the UK Reproducibility Network
- The Open Life Science organisation applied to join the UK Node
- Partnered in 10 successful Horizon Europe projects covering FAIR, metagenomics, biodiversity, digital twins, infectious diseases, cancer and industrial biotechnology
- Held leadership positions in FAIR data and software, metadata, computational workflows, RO-Crate FAIR digital objects and knowledge commons services
- Awarded funding for the Node coordination office until 2024
- Supporting development of BioFAIR, a UK Data and Method Commons for the life sciences, which has been awarded initial funding of £6.3m from UKRI (subject to Business Case)
- Led flagship resources: data (RDMkit, FAIR Cookbook), tools (WorkflowHub), training (TeSS), interoperability (FAIRsharing)
- Led the ELIXIR Interoperability Platform
- Co-led linking resources into a coherent ELIXIR Knowledge Commons.

ELIXIR Platforms

ELIXIR activities are divided into five Platforms, each focusing on one specific area in bioinformatics service provision: Data, Tools, Interoperability, Compute and Training.

The Platforms bring together experts from within ELIXIR to develop a vision for the development and operation of activities across the ELIXIR Nodes, drawing on their technical expertise and resources.

Each Platform has three Platform Leads appointed by the ELIXIR Heads of Nodes Committee. The Platform Coordinator, based at the ELIXIR Hub, manages the work across the Nodes providing support to Platform Leads, overseeing the implementation projects and liaising with other ELIXIR Platforms and Communities.



Data Platform

The ELIXIR Data Platform drives the use, re-use and realisation of the full value of life science data by providing users with robust, long-term sustainable data resources within a coordinated, scalable and connected data ecosystem. In 2022, the ELIXIR Data Platform Executive Committee welcomed a new co-lead, Ulrike Wittig from ELIXIR Germany.

In 2022, the Scalable Curation Implementation Studies⁵⁷ started. Four studies are underway to develop curation capabilities for all community databases in different areas:

- *Scalable extraction of human genetic and phenotypic data from peer-reviewed literature*⁵⁸. This project will extend and integrate partners' existing text mining tools to provide a reusable workflow to extract human genotype-phenotype associations from scientific literature (full-

texts, tables and supplementary materials)

- *Integrating epitranscriptomic data into the ELIXIR ecosystem*⁵⁹. This project plans to upgrade REDportal providing researchers with an accurate, sustainable and accessible epitranscriptome resource via integration into the ELIXIR ecosystem
- *Curation of lipid pathways by domain experts to generate open access biology resources*⁶⁰. This project aims to curate high-quality biochemical knowledge (reactions/enzymes/genes) on lipid metabolism, working with lipid experts worldwide
- *APICURON integration with curation databases*⁶¹. APICURON⁶², a web server providing biological databases and organisations with real-time tracking of biocuration activities, will be connected with Pfam, Rfam, IntAct, SABIO-RK,

Strategic Objectives



PomBase, Reactome, SILVA and BioModels databases.

Work started on the Data Platform's priorities for 2022 to 2023. These include:

- Identification and deepening of connections between different data resources, for example, reference databases (the Core Data Resource⁶³ framework), data repositories (the ELIXIR Deposition Database⁶⁴) and aggregation databases for specific communities and metadata registries (in partnership with the ELIXIR Interoperability Platform)
- Development of further support for ELIXIR Communities through scalable curation and community curation
- Increased visibility and impact of ELIXIR through international collaborations.

57 <https://elixir-europe.org/internal-projects/commissioned-services/2022-edp3>

58 <https://elixir-europe.org/internal-projects/commissioned-services/2022-human-gen-phen>

59 <https://elixir-europe.org/internal-projects/commissioned-services/2022-rna-editing>

60 <https://elixir-europe.org/internal-projects/commissioned-services/2022-lipid-pathways>

61 <https://elixir-europe.org/internal-projects/commissioned-services/2022-apicuron>

62 <https://apicuron.org>

63 <https://elixir-europe.org/platforms/data/core-data-resources>

64 <https://elixir-europe.org/platforms/data/elixir-deposition-databases>

The Data and Interoperability Platforms joint face-to-face in Geneva, Switzerland



The Data Platform renewed the Core Data Resources (CDR) Annual Indicator Monitoring (AIM) process during 2022, and prepared for the 2023 selection round and periodic review of existing resources.

International engagement is a key aspect of the Data Platform and was further strengthened in 2022. ELIXIR CDRs had a significant presence in the first round of Global Biodata

Coalition (GBC)⁶⁵ Resource selection, with 12 being recognised as significant international data resources for the biosciences. The Data Platform worked closely with the GBC, holding regular meetings and agreeing to align metrics and common standards for data resource recognition. This cooperation ensures visibility for ELIXIR on the international stage with policy makers and international funders.

Experts from the Data Platform have been working with the ELIXIR Biocuration Focus Group⁶⁶ to bridge ELIXIR and the international biocuration stakeholders, such as the International Society for Biocuration, and to represent and connect with the community of professionals on whose work life scientists depend.

65 <https://globalbiodata.org>

66 <https://elixir-europe.org/focus-groups/biocuration>

Interoperability Platform

The ELIXIR Interoperability Platform continued to promote best practices in the re-use of metadata and the application of the FAIR principles. The Platform Executive Committee welcomed two new co-leads, Tony Burdett from EMBL-EBI and Susanna-Assunta Sansone from ELIXIR UK.

In 2022, Interoperability Platform activities focused on interoperability stories⁶⁷ and the development of an Interoperability Knowledge Hub⁶⁸.

Interoperability stories bring together examples from the ELIXIR Services and Communities where interoperability products and practices have played a key role in scientific results. These have been connected to a parallel activity in the European Open Science Cloud (EOSC) Association Task Force on Semantic Interoperability⁶⁹ where the interoperability stories will become EOSC best practice examples.

The Knowledge Hub effort has brought together all components

of the ELIXIR FAIR services ecosystem, including RDMkit⁷⁰, the FAIR Cookbook⁷¹, and the Data Stewardship Wizard⁷², and established joint editorial boards, bidirectional cross-referencing and an overview through the ELIXIR website What we offer page⁷³. This work was developed through joint meetings with ELIXIR-CONVERGE, a workshop at the ELIXIR All Hands Meeting 2022 and a project at BioHackathon Europe 2022.

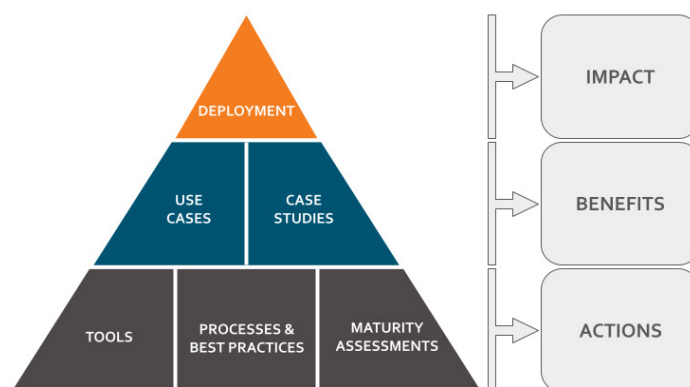
The promotion of FAIR and open data is a theme of several international organisations, including EOSC⁷⁴ and the Research Data Alliance (RDA)⁷⁵. In alignment with this theme, the Interoperability Platform contributed to the EOSC Symposium 2022⁷⁶ with talks on FAIRsharing, RO-Crate, the FAIR Cookbook and the ELIXIR EOSC Strategy 2022. The Platform members also contributed to sessions in RDA plenaries, including the life science interest group and the FAIRsharing working group.

Interoperability activities within

ELIXIR have also been carried out through EU-funded projects. The Innovative Health Initiative (IHI) FAIRplus project⁷⁷, which was completed in 2022, developed the FAIR Cookbook containing recipes for FAIRification. The Cookbook has been adopted into the national service delivery plans of ELIXIR Luxembourg and ELIXIR UK, with ELIXIR Switzerland and ELIXIR Spain currently adding it to theirs. ELIXIR-CONVERGE⁷⁸ is coming close to completion (in mid-2023) and the technical outputs, such as the RDMkit and the CONVERGE Data Management Expert Network will be sustained through their connections to the ELIXIR Interoperability Platform.

All these activities, along with joint strategic planning for the Recommended Interoperability Resources (RIRs)⁷⁹ and CDRs, were addressed by the joint Data and Interoperability face-to-face meeting 2022, hosted by ELIXIR Switzerland in Geneva.

The context of interoperability stories



67 <https://elixir-europe.org/internal-projects/commissioned-services/2022-eip1>
 68 <https://elixir-europe.org/internal-projects/commissioned-services/2022-eip2>
 69 <https://www.eosc.eu/advisory-groups/semantic-interoperability>
 70 <https://rdmkit.elixir-europe.org>
 71 <https://faircookbook.elixir-europe.org/content/home.html>
 72 <https://ds-wizard.org>
 73 <https://elixir-europe.org/what-we-offer>
 74 <https://eosc-portal.eu>
 75 <https://www.rd-alliance.org>
 76 <https://events.eoscfuture.eu/symposium2022/2606111>
 77 <https://fairplus-project.eu>
 78 <https://elixir-europe.org/about-us/how-funded/eu-projects/converge>
 79 <https://elixir-europe.org/platforms/interoperability/rirs>



Tools Platform

Strategic Objectives

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The ELIXIR Tools Platform brings together experts to connect different services, best practices and guidelines to support the development of research software, including workflows with a special focus on FAIRness and community engagement. It tackles the complex task of packaging, containerisation and deployment of software. The Platform has made approximately 80,000 containers available from a newly launched AWS-BioContainer repository mirror, a major achievement for the BioConda/Biocontainers project⁸⁰. This represents a significant step forward in sustaining bioinformatics tools by including commercial cloud providers as hosting alternatives.

In 2022, the new joint Galaxy-EOSC EuroScienceGateway project⁸¹ was launched to strengthen and consolidate Galaxy as a European research infrastructure. The project works closely with the EOSC Association and involves many ELIXIR partners and members alongside key external European research partners and other infrastructures. The Galaxy user base has expanded with new software releases and the integration of the Beacon human genomic cohort search service. The project will

strengthen the promotion of ELIXIR's mature life science services in EOSC.

The Tools Platform continued supporting benchmarking activities through OpenEBench⁸², which has released an observatory for software development based on the translation of FAIR principles for research software. To improve user experience, a revamp of the OpenEBench front-end was carried out in 2022. This included adding project spaces⁸³ to visualise contributions made by different research projects, for example, the Personalized Medicine Center of Excellence (PerMedCoE) contributed additional metrics to represent power consumption when using research software.

The bio.tools registry and EDAM have been extended to include bioimaging, AI and machine learning, mass spectrometry imaging and cytometry. An EDAM extension, EDAM Geo, was developed for interdisciplinary applications, such as public, global and planetary health. The team also built an EDAM quality control package, Caséologue, to ensure the quality of EDAM on each new release. Ongoing collaboration with the WorkflowHub team has led to the development of a new feature allowing users to link

registered workflows to software tools through bio.tools.

The Tools Platform software best practices group collaborated with the Data Stewardship Wizard team to refine the Software Management Wizard and improve usability, support and content. Training material for Software Management Plans (SMPs) have been developed and presented to external groups such as Consortium of European Social Science Data Archives (CESSDA)⁸⁴. These efforts were presented at international conference on FAIR Digital Objects (FDO 2022)⁸⁵, UNESCO's Global Call for Best Practices in Open Science⁸⁶ and Semantic Web Applications and Tools for Health Care and Life Science (SWAT4HCLS)⁸⁷.

The developments across the Tools Platform have strengthened the Tools Ecosystem, which links ELIXIR services by coordinating the metadata they generate. A new digital identity and governance model is ready to be approved by the wider community in 2023. The development version of bio.tools is now running exclusively using the Tools Ecosystem GitHub repository and is intended to be used for each of the components.

80 <https://biocontainers-edu.readthedocs.io/en/latest/index.html>

81 <https://galaxyproject.org/projects/esg/>

82 <https://openebench.bsc.es/>

83 <https://openebench.bsc.es/projects>

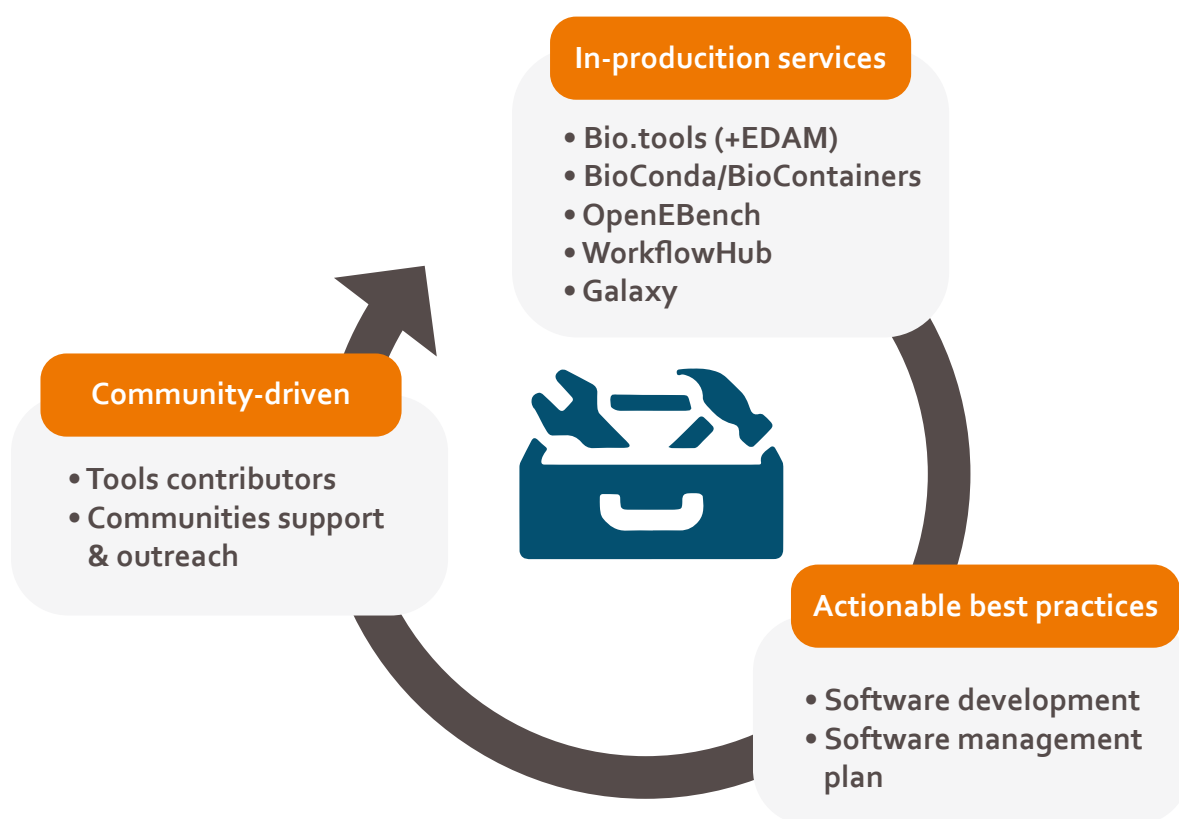
84 <https://www.cessda.eu>

85 <https://www.fdo2022.org>

86 <https://www.unesco.org/en/open-science>

87 <https://www.swat4ls.org>

The Tools Platform's contribution to services, best practices and the community





Compute Platform

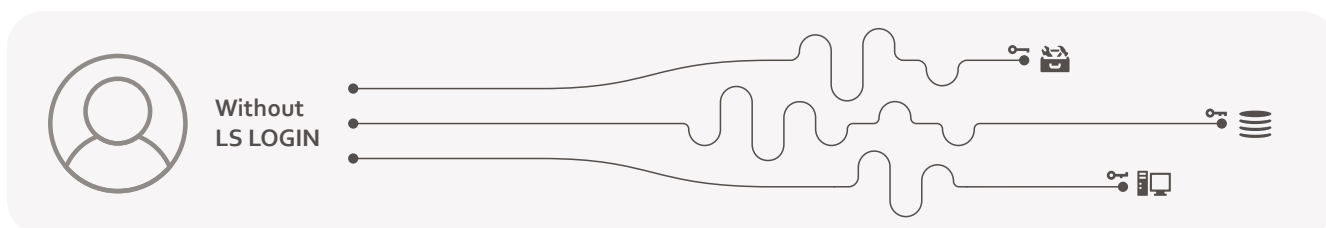
Strategic Objectives

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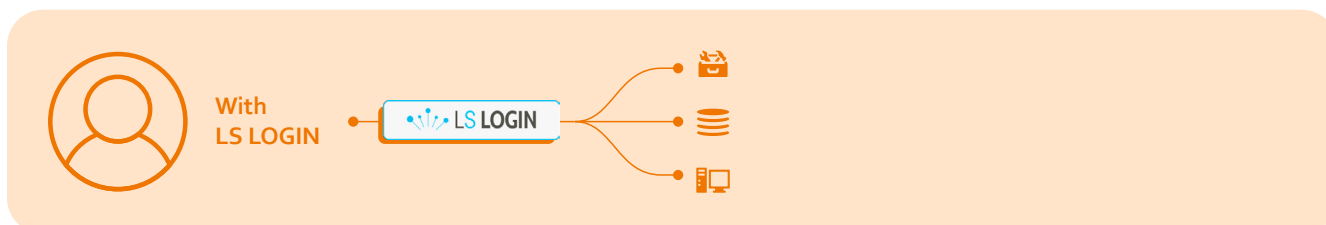
An Authentication and Authorization Infrastructure (AAI) solves the issue of signing in to a range of services with the same account, which is fundamental for accessing a broad range of ELIXIR and life science services. In 2022, the ELIXIR-AAI was successfully migrated⁸⁸ to Life Science AAI (LS Login) through the EOSC-Life project⁸⁹, which involved provision of full documentation, guidance on day-to-day operations and technical support. The migration was an opportunity to add improvements in handling data protection through provisioning consents, further adoption of AARC guidelines (AARC Go6g), and deployment of the GA4GH passports and visas standard to version v1.2.

A new service catalogue has been created to track LS Login integrated services⁹⁰. By the end of 2022, there were 9,696 active ELIXIR identities, an increase of 41% since 2021. LS Login was integrated by 146 production relying services with a further 161 in testing, and the availability of services was 98.8% with 13,340 logins/month. The Platform is planning to pilot a multi-factor authentication component, a new experimental feature for integrated services, into the production environment of LS Login. Throughout 2022, community engagement calls for AAI providers were held frequently and all training materials are available in ELIXIR's training portal, TeSS⁹¹.

ELIXIR AAI migrates to Life Science Login



TIME SPENT



88 <https://elixir-europe.org/AAI-migration>

89 <https://www.eosc-life.eu/news/launch-of-ls-login>

90 <https://services.aai.lifescience-ri.eu>

91 <https://tess.elixir-europe.org/materials/elixir-aa-i-engagement-meetings-materials>

Through the Hybrid Cloud task, experts in the Compute Platform continued to coordinate technical, operational and funding aspects of cloud, data and compute services across Europe. A range of potential European Open Science Cloud (EOSC) infrastructures was formed with the federation of private clouds (for example, EMBL-EBI Embassy) and national community clouds (for example, cPouta at ELIXIR Finland, de.NBI at ELIXIR Germany and MetaCentrum Cloud at ELIXIR Switzerland) together with the public commercial clouds (for example, AWS, Google Cloud, Azure). The Compute Platform focused on developing ELIXIR life sciences use cases and their potential to provide solutions for such hybrid cloud deployments.

A demonstrator in metagenomics has been implemented through the EOSC-Life project by Bielefeld University and EMBL-EBI. As a first hybrid cloud prototype, the cloud-based workflow has been moved between different sites of the de.NBI Cloud,

demonstrating easy deployment on different infrastructures. Based on this prototype, a framework, SLRUM, is being developed to automate a hybrid cloud setup and deployment of batch queueing systems followed by deployment of NextFlow based containerized workflows.

The Compute Platform continues to address the robust, reproducible analysis of large volumes of data through the Container Orchestration task and GA4GH ELIXIR Cloud & AAI⁹² Driver Project. Experts in the Platform are co-developing the GA4GH Cloud API standards and proof of concept implementations to address real-world use cases and promote the standards within and beyond the ELIXIR community. This includes conducting interoperability tests with other GA4GH Cloud implementers in academia and industry⁹³. In 2022, the Compute Platform also co-led the approval of the Task Execution Service (TES) API upgrade to v1.1 and is working on new website⁹⁴, documentation hub⁹⁵ and GA4GH API-

based service registry⁹⁶ to promote the effort and ease onboarding of additional compute nodes.

A GA4GH TES gateway⁹⁷ is being developed with a basic task distribution logic that aims to minimise data transfer for federated workloads, as well as a suite of reusable front-end components for operationalising the GA4GH Cloud-based infrastructures in web-based application⁹⁸. The latter are being used in Krini⁹⁹, a web application through which end users will be able to trigger the execution of individual containerised and workflows written in workflow languages such as CWL, Snakemake and Nextflow, via the GA4GH Task and Workflow Execution Service (WES) APIs. An initial client-side GA4GH TES API implementation in the Galaxy workflow management system has been delivered and further such integrations are planned in the recently initiated EuroScienceGateway project¹⁰⁰.

92 <https://github.com/elixir-cloud-aa/elixir-cloud-aa>

93 <https://www.ga4gh.org/news/ga4gh-tes-api-bringing-compatibility-to-task-execution-across-hpc-systems-the-cloud-and-beyond>

94 <https://elixir-cloud.dcc.sib.swiss>

95 <https://elixir-cloud-aa.github.io>

96 <https://elixir-cloud.dcc.sib.swiss/ga4gh/registry/v1/ui>

97 <https://protes.rahtiapp.fi/ga4gh/tes/v1/ui>

98 <https://web-components-beta.vercel.app>

99 <http://krini.rahtiapp.fi>

100 <https://github.com/galaxyproject/galaxy/pull/14777>

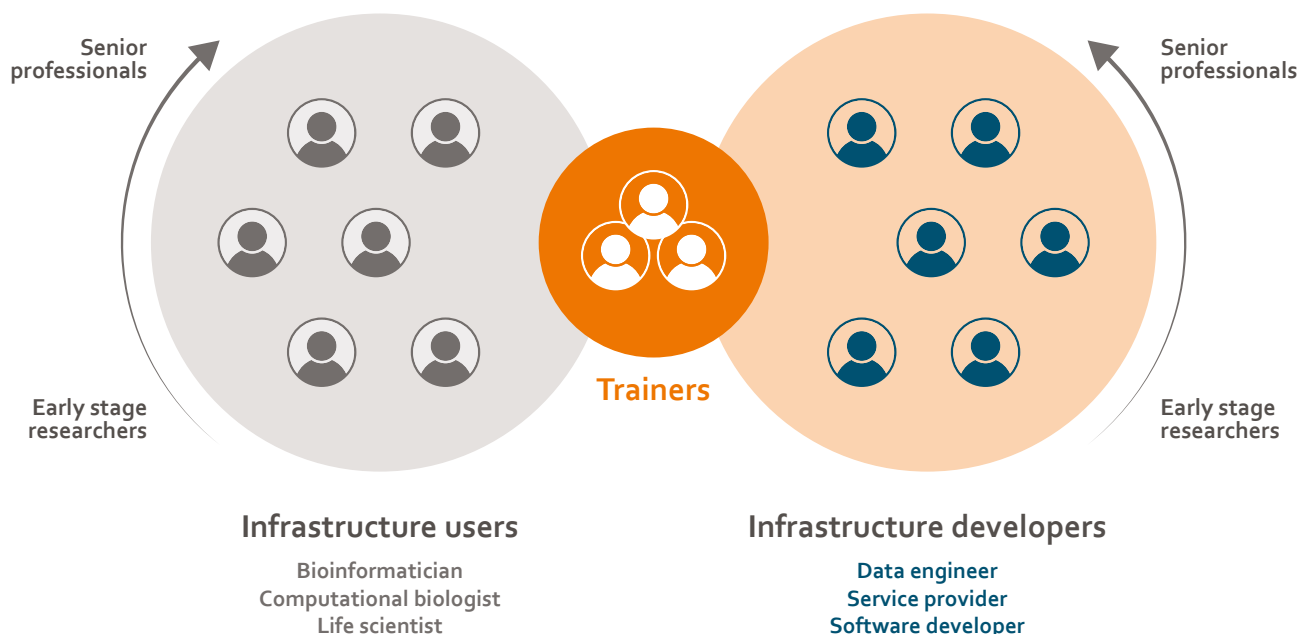


Training Platform

Strategic
Objective

1

Training Platform Users



Training Platform users: The Training Platform works with both service consumers and service providers, and offers training appropriate to different levels of expertise.

In 2022, ELIXIR Training Platform saw Executive Committee co-lead Celia van Gelder (ELIXIR Netherlands) step down with new co-lead Eva Alloza (ELIXIR Spain) joining the team. Work was carried out in the Containers Strategic Implementation Study to identify and develop use cases to build a compendium of requirements. Led by the co-leads, the Platform produced an overarching strategy document defining key objectives for the ELIXIR 2024-2028 Programme. A report on the impact of the Training Platform¹⁰¹ was published, highlighting adoption of the Platform's strategy across all ELIXIR Nodes and identifying future work Programme activities.

The ELIXIR Training Platform continued to scale hybrid training delivery, ensuring training remains inclusive and accessible to all. Approximately 100 events were delivered by ELIXIR Nodes in 2022, with the vast majority being fully hybrid. After a comprehensive curation process, TeSS¹⁰² lists over 8,473 training events since 2016 from training providers within and beyond ELIXIR, with 1,884 training materials publicly available. Additional training was carried out as part of ELIXIR-CONVERGE (data management and stewardship) and the BY-COVID project (infectious diseases).

Links between the Training Platform and ELIXIR Communities were a continued focus and were strengthened with a dedicated workshop during ELIXIR All Hands Meeting 2022. The Platform's training collections and learning pathways were identified as potential co-creation mechanisms between the Platform and ELIXIR Communities. The Platform has been actively involved in preparing training components embedded in the (emerging) Biodiversity, Single-Cell Omics and Systems Biology Community Implementation Studies.

101 <https://f1000research.com/documents/11-1366>

102 <https://tess.elixir-europe.org>

During 2022, five Train-the-Trainer courses were held, accompanied by Community-specific support. In collaboration with ELIXIR-CONVERGE there was a particular focus on FAIR training. The FAIR Training Focus Group oversaw a project focusing on FAIR training during BioHackathon Europe 2022, and the first release of the Bioschemas training profiles was published in bioRxiv¹⁰³ in partnership with GOBLET.

The Training Platform continued active connections to initiatives beyond ELIXIR. It has a strong presence within the EOSC Association, with Platform members participating in EOSC task forces, events and activities, and the Platform featured in the EOSC

Symposium¹⁰⁴. GOBLET was key collaborator, with Training Platform activities presented at COBLET2022¹⁰⁵. The ELIXIR-GOBLET collaboration led to two professional training guides published in 2022 (Introducing¹⁰⁶ and Using¹⁰⁷ the mastery rubric for bioinformatics). Training Platform representatives attended alignment meetings with both the Australian BioCommons and the US National Institutes of Health (NIH). Finally, the Training Platform presented at the ECCB2022¹⁰⁸ conference with an ELIXIR-CONVERGE poster, The new Community of Practice for Data Management/Data Stewardship Training, and a session on cross-continent collaboration, ELIXIR meets Latin America¹⁰⁹.

103 <https://www.biorxiv.org/content/10.1101/2022.11.24.516513v1>

104 <https://events.eoscfuture.eu/symposium2022/1938612>

105 <https://doi.org/10.5281/zenodo.7297918>

106 <https://f1000research.com/documents/11-735>

107 <https://f1000research.com/documents/11-743>

108 <https://eccb2022.org>

109 <https://elixir-europe.org/events/elixir-outreach-webinar-latin-america-data-management-and-training-opportunities-engagement>

ELIXIR Communities and Focus Groups

Bringing together experts from particular life sciences areas, ELIXIR Communities develop targeted standards, services and training. They capture research needs from across ELIXIR Nodes and partner organisations and translate them into formal requirements to drive the portfolio of services in ELIXIR Platforms. These strong links ensure that services developed are fit-for-purpose and serve real research community needs.

ELIXIR Communities provide a mechanism to reach out to defined groups of experts including the other research infrastructures of the ESFRI roadmap¹¹⁰. In turn, ELIXIR provides Communities with a formal, well-defined structure with access to funding opportunities. They can participate in Community-led Implementation Studies and members of Communities use the networking opportunities to develop proposals for EU funding.

In 2022, there were 15 ELIXIR Communities, including two new Communities - Systems Biology and Single-Cell Omics - launched towards the end of the year. There is one emerging Community: Biodiversity. The selection of new Communities is based on a well-defined process:

- 1. Community proposal** - the future Community submits a formal proposal.
- 2. Heads of Nodes invitation** - the Heads of Nodes Committee agree to the Community proposal.
- 3. Workshop to establish white paper** - the nascent Community develops a white paper to establish the Community's infrastructure needs, describe the roadmap, and make the necessary connections with ELIXIR Platforms.

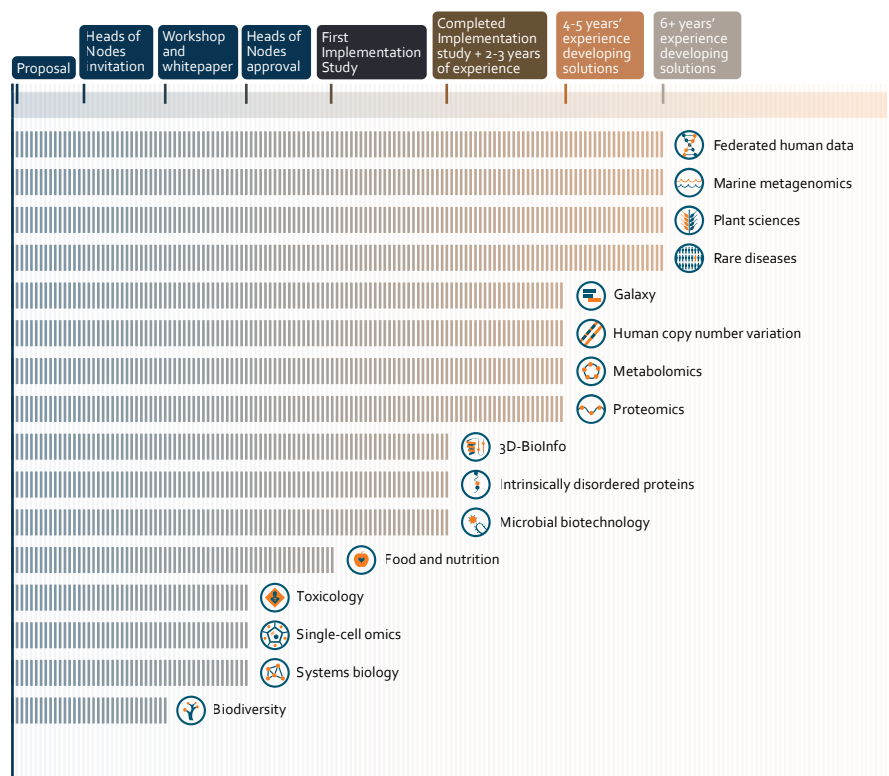
- 1. Community establishment** - the Heads of Nodes Committee agree to the white paper, which has been widely consulted across ELIXIR.

Once a Community is established, it receives funding through an initial Implementation Study to kick start technical developments and community-building activities. Over time, with annual meetings and collaboration with other external initiatives, ELIXIR Communities grow and mature. The respective maturity of a Community can be described

within three phases:

1. Recently selected Communities who are about to or have just begun their first Implementation Study.
2. Communities recently finishing their first Implementation Study that have been implementing the Community roadmap for two-three years.
3. Communities with over four years of work developing standards or technical solutions to meet the Community's needs.

The maturity journey of the ELIXIR Communities



¹¹⁰ <http://roadmap2018.esfri.eu/projects-and-landmarks>



3D-Bioinfo

The ELIXIR 3D-BioInfo Community gathers resources and promotes standards for structure-based data and tools. In 2022, the Community held a successful Annual General Meeting at EMBL-EBI with 65 people in person and 200 online. The Community focused on five major activities:

Structural and functional annotations of proteins

The PDBe KnowledgeBase consortium was expanded to include 31 groups from 13 Nodes. 3D-Beacons, a sister resource providing access to predicted protein structures, grew significantly and now contains more than 600 models, including AlphaFold, META and RosettaFold.

Protein complexes

A manuscript on the benchmark study on *Discriminating physiological from non-physiological interfaces in structures of protein complexes* was prepared for submission to Proteomics. In addition, a benchmark dataset of conformational ensembles

of PDB structures was compiled and a set of sequence and structural alignment tools and dynamic domain analysis tools evaluated.

Protein ligand interactions

Development of the NextFlow pipeline to create a large benchmark set of ligand-protein complexes was significantly progressed.

Nucleic acids

Work was carried out on an overview of nucleic acid valence geometry parameters, which will be followed by the formulations of recommendations for Protein Data Bank (PDB) validation. An RNA structure-function meeting was organised in Spain.

Protein engineering

The information on resources in bio.studies was expanded and a successful workshop was held on protein engineering in Zagreb, Croatia, with the Federation of European Biochemical Societies (FEBS).



Food and Nutrition

The ELIXIR Food and Nutrition Community Implementation Study was successfully approved and initiated in July 2022. The Community held its first face-to-face Community meeting in Tarragona, Spain, linked with NuGO¹¹¹ week. The meeting included a workshop to kick-off Implementation Study tasks, during which five datasets were uploaded to the phenotype databases, MGNIFY and metaboLights.

The Community held extended hacking meetings to work on the Implementation Study. Details of the Implementation Study work were presented to Community members to facilitate the selection of two research questions for a hackathon in 2023.

In 2022, the experts from the Community joined BioHackathon Europe 2022 with the project *Alignment of food and nutrition study data*¹¹², focused on ontology expansion.

¹¹¹ <https://www.nugo.org/nugo-week-conferences>

¹¹² <https://github.com/elixir-europe/biohackathon-projects-2022/tree/main/1>



Galaxy

In 2022, the ELIXIR Galaxy Community achieved a milestone with the Galaxy project's first European funded project, EuroScienceGateway. The project brings together ELIXIR Nodes to establish a distributed workflow-based gateway to computing and storage infrastructures and services for European scientists, in collaboration with EGI and the EuroHPC Joint Undertaking.

There was a continued focus on enabling data intensive analysis, both within the life sciences and beyond. The Community further expanded the analyses available for COVID-19 and repurposed them for mpox and other pathogens. The start of the Biodiversity Genomics Europe (BGE) project allowed further engagement with the Biodiversity Community. The Galaxy Training Network has been extended by the addition of new scientific areas, for example, synthetic biology, and now covers 308 tutorials spanning 19 different scientific areas.

The Galaxy Community brought members together through events such as the Smörgåsbord 2022 online training week, European Galaxy Days 2022 and BioHackathon Europe 2022. Work completed at these events led to further improvement in the Galaxy platform. As part of the Implementation Study, the Community focused on facilitating data management in Galaxy, expanding workflow standard support (by increased CWL conformance and export of provenance through RO-crate) and integrating with GA4GH standards like DRS, TES and Beacon.



Intrinsically Disordered Proteins

Research on intrinsically disordered proteins (IDPs) generates large amounts of diverse data describing IDP structural properties, functional modules, regulatory mechanisms and dysregulation in disease. The ELIXIR IDP Community drives the creation of tools and resources to support the characterisation of IDPs through the organisation of efforts such as the collection and annotation of IDP data.

In 2022, the Community concluded its first Implementation Study focused on the development of formats for standardised data transfer and the creation of a central hub for data dissemination. An entire set of new gene ontology terms have been created and IDP function annotations are now propagated into Core Data Resources, including UniProtKB. Biocuration was improved through the adoption of the Minimum Information About Disordered Experiments standard (MIADEx) by the DisProt database and the development of guidelines for interpreting IDP experiments and recording TeSS webinars.

In a second ongoing Implementation Study, the Critical Assessment of protein Intrinsic Disorder (CAID) was connected to the CASP and CAFA challenges, and is now fully integrated into OpenEBench, with bio.tools covering CAID and other IDP methods. Finally, a joint study with the 3D-Bioinfo and Proteomics Communities is defining common interests for future collaboration.



Marine Metagenomics

The past year represents a landmark for the Marine Metagenomics Community as it expands within ELIXIR to become the Microbiome Community, encompassing all environments. Increasing the scope of the Community also increases its capacity. The leadership of the Community has changed with the arrival of Bérénice Batut and Eric Pelletier to assist Rob Finn. The Community white paper was finalised at the end of 2022.

The year has witnessed numerous instances of Community members participating in large, successful grants including BiOcean5D, BlueRemediomics, BlueCloud II and MICROBE. These leverage aspects of data management, processing and provenance, established as part of the Community and the ELIXIR Platforms. For example, the EOSC-Life demonstrator implemented a lightweight version of the MGnify pipeline, MetaGOFlow. Using Platform solutions, the Community members are working on importing MetaGOFlow RO-Crates as a means of federating analyses.

The Community led a project at BioHackathon Europe 2022 focusing on enhancing MGnify with notebooks for extended microbiome analysis. In addition to increasing analysis functionality, the Community also worked on technical improvements including running notebooks on the Galaxy Europe infrastructure, the development of Jupyter Lab interface extensions and documentation to enable more interactive notebook experiences.



Metabolomics

In 2022, the ELIXIR Metabolomics Community successfully completed the *Standardising the fluxomics workflows* Implementation Study. The Community held a hybrid Community meeting, alongside the International Metabolomics Society meeting (Valencia, Spain), in which the Community's goals were restated and updated. The Community was among the three mature Communities reviewed by a Community Review Committee, receiving positive feedback for its importance for ELIXIR, activities and currently established objectives.

Steffen Neumann (ELIXIR Germany) and Maria Klapa (ELIXIR Greece) were appointed new Community co-leads, replacing Merlijn van Rijswijk and Thomas Hankemeier (both ELIXIR Netherlands). Claire O'Donovan (EMBL-EBI) continues her co-lead tenure.



Microbial Biotechnology

In 2022, the Community re-established its monthly calls and held several workshops, including the Metabolic modelling and Data Integration workshop at the ELIXIR All Hands Meeting 2022. The Community made progress around the Implementation Study, focusing on establishing a framework for microbial biotechnology to manage and manipulate strains, samples, knowledge, data and metadata, especially in the area of automation. Other highlights include addressing bottlenecks underlying genome-scale metabolic modelling and identifying obstacles of modelling microbial consortia¹¹³.

The Community built close collaborations with the newly established Systems Biology Community and the recently re-focused Microbiome Community (formerly Marine Metagenomics) through activities, such as participating in Biohackathon Europe 2022 with the project FAIR knowledge representation for user facing applications. The project focused on data management recommendations for biotechnology and synthetic biology researchers.

2022 saw substantial involvement of the Community in industry-related

projects such as the Bioindustry 4.0¹¹⁴ and BioS¹¹⁵ developing capacities for digitisation of industrial biotechnology. The Community is also working closely together with the ESFRI IBISBA¹¹⁶ in industrial biotechnology.

Representatives from the Community are preparing an ELIXIR Knowledge Exchange Scheme project with an SME to work on data and knowledge management in an automated enzyme characterisation workflow.

Further funding was secured to continue key aspects of the Implementation Study. For example, the ELIXIR Netherlands Node has acquired funding to develop a data fabric infrastructure for microbial related activities. The Community also worked closely with the Dutch-funded open infrastructure, UNLOCK¹¹⁷, which aims to explore new horizons for research on microbial communities. The Microbial Biotechnology Community has contributed training materials to TeSS and BioSB-NL, especially in the areas of enzyme annotation, constraint-based modelling, metagenomics, data science and digital twins.

113 Scott Jr. W.E., Benito-Vaquerizo S., Zimmermann J., et al. A Structured Evaluation of Genome-Scale Constraint-Based Modeling Tools for Microbial Consortia. *bioRxiv*. 2023.02.08.527721; doi: <https://doi.org/10.1101/2023.02.08.527721>

114 <https://www.ibisba.eu/EU-Projects/Horizon-Europe>

115 <http://www.bios-project.eu>

116 <https://www.ibisba.eu>

117 <https://m-unlock.nl>



Plant Sciences

In 2022, ELIXIR Plant Sciences Community worked to disseminate Community tools, data standards, good practices and service bundles. This was mostly conducted as part of the Implementation Study *Increasing Plant data findability and reuse beyond ELIXIR*¹¹⁸. The plant visualisation service bundle and the plant orthology service bundle, both providing guidance on optimal tool use, are now ready for the wider community. The Community produced descriptions of the phenomics tools assembly and made it accessible to users in the RDMkit and as a FAIR Cookbook recipe. This work continues in collaboration with EMPHASIS, the plant phenotyping infrastructure, and key projects such as AGENT, a Horizon 2020 project on the genetic resources of cereals.

The Community also participated in BioHackathon Europe 2022 with the project *Plant data exchange and standard interoperability*¹¹⁹. During the event, standards and data management were addressed, including mechanisms for connecting ISA, MIAPPE, Bioschemas and RO Crate. The work was widely disseminated, especially in ELIXIR France and ELIXIR Germany, through the first BioHackathon Germany. This assisted the incorporation of the MIAPPE standard and tools such as the MIAPPE Wizard and TINA into the day-to-day activities of data-producing laboratories.

In addition, the Community is involved in two new Horizon Europe projects starting in 2022 and 2023 respectively, AgroServ and PHENET. Both projects aim to unify and standardise workflows and services for phenotyping across Europe.



Proteomics

In 2022, most activities of the ELIXIR Proteomics Community concerned further development of open analysis workflows. After concluding the ELIXIR 2019 Implementation Study, four different workflows for label-free proteomics data analysis were bundled into the WOMBAT-P pipelines¹²⁰. These workflows can be run via NextFlow and have been successfully tested on multiple public datasets. A cloud application for running the WOMBAT-P workflows has been developed and is being tested.

In the ongoing 2021 Implementation Study, eight proteomic analysis workflows were selected for further use, including the WOMBAT-P pipelines and five test datasets. Some workflows also need to be redeveloped to run in Nextflow. Work is ongoing to refine the SDRF-proteomics format for storing sample metadata about datasets to run the pipelines (semi)-automatically.

In 2022, several meetings were held to align the activities of the ELIXIR Proteomics, 3D-Bioinfo and Intrinsically Disordered Proteins Communities. A white paper was initiated to summarise the ongoing interactions and future plans. Finally, the first formal review of the Community took place with positive feedback.



Single-Cell Omics

The ELIXIR Single-Cell Omics (SCO) Community aims to identify the main challenges in single-cell and spatial omics research and coordinate an international effort to best serve the needs of researchers. In 2022, the Community published a roadmap for the field¹²¹, hosted a workshop at the 2022 ELIXIR All Hands Meeting, organised a workshop in Stockholm and defined its first Implementation Study planned for 2023-2024.

Two international training events were held: Spatial omics data analysis in Stockholm, Sweden; and SpaceHack for benchmarking cell segmentation in spatial transcriptomics data in Berlin, Germany.

Both events included organisers from multiple ELIXIR Nodes and external experts in software packages. The Community is planning more courses and workshops for early 2023.

The Community has created a Github repository for collaborative work and defined strategies to work collectively across Nodes, including integration with the local research and existing international consortia.

118 <https://elixir-europe.org/internal-projects/commissioned-services/increasing-plant-data-findability>

119 <https://biohackrxiv.org/c724r>

120 <https://github.com/wombat-p/WOMBAT-Pipelines>

121 Czarnewski P, Mahfouz A, Calogero RA et al. Community-driven ELIXIR activities in single-cell omics. *F1000Research* 2022, 11(ELIXIR):869, <https://doi.org/10.12688/f1000research.122312.1>



Systems Biology

The ELIXIR Systems Biology Community aims to make systems modelling central to research in biology. Systems models are developed based on the understanding of biological problems, are used to design biological experiments, and help with the interpretation of collected data. The combined results allow the development of actionable solutions to the original biological problem. The Community aims to contribute to the activities of other ELIXIR Communities by providing expertise and perspectives on data analysis, integration and generation.

In 2022, the Community was formally recognised, published its foundational white paper and prepared plans for its first Implementation Study. At the 2022 ELIXIR All Hands Meeting, the Community discussed potential synergies in a workshop jointly organised with five other ELIXIR Communities. The Community led a project at BioHackathon Europe 2022 to develop a TeSS workflow: *Training Systems biology curators in building interoperable and reusable models following a learning path approach*. Community members presented in a number of international meetings, including the ELIXIR Community track at the ECCB 2022 conference, the ISGSB 2022 conference in Innsbruck, and Foundations for Systems Biology in Engineering (FOSBE) 2022.



Toxicology

The ELIXIR Toxicology Community continued to grow and establish links with other projects. Close alignment with the European Partnership for the Assessment of Risks from Chemicals (PARC) initiative, which includes the implementation of FAIR guidelines, remains important. A joint meeting was held with PARC, the European NanoSafety Cluster, the InChi Trust, GO FAIR, NanoFabNet and DaNa projects to strengthen existing and establish new collaborations.

The Toxicology Community participated in the 2022 ELIXIR All Hands Meeting, started a project in BioHackathon Europe 2022 and presented at the Spring 2022 Tools Platform meeting. During the BioHackathon, interoperability with PubChem was established for chemical substances, and PFAS was identified an important research topic. The Tools Platform meeting resulted in new toxicology sections in bio.tools and WorkflowHub.

In 2022, the Community launched its website and held its first online meetings focusing on Bioschemas updates to make training material, chemicals and datasets more findable.



Federated Human Data

The ELIXIR Federated Human Data (FHD) Community coordinates several European activities on developing federated networks to enable cross-border access to genomic and associated pheno-clinical data. The objective is furthered by the FHD Implementation Study 2022-2023.

The Community held bi-monthly meetings for national Nodes to share updates on progress towards joining the Federated EGA network and other European federated networks. The meetings provide a forum for discussion, feedback, knowledge sharing and partnership. In 2022, the FHD Community hosted national use case presentations from Greece, Spain, Portugal, and Canada, and heard updates from EC projects such as B1MG.

In 2022, the FHD Community hosted a highly-attended Federated EGA workshop at the 2022 ELIXIR All Hands Meeting, where each ELIXIR Node was represented. A virtual Federated EGA technical and operational Q&A webinar was co-hosted with ELIXIR and attended by more than 50 people.

The FHD community continues to work in collaboration with European initiatives of interest, such as the Federated EGA, Beyond One Million Genomes (B1MG), and the European Genomic Data Infrastructure (GDI) project.



Human Copy Number Variation

The ELIXIR human Copy Number Variation (hCNV) Community provides guidance and implements processes for detection, annotation, interpretation and sharing of CNV for genomics research and clinical use cases.

The Community-led activities are supported by two Commissioned Services. The first involves the prototyping and adoption of standards for CNV discovery and data exchange. The Community worked with the ELIXIR Beacon project to adapt and test Beacon V2 specifications with respect to the CNV domain and provide a reference implementation for the Progenetix database, with ongoing adoption through the French CNV database Bancco. In parallel, participants contributed to the GA4GH variant call format (VCF) taskforce to simplify the representation of CNV in upcoming VCF specifications.

The second project aims to produce whole exome sequencing (WES) reference CNV datasets for detection and benchmarking. In coordination with the Galaxy Community and the Tools Platform, the Community prototyped a benchmarking environment for CNV detection tools. Work is planned for containerising and inclusion in Galaxy CNV callers and evaluation against whole genome sequencing (WGS) reference datasets.

In 2022, the hCNV Community continued to strengthen links with ELIXIR Communities and Platforms and beyond with presentations during the 2022 ELIXIR All Hands Meeting and at GA4GH Connect Beacon workshops.



Rare Diseases

The ELIXIR Rare Diseases Community extends and generalises the system of access authorisation and high volume secure data transfer developed within the European Genome-phenome Archive (EGA). The goal of the Community is to create a federated infrastructure enabling researchers to discover, access and analyse different rare disease repositories across Europe.

In 2022, the Community launched a new Implementation Study, *ELIXIR Rare Disease Community services and international collaborations*. The Rare Diseases Community participates in the European Joint Programme on Rare Diseases (EJP RD), where Beacon V2 is being tested for data discovery in the EJP RD virtual platform.

As part of the GA4GH-ELIXIR strategic partnership, the Community joined the tenth GA4GH plenary workshop to identify the needs of the rare disease research community for future standards, products and projects. In 2022, the Community organised a workshop on FAIR data analytics at the ELIXIR All Hands Meeting and presented a talk on infrastructure for FAIRification of rare disease resources at the ECCB 2022 conference.



Biodiversity (Emerging Community)

An ELIXIR Biodiversity group has existed in the form of a Focus Group since May 2019. After publishing an F1000 paper, *Recommendations for connecting molecular sequence and biodiversity research infrastructures through ELIXIR*¹²², the group was formally invited to evolve into an emerging Community.

In the second half of 2022, the group focussed on writing the Community white paper and drafting the Community Implementation Study. The group then moved rapidly towards full Community status and expanded its Node involvement, with about 16 Nodes now represented. Activities for the next year include formalising the biodiversity service list through RDMkit and networking through a range of meetings and activities. These activities will be enabled via the Community Implementation Study, likely to start in 2023..

122 Waterhouse RM, Adam-Blondon AF, Agosti D, et al. Recommendations for connecting molecular sequence and biodiversity research infrastructures through ELIXIR. F1000Res. 2021 Dec 3;10:ELIXIR-1238. doi: 10.12688/f1000research.73825.2

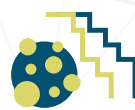


Focus Groups

ELIXIR Focus Groups bring interested parties together around a particular topic, especially to address emerging areas of interest and identify strategies for progression. As of 2022, there are 10 ELIXIR Focus Groups. During the year, the Registries Focus Group came to an end, the Systems Biology Focus Group evolved into the System Biology Community and the Biodiversity Focus Group worked towards becoming the Biodiversity Community.

Biocuration Focus Group

The ELIXIR Biocuration Group, set up by biocurators within ELIXIR, kicked-off in February 2022 and has a growing attendance at its monthly calls. In 2022, the group developed training materials for underserved areas of biocuration and initiated a collaboration with the ELIXIR Training Platform. The Group also participated in BioHackathon Europe 2022 with a project on training materials and benefited from the opportunities offered by the International Society of Biocuration (ISB) through the ELIXIR travel grant scheme. Finally, Focus Group members initiated a review of biocuration tool requirements and plan to act as an engagement user group to shape and evaluate biocuration text-mining technologies.



Cancer Data Focus Group

Since being established at the start of 2020, the ELIXIR Cancer Data Focus Group has gathered experts from 17 ELIXIR Nodes and identified 10 use cases, along with defining other challenges in cancer data management in bioinformatics infrastructures. In 2022, experts from the Focus Group came together to kick-off two EU Research and Innovation Action proposals: *A European-wide foundation to accelerate data-driven cancer research* and *Providing cutting edge cancer research services across Europe*. The Focus Group continues to hold monthly meetings and work towards finalising a white paper addressing the challenges in cancer data analysis in research and clinical practice.



Communication Focus Group

In 2022, quarterly meetings of ELIXIR Communications Focus Group were re-initiated after a pause since 2020. Focus Group members met to discuss topics such as communication with scientific users, placing impact at the heart of communications and building Node capacity in communications. The Focus Group continues to provide a focal point for anyone working within ELIXIR to share ideas and expertise in communications.



EOSC Focus Group

Throughout 2022, EOSC Focus Group members met monthly to align ELIXIR and EOSC initiatives, host talks from new EOSC projects led by ELIXIR members, and exchange information between EOSC Association Task Forces. The Focus Group prepared an ELIXIR-EOSC strategy document which was published on Zenodo¹²³. The document provides guidance for ELIXIR's life scientists, both those new to EOSC and those with experience. In November 2022, Focus Group members attended the 2022 EOSC Symposium with over 20 ELIXIR-affiliated members presenting posters and talks.



FAIR Training Focus Group

The ELIXIR FAIR Training Focus Group brings together ELIXIR members and the international training community with the goal of ensuring training materials are shared FAIRly to maximise their re-use. The Focus Group engaged with the training community at several international events including the Bioinformatics Education Summit, COBLET 2022/ GOBLET AGM, BioHackathon Europe 2022, the Education Summit, Biohackathon Germany and the Banbury Center Meeting, *Making career-spanning learning in the life sciences inclusive and effective for all*. The Group expanded on their 2021 publication *10 Simple Rules for Making Training Materials FAIR* by i) rewording the FAIR principles to be more appropriate for training materials ii) working with the international community to develop an online FAIR training handbook (to be published in 2023) and iii) releasing the Bioschemas training profiles: Course¹²⁴, CourseInstance¹²⁵ and TrainingMaterial¹²⁶.

123 Tedds J, Capella-Gutierrez S, Clark-Casey J, et al. (2022). ELIXIR EOSC Strategy 2022. Zenodo. <https://doi.org/10.5281/zenodo.7120997>

124 <https://bioschemas.org/profiles/Course/1.0-RELEASE>

125 <https://bioschemas.org/profiles/CourseInstance/1.0-RELEASE>

126 <https://bioschemas.org/profiles/TrainingMaterial/1.0-RELEASE>



Health Data Focus Group

During 2022, the ELIXIR Health Data Focus Group continued to identify common challenges facing the secondary use of health data for research and policy-making purposes. The Group facilitated knowledge exchange presentations from various health data initiatives outlining the successes, challenges and lessons learnt on the re-use of health data. These learnings are being incorporated into a white paper reviewing the management of health data re-use by ELIXIR members. Several members of the Group have participated in workshops led by the RMD toolkit to help create and publish guidelines on the management of the secondary use of health data along with genomic data.



Impact Focus Group

In 2022, the ELIXIR Impact Focus Group had a full year of activities taking place as part of both the ELIXIR-CONVERGE project and the Strategic Implementation Study, *Impact evaluation at Node-level-getting it done*, led by ELIXIR Portugal, Norway and Belgium. Formal training in impact was accompanied by a series of Show and Tell events where Nodes presented their impact case studies to ELIXIR peers. Case studies were chosen by the Nodes and are based on their national circumstances and stakeholders. This knowledge exchange exercise was found to be invaluable to both the presenting Nodes and their impact colleagues who, more than ever, feel part of an engaging and supportive community of practice in the field of impact. ELIXIR is increasingly recognised as a trailblazer in the field of impact in distributed infrastructures, both in the life sciences and beyond.



Innovation and Industry Focus Group

In 2022, the Innovation and Industry Focus Group held three meetings attended by representatives from ELIXIR Nodes. Participants shared industry engagement experiences of using ELIXIR mechanisms to work with industry, such as the Knowledge Exchange scheme and BioHackathon Europe, and individual Nodes presented their national industry engagement activities. The Focus Group supported the creation of the guide *How to engage with industry*, advised on establishing performance indicators for industry engagement and showcased Node industry activities on an interactive map on the ELIXIR industry webpage.



Machine Learning (AI) Focus Group

The ELIXIR Machine Learning (AI) Focus Group held monthly calls to coordinate activities across the three task forces run by members of the group. The first task is the annotation of publications using the DOME recommendations, during which over 150 publications were annotated by more than 20 people. The annotations and basic information for the publications are available in the DOME registry¹²⁷. This task has led to a newly funded Strategic Implementation Study, starting in January 2023. The second task is the compilation of training datasets for life sciences. Selected datasets were identified and characterised, taking aspects relevant to machine learning training into account, and a publication is being prepared. The third task was to create a tool to synthesise data and identify characteristics describing synthetic datasets. Preliminary results from the work done at the BioHackathon Europe 2022 will be published in BioHackrXiv. The Focus Group also started defining metadata schemas to structure information in the DOME recommendations, this work is in partnership with NFDI4DataScience and the Research Data Alliance FAIR4MachineLearning interest group.



Research Data Alliance (RDA) Focus Group

The ELIXIR RDA Focus Group held monthly calls throughout the year to facilitate synergies between ELIXIR's life scientists and the diverse cross-domain topics of the RDA. Focus Group members were assisted to attend, both remotely and in-person, the 19th RDA plenary event in Seoul, South Korea through the ELIXIR travel grant scheme. ELIXIR attendees published a report on the key outputs of the event¹²⁸. The RDA Focus Group elected a new steering committee consisting of five members (Allyson Lister, Wolmar Nyberg Åkerström, Bengt Persson, Susanna-Assunta Sansone and Fotis Psomopoulos)¹²⁹. Wolmar Nyberg Åkerström was elected ELIXIR's co-chair to the RDA's new Life Science Data Infrastructures Interest Group (formerly the ELIXIR Bridging Group) alongside representatives from NIH, Australian BioCommons and H₃ABIONET. The Focus Group ran a landscape analysis to understand the points of interaction between ELIXIR members and the RDA, the results of which will be shared in 2023.

127 <https://registry.dome-ml.org>

128 Åkerström WN, Lieby P, Suchánek M, et al. (2022). ELIXIR Report of the 19th Plenary of the RDA, June 2022. Zenodo. <https://doi.org/10.5281/zenodo.7056753>

129 <https://elixir-europe.org/focus-groups/rda-activities>

Our flagship events

All Hands Meeting – connecting all ELIXIR members

The ELIXIR All Hands meeting is an annual event bringing together the ELIXIR family to share updates, develop new plans and strengthen personal connections.

After two years of virtual events, ELIXIR All Hands 2022 was a welcome return to an in-person gathering. 306 participants from 22 Nodes were registered for the meeting and 15 guests attended, including nine from non-Member countries. Two well-received keynote lectures set the stage: Marialuisa Lavitrano, Professor at the University of Milano-Bicocca spoke on *Why Open Science? Where does EOSC come*

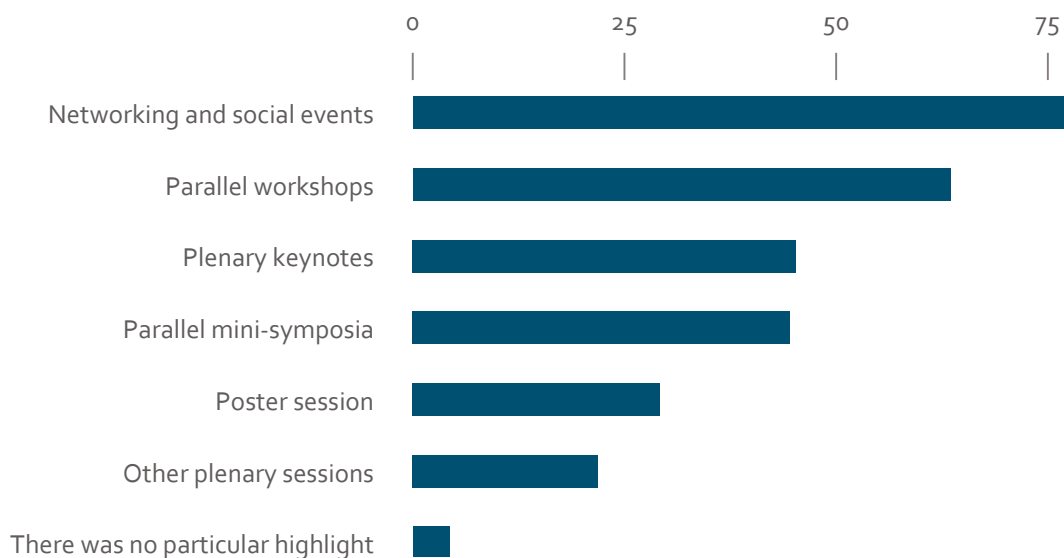
from? and Gerrit A. Meijer, Head of Research and Innovation at the Netherlands Cancer Institute, on *Towards data-driven health*.

Taking place over four days, ELIXIR All Hands Meeting built community relations through a diverse programme of workshops, mini-symposia and plenary sessions focused on emerging and established topics across a range of ELIXIR's activities. Being back in person gave participants opportunities to make new connections and deepen existing ones, and everyone was able to share their work and ideas with ELIXIR colleagues.

306
PARTICIPANTS

Survey responses from the All Hands Meeting 2022

EVENTS SEEN AS HIGHLIGHT IN ALL HANDS MEETING 2022 (%)



Our collaboration, outreach and industry support efforts

Demonstrating ELIXIR's impact

Strategic Objective

5

ELIXIR impact dashboard

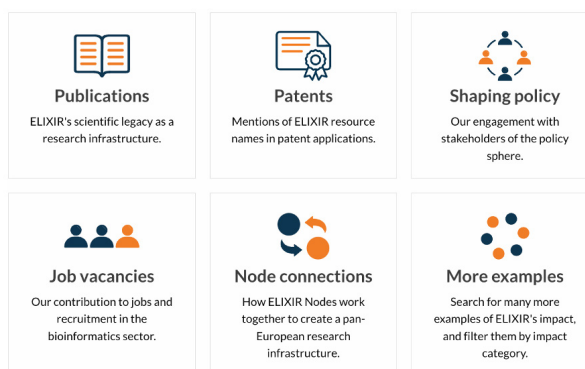
In 2022, ELIXIR's impact dashboard was released on the ELIXIR website. The impact dashboard¹³² is home to a number of real-time performance and impact indicators, and is regularly updated and enriched with new tiles. It was built to address the many requests from external stakeholders wishing to find out about ELIXIR's impact.

The impact dashboard features a range of examples of ELIXIR's impact, including publications, policy impact, job creation, patents and connections made between bioinformaticians in ELIXIR Nodes.

Key ELIXIR-supported publications in 2022

In 2022, ELIXIR partners published a total of 145 peer-reviewed research publications (including pre-prints). Over the years, ELIXIR supported publications have amassed more than 15,000 citations¹³³. Scientific impact develops over time and is difficult to accurately measure. An altmetric score¹³⁴ can act as a proxy by scoring the papers receiving the most attention through a range of channels (for example, news outlets, Wikipedia, blogs, social media). On the right is a selection of ELIXIR-supported papers that are in the top five percent of all research outputs, as scored by Altmetric. These papers all received much attention not only on Twitter but also in Wikipedia and news media.

ELIXIR impact dashboard



Top 5% ELIXIR-supported papers scored by Altmetric

TITLE	ELIXIR NODES	ATTENTION SCORE
The LOTUS initiative for open knowledge management in natural products research ¹³⁵	CZ, NL	<p>118 referenced in 6 wikipedia pages</p>
The GA4GH Phenopacket schema defines a computable representation of clinical data ¹³⁶	CH, ES, EBI, FI, NL, Hub	<p>99 already 20 citations in the first 6 months</p>
Introducing the FAIR Principles for research software ¹³⁷	GR, Hub, DE	<p>241 355 Twitters from >9 countries</p>
Extension of the shelf-life of fresh pasta using modified atmosphere packaging and bioprotective cultures ¹³⁸	IT	<p>255 27 news outlets!</p>

132 <https://elixir-europe.org/about-us/impact>
 133 <https://elixir-europe.org/about-us/impact/publications>
 134 <https://www.altmetric.com>
 135 <https://elifesciences.org/articles/70780>
 136 <https://www.nature.com/articles/s41587-022-01357-4>
 137 <https://www.nature.com/articles/s41597-022-01710-x>
 138 <https://www.frontiersin.org/articles/10.3389/fmicb.2022.1003437/full>

Source: <https://www.altmetric.com/about-our-data/the-donut-and-score/>

- Twitter
- Blog
- LinkedIn
- News
- Reddit
- Research highlight platform
- Wikipedia
- Policy documents

ELIXIR-supported articles have policy impact

Many ELIXIR-supported publications have an impact in the policy sphere. Using the Overton.io database¹³⁹, citations of ELIXIR-supported publications can be monitored in policy documents, which include guidelines, think tank publications and working papers. Over the years, 49 ELIXIR-supported publications have been cited in 77 different policy sources, including the Publications Office of the European Union, other intergovernmental bodies (for example, the Organisation

for Economic Development and Cooperation, the World Health Organisation and the Food and Agricultural Organisation of the United Nations) and by a number of governments within and beyond Europe. In total, 262 different policy documents have cited ELIXIR-supported publications, 61 of which were published in 2022.

Highlights of 2022 include *Towards a European Health Research and Innovation Cloud (HRIC)*¹⁴⁰ cited by the official state bulletin of Spain¹⁴¹, *FAIRsharing as a community approach to standards, repositories and policies*

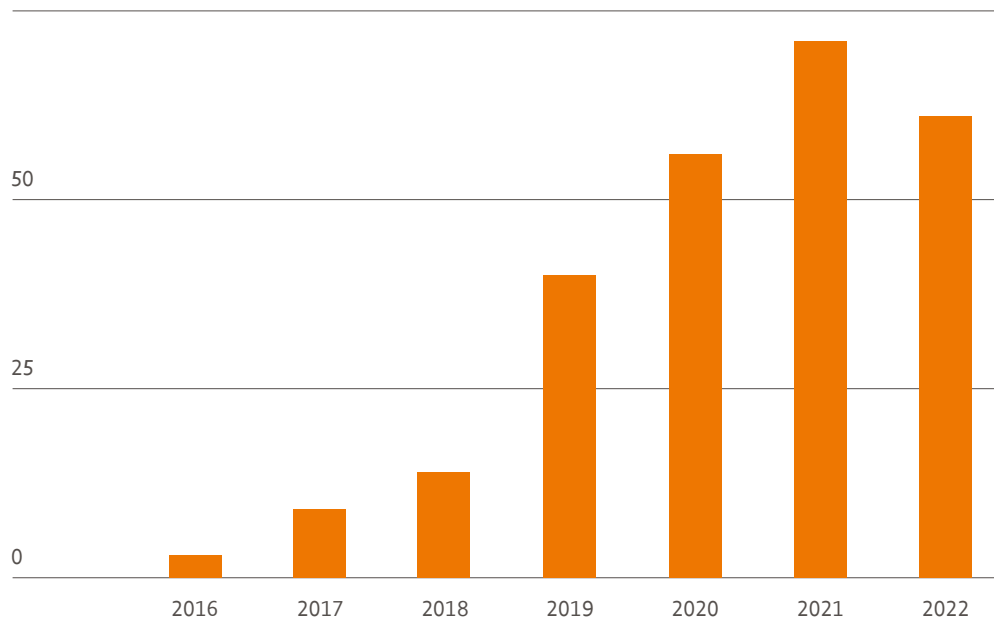
cited in a European Commission report¹⁴², and *The COVID-19 Data Portal: accelerating SARS-CoV-2 and COVID-19 research through rapid open access data sharing* cited in a UK Government report¹⁴³.

By far the most cited ELIXIR-supported publication remains *The FAIR Guiding Principles for scientific data management and stewardship*, cited in 2022 by the World Meteorological Organisation¹⁴⁴, and by 200 policy documents in recent years.

Citation of ELIXIR-supported publications in policy documents, including guidelines, think tank publications and working papers (data from Overton.io)

POLICY DOCUMENTS MENTIONING ELIXIR

75



139 <https://www.overton.io>

140 <https://doi.org/10.1186/s13073-020-0713-z>

141 <https://cpage.mpr.gob.es/producto/genoma-y-epigenetica>

142 <https://op.europa.eu/en/publication-detail/-/publication/fo23acef-ba07-11ec-b6f4-01aa75ed71a1/language-en/format-PDF>

143 <https://www.gov.uk/government/publications/intelligent-open-science-viral-genomic-data-sharing-during-the-covid-19-pandemic>

144 https://library.wmo.int/index.php?lvl=notice_display&id=22134

Collaborations beyond Europe

ELIXIR-GA4GH Strategic Partnership



Global Alliance
for Genomics & Health
Collaborate. Innovate. Accelerate.

In 2022, GA4GH approved standards were used in the ELIXIR-driven project Beyond One Million Genomes (B1MG) as a proof of concept for rare disease. In this demonstrator, the GA4GH standards were used together to show how a researcher could search for, access and analyse data within a federated data ecosystem. ELIXIR released version two of the Beacon API for genomic data discovery in collaboration with the GA4GH discovery work stream. The updated protocol greatly expands functionality to increase the tool's utility and emphasises responsible access to clinical genomic data for research purposes.

Australian BioCommons Collaboration Strategy



Australian BioCommons

The ELIXIR:Australian BioCommons collaboration strategy entered its third year in 2022. Despite the geographic and time-zone challenges, collaborations have been fruitful and mutually beneficial. Mechanisms of collaboration have included participation in the ELIXIR Platform and Community calls and meetings (some in-person), co-authorship on publications, and an in-person delegation at the ELIXIR All Hands Meeting. A particular highlight has been the well organised and productive Australian participation in BioHackathon Europe 2022, during which Australia-based participants gathered in one location and adopted a Parisian lifestyle. Technical touchpoints include the Tools and Training Platforms, RO-Crate, EDAM, WorkflowHub, TeSS:DReSA, FAIR training materials, Galaxy, and the Federated Human Data and Single-Cell Omics Communities.

Office for Data Science Strategy of the US National Institutes of Health (NIH)



National Institutes of Health
Office of Data Science Strategy

ELIXIR strengthened its relationship with the US National Institutes of Health (NIH), specifically the Office of Data Science Strategy (ODSS). Building on existing NIH:ELIXIR points of contact, including the Global Biodata Coalition and the many ELIXIR resources that benefit from NIH funding, the collaboration focused on exploiting synergies between areas of technical implementation in data science for mutual benefit. There was a range of interactions, such as reciprocal invitations at events, collaborations on projects and quarterly update calls, and the NIH is now represented on the editorial boards of two flagship ELIXIR resources, RDMkit and FAIR Cookbook. Other highlights include NIH representation in the DOME recommendations working group (on machine learning) and further interactions through the Research Data Alliance where NIH and ELIXIR Nodes co-chair an interest group.

Research Data Alliance



In 2022, ELIXIR continued its long-standing and rewarding exchange with the Research Data Alliance (RDA). The RDA ELIXIR bridging force that had been active in the RDA since 2014 transitioned into the Life Science Data Infrastructures Interest Group¹⁴⁵ with a new set of co-chairs representing ELIXIR, the Australian BioCommons, the NIH Office of Data Science Strategy in the USA and H3ABioNet in Africa. The 2022 RDA plenary meeting was part of International Data Week with many sessions from SciDataCon 2022 organised by CODATA¹⁴⁶ and WDS¹⁴⁷. There were a wide range of synergies across technical communities and disciplines, including the FAIR for research software recommendation from the RDA that is being adopted by the ELIXIR Tools Platform. Another example is the launch of the community champions programme¹⁴⁸, endorsed by ELIXIR and supported by the FAIRsharing¹⁴⁹ registry (developed with RDA and EOSC-Future seeds funds) under the auspices of the RDA FAIRsharing working group. FAIRsharing champions act as advocates promoting the value of standards, databases and policies, enriching their descriptions in FAIRsharing, and creating resource based educational material.

Global Biodata Coalition collaboration



In 2022, ELIXIR continued to build relations with the Global Biodata Coalition (GBC). Alignment of the ELIXIR and GBC accreditation processes were maintained through quarterly calls. These are selection processes for the ELIXIR Core Data Resources (CDRs) and GBC Global Core Biodata Resources (GCBRs), which operate at European and global levels respectively. ELIXIR facilitated participation of CDRs in the first GCBR selection process by aligning monitoring dates and preparing mappings of ELIXIR monitoring metrics to those required by the GBC to reduce duplication of effort. ELIXIR CDRs featured strongly in the first selection of GCBR status accreditation. Twelve of the 37 resources were ELIXIR CDRs, over half of the current CDR portfolio¹⁵⁰. Guy Cochrane, a member of the EMBL-EBI Node and Head of the European Nucleotide Archive was appointed Executive Director of Global Biodata Coalition¹⁵¹, and Niklas Blomberg, ELIXIR Director, was Chair of the first round of GCBR selection.

¹⁴⁵ <https://www.rd-alliance.org/groups/life-science-data-infrastructures-ig>

¹⁴⁶ The International Science Council's Committee on Data, <https://codata.org>

¹⁴⁷ World Data System, <https://worlddatasystem.org>

¹⁴⁸ https://fairsharing.org/community_champions

¹⁴⁹ <https://fairsharing.org>

¹⁵⁰ https://elixir-europe.org/news/GCBR_2022

¹⁵¹ <https://www.ebi.ac.uk/about/news/announcements/cochrane-global-biodata-coalition>

Enabling and supporting industry collaboration

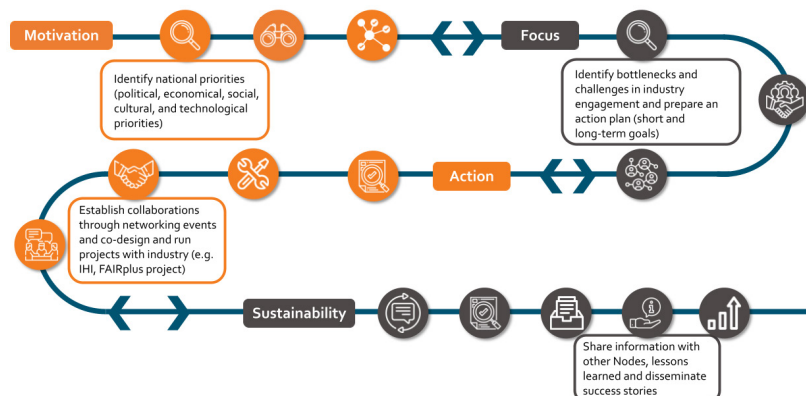
How to engage with industry

To strengthen Node engagement efforts with industry, the guide *How to engage with industry* was produced in 2022. It draws on learnings from the implementation of the ELIXIR industry strategy, experiences of individuals within ELIXIR working in industry-academia collaborations and the ELIXIR Industry Advisory Committee, and current literature on public private partnerships. The guide is available on the ELIXIR intranet.

Industry map

Tracking Node industry engagement activities helps to understand the impact of ELIXIR's industry programme. In 2022, an interactive map was established on the ELIXIR website to showcase each Node's industry-related activities¹⁵². Currently, 14 ELIXIR Nodes are actively engaged with industry and are represented on the map, which is regularly updated. The industry web page was also refreshed to better reflect ELIXIR's efforts in industry engagement.

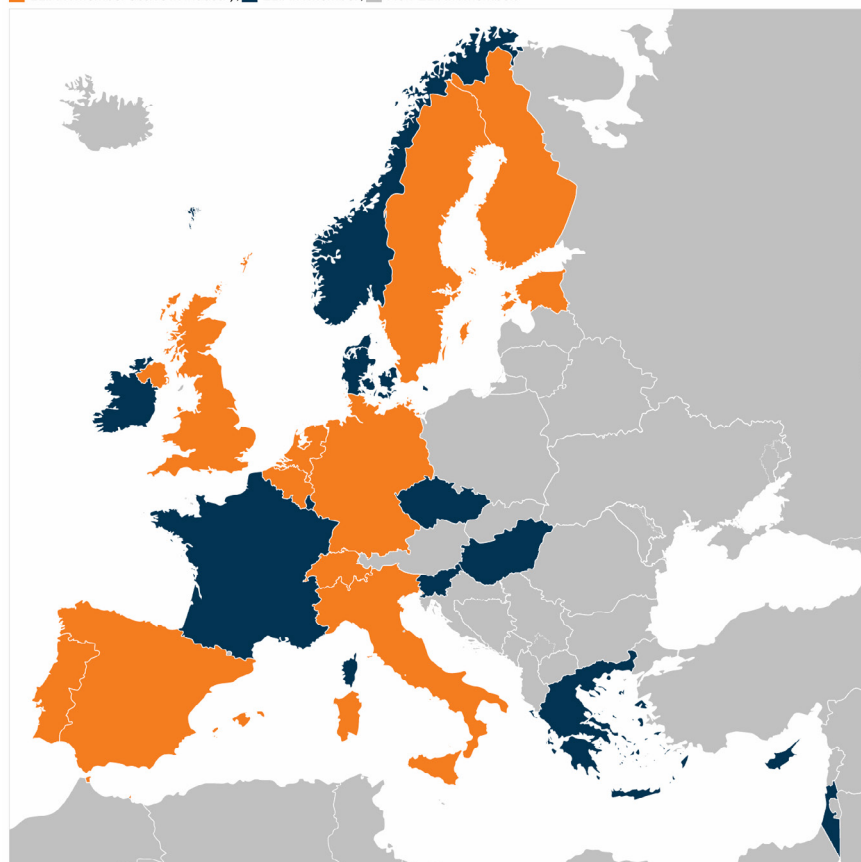
Building an industry engagement strategy



Industry map of ELIXIR Node industry activities

What we are doing with industry and SMEs

■ ELIXIR member active in industry; ■ ELIXIR member; ■ Non-ELIXIR member.



¹⁵² <https://elixir-europe.org/industry>

Facilitating conversations through industry events

In 2022, ELIXIR held three events that actively involved the industry sectors: two ELIXIR Innovation and SME Fora, one focused on FAIR practices and another one on healthcare diagnostics, and an ELIXIR Bioinformatics Forum (EBIF) focused on the machine learning ecosystem. More than 200 participants joined these events, where ELIXIR members had the opportunity to connect and network with industry experts from

over 60 companies. In the Innovation and SME Forum, *Data driven innovation in healthcare diagnostics*, the flash talks session served as a successful platform for experience sharing and exchange from industry and academia. In EBIF, the well-received roundtable discussion gave participants and presenters a chance to exchange ideas and discuss solutions to shared challenges.

Roundtable discussion during ELIXIR Bioinformatics Forum 2022



Node capacity building

As a people infrastructure, supporting the professional learning of Node staff is at the heart of ELIXIR. Training in senior management and operations is important to equip ELIXIR Nodes for effective functioning. In November 2022, 13 staff were selected by ELIXIR to participate in the Executive Masters in Management of Research Infrastructure (EMMRI). The EMMRI course featured strong representation from ELIXIR, with modules ranging from financial management to service

provision. To date, ELIXIR has funded 26 participants from 11 different ELIXIR Nodes to complete specific modules. Experts from ELIXIR have contributed as guest speakers and ELIXIR is highlighted as a use case in the strategic management and financial sustainability modules.

At the end of 2022, a dedicated Staff Exchange Project called *Open access tools for effective management of ELIXIR Nodes based on collaborative*

work developed in ELIXIR-CONVERGE, RITRAIN, RitrainPlus and EMMRI also started. The project involves 12 Nodes and aims at familiarising staff with open access tools for effective ELIXIR Node management. Based on consultations carried out during 2022, a dedicated Node development component will feature strongly in ELIXIR's Scientific Programme 2024-2028, equipping Node staff with the training and resources to run efficient and effective ELIXIR Nodes.

Gender proportion at ELIXIR meetings across 2022

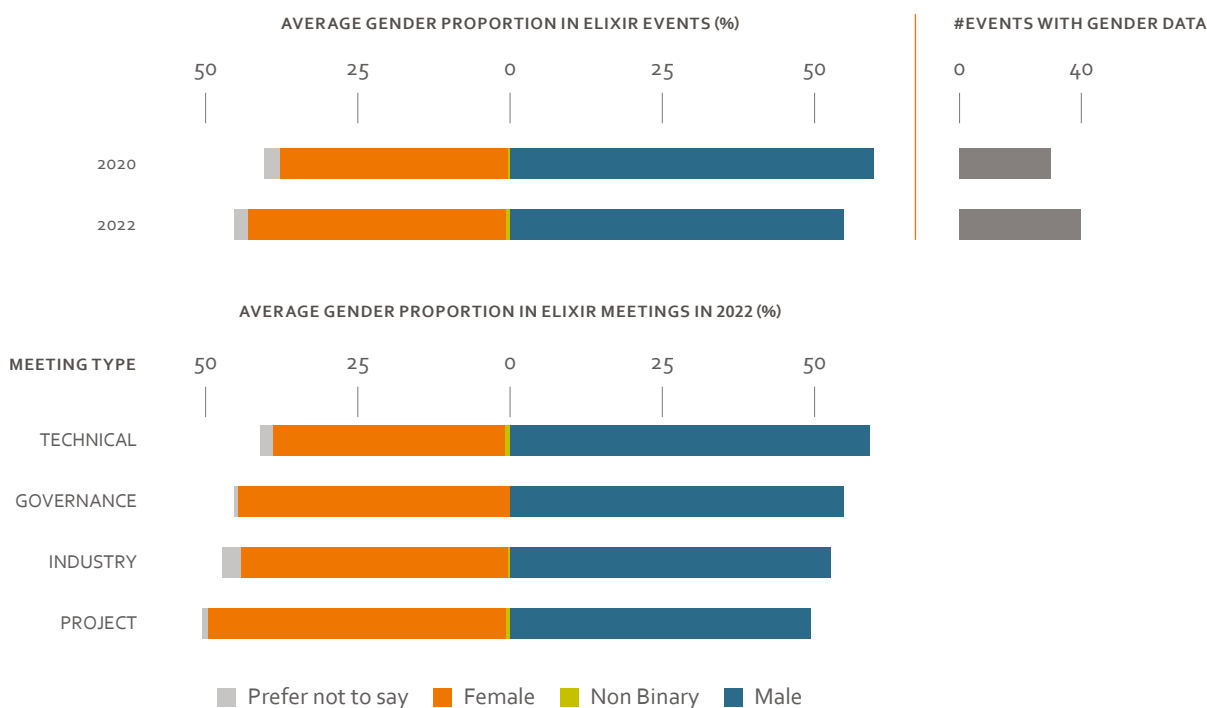
ELIXIR strives to encourage gender balance in bioinformatics. Starting from 2020, ELIXIR has collected gender information as part of the registration process in all events with the aim of supporting the work on equality, diversity and inclusion, following requirements of important funders, such as the European Commission and its gender equality strategy.

Events in 2022 (both in-person and hybrid) showed an increase in female and non-binary participants compared to 2020. Overall, 55% participants

identified as male, 43% as female, 0.55% as non-binary and 1.6% preferred 'not to say'.

Analysed by meeting type, ELIXIR technical meetings (Platforms, Communities, All Hands and Biohackathon) had a lower proportion of female participants (38%) whilst externally-funded project meetings had an average of 49% female participation. Governance and industry events had a similar female representation of 44%. The technical events had on average the highest proportion of non-binary (0.7%) and

prefer 'not to say' participants (2.11%) whilst the governance meetings had no non-binary participants and only 0.5% preferred 'not to say' participants.



Our people

ELIXIR Hub staff

The ELIXIR Hub has six teams which coordinate and support all ELIXIR Nodes and members:

- Administration and Operations
- External Relations
- Human Genomics and Translational Data
- Project Management
- Technical
- Legal

Together with the ELIXIR Director and the Head of Programme and Strategy, the heads of the six teams form the ELIXIR Hub management team. The staff in the Hub represent a mix of nationalities and cultures, reflecting the diversity of ELIXIR Nodes.

Changes and additions

The ELIXIR Hub has significantly evolved and expanded to meet the needs of partners. In 2022, ELIXIR Hub welcomed 11 new starters and a new Head of Operations, Ivana Veršić, replacing Susanna Repo who moved on to ELIXIR Finland.

Zuzana Clarke joined the Administration and Operations team to help establish

and strengthen ELIXIR's event strategy, filling the gap left by Melissa Balzano. Alice Gregory joined as Administrative Assistant to support administrative tasks in the Hub.

Despoina Sousoni joined the External Relations team as Industry Outreach Officer. Elaine Westwick and Yun-Yun Tseng joined the External Relations Team as Communications Officers, replacing Erin Haskell and Xènia Pérez Sitjà. The External Relations team added a new position, External Relations Officer, welcoming Erika Balsyte.

Sirarat Sarntivijai and Jen Harrow both left ELIXIR the Technical team for new roles in the industry; Clare Garrard and Mantos Pitoulis joined in their place.

In 2022, ELIXIR's EC funded portfolio expanded. At the end of the year, the Project Management Office welcomed two new starters, Laura Carletti and Marieke Willems, to support the management of EU projects. Daniel Barrowdale joined the Human Genomics and Translational Data team to support cancer-related EU projects, replacing Anamika Chatterjee who left for a role in Norway.

Flags of all nationalities:



CANADA



LITHUANIA



CROATIA



SLOVAKIA



FRANCE



SPAIN



GERMANY



SWEDEN



GREECE



TAIWAN



INDIA



UK



IRELAND



USA



ITALY



FINLAND

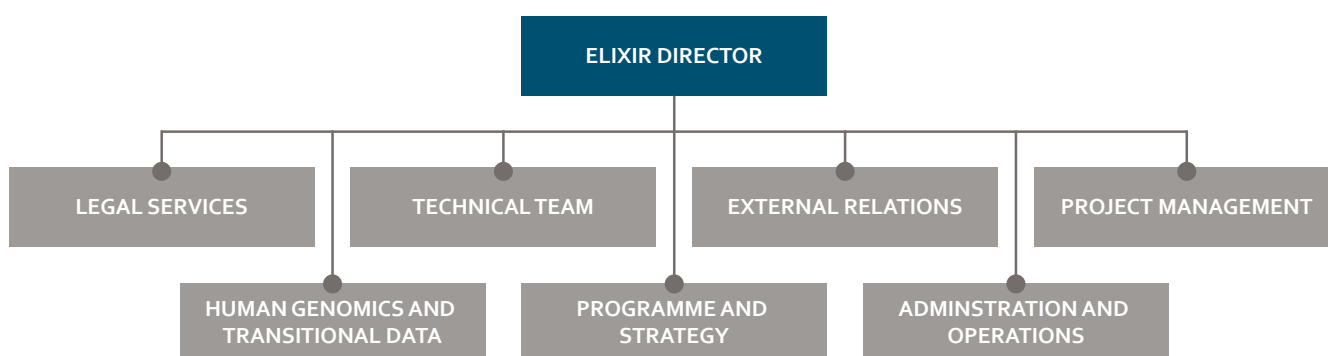


NETHERLANDS



ZIMBABWE

ELIXIR Hub structure



Governance

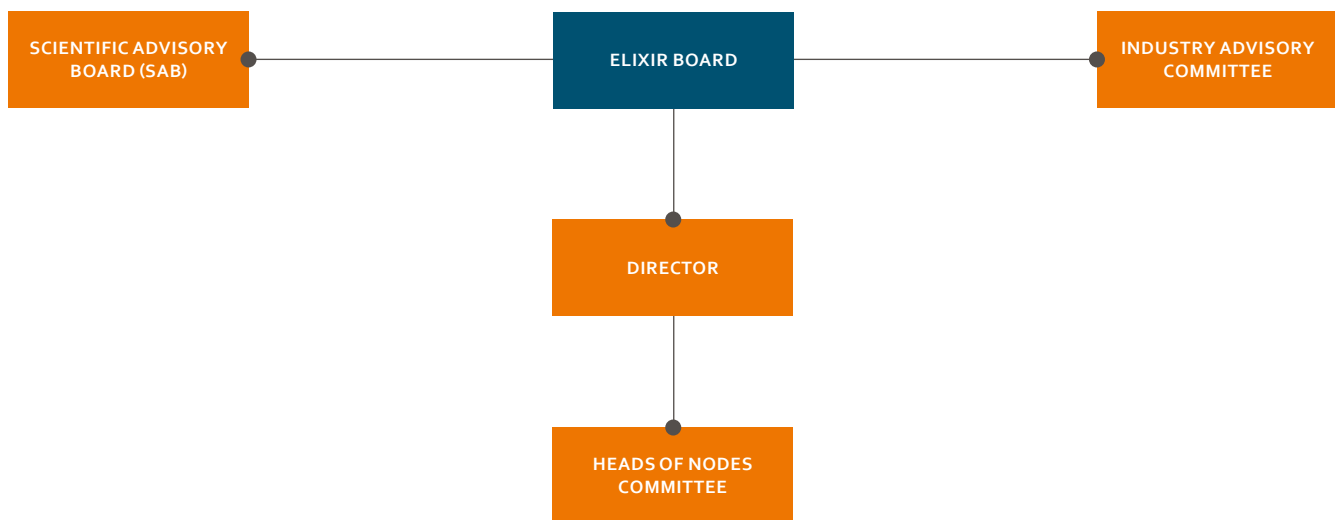
The highest decision-making body in ELIXIR is the ELIXIR Board, composed of representatives of ELIXIR members. The ELIXIR Scientific Advisory Board (SAB) advises the Board on ELIXIR scientific strategy and reviews the applications from ELIXIR Nodes. The SAB is an independent body, made up of leading experts from around the world, and includes two independent ethics advisors to advise on ethical, legal and social issues related to

ELIXIR. SAB members are appointed by the ELIXIR Board. The Heads of Nodes Committee has a major role in developing and agreeing the ELIXIR scientific and technical strategy, and is composed of scientific representatives of each of the ELIXIR Nodes.

The Head of Node is appointed by each Node according to national processes. The Industry Advisory Committee (IAC) consists of experts

from industry users, including SMEs, suppliers and publishers who provide high-level strategic advice and input from industry stakeholders. Members of the IAC are appointed by the ELIXIR Board. The ELIXIR Director leads the ELIXIR Hub and is responsible to the ELIXIR Board for implementing the ELIXIR Scientific Programme. The ELIXIR Director chairs the Heads of Nodes Committee.

ELIXIR governance hierarchy



ELIXIR Board members

Chair: Ferran Sanz (Spain)

Vice-Chair: Isabel Rocha (Portugal)

Vice-Chair: Alexander Goesmann (Germany)

MEMBER	ADMINISTRATIVE DELEGATE	SCIENTIFIC DELEGATE
Belgium	Virginie Storms	
	Michele Oleo	
	Didier Flagothier	
Czech Republic	Jan Burianek	Luděk Matyska
Denmark	Nynne Lucca Christiansen (replaced Line Bekker Poulsen in November 2022)	Anders Krogh
EMBL	Plamena Markova-Anderson	Alvis Brazma
		Edith Heard
Estonia	Toivo Räm	Lili Milani
	Priit Tamm	
Finland	Riina Vuorento	Per Öster
	Sirpa Nuotio	
France	Eric Guittet	Hugues Roest Crollius
Germany	Annette Kremser	Alexander Goesmann
		Rolf Backofen
Greece	Argyro Karachaliou	Babis Savakis
		Christos Ouzonis
Hungary	Klára Horváth	Zsuzsanna Dosztányi
Ireland	Noelle Waldron	Maria Nash
Israel	Barak Gateno	Iris Eisenberg
Italy	Bertelletti Mauro (replaced Grazia Pavoncello in December 2022)	Rita Casadio
Luxembourg	Romain Martin	Regina Becker
	Bruno Rodrigues	
Netherlands	Ana de Castro	Ruben Kok
Norway		Rein Aasland
		Stig Omholt (stepped down in November 2022)
Portugal	Andreia Feijão	Isabel Rocha
	Tiago Saborida	
Slovenia	Albin Kralj	Damjana Rozman
Spain	Ignacio Baanante	Ferran Sanz
	Cristina Bauluz (stepped down in September 2022)	
Sweden	Malin Sandström (replaced Mikael Borg in December 2022)	Björn Andersson
Switzerland	Doris Wohlfender-Bühler	Christian von Mering
UK	Mark Palmer	Christine Orengo (replaced Christopher Rawlings in April 2022)
	Amanda Collis	

ELIXIR Heads of Nodes Committee

Chair: Niklas Blomberg (ELIXIR Director)

MEMBER	HEAD OF NODE	DEPUTY HEAD OF NODE
Belgium	Frederik Coppens	Kim De Ruyck
Czech Republic	Jiří Vondrášek	Karel Berka
Denmark	Lars Juhl Jensen (replaced Søren Brunak in November 2022)	
EMBL-EBI	Johanna McEntyre and Ewan Birney	
Estonia	Jaak Vilo	Hedi Peterson
Finland	Tommi Nyrönen	Ilkka Lappalainen
France	Jacques van Helden and Claudine Médigue	Anne-Françoise Adam-Blondon
Germany	Andreas Tauch	Alfred Pühler
Greece	Martin Reczko	Christoforos Nikolaou
Hungary	Balázs Gyórfy	
Ireland	Denis Shields	Colm Ryan
Israel	Dan Ben-Avraham	
Italy	Graziano Pesole	Silvio Tosatto
Luxembourg	Reinhard Schneider	Wei Gu
Netherlands	Jaap Heringa	Morris Swertz
Norway	Nils Peder Willassen and Sushma Nagaraja Grellscheid (replaced inge Jonassen in April 2022)	
Portugal	Mário Silva	Ana Portugal Melo
Slovenia	Brane Leskošek	
Spain	Alfonso Valencia	Salvador Capella-Gutierrez
Sweden	Bengt Persson	Jessica Lindvall
Switzerland	Ron Appel (stepped down in October 2022) and Christophe Dessimoz (replaced Christine Durinx in April 2022)	
UK	Carole Goble and Neil Hall	
Cyprus	George Spyrou	Vasilis Promponas

ELIXIR Scientific Advisory Board members

Chair:

BF Francis Ouellette

Neuro Bioinformatics Core & Tannenbaum Open
Science Institute, Canada

Vice-Chair:

Janet Kelso

Max Planck Institute for Evolutionary
Anthropology, Germany

Philip Bourne

University of Virginia, USA

Ana Sofia Carvalho

Catholic University of Portugal, Portugal

Jennifer Gardy

Bill & Melinda Gates Foundation, USA

Robert Gentleman

Harvard Medical School, USA

Melissa Haendel

Oregon Health and Science University, USA

Larry Hunter

University of Colorado, USA

(stepped down in October 2022)

Elina Ikonen

University of Helsinki, Finland

Nicola Mulder

UCT Computational Biology Group (NBN), South Africa

Susan Wallace

University of Leicester, UK

Doreen Ware

USDA ARS, Cold Spring Harbor Laboratory, USA

ELIXIR Industry Advisory Committee members

Chair:

Natalia Jiménez Lozano

Atos, UK

Vice-Chair:

Filip Pattyn

FAQIR, Belgium

Ian Barrett

AstraZeneca, UK

Thomas Exner

Seven Past Nine GmbH, Germany

Andreas Kremer

ITTM, Luxembourg

Klaus Maisinger

Illumina, UK

Geert de Myer

Waltham Petcare Science Institute, MARS UK, UK;
appointed April 2022

Jörg Peplies

Ribocon GmbH, Germany

Elizabeth Reynolds

General Bioinformatics, UK

Philippe Sanseau

GlaxoSmithKline, UK

Catherine Sirven

Bayer, France

Bérénice Wulbrecht

ONTOFORCE, Belgium; appointed in November 2022

Financial Data

The budget of ELIXIR is set annually by the ELIXIR Board and all funds related to its activities, including its surplus, ring-fenced with EMBL's accounts

		31/12/2022	2022	31/12/2021
		ACTUAL	BUDGET	ACTUAL
		€000	€000	€000
INCOME				
ELIXIR Member state contributions				
Ordinary contributions	(a)	7,526	7,500	7,378
Foreign exchange (loss)/gain on sterling contributions	(b)	(23)	-	(101)
Grant income	(c)	1,828	2400	1,130
Miscellaneous income		-	-	(80)
Net Income		9,331	9,900	8,327
EXPENDITURE				
Technological Activities				
Salaries		760	700	706
Running costs		230	600	196
Commissioned services		3,584	5,200	2,894
Total expenditure Technological Activities		4,574	6,500	3,796
Directorate and Administrative expenditure				
Salaries		1,245	1,300	1,160
Running costs		576	600	297
Total expenditure Directorate and Administration		1,821	1,900	1,457
Support and Admin Infrastructure costs		1,057	900	883
Grant expenditure incurred		1,835	2,400	1,068
Total expenditure		9,287	11,700	7,204
SURPLUS/(DEFICIT)	(d)	44	(1,800)	1,123

(a) ELIXIR Member state contributions

	31/12/2022	31/12/2021
	€000	€000
Belgium	207	203
Cyprus	3	3
Czech Republic	73	71
Denmark	142	139
Estonia	10	10
Finland	102	100
France	1,149	1,126
Germany	1,591	1,560
Greece	92	90
Hungary	48	47
Ireland	85	83
Israel	132	129
Italy	849	833
Luxemburg	16	15
Netherlands	359	352
Norway	207	203
Portugal	87	85
Slovenia	18	18
Spain	558	547
Sweden	237	232
Switzerland	313	307
United Kingdom	1,249	1,225
Total	7,526	7,378

(b) Foreign exchange (loss)/gain on sterling contributions

The UK pay its Member State contributions in Sterling (ELIXIR/2015/28) as a hedging mechanism for currency movements, considering that most of the ELIXIR staff expenditures are in Sterling. The nominal loss arises from the difference between the value of these contributions valued in Euros at the date of payment and the date of the approval of the 2022 ELIXIR Budget due to fluctuations of the value of Sterling against the Euro in this period.

(c) Grant income

	2022	2021
	€000	€000
Grant funding awarded	15,639	8,135
Grant income earned in the current year	1,828	1,130
Grant expenditure incurred in the current year	(1,835)	(1,068)
Unutilised grant income	7,676	2,007

(d) Surplus/(Deficit)

This surplus is included in the EMBL general reserve, but has been ring-fenced for the use by ELIXIR.

(e) The following countries have amounts prepaid/owing at 31 December 2022

	2022 contribution owing
	€000
Denmark	(281)
Netherlands	(359)
Greece	(182)
Total	(822)

	Contribution prepaid
	€000
Germany	1,623
Slovenia	18
Total	1,641



Credits and Acknowledgments

This report was produced on the direction of the ELIXIR Board by the ELIXIR External Relations team at the ELIXIR Hub.

With a special thanks to all who contributed to the development of ELIXIR in 2021, notably the ELIXIR Heads of Nodes, Platform and Community Leads, Training and Technical Coordinators, Hub staff and members of the numerous working groups throughout ELIXIR.

Hinxton, UK, May 2023

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A network diagram with nodes and connections, overlaid on a dark blue background. A large white circle is positioned on the right side of the image.

Data for life

ELIXIR HUB

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