EBRAINS

EBRAINS AISBL

Annual Report 2021-22

EBRAINS AISBL Timeline

Date	Event
23 Aug 2019	EBRAINS AISBL created, Full Members: CEA (FR), FZJ (DE), UIO (NO), UPM (ES), KTH (SE), EPFL (CH)
5 Dec 2019	Belgian Royal Decree confirms EBRAINS AISBL as a legal entity under Belgian law
27 Feb 2020	CNR (IT) joins as seventh Full Member of EBRAINS AISBL
7 Apr 2020	Paweł ŚWIEBODA appointed CEO of EBRAINS AISBL, replacing Andreas MORTENSEN (EPFL)
27 May 2020	Creation of EBRAINS, Ixelles, Succursale de Genève (Swiss branch of EBRAINS AISBL)
17 Jun 2020	Paweł ŚWIEBODA becomes Director General HBP, vice Andreas MORTENSEN (EPFL)
8 Sep 2020	Proposal for inclusion of EBRAINS RI in ESFRI Roadmap 2021 submitted (see p.10)
30 Nov 2020	BoD mandates CEO to start bilateral talks to initiate National Node creation (see p.7)
24 Feb 2021	BoD appoints members of EBRAINS AISBL Management Board (see p.19)
1 Mar 2021	Role of Coordinator of Human Brain Project transferred to EBRAINS AISBL from EPFL
15 May 2021	EBRAINS RI presents its case at ESFRI Roadmap 2021 Hearing
1 Jun 2021	EPFL Human Brain Project staff employed by EBRAINS AISBL
1 Jun 2021	Charité Universitätsmedizin Berlin (DE) becomes first Associate Member of EBRAINS AISBL
30 Jun 2021	ESFRI announces inclusion of EBRAINS RI in ESFRI Roadmap 2021
Sep 2021	EBRAINS AISBL receives first Expression of Interest to create a National Node
Jan 2022	EBRAINS AISBL receives tenth Expression of Interest to create a National Node
1 Jan 2022	Université d'Aix Marseille (FR) joins EBRAINS AISBL as Associate Member
20 Jan 2022	EBRAINS AISBL submits EBRAINS Proposal for Horizon Europe HE INFRA-2021-DEV call to EC
1 Feb 2022	Bit&Brain Technologies S.L. (ES) joins EBRAINS AISBL as Associate Member
1 Feb 2022	Consorci Institut d'investigacions Biomèdiques August Pi i Sunyer (ES) becomes Associate Member
1 Feb 2022	Fundación Sant Joan de Déu (ES) joins EBRAINS AISBL as Associate Member
1 Feb 2022	Quirónsalud (ES) joins EBRAINS AISBL as Associate Member
1 Feb 2022	Universidad Rey Juan Carlos (ES) joins EBRAINS AISBL as Associate Member
1 Apr 2022	Fundació Institut de Bioenginyeria de Catalunya (ES) becomes Associate Member
12 Apr 2022	EBRAINS invited by EC to prepare Grant Agreement for INFRA-2021-DEV
1 May 2022	Zentralinstitut für Seelische Gesundheit (DE) joins EBRAINS AISBL as Associate Member
1 May 2022	Université Grenoble Alpes (FR) joins EBRAINS AISBL as Associate Member
3 May 2022	Karolinska Institutet (SE) joins EBRAINS AISBL as Associate Member
1 Jul 2022	Universiteit Hasselt (BE) joins EBRAINS AISBL as Full Member
1 Jul 2022	Five new Associate Members (in BE, DE, ES and SE) join EBRAINS AISBL

[1] European Strategy Forum on Research Infrastructures

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Message from the Chairman

EBRAINS' inclusion in the ESFRI Roadmap 2021 lends weight to our argument that the European research infrastructure (RI) landscape should benefit greatly from a dedicated "one-stop-shop" offering research tools and services tailored to neuroscience needs. EBRAINS will enhance Europe's overall research capabilities and should prove an invaluable complement to RIs covering other life science needs, such as Euro-BioImaging (biological and biomedical imaging), BBMRI-ERIC (biobanking) and ELIXIR (data-driven life science). Thank you to our scientists, engineers and staff for ensuring that EBRAINS met the demanding ESFRI criteria, and to the French government for leading the submission. The high assessment scores we received from ESRI are most encouraging.

EBRAINS, based on the results of the Human Brain Project, offers a uniquely broad range of services, covering neuroscience data and knowledge, brain atlases (on different scales and covering different species), a range of simulation engines (from cellular level to whole brain), brain functional imaging, brain-related medical data, neurorobotics, neurotechnologies and dedicated High Performance Computing. Available via a single point of access, these support the emergence of a broadening digital neuroscience community, built around multidisciplinary working, easier sharing and reuse of results and data, and parallel use of different tools to examine specific aspects of the brain, which might be harder to unlock using just one approach.

Enabling scientific breakthroughs is the main objective of EBRAINS. Thus far, EBRAINS has supported many scientific advances, within the HBP and beyond, some of which are starting to find practical applications. The Multilevel Human Brain Atlas which is openly available on EBRAINS as a collaborative resource is an invaluable tool for brain research and medicine. It integrates multi-scale brain data and requires supercomputers and AI. Personalised digital brain models help identify the areas where epilepsy seizures emerge in a patient's brain. It constitutes a precise tool to assist individual surgery decisions and improve outcomes. Mimicking the brain makes Artificial Intelligence more energy efficient. New spiking neural networks are implemented in two large-scale neuromorphic systems on EBRAINS (SpiNNaker and BrainScaleS 2). A robot with brain-inspired movement and cognition has been developed and surpasses traditional AI in performing precise movements and safely interacting with humans.

Important though the HBP has been for setting up EBRAINS, in its post-HBP future form, our RI needs to be open to and serve the full breadth of the neuroscience community and, indeed, other communities. EBRAINS is already taking concrete steps in to broaden its membership; it currently has eight Associate Members that were not in the HBP and has just granted Full Membership (i.e. a prospective National Node Lead Partner) to Belgium's Hasselt University, also never a member of the HBP Consortium.

The scientific progress that EBRAINS has enabled thus far was mainly that achieved by researchers working within the HBP, but they are being joined by a growing number from outside its ranks, including 68 active or completed Partnering Projects. Today, EBRAINS supports projects with lead institutions in Australia, Canada, India, Japan and the United States. EBRAINS is very much open to working with other scientific groups, through individual collaborations or joint projects, and we look forward to welcoming more partners and more users as EBRAINS starts the transition to its post-HBP form.

Professor André SYROTA

Chairman, Board of Directors, EBRAINS AISBL
Chairman, Stakeholder Board, the Human Brain Project
Advisor, Commissariat à l'énergie atomique et aux énergies alternatives
Former Chairman and CEO, INSERM
Professor Emeritus, Université de Paris Sud

Message from the Chief Executive Officer

The past year and a half have been tremendous for EBRAINS, which has shown itself to be a vibrant hub of brain science. Our association has focused on its core mission of preparing to operate a unique, state-of-the-art research infrastructure (RI), developed by the Human Brain Project.

In 2021, the EBRAINS AISBL became Coordinator of the HBP, an EU Future and Emerging Technology Flagship with a major scientific agenda focused on understanding the multiscale human brain connectome. Feedback from the recent EC mid-term review of the HBP's final phase was that "the project has delivered exceptional results with potentially significant impact", which augurs well for EBRAINS' post-HBP future.

Development of the EBRAINS RI has continued with new releases of tools and services. Our RI brings together a wide range of tools and services that no single European country could put together on its own. What is more, we are creating a synergy between the strengths of individual communities, from data management, via modelling and simulation tools, to brain-inspired technologies.

Much effort is being invested now in building a network of EBRAINS National Nodes, to implement the well-tested ESFRI "central hub & national node" model and to prepare to transition from being predominantly EU-funded to a diversified sustainable funding model, in which Member States and Associated Countries cover the bulk of the cost of operating the infrastructure. Individual Nodes are becoming vibrant national scientific communities, with emerging plans for capitalising on the unique capabilities of EBRAINS' tools and services. As a European RI, we do not want to recreate silos and are therefore building horizontal cross-Node mechanisms for different scientific disciplines to help shape the future EBRAINS' service offering. This perspective lies behind the concept of EBRAINS Solutions, which will complement that of our Service Categories in addressing our offering more precisely and tangibly to different scientific communities. You will hear more about this in the latter part of 2022.

As we work on making EBRAINS ever-more relevant to brain science, we are also expanding the membership of the association, which now boasts eight Full and 16 Associate Members, with more applications being processed Through our governance formula, Members have a decisive say over our plans to promote brain research and operate our RI. We cherish the links with them and intend to build an ever-closer community of institutions committed to the advancement of brain science.

As a reference RI for neuroscience and brain health, EBRAINS is increasingly active in the debate about the future of European brain research. With the European Brain Council, we hosted the first European Brain Summit in Oct 2021, where the concept of a European Brain Initiative was launched. With the Organisation for Economic Cooperation and Development, we co-hosted a Round Table to discuss ways to align European and national research agendas, and increase the accessibility and actionability of brain health data. In parallel, EBRAINS has been instrumental in launching the European Network of Neurotechnology Platforms, a grouping of leading research organisations with an interest in bringing innovations to the clinic and to the market.

We are in a fascinating and formative period for EBRAINS: prospects for brain science have never been stronger and we are delighted to play our part in this process, for the benefit of European citizens.

Paweł ŚWIEBODA

Chief Executive Officer, EBRAINS AISBL
Director General, the Human Brain Project

Strategic Priorities and Objectives

Early in 2021, the EBRAINS Management Board (MB) started to define a strategic planning and management framework for EBRAINS, using the Balanced Scorecard approach[2], with separate scorecards for: **Finance, Users/Stakeholders, Internal Processes** and **Organisational Capacity**.

The high-level elements of the framework are shown in the table below. The Strategic Priorities show where EBRAINS wants to go and the Strategic Objectives set out the main things that we have to do to get there. The MB has defined Key Results for each Strategic Objective and defined indicators and targets to help it manage implementation and measure progress.

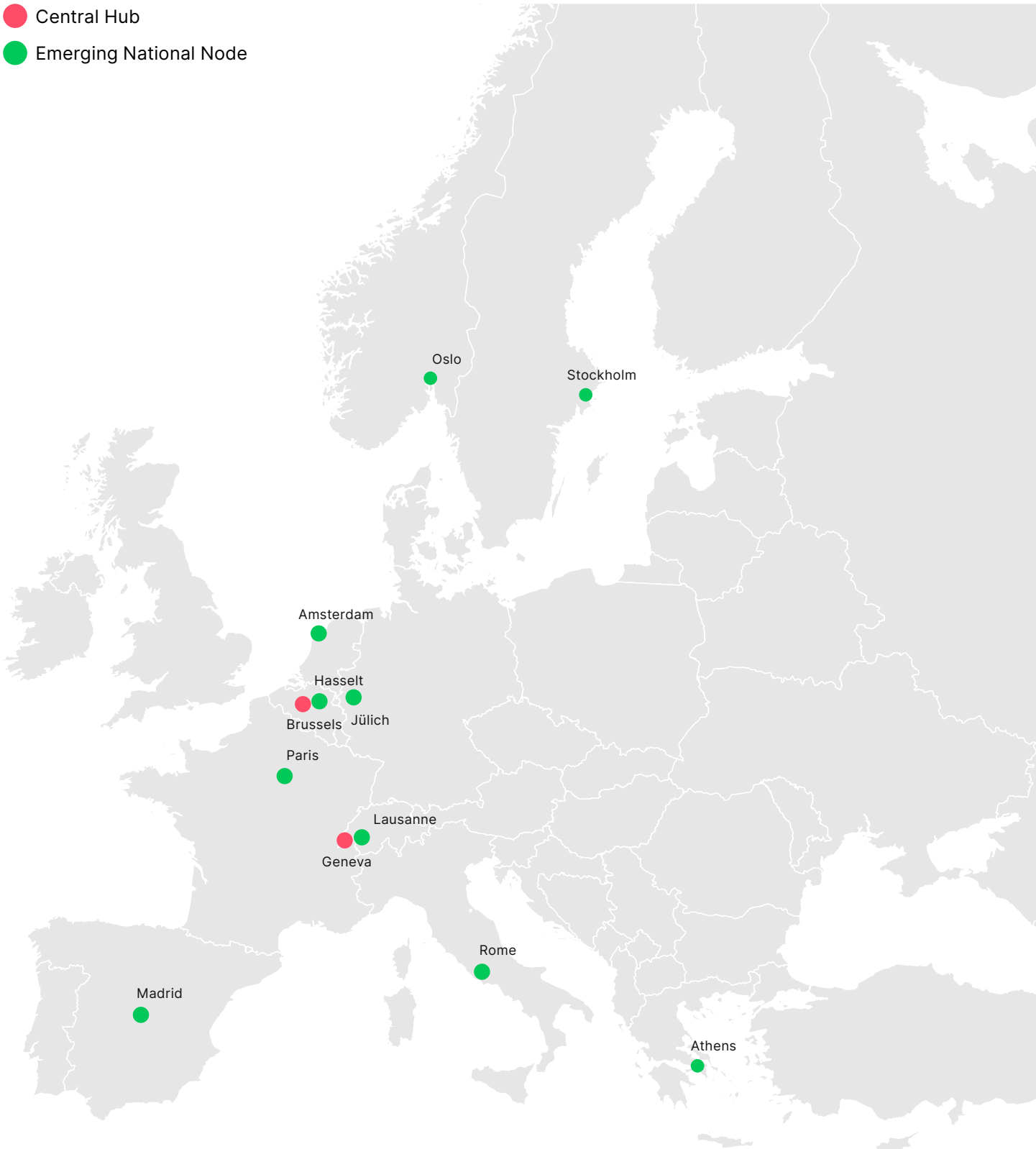
The framework was validated with AISBL staff and the Board of Directors (BoD) Sep-Oct 2021. Their recommendations were incorporated in the current version shown below, which was approved by the BoD on 2 Feb 2022. Each scorecard is "owned" by an MB member who reports progress to the MB each quarter. The process is supported by the Chief Programme Officer and the EBRAINS Programme Office (EPO) team.

<table>
<tr><th>GO-TO INFRASTRUCTURE</th><th>FINANCIAL SUSTAINABILITY</th><th>HBP SUCCESS</th></tr>
<tr><td colspan="3">EBRAINS STRATEGIC PRIORITIES</td></tr>
<tr><td>EBRAINS should be the Go-To Infrastructure for brain researchers, meeting their research needs and demands.</td><td>EBRAINS should be financially sustainable with diverse sources of income.</td><td>EBRAINS will coordinate the HBP to ensure its succes as an EU Flagship with lasting impact on brain research</td></tr>
<tr><td colspan="3">EBRAINS STRATEGIC OBJECTIVES</td></tr>
<tr><td>Ensure top-level impact of the Research Infrastructure.
Increase value of products for users and product/market fit.
Improve user experience
Increase product offering</td><td>Secure funding for Central Hub operations and basic infrastructure
Secure funding for service and support provision
Secure diversified sources of funding</td><td rowspan="2">Improve scope of scientific engagement
Improve communication of HBP achievements</td></tr>
<tr><td colspan="2">Support National Nodes and AISBL members</td></tr>
<tr><th>GO-TO INFRASTRUCTURE</th><th>FINANCIAL SUSTAINABILITY</th><th>HBP SUCCESS</th></tr>
</table>

[2] https://hbr.org/1992/01/the-balanced-scorecard-measures-that-drive-performance-2

EBRAINS: a distributed research infrastructure on the ESFRI Roadmap

EBRAINS plans to make tools and services to support brain research available via 10 emerging National Nodes, coordinated by a Central Hub, the EBRAINS AISBL, located in Belgium and Switzerland. The number of Nodes will continue to grow and EBRAINS is already in discussion with a number of countries to translate their interest into Node building.



Organisational Framework

As a distributed RI on the European Strategy Forum on Research Infrastructures (ESFRI) Roadmap, the EBRAINS RI is being built as a network of **National Nodes**, which are the primary suppliers of user-facing tools and services. Node activities are coordinated by a **Central Hub**, the EBRAINS AISBL. With the advent of the EBRAINS Preparation Phase (a key formal ESFRI-defined stage in the development of an RI), the initial set of EBRAINS National Nodes is starting to take shape and additional Nodes are under consideration.

The Central Hub

The Central Hub is responsible for:

- Coordinating the National Nodes.
- Coordinating and managing the operation of RI services and facilities provided by National Nodes and by the Central Hub, ensuring that quality standards established by the BoD are adhered to.
- Coordinating and managing access to the RI services provided by National Nodes and the Central Hub.
- Leading the collective effort by all EBRAINS Members to promote the RI.
- Managing interactions with other relevant RIs and brain initiatives in Europe and globally.
- Defining the collective EBRAINS strategy for securing government and private funding, to maintain, update and strengthen the RI service offering provided by National Nodes and Central Hub.
- Identifying and monitoring measurable Key Performance Indicators, addressing the excellence of scientific services, the sustainability of the RI as a whole and the individual services it offers.
- Supporting the RI governance structure, helping it to function effectively and coordinating the implementation of its decisions by all Members.

National Nodes

A National Node is the part of the EBRAINS RI that is implemented in one country by one EBRAINS Member or, preferably, a group of EBRAINS Members, based in that country. Each Node Partner must be a legal entity (university, research institute, company or NGO) and be a Full or Associate Member of the AISBL. The Node Partners are responsible for providing a defined set of user-facing services, agreed with the BoD, within the framework of the EBRAINS Strategy. A National Node is also responsible for developing the EBRAINS community within its country. A National Node must offer at least one defined EBRAINS RI service and provide supporting services (events, user and community support, and industry exploitation). A National Node may also, with BoD agreement, provide base infrastructure services and/or facility-based services. Each National Node is led by a **Lead Partner**, responsible for coordinating, organising and representing the Node. In the EBRAINS PREP project, each Lead Partner is responsible for preparing a viable **Node Plan** for its Node and for obtaining all the required signatures for the **National Node Agreement**. In 2022, the Lead Partner is expected to:

- Define the organisation of its Node.
- Define the strategy of its Node (with the other Node Partners).
- Ensure the flow of information between the Central Hub and the Node Partners.
- Organise EBRAINS community activities to increase community support and the RI user base.
- Interact with its national government to obtain its support and national funding for EBRAINS.
- Apply for its Node to be on its country's national RI roadmap.

Where a Node is implemented by more than one Partner, a National Node consortium agreement between the Partners should specify clearly how responsibilities for the Node, its services and its operations, are distributed between the Partners. The Lead Partner appoints a named individual, the **Node Leader**, to lead and manage the Node, supported by a **Node Scien-**

tific Coordinator and a **Node Manager**. Each National Node is responsible for organising and funding itself to deliver the service(s) that it has committed to the BoD to provide, in line with the EBRAINS Strategy, its Node Plan, its National Node Agreement, its Service Agreements and other quality requirements and standards, which will be managed centrally.

Legal framework

The EBRAINS AISBL is an international non-profit association based in Belgium. The **AISBL Statutes** contain the basic rules, such as objectives, membership, governance decision-making, accession and dissolution, and state the rights and obligations of all parties involved in the operation of the association, such as the members of the General Assembly and the BoD. The **AISBL By-laws** specify details on meetings, voting, management team responsibilities, legal and financial powers, etc.

The statutes allow for two types of **Membership**. One is Full (currently limited to one per country) and the other is **Associate**. Membership details are set out in the AISBL Statutes and By-Laws, and are provided to all Members as part of the process to become a Member. Each Member nominates an individual to represent it in the Association. All Node Partners or other entities providing services through the EBRAINS RI must be either Full or Associate Members. It is strongly recommended that the Lead Partner of a Node be a Full Member of the Association and so be able to vote on in the EBRAINS GA on important RI decisions.

A National Node is constituted via a **National Node Agreement** which defines the relationship between the Node Partners and the EBRAINS AISBL. This agreement, which will be similar for each National Node, will define the rights and obligations of the AISBL and the National Node consortium.

Node Service Agreements will be signed directly between the EBRAINS AISBL and each Member (Node Partner) that offers an EBRAINS RI Service. These service agreements will define the rights and obligations of both parties to guarantee service delivery.

Funding framework

Today, EBRAINS relies primarily on EU funding, mostly through the HBP SGA3 grant, supplemented to a limited extent by AISBL membership fees, to cover the costs of running its Central Hub and offering RI services. In the near future, the HBP grant will be complemented by additional EU funding to help the transition of the EBRAINS RI from the HBP environment to a post-HBP one.

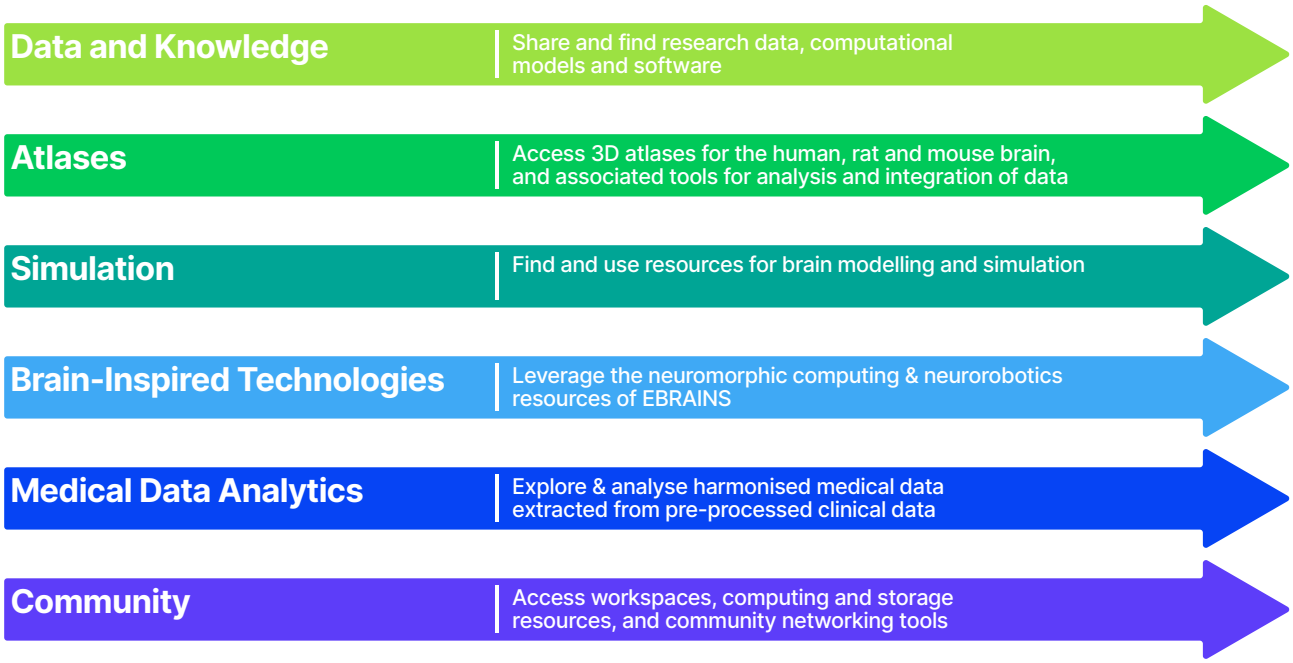
The future sustainable, diversified funding model that EBRAINS will need to put in place as part of this transition will give a much more prominent place to national funding, supplemented by other sources, and a much reduced role for EU funding. Successful applications by National Nodes to have the services they offer included in their respective national infrastructure roadmaps (and hence funding plans) will be a critical element for implementing this transition. This process will be closely monitored and supported by the EBRAINS Central Hub.

Future evolution

As part of the "EBRAINS PREP" Horizon Europe Project, EBRAINS will review the legal forms used by ESFRI Landmark RIs (mature, operational RIs with national funding) and decide which one EBRAINS will have in place for its Operation Phase. Of the 37 current ESFRI Landmark RIs, 21 have adopted the European Research Infrastructure Consortium (ERIC) format, and the ESFRI Final Report on EBRAINS' successful proposal for inclusion as a project in the ESFRI Roadmap 2021 Roadmap recommended that EBRAINS "Consider using ERIC as the final legal entity".

Supercomputer at the French Alternative Energies and Atomic Energy Commission (CEA)

EBRAINS AISBL Research Infrastructure Service Categories



EBRAINS RI supporting Science: The tools and capabilities offered by EBRAINS to support neuroscience research are grouped in six thematic Service Categories.

Developments in 2021-22

EBRAINS AISBL Membership expansion

The EBRAINS AISBL currently has eight Full Members and 16 Associate Members.

Accession	Institution Name	Country	Membership
23 Aug 2019	Commissariat à l'énergie atomique et aux énergies alternatives	FR	Full
23 Aug 2019	Forschungszentrum Jülich	DE	Full
23 Aug 2019	Universitetet i Oslo	NO	Full
23 Aug 2019	Universidad Politécnica de Madrid	ES	Full
23 Aug 2019	Kungliga Tekniska Hoegskolan	SE	Full
23 Aug 2019	École Polytechnique Fédérale de Lausanne	CH	Full
27 Feb 2020	Consiglio Nazionale delle Ricerche	IT	Full
1 Jul 2022	Universiteit Hasselt	BE	Full
1 Jun 2021	Charité Universitätsmedizin Berlin	DE	Associate
1 Jan 2022	Université d'Aix Marseille	FR	Associate
1 Feb 2022	Bit&Brain Technologies S.L.	ES	Associate
1 Feb 2022	Consorci Institut d'investigacions Biomèdiques August Pi i Sunyer	ES	Associate
1 Feb 2022	Fundación Sant Joan de Déu	ES	Associate
1 Feb 2022	Quirónsalud	ES	Associate
1 Feb 2022	Universidad Rey Juan Carlos	ES	Associate
1 Apr 2022	Fundació Institut de Bioenginyeria de Catalunya	ES	Associate
1 May 2022	Zentralinstitut für Seelische Gesundheit	DE	Associate
1 May 2022	Université Grenoble Alpes	FR	Associate
3 May 2022	Karolinska Institutet	SE	Associate
1 Jul 2022	Vrije Universiteit Brussel	BE	Associate
1 Jul 2022	Umeå Universitet	SE	Associate
1 Jul 2022	Stockholms Universitet	SE	Associate
1 Jul 2022	Fundación de Investigación HM Hospitales	ES	Associate
1 Jul 2022	Universität Heidelberg	DE	Associate
(candidate)	Universiteit Antwerpen	BE	(Associate)
(candidate)	Heidelberg Institute for Theoretical Studies	DE	(Associate)
(candidate)	Katholieke Universiteit Leuven	BE	(Associate)
(candidate)	Université de Bordeaux	FR	(Associate)
(candidate)	Institut du cerveau et de la moelle épinière	FR	(Associate)
(candidate)	Institut national de la santé et de la recherche médicale	FR	(Associate)

EBRAINS on ESFRI Roadmap

ESFRI plays a key role in European RI policy. Emerging RIs apply for inclusion in ESFRI's periodically updated Roadmap as a probationary "project". If they then satisfy certain criteria within a specified timeframe, they are promoted to a "landmark": an operational RI with national funding. The EBRAINS RI submitted its proposal for inclusion in the ESFRI 2021 Roadmap on 8 Sep 2020, and presented its plans and answered reviewers' questions at an ESFRI Roadmap 2021 Hearing on 15 Apr 2021. On 30 Jun 2021, ESFRI announced that the EBRAINS RI was accepted for inclusion as a project in the ESFRI Roadmap 2021. As a result, EBRAINS was invited to apply for a call for an ESFRI Roadmap-related RI project under the EU's Horizon Europe research funding period: INFRA-2021-DEV-02-01 (see EBRAINS involvement in EU Projects).

Brussels AISBL office move

Reflecting EBRAINS' growing maturity, the AISBL moved to a new office address in the Brussels suburb of Watermael-Boitsfort on 1 Jun 2021. On 16 Jun 2021, the EBRAINS General Assembly approved moving the legal seat of the AISBL to that address. EBRAINS now has 36 employees, including an infrastructure team developing some of the key EBRAINS tools, such as the Knowledge Graph.

EBRAINS in EU Projects

The origins of the EBRAINS RI lie in the EU's HBP FET Flagship project, which started in Oct 2013, funded under FP7 and then Horizon 2020. The HBP's current SGA3 grant runs until Sep 2023, when the HBP will end. As part of its transition to an enduring post-HPB RI, the EBRAINS AISBL is getting involved in projects funded under the current EU Framework Programme, Horizon Europe (HE):

EBRAINS AISBL as Coordinator

- EBRAINS PREP (HE Call: INFRA-2021-DEV 02 01). A EUR 3 million grant to put in place the organisational framework for the transition to an operational ESFRI RI. The EBRAINS' Proposal was selected for funding in Apr 2022 and the Grant Agreement is in preparation. The AISBL budget is EUR 1.3 million.

- EBRAINS SERV (HE Call: INFRA-2022-SERV 01 01). A grant of EUR 38 million to operate the EBRAINS RI post-HBP and adapt its technical framework. The Proposal is in preparation, for submission by Sep 2022.

EBRAINS AISBL as Partner

- PHRASE (HE Call: EIC-2021-TRANSITION). The focus is the use of AI to improve rehabilitation of stroke patients. The Coordinator is Eodyne Systems S.L and the project started 1 Apr 2022. EBRAINS contributes to tool development, interoperability and business model, with an AISBL budget of EUR 0.5 million.

- eBRAIN Health (HE Call: INFRA-2021-TECH). The focus is modelling/simulating neurobiological phenomena of human brain function and dysfunction. The Coordinator is Charité Universitätsmedizin Berlin and the proposal was accepted Jan 2022. EBRAINS contributes to tool development, interoperability and business model, with an AISBL budget of EUR 1 million.

HBP Coordination

The EBRAINS AISBL was set up to manage the RI created by the HBP and make it sustainable after the end of the HBP, and to replace Switzerland's EPFL as HBP Coordinator, which it did on 1 Mar 2021. To allow the AISBL to take over this demanding role seamlessly, the experienced HBP Project Coordination Office team left the EPFL and became AISBL employees on 1 Jun 2021.

Since then, the AISBL has fulfilled all the Coordinator tasks, include overseeing technical and financial reporting to the European Commission (EC), timely submission of quality deliverables, amending the Grant Agreement and distributing funding to beneficiaries. The AISBL supported the HBP through some significant steps in 2021-22. The first was a preliminary EC review of the HBP in the first eight months of SGA3, focusing on the HBP's "Scientific Showcases" to highlight cutting-edge research. The review found that the Showcases "start to demonstrate critical elements of the HBP and EBRAINS infrastructure". The AISBL coordinated preparation of the report and review meeting.

The AISBL made a similar contribution to the larger mid-SGA3 project report and review, covering Apr 2020 to Dec 2021. The report was 250 pages (excluding annexes) and the review took four full days. The full EC review report is expected shortly, but the preliminary feedback was positive: "The project has achieved most of its objectives and milestones for the period, with relatively minor deviations", "The project has delivered exceptional results with potentially significant impact (even if not all objectives", and "Management and Coordination has substantially matured and professionalized over the past years. The current reorganization is very much appreciated."

COVID delayed HBP work and the project was granted a six-month extension, which pushes its end date to Sep 2023, but with no extra funding. The AISBL led implementation of this major change via Amendment 4 to the SGA3 GA, the most complex HBP amendment to date and possibly the largest EC grant amendment ever. It was signed by the EC and the HBP in Jan 2022.

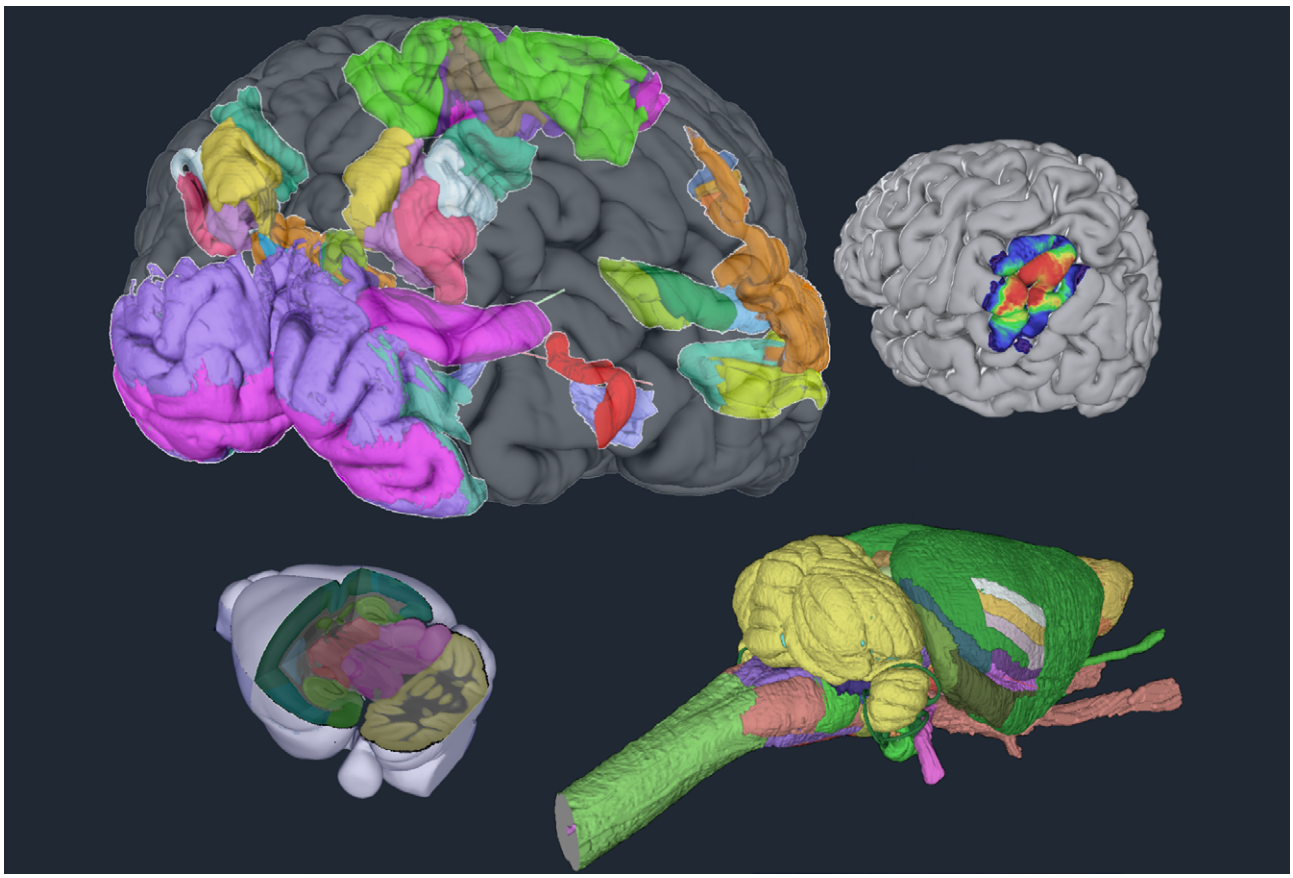
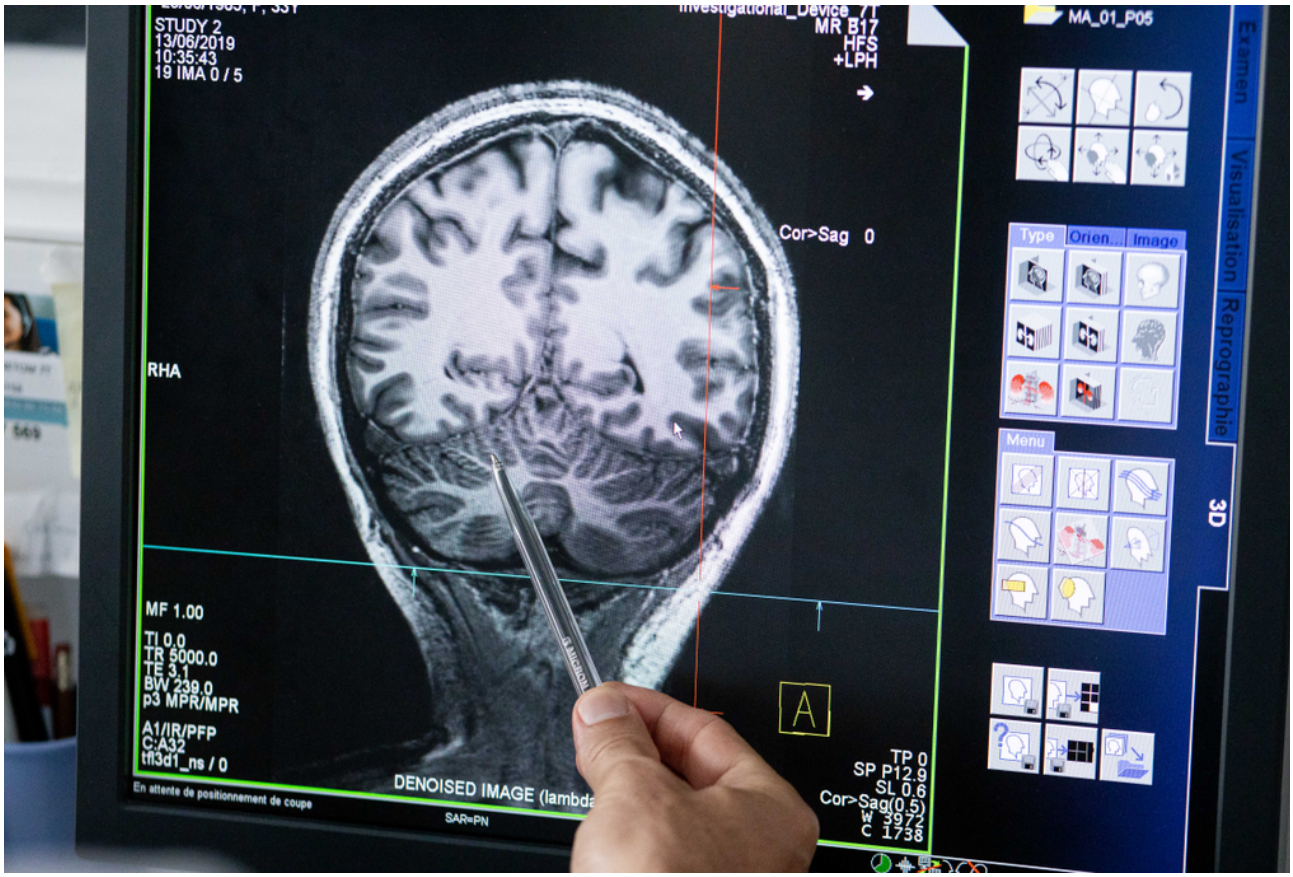


Illustration of selected reference atlases available in EBRAINS. Top left: BigBrain model with high-resolution 3D maps of a subset of regions from the Julich-Brain human cytoarchitectonic atlas. Top right: a single probabilistic map from the Julich-Brain human cytoarchitectonic atlas. Bottom left: early version of the Allen Mouse Brain Atlas. Bottom right: early version of the Waxholm Space rat brain atlas.



The ground-breaking EPINOV clinical trial aims to improve surgery outcomes in drug-resistant epilepsy. The convergence of a patient's data from diverse brain imaging sources (MRI, CT,..) allows the building of a patient-specific brain model for more precise targeting of the surgery.

Science

The Scientific Case that EBRAINS presented in its proposal for the ESFRI Roadmap 2021 included:

Scientific field(s)

EBRAINS aims to serve brain research and brain medicine, research and development in AI, computing and data science, as well as other technologies benefiting from insights into brain organisation. The nature of such research is multi- and interdisciplinary. EBRAINS aims to educate next-generation researchers at the interface of neuroscience and computing, to act legally and ethically responsible, and to benefit the European society in the era of digitalisation.

Scientific vision and mission

EBRAINS has been conceptualised and its development has been started in the Human Brain Project (HBP), with its unique approach of "computing the brain". The HBP aims to decode the human brain's complexity, which is only feasible on the basis of most powerful ICT platforms such as those provided by EBRAINS. The synergy that is created at the intersection of neuroscience and ICT not only helps to better understand the brain, but also to translate this knowledge into advances in medicine, computing and other technologies. EBRAINS is generating the necessary synergy between the fragmented national scientific efforts to tackle one of the most challenging areas of research, to bring multiple disciplines and powerful ICT resources to bear on this important subject, and to provide a unique, distributed digital research infrastructure in this field.

The EBRAINS infrastructure is shaped by the principle of co-design, which means that the needs of the scientists serve as the basis for tools and services which are developed and their insight and expertise flow into the conception and realisation of the infrastructure.

The Preparation Phase of building the infrastructure will concentrate on capabilities for exploring multi-level brain connectivity, the basis for information processing in the brain. Connectivity is a key principle, with relevance for basic neuroscience, understanding consciousness and its disorders, as well as targeting improved artificial neuronal networks and medical technologies, including connectivity-based models for personalized therapies. Connectivity encompasses signal transduction at the level of transmitter molecules, axons, dendrites, cells and their microcircuits, as well as large-scale networks and their dynamics. The investigation of "dysconnectivity" in patients represents a kind of natural experiment, and informs us about the principles of healthy, normal connectivity. Plasticity and learning are features of brain networks that are highly relevant to understand their function and dysfunction. We can learn from the principles of connectivity and resulting brain function to shape artificial neuronal networks and even incorporate such knowledge in solutions for innovative neurorobotics and neurotechnology. Powerful artificial neuronal networks are mandatory for analysing connectivity, which involves 2-3 million kilometres of "cables" in a human brain, to capture its dynamics, to handle the big data challenge, and to identify and predict principles of brain connectivity. Thus, the development of artificial neuronal networks not only benefits from insights into natural neuronal networks, but the latter can also be better explored and modelled with more powerful artificial networks.

In the medical area, the possibility offered by EBRAINS to create digital twins of individual human brains will contribute to progress in personalised and precision medicine. Evidence to date shows that the surgical treatment of epilepsy can be improved by use of The Virtual Brain methodology in EBRAINS, and this is now being explored in a randomised, controlled clinical trial. Similar approaches are likely to lead to more effective individualised neuro-rehabilitation and brain prosthetics. Multiscale models will also help to identify sub-categories of neurodegenerative and mental health disorders, and offer opportunities to discover and probe innovative pharmacological interventions.

The HBP-EBRAINS approach has already led to a significant number of breakthroughs, including: the development of spike-based learning algorithms, which have been implemented on neuromorphic computers to obtain general-purpose tools for a new generation of AI applications; innovative theoretical models that make use of results from experimental neuroscience addressing the multi-scale organization of the brain; and significant advances in understanding the neural basis of learning and perception, spatial memory, multisensory integration, sleep and consciousness.

The continuous development and use of brain-derived technologies will expand outside of the field of brain research and facilitate the emergence of a rich ecosystem of academic and industrial research; exploring and, ultimately, commercializing novel applications.

Long-term science programme

The HBP has laid the foundation for empowering empirical and theoretical neuroscience to approach the different spatial and temporal scales of brain organisation, explore their links, and understand the neural mechanisms behind an amazing spectrum of cognitive functions and behaviour. EBRAINS offers therefore state-of-the-art neuroinformatics and data science, a comprehensive multi-level and multiscale atlas, an array of simulation software, neuromorphic computing and neurorobotics platforms, all underpinned by high-performance analytics and computing resources. It provides a platform where the different tools and services can be combined with each other in a flexible way, with access to the HBP's comprehensive data resources. The HBP's work to date has resulted in a growing treasure trove of data, tools and models that is high-quality, well-curated and accessible to the international research community. This achievement is unique in many respects; both in its multi-scale, multi-level approach, but also in its impact, which is augmented by sharing resulting experimental data with the broader scientific community, thereby encouraging greater collaboration between scientists. The challenge for neuroscience here is significant, considering that the plethora of research sub-communities, each with its own methods, technologies and standards, often acting independently from each other. EBRAINS offers solutions to integrate data across the whole community, which also is a prerequisite for increasing reproducibility of research, a key issue for many research communities.

With EBRAINS, Europe has assumed a pioneering role, both in terms of the HBP's multidisciplinary approach and the establishment of a sustainable European infrastructure for brain research.

ESFRI Final Report on the EBRAINS proposal

Overall Findings	☐ Low	☐ Medium	☒ High	☐ Very high
Overall Assessment of Scientific Case	☐ Low	☐ Medium	☒ High	☐ Very high
Scientific Excellence	☐ Low	☐ Medium	☒ High	☐ Very high

SCIENTIFIC EXCELLENCE: REPORT COMMENTS

"Overall, "Scientific Excellence" of the RI is scored "high" as the whole proposal is well balanced and reflected upon and as it's in fact a continuation of the HBP FET flagship. The awarded score is deserved since a large ecosystem indeed allows (next generation) neuroscience researchers to advance faster, thereby building up past developments".

OVERALL CONCLUSIONS & RECOMMENDATIONS: REPORT COMMENTS

"EBRAINS will deliver a significant boost and support to the neuroscience community. The neurosciences and neuroscientific progress are of very high importance to society and can be considered as a strength of European Research. Not only from a clinical neuroscience viewpoint as to cure brain diseases, injuries, congenital deviations or ageing effects in a silvering economy, but also due to its possible spin-offs like improved AI algorithms and neuromorphic computers."

HBP Scientific Research Director Prof. Katrin AMUNTS, Forschungszentrum Jülich, presenting to the European Brain Summit in Brussels, Oct 2021.

Discussion at the European Brain Summit. From left to right: Prof. Philippe AMOUYEL (Chair, EU Joint Programme – Neurodegenerative Disease Research), Hillary SUTCLIFFE (stakeholder consultation specialist), Paweł ŚWIEBODA (CEO, EBRAINS) and Frédéric DESTREBECQ (Executive Director, European Brain Council).

Communications and Stakeholder Engagement

Building EBRAINS awareness and reputation

The "Discover EBRAINS" brochure was published in 2020, followed by important dissemination efforts on the HBP "Showcases" that show how the EBRAINS RI enables complex scientific projects. A series of "Brain Matters" webinars allowed researchers to detail key scientific achievements, underscoring how the EBRAINS RI contributed to them. The inclusion of EBRAINS on the ESFRI Roadmap was an important milestone, which was intensively leveraged in communication efforts. An improved EBRAINS website was launched in early 2021, highlighting the RI's services, and EBRAINS also strengthened its social media channels.

Reaching out to new communities

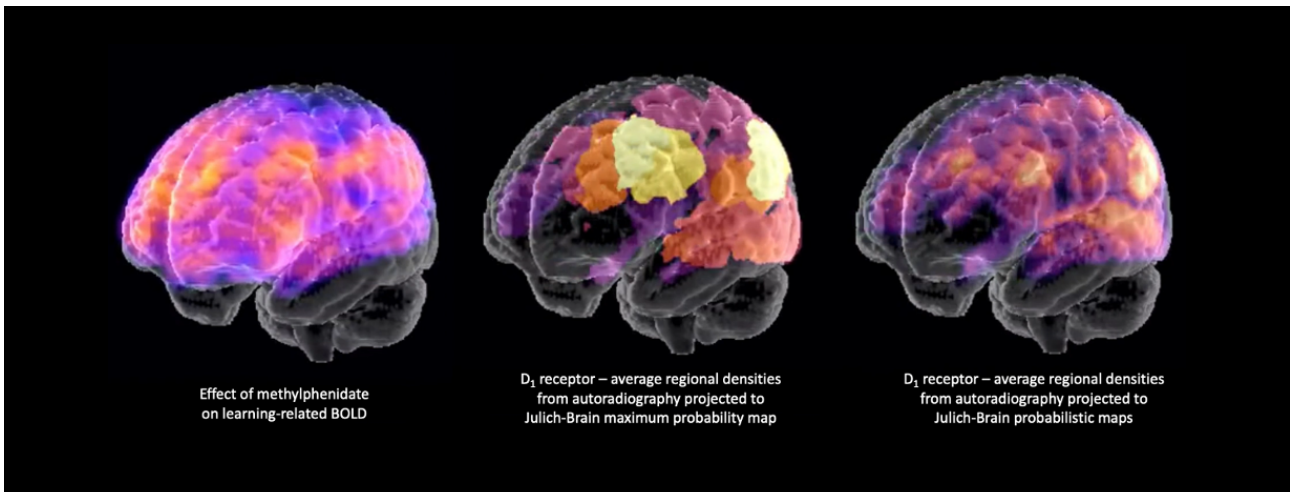
Awareness of the EBRAINS RI was increased via presence at major neuroscience conferences (FENS and SfN), brain disease-oriented seminars (Alzheimer Europe Association and "One Neurology"), health data-related workshops (EU Health Data Space project), and the HBP Summit in Brussels in Oct 2021. "EBRAINS Roadshows" introduced the EBRAINS RI to European neuroscience associations in nine European countries and relations were strengthened with the INCF, the International Brain Initiative and the World Health Organisation. Involvement in the European Brain Research Area connected EBRAINS with other key brain research stakeholders, paving the way for future collaboration. Training on EBRAINS' services was conducted at different events, especially during the HBP Scientific Conference, which was attended by more than 200 scientists from outside the HBP.

Positioning EBRAINS as a key player in brain research

By leveraging EBRAINS' inclusion in the ESFRI Roadmap 2021 and its presence in RI fora, workshops and discussions, EBRAINS strengthened external recognition of the value it brings to science, positioning the organisation as a key player in the European RI landscape. EBRAINS has also advocated the importance of brain research for society and citizens, organising events reaching more than 5,000 people to raise awareness of the need to invest in finding solutions for neurodegenerative diseases. These included a video conference co-organised with *Politico* in 2020 and another with the *Brussels Times* in 2021; two high-level round-table meetings co-organised with the OECD for influential brain research stakeholders; and the European Brain Summit, a major conference with EU and Member State policymakers' participation, co-organised with the European Brain Council.

Laying the foundation for EBRAINS Node communication

The AISBL communications team is supporting the implementation of the network of emerging National Nodes, laying the foundations for consistent communication strategies at Node level, while taking the specificities of each country into account. The work will continue in the coming months as part of EBRAINS' mission to build its distributed infrastructure across Europe.



Science supported by the EBRAINS RI: Integrating computer modelling with receptor-enriched fMRI to predict dopamine drug effects (HBP SGA3 Work Package 2).

On 7 Feb 2022, Christian FAUTEUX (Chief Programme Officer, EBRAINS - standing) briefed George FREEMAN (UK Minister for Science, Research & Innovation – seated, second from left) on the EBRAINS RI.

EBRAINS and HBP leaders presented the EBRAINS RI at a well-attended event to mark the start of the French Presidency of the EU and the 20th anniversary of ESFRI, held at the NeuroSpin research centre, Paris Saclay, 24 Mar 2022.

Closing session of the HBP Summit 2021, Credit_ HBP, EBRAINS

Introduction of the HBP Summit 2021 by Pawel Swieboda, Katrin Amunts, Jan Bjaalie, Credit_ HBP, EBRAINS

EBRAINS, other RIs and International Projects

As an RI serving the data, computing and digital research areas, EBRAINS aligns with other ESFRI data infrastructures in delivering what ESFRI describes as "data assets supported by people, processes and technology". Researchers using EBRAINS services have access to integrated computing and storage services at leading European supercomputing and data centres, which are part of the Fenix RI, realised through the EU-funded Interactive Computing E-Infrastructure (ICEI) project, which is part of the HBP FET Flagship. The partners in the Fenix consortium are all Hosting Members of the Partnership for Advanced Computing in Europe (PRACE), an ESFRI Landmark[4] RI.

The EBRAINS RI is the "one-stop-shop" offering scientists and developers the most advanced tools and services specifically for brain research, but other RIs also provide services which are relevant for those communities. Thus, EBRAINS foresees interactions with other ESFRI RIs, in particular in the health field, on biological and biomedical imaging, models for disease, translational medicine, biobanking, and bioinformatics. Key RIs providing services which are complementary to EBRAINS include Euro-BioImaging[5], INFRAFRONTIER[6], EATRIS[7], BBMRI[8], and ELIXIR[9].

EBRAINS also collaborates with research projects and organisations around the world, including the International Brain Initiative (IBI), the International Neuroinformatics Coordinating Facility (INCF), and the International Brain Research Organization (IBRO).

The HBP was a founding member of the IBI. Launched in 2018, it brings together the HBP, US BRAIN Initiative, Japan's Brain/MINDS, the Korea Brain Initiative, the Australian Brain Alliance, the Canadian Brain Research Strategy and the China Brain Project. Outputs include analysis and recommendations in areas of common interest, such as neuro-ethics, data sharing and standardisation, and international data governance (Rommelfanger *et al*., *Neuron*, 2019; Salles *et al*., *Neuron*, 2019; Eke *et al*., *PsyArXiv*, 2021). In Oct 2021, IBI representatives participated in a workshop organised by the European Parliament Panel for the Future of Science and Technology (STOA), focused on the IBI's role as a forum for international collaboration and the potential to strengthen its ability to facilitate networking and promote collaboration among different countries and sectors. Recommendations and observations were published in *Lancet Neurology* (Quaglio *et al*., 2021).

The INCF promotes standards and best practise in neuroscience. It maintains an encyclopaedia of terms which are included in the EBRAINS Data and Knowledge services. Through the INCF, EBRAINS has interacted with other neuroscience infrastructure providers world-wide, leading to a set of recommendations for neuroscience data repositories (Sandström *et al*., *Sci Data*, 2022). The HBP and EBRAINS meet with experts internationally through more than 40 active INCF Working Groups. Interactions include development of ontologies and common metadata standards. The HBP and EBRAINS also contribute content to the INCF Training Space, a service which delivers training material to the global research community.

The IBRO is the global association of neuroscience societies, which aims to promote and support neuroscience around the world. EBRAINS has worked with the IBRO to deliver a series of Virtual Master Class workshops, aimed at training research group leaders and senior investigators throughout the world on the use of EBRAINS Tools and Services, on the principle of "train-the-trainer". The first edition took place in 2021 and focused on the vast array of brain atlasing and simulation services available via the EBRAINS RI.

[4] ESFRI Landmarks are RIs that have reached the advanced implementation phase on the ESFRI Roadmap.
[5] Euro-BioImaging: access to imaging technologies, training & data services in biological & biomedical imaging.
[6] INFRAFRONTIER: generation, phenotyping, archiving and distribution of model mammalian genomes.
[7] EATRIS is the European infrastructure for translational medicine.
[8] BBMRI-ERIC is a European research infrastructure for biobanking.
[9] ELIXIR-Europe brings together European bioinformatics resources to support data-driven life science research.

EBRAINS AISBL Board of Directors

Member	Institution	Country
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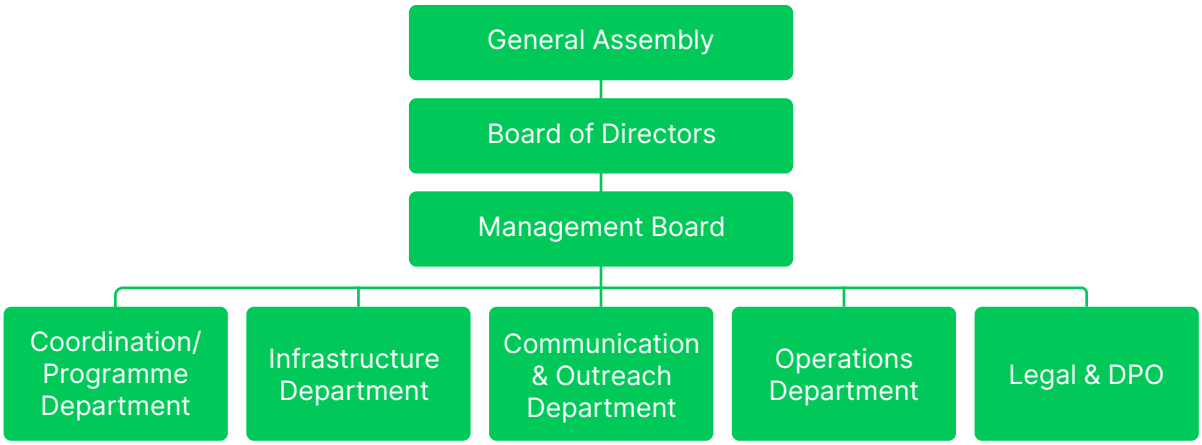

EBRAINS Visual Identity Update

On 4 Apr 2022, EBRAINS unveiled its updated visual identity, in which the original logo (left) was replaced by a new version (right), which features adjusted colours and fewer, but bigger “brain waves”. This provides better digital reproduction and a clearer image when executed in small sizes.

Old version

New version

Financial Information

For the period 1 Jan 2021 to 31 Dec 2021. All values are Euros.

INCOME			
Membership contributions	715,000		
Project contributions	2,677,707	of which:	
		H2020 HBP SGA3[10]	2,635,101
		H2020 HBP ICEI[11]	22,781
		H2020 EBRA[12]	19,825
		Sub-total	**2,677,707**
Financial income & other operating income	236,201		
Profit carried forward from previous period	541,685		
Total income for 2021			**4,170,593**

EXPENDITURE			
Personnel costs	3,021,381		
Services and goods	999,514	of which:	
		Rental & related costs	113,393
		Consultancy & service fees	728,209
		Other costs	157,912
		Sub-total	**999,514**
Other operating expenses	19,584		
Depreciation	2,962		
Financial expenses	31,912		
Total expenditure for 2021			**4,075,353**
Net result for 2021			**95,240**

[10] Human Brain Project 3rd Specific Grant Agreement (the final funding period for the HBP FET Flagship).
[11] Human Brain Project Interactive Computing E-Infrastructure (separate HBP grant for base infrastructure).
[12] European Brain Research Area. Partners: European Brain Council, EU Joint Programme – Neurodegenerative Disease Research, ERA-NET NEURON and the HBP.

Looking forward

Research Infrastructure Transition

The transition of the RI from the HBP to EBRAINS should be complete by the end of the HBP in Sep 2023. Two EU HE calls will help this transition. A Grant Agreement should be signed shortly for the EBRAINS PREP project (for the INFRA-2021-DEV-02-01 call), which will provide the Central Hub and Nodes with EUR 3 million to fund the putting in place of a new organisational and contractual framework that will allow the EBRAINS RI to operate on a primarily Member State-funded basis in the future. An "EBRAINS SERV" proposal is being prepared to address the second call, INFRA-2022-SERV-01-01, which should provide EUR 38 million to operate the RI in the transition and update the RI's technical framework to make it sustainable in a post-HBP funding environment. The two grants will help the EBRAINS National Node Partners to secure long-term funding for their RI contributions.

The National Nodes should use the remainder of this year to finalise their internal arrangements and agree on how their contributing Partners will collaborate. National Node agreements will need to be concluded with the Central Hub, as part of the EBRAINS PREP Project, which should also see National Nodes applying for national RI roadmap funding. An "EBRAINS-SERV" proposal is being prepared to address the second call with most relevance for EBRAINS, INFRA-2022-SERV-01-01, to operate the RI and update its technical framework.

HBP Coordination

The AISBL will receive and analyse the EC's Review Report on the SGA3 mid-term M21 Review, and then assign responsibility for follow-up actions, monitor their implementation and communicate progress on that front to the EC. The AISBL will also prepare for intense activity in the last few months of SGA3, which will see the preparation, internal quality control review and submission of some 60 HBP Deliverables, the Project Periodic Report on the second half of SGA3, a Final Report on the whole of SGA3 and, probably, a retrospective report on the HBP as a whole.

The six-month no-cost extension granted to the HBP in SGA3 should allow Partners to make up for delays experienced due to COVID, but stretching funding foreseen for 36 months to cover 42 months will call for careful monitoring and management of HBP financial resources. It will be very important to avoid any underspending. This will require early identification of any potential underspending within individual work packages and tasks, so resources can be reassigned in a timely, transparent and efficient manner, to ensure that project-critical activities can be sustained in the 6-month "no-cost" extension period.

Communications

Upcoming activities include preparing HBP and EBRAINS RI participation in key scientific conferences such as the 8th EAN Congress in Vienna (25-28 Jun 2022), the FENS Forum in Paris (9-13 Jul 2022) and the International Conference on Research Infrastructures (ICRI) in Brno (12-21 Oct 2022. Planning will also start for the HBP 2023 Summit in Marseille (28-31 Mar 2023).

EBRAINS on the internet & in social media

www.ebrains.eu

@EBRAINS_eu

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EBRAINS

EBRAINS, International non-profit association
Chaussée de la Hulpe 166, “Glaverbel”, First Floor, Section B, 1170 Brussels, Belgium

Company registration number 0740.908.863 - VAT BE 0740.908.863 | Banque/Bank/Bank Account: IBAN: BE31 7360 6257 3855-BIC: KREDBEBB