EBRAINS 2.0

D4.4 Co-design strategy for WP4

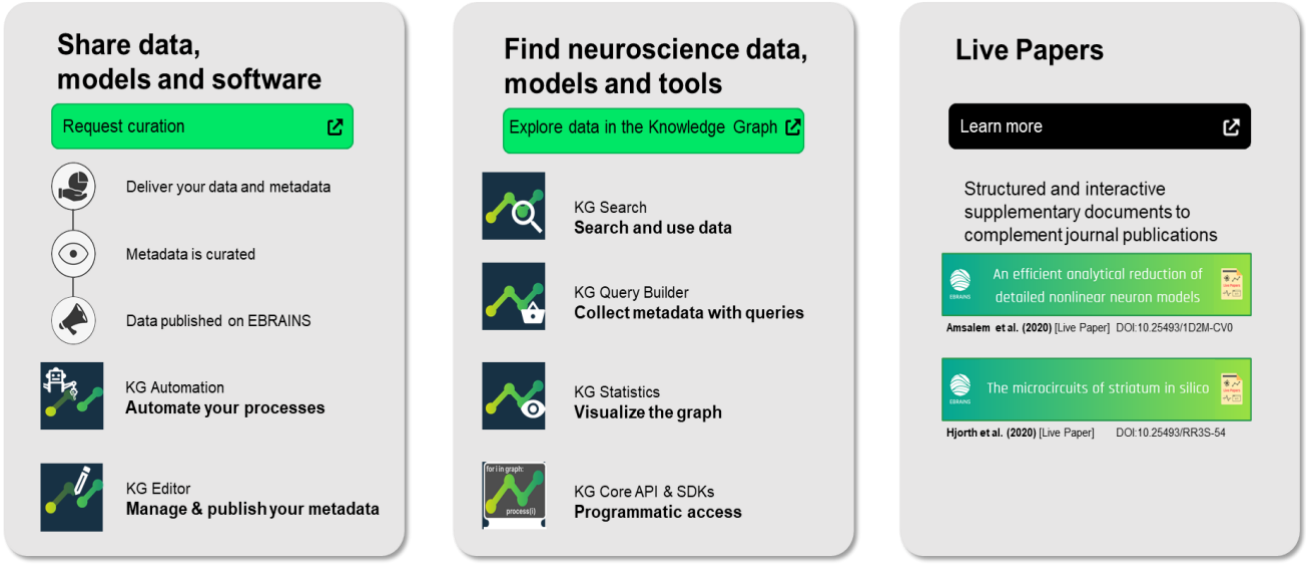

Figure 1: WP4 main user facing services build on a strong data sharing platform, well-organised data and metadata, and live papers.

Funded by the European Union

EBRAINS 2.0 has received funding from the European Union's Research and Innovation Program Horizon Europe under Grant Agreement No. 101147319.

Project Number:	101147319	Project Name:	EBRAINS 2.0

Deliverable No. & Name:	D4.4 Co-design strategy for WP4
Deliverable Description:	Report on the strategy that WP4 will follow to perform co-design activities with other partners in the project and external stakeholders
Deliverable Type:	R - Document, report
Dissemination Level:	PU = Public
Planned Delivery Date:	Project Month M6
Actual Delivery Date:	Project Month M6 / 28 June 2024
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Funding:	EBRAINS 2.0 has received funding from the European Union's Research and Innovation Program Horizon Europe under Grant Agreement No. 101147319.
Keywords:	Co-design, data sharing, curation, FAIR
Abstract:	The co-design actions of WP4 are centred around the integration of new data from both internal and external sources and ensuring GDPR-compliant data processing where necessary. These actions aim to expand metadata schemas for new data types, adapt the curation workflow to user needs by automating more steps, and develop data management solutions that comply with EU data protection regulations for platforms like the Health Data Cloud and the Human Intracerebral EEG Platform. The Health Data Cloud VRE at Charité provides a GDPR-compliant infrastructure for showcasing co-design efforts involving personal data. Additionally, the co-design activities focus on further integrating the Health Data Cloud into EBRAINS. Coordination meetings and collaborative software development facilitate these efforts.

The co-design actions further aim to achieve seamless integration of strategically relevant datasets and to establish accompanying analytical workflows using EBRAINS tools and services. Effective communication and coordination are emphasized to foster collaboration among project partners. External stakeholders, including consortia and institutional services, are engaged through targeted discussions and workshops to enhance data consistency, resource optimization, and user workflows.

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1. List of Abbreviations and Acronyms used

Abbreviation/Acronym	Meaning
EBRAINS RI	EBRAINS Research Infrastructure
EEG	Electroencephalogram
FAIR	Findable, Accessible, Interoperable and Reusable
GDPR	General Data Protection Regulation
HDC	Health Data Cloud
HIP	Human Intracerebral EEG Platform
HPC	High performance computing
KG	Knowledge Graph
openMINDS	a metadata framework for linked data
VRE	Virtual Research Environment
WP	Work Package

2. Introduction

“EBRAINS is a dynamic research infrastructure, aiming to address and adapt to the emerging needs of the neuroscience community and brain research at large. To achieve this, a comprehensive model of the different and complementary pathways by which EBRAINS software and services can be built upon and extended by its user community at large is inherent in its architectural design.”

This deliverable presents the strategy the EBRAINS 2.0 partners will follow to perform co-design activities within their respective work packages, across the entire project as well as with other project partners and external stakeholders.

Definition of Co-Design:

Co-Design is an iterative process to collect the requirements and expectations from different stakeholders and integrate them into the design and implementation of a tool, service or platform with the objective of maximizing its adoption, usability, reliability, transparency and impact. Stakeholders could be project-internal users, partners from other WPs, external users, communities, indirect beneficiaries, external institutions, society, policy makers etc.

The planning of the co-design deliverables (D1.6, D2.5, D3.6, D4.4, D5.5 and D6.5) was developed in close coordination between the work packages, and the template for the reporting was developed jointly over several iterations.

Brief description of the WP4-Scope

The main goal of WP4 is to establish EBRAINS as a global leader in the development and provision of viable data sharing, discovery, and (re)use within the field of neuroscience. The services will empower neuroscientists with resources and tools they need to advance our understanding of the brain and accelerate breakthroughs in brain research but also to effectively differentiate and address the implications of both sex and gender in their research. The services will encompass a comprehensive range of neuroscience data, with a special focus on foundational data, enabling the discovery of diverse and multifaceted information across various levels of analysis, all integrated within a common semantic and brain atlas framework. The services will go beyond data storage by ensuring that prioritised sub-groups of data that share similar characteristics, originating from various sources, are curated, standardised and harmonised to promote interoperability (Figure 1).

3. Co-Design Roadmap

This deliverable provides an overview of co-design actions aimed at achieving key goals of WP4 in the domain of designing and implementing tools, services, or platforms to maximise adoption, usability, reliability, transparency, and impact. WP4 co-design actions are partially specific to WP4 but mainly integrated into actions across the EBRAINS 2.0 project as a whole. All actions are regularly monitored, and if necessary, updated along the project.

The co-design actions can be categorised along the involved stakeholders:

- amongst contributors of WP4 tasks (Table 1)
- between WP4 contributors and contributors from tasks of other EBRAINS 2.0 WPs (Table 2 and Table 3)
- between WP4 contributors and contributors from external projects (Table 4)

The identification of the co-design actions was guided by the following questions:

- What are the needs and requirements of the users of WP4-relevant tools/services/ platforms?
- How can information about user needs and requirements effectively be collected?
- How can success in terms of adoption, usability, reliability, transparency, and impact of WP4-relevant tools/services/platforms be measured?
- How can the consortium effectively deliver co-design actions?

3.1.1 Co-Design Activities within WP4

The primary goals of WP4 internal co-design actions are to integrate new data from the project or from external data providers and to ensure GDPR-compliant data processing where required. The co-design activities/actions towards these goals will expand metadata schemas to accommodate new data types, further adapt the curation workflow to user needs (especially by automating more workflow steps) and develop data management solutions that comply with EU data protection requirements for the Health Data Cloud (HDC) and the Human Intracerebral EEG platform. The Health Data Cloud virtual research environment (HDC-VRE) at Charité provides a GDPR-compliant infrastructure for hosting co-design showcases involving personal data. Additionally, the co-design actions focus on further integrating the Health Data Cloud into EBRAINS and achieving its certification. At a general level, WP4 will also oversee all its co-design actions and create a space for data/software exchange and repository. The actions towards these goals are primarily coordination meetings and the use of GitHub and GitLab for managing the collaborative software developments.

Table 1: Internal WP4 co-design actions undertaken towards key goals

Goal	Action	Responsible for Action (Task, WP or Person)	Time line (Project Month)	Indicators
Integration of relevant new/external data (including data received through the open calls)	Extend metadata schemas for in-depth metadata and apply to all comparable datasets	T4.1, T4.2, T4.5	M1-36	Number of datasets with in-depth metadata
	Adapt curation workflow (including adding more automated approaches) for integration of external data	T4.2, T4.6, T4.7	M1-36	Number of externally hosted datasets indexed in the EBRAINS Knowledge Graph

	Showcase the acquired data on EBRAINS	T4.5, T4.6	M1-36	Number of dissemination events
GDPR-compliant processing of health data	Develop data management solutions in compliance with EU data protection requirements including the Health Data Cloud and the Human Intracerebral EEG platform. The HDC-node VRE at Charité offer a GDPR-evaluated infrastructure to host those Co-Design showcases where personal data is involved. In addition, the co-design activity is engaged with further integrating HDC into EBRAINS and it's certification	T4.4	M1-36	EBRAINS DPO approves the processing of health data
Trigger / oversee co-design activities between tasks	Weekly and on-demand openMINDS development meetings to reflect the needs of data providers	T4.1; T4.2	M1-36	Number of tickets or emails
	Regular Technical coordination meetings	T4.6	M1-36	Meeting schedule in operation and minutes accessible in WP4 collab
	Interactions for adapting the curation workflow for sharing metadata for sensitive data via the EBRAINS Health Data Cloud	T4.2; T4.4	M1-36	Meeting schedule in operation and minutes accessible in WP4 collab
Create a space for data/software exchange and repository	GitHub project for issue tracking and pull requests and GitLab project for WP4	T4.1	M1-36	Issues available in GitLab and GitHub

3.1.2 Co-design activities with project-internal stakeholders

The primary goals of the EBRAINS 2.0 project internal co-design actions are to achieve seamless integration of datasets with strategic relevance for EBRAINS. This involves identifying the necessary software and data to facilitate this integration, ensuring that datasets can be efficiently incorporated into EBRAINS tools and services. Additionally, the actions aim to enable automated workflows using EBRAINS software tools, services, and data, enhancing efficiency and consistency. Effective communication and coordination are also central to these efforts, fostering collaboration and alignment among all partners involved in the project. The co-design activities/actions towards these goals revolve around the expansion of the required metadata schemas and the workflow for metadata curation and integration of the data in the Knowledge Graph, making sure that strategically relevant are easily discoverable and with links to compatible tools for visualization and analysis. The developments also include data management solutions in compliance with EU data protection requirements to host co-design showcases with personal data involved (HDC and HIP). The actions include selecting foundational datasets, standardising formats, identifying software and service dependencies, defining programmatic interactions between the EBRAINS Knowledge Graph and other services, providing components for data analysis workflows, highlighting training materials, and promoting data sharing via EBRAINS at education and training events. The above is detailed in Table 2. At the level of the EBRAINS 2.0 showcases, WP4 contributes primarily to adding new metadata schemas, integrating new data, and adding the required new content types in the EBRAINS Knowledge Graph (Table 3).

Table 2: Overview of Actions for co-design activities with project-internal stakeholders

Goal	Action	Responsible for Action (Task, WP or Person)	Time line (Project Month)	Indicators	Co-Design Partner / Stakeholder
Integration of datasets with strategic relevance for EBRAINS	Create metadata schemas and a workflow for standardised integration of human data to EBRAINS	T4.1, T4.2	M1-30	Number of new metadata schemas	WP1, WP2, WP4 (T1.6, T2.1, T2.4, T2.5, T2.8, T4.5, T4.6)
	Showcase the imaging features extracted from 5M connectome data	T1.4	M30-36	Data cluster for the 5M connectome data, showcasing their availability for query in the atlas viewer	WP1, WP2, WP4 (T2.7, T4.5)
	Ensure that foundational datasets are maximally represented in groups/clusters, with in-depth metadata and visualisation in viewers	T1.3, T1.4, T4.5	M6-30	Number / ratio of foundational datasets represented in a cluster	WP1, WP4 (T4.1, T4.2)
	Open calls for strategic large data collections	T4.7	M1-M12	Integration of dataset from open call recipients in the KG	All WPs
	Development of data management solutions in compliance with EU data protection requirements to host Co-Design showcases where personal data is involved (HDC and HIP).	T4.4	M1-M6	Report	WP1, WP2, WP4 (T1.7, T1.6, T2.7, T2.8, T2.9)
Identify software and data required	Explore and select relevant foundational	T4.2, T4.6	M6-18	Number of datasets with EBRAINS atlas	WP1, WP2, WP4 (T1.3, T1.4, T2.2,

to integrate datasets	datasets across different resources			tool integrations	T4.1)
	Make mostly precise agreements on format, anatomical localisation, and brain coverage of the identified datasets	Task leaders/lead developers	M1-M12	Deliverable and milestone reports	WP2, WP4
	Identify software dependencies Identify service dependencies Identify dependencies between tasks	Task leaders/lead developers	M1-M10	Roadmap for implementation to provide to Technical Coordination	All WPs
	Define programmatic interaction between the HIP, the MIP with the EBRAINS KG and data curation workflows for making metadata FAIR	T5.6 (HIP and MIP developers), T5.5 KG together with T4.1 & T4.2; supporting several tasks in WP2	M1-M12	Roadmap for implementation	WP2, WP4, WP5, WP6
	Identify hardware system registration in EBRAINS KG	T5.5, T5.6, T4.1	M1-M36	Report	WP4, WP5
Enable automated workflows using EBRAINS software tools, web services, and data.	Provide scientists with a rich library of components for building data analysis workflows	T4.3, T5.5, T6.4	M6-36	Number of CWL components for data analysis pipelines available in the User Dashboard.	WP4, WP5, WP6
	Allow users to record workflow runs and easily share the resulting outputs through the KG	T4.3, T5.5	M9-36	Number of datasets generated by automated workflows and shared via the KG	WP4, WP5
Communication and coordination	Install communication channels across WPs	Task leaders/lead developers	M1-M36	GitLab entries, meeting minutes	All WPs
	Highlight available training materials for workflows on cluster pages; create novel material where needed	T4.5, T4.6, T7.1	M12-36	Number of tutorials for workflows represented in clusters	WP4, WP7
	Promote data sharing via EBRAINS at education and training events	T7.1, T7.2, T4.6	M6-30	Number of datasets on EBRAINS	WP7, WP4

Table 3: Overview of showcases identified in EBRAINS 2.0 and contribution from each WP. More comprehensive descriptions can be found in D6.5. Co-design actions related to showcases are supported and coordinated by T6.5.

Showcase	WP4 involvement
Atlas-driven analysis of multimodal feature maps	Provide necessary new metadata schemas and integration of necessary metadata in the EBRAINS Knowledge Graph
QUINT workflow for the analysis of rodent microscopy data	Supervise creation of necessary file content types to be included in the EBRAINS Knowledge Graph

Collaborative Brain Wave Analysis Pipeline (Cobrawap)	Provide necessary new metadata schemas and integration of necessary metadata in the EBRAINS Knowledge Graph
Personalised multi-scale brain models for the creation of digital twins in clinical applications	Provide necessary new metadata schemas and integration of necessary metadata in the EBRAINS Knowledge Graph

3.1.3 Co-design activities with project-external stakeholders

The primary goals of the co-design actions with the stakeholders external to the project are in line with the EBRAINS 2.0 project internal goals as outlined in section 3.1.2. The external stakeholders are consortia and projects, and in some cases institutional services, having overlapping areas of interests with EBRAINS. The actions will lead to targeted discussions and dialogues, through workshops and/or bilateral attendance at technical coordination meetings, aimed at identifying concrete steps towards interoperability of services in the domain of data consistency and standardisation, resource optimisation, improved data accessibility, more streamlined workflows, and enhanced user workflows. Actions toward the various goals are detailed in Table 4. As background information, Figure 2 illustrates the extensive co-design efforts of the Health Data Cloud – Virtual Research Environment. These efforts involve contributions from WP4 and a broad range of projects and stakeholders across Europe.

Table 4: Overview of Actions for co-design activities with project-external stakeholders

Goal	Action	Responsible for Action	Time line	Indicators	Co-Design Partner Stakeholder
(Strategic) Partnerships with external projects in respect of FAIR data concepts	Initiate discussions with EPND (the European Platform for Neuro-degenerative Diseases, a consortium of multi-disciplinary public and private sector partners in neurodegenerative disease research), to define strategies for Metadata Syndication / Findability and Interoperability between projects. As a second step AAI federation could be discussed with EPND	Initiation of contact: Birgit Schaffhauser. Main points of contact for technical matters: Lyuba Zehl and WP Manager. Key contributors: T4.6 and team members from T5.5 (Knowledge Graph) T5.6 (MIP)	M12-M18	Contact between EPND and EBRAINS Health platforms established. Bilateral attendance at technical coordination meetings	EPND, the European Platform for Neurodegenerative Diseases
	Initiate discussions with eCREAM (https://ecreamproject.eu/), a project with the central aim to enable clinical and quality of care assessment research using data extracted directly from Electronic Health Records (EHR) of Emergency Departments (ED). eCREAM will use the MIP for efforts towards making metadata FAIR; their metadata will be represented in the EBRAINS Knowledge Graph and data will be federated via the MIP. Currently the project is following FHIR, SNOWMED CT and EEHRXF standards. Some work on interoperability with openMINDs will therefore be required. ECRIN is a major partner in the efforts towards making metadata FAIR.	Initiation of contact: Birgit Schaffhauser. Main points of contact for technical matters: Lyuba Zehl together with WP Manager. Key contributors: T4.1, T4,2, T5.5 (Knowledge Graph), and T5.6 (MIP)	M24	Contact between eCREAM and EBRAINS Health platforms established. Bilateral attendance at technical coordination meetings	eCREAM (https://ecreamproject.eu/)

Harmonising metadata standards	Standardisation of schemas	T4.2, T4.6	M1-36	Workshop with the external stakeholders with report on follow up actions, including timeline	SPARC DANDI FAIR-IMPACT DCAT EPND
	Standardisation of Ontologies	T4.2, T4.6	M1-36	Workshop with the external stakeholders with report on follow up actions, including timeline	Interlex Knowledgespace
Integration of externally registered datasets	Find and integrate datasets with EBRAINS brain atlases	WP1, T4.2, T4.3, T4.5	M1-36	Number of datasets integrated in EBRAINS	Allen Data NeMO
	Find and integrate sensitive data to HIP, MIP and HDC services	WP2, T4.2, T4.3, T4.4, T4.5	M1-36	Number of clinical datasets on EBRAINS	TSD-UiO
Open calls	Attract large collections of human or animal data to sharing via EBRAINS	T4.7	M6-M18	Report	External data providers
Integrate EBRAINS workflows with Brain Models	Use the model templates provided by the Task 3.2 to migrate relevant models from ModelDB that can utilise EBRAINS workflows	T3.2, T4.1, T4.2, T4.3, T4.6	M6-30	Number of models shared via EBRAINS	Model DB
Harmonizing Policies and Governance	Establish common policies and governance frameworks for data sharing,	WP4	M6-30	Report	BRiDGE project
Optimise the user-facing side of the curation workflow based on user feedback	Feedback surveys	WP4, WP7	M1-M36	Report	External data providers
Create European network of GDPR-compliant processing platforms	Develop HDC	T4.4	M1-M36	Europrivacy certification, DPOs and supervisory authorities approve processing of health data	European Commission, TEF-Health eBRAINS-Health
Build alliances with industrial stakeholders	Promote data sharing via EBRAINS	T 7.6, T4.6	M6-30	Number of datasets on EBRAINS	

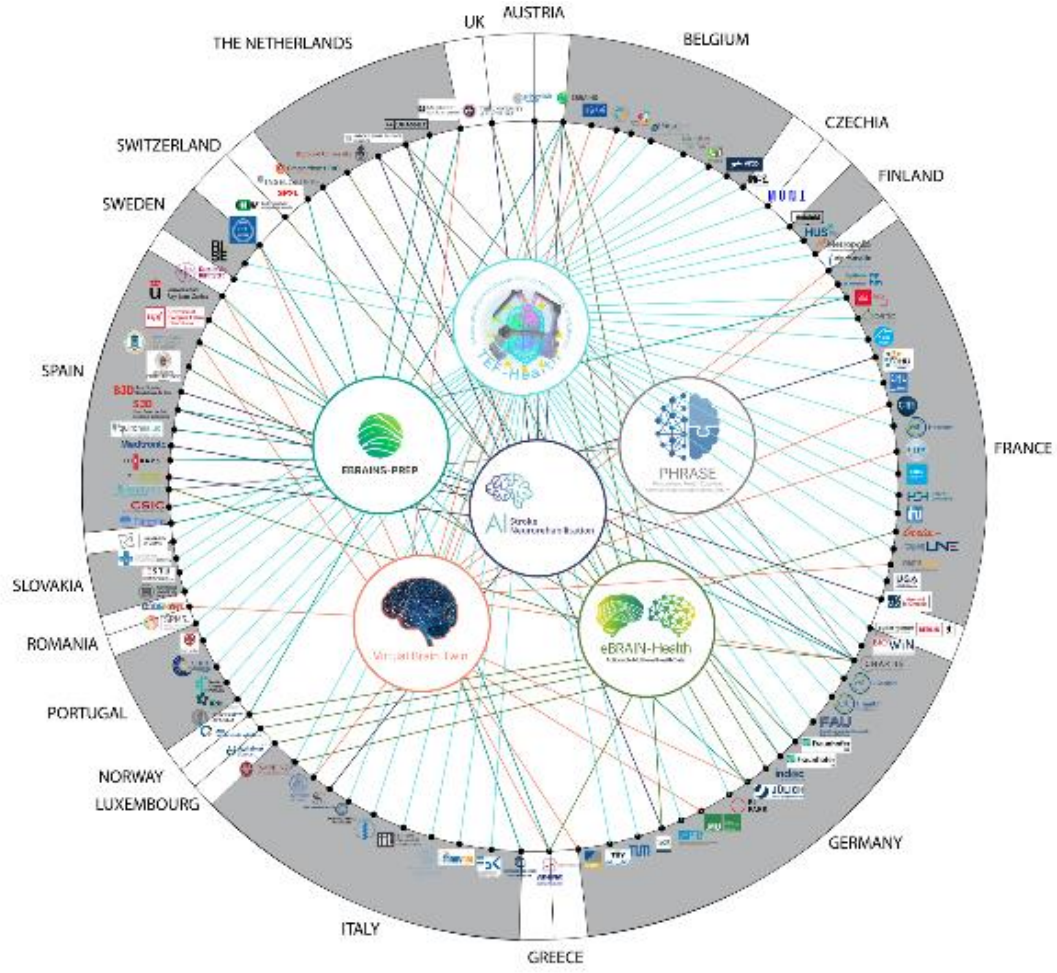

Figure 2: Through the HDC, EBRAINS contributes to the extensive co-design efforts of the HDC-VRE, involving several projects and numerous partners across Europe

4. Outlook

The planned co-design actions of WP4 contributes to the overall EBRAINS 2.0 efforts toward delivering future benefits to the research community. By integrating new data from both internal and external providers and ensuring GDPR-compliant data processing, these actions will expand and enrich the research data available. The focus on expanding metadata schemas to accommodate new data types and automating more steps in the curation workflow will make data integration more efficient and user-friendly. Additionally, the development of GDPR-compliant data management solutions ensures that sensitive data can be securely and compliantly handled. The integration of the Health platforms (HDC, HIP, and MIP) will further enhance their usability.

The interactions both across work packages of WP4 and with external stakeholders will overall facilitate collaboration and resource sharing, fostering a more interconnected research community. The coordination meetings and use of platforms like GitHub and GitLab for collaborative software development will further streamline these efforts.

Ultimately, the co-design activities will lead to a more cohesive and efficient research environment. By standardising formats, identifying software dependencies, and defining programmatic interactions, WP4 will through EBRAINS 2.0 contribute to enhancing data accessibility and usability. Providing scientists with robust tools for data analysis, highlighting training materials, and promoting data sharing at educational events will further support the research community.