EBRAINS 2.0

D3.6 Co-design strategy for WP3
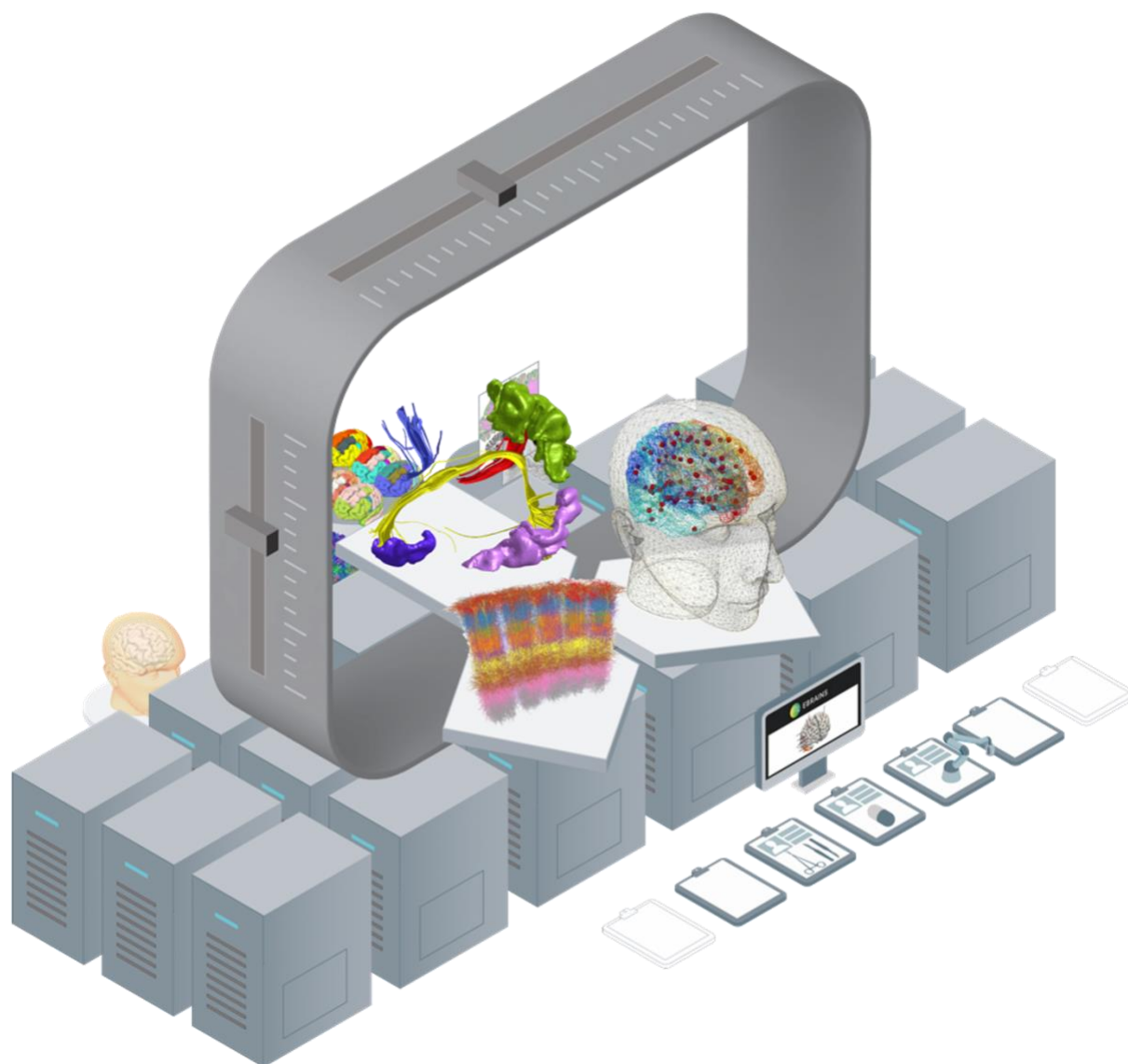

Figure 1: Illustration of WP3's activities

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1. List of Abbreviations and Acronyms used

Abbreviation	Meaning
HPC	High Performance Computing
WG	Working Group
TC	Technical Coordination
WP	Work Package

2. Introduction

EBRAINS is a dynamic 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 that 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 maximising 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 WP3-Scope

The WP3's activities aim at establishing the modelling and simulation framework to work with digital twins in EBRAINS, enabling the user to easily configure digital twins from well-parameterized, ready-to-use standard brain models and adapt them to the user's needs. The digital twins will permit personalisation through the integration of individual data. State-of-the-art software will enable simulation of brain function and behaviours across scales, species and paradigms, and provide validation and inference capacities for use with experimental data. The usability of the EBRAINS 2.0 modelling and simulation framework will be enhanced through the provision of demonstrators, education and community outreach activities.

The achievement of the overall objectives is assured by a consistent and coherent work programme reflected in the technical tasks defined as follows:

- o Task 3.1 SIMULATE. Provide the multiscale model building and simulation tools for Digital Twins (T3.1)
- o Task 3.2 INTEGRATE. Provide standard brain models for integrated use in EBRAINS workflows (T3.2)
- o Task 3.3 OPERATE. Build workflows to operate DIGITAL TWIN brain models (T3.3)
- o Task 3.4 DEMONSTRATE. Provide use cases as demonstrators (T3.4)
- o Task 3.5 CURATE. Maintain, upgrade and enhance the usability, robustness, reliability and performance of the workflow software (T3.5)
- o Task 3.6 OPEN CALLS. Promoting the neuroscientific use of digital brain twins and simulation services (T3.6)
- o Task 3.7 Management, and dissemination (T3.7)

3. Co-Design Roadmap

3.1 Identified Co-Design Activities

This deliverable provides an overview of co-design actions aimed at achieving key goals of WP3 in the domain of designing and implementing tools, services, or platforms to maximise adoption, usability, reliability, transparency, and impact. WP3 co-design actions are partially specific to WP3 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 WP3 tasks (Table 1);
- between WP3 contributors and contributors from tasks of other EBRAINS 2.0 WPs (Table 2 and Table 3);
- between WP3 contributors with 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 WP3-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 WP3-relevant tools/services/platforms be measured?
- How can the consortium effectively deliver co-design actions?

3.1.1 Co-Design Activities within WP3

Table 1 shows the identified actions in order to organise the co-design activities internally of WP3. The seven tasks in WP3 are organised to enable the user to easily configure digital twins from well-parameterized, ready-to-use standard brain models and adapt them to the user's needs. To serve this need, we will establish, organise and operate digital twin technology by 1) simulating brain models, establishing robust, scalable and flexible multiscale simulation engines optimised for use in EBRAINS; 2) building well-parametrized, modular, configurable and easy-to-use standard models of digital twins at the scales of the full brain, multi-region brain networks and cellular levels; 3) operating the digital twins with empirical data for purposes of validation, inference and personalisation; and 4) demonstrating the use of the standard models in applications of neurorobotics, multiscale drug effects and digital twin guided clinical applications for diagnostics and therapy. An open call will invite the community to use these tools and contribute to their development and evaluation.

Table 1: Overview of actions for co-design activities with WP3 - internal stakeholders

Goal	Action	Responsible for Action (Task, WP or Person)	Timeline (Project Month)	Indicators
Identify co-design activities between tasks	Request every Task Leader to identify what activities are foreseen to support the link between science and technology	T3.7	M5	Report about co-design activities
Identify co-design activities between tasks	Build template projects (examples of good practices for integration into EBRAINS)	T3.5	M8	Template projects are used and new projects get integrated

Create a space for data/software exchange and repository	Set up a Gitlab[1] project for WP3	T3.5	M4	Project exists and WP members have access to it
Ensure task workflows are supported by available simulators and tools	Identify task workflow dependencies on tools and simulators, with respect to versions and availability.	T3.1, T3.5	M12	Contributed Spack[2] packages for EBRAINS Collaboratory & HPC deployment
Ensure new task requirements are supported by simulators	Establish roadmap between simulators and tasks and identify new feature implementation for those tasks.	T3.1, T3.7	M12	Roadmap summary
Enable NEST[3] Desktop to represent large-scale hierarchical network models	Translate model requirements to NEST Desktop features	T3.1, T3.2	M10	NEST Desktop release
Ensure the link between demonstration use cases and model inference	Replicate benchmark data used for model validation/inference with demonstrator data	T3.4, T3.2, T3.3	M24/36	Existing notebooks, but with different data
Apply calibration and validation tools to models developed in WP3	Select and optimize appropriate model inversion scheme according to the data features	T3.3, T3.2	M36	Notebooks with examples (starting with M12 deliverable); tagging models with the validation status
Promote the neuroscientific use of EBRAINS 2.0 digital brain twins[4] and simulation services by organizing Open Calls	Organize Open Calls, evaluate the proposals, select one proposal for funding	T3.6	M11	Evaluated the proposals received, one proposal for funding
Identify software dependencies	Requests to T3.1 from all other tasks	T3.7, T3.5	M18	List of software dependencies

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[1] GitLab is a web-based Git repository that provides free open and private repositories, issue-following capabilities, and wikis. It is a complete DevOps platform that enables professionals to perform all the tasks in a project—from project planning and source code management to monitoring and security.

[2] Spack is a multi-platform package manager that builds and installs multiple versions and configurations of software.

[3] NEST is a simulator for spiking neural network models of any size. The description of NEST simulator can be found: https://www.ebrains.eu/tools/nest

[4] Digital twins are computer-based, mathematical brain models that can be continuously updated with measurement data.

3.1.2 Co-design activities with project-internal stakeholders

Table 2 shows the identified actions in order to organise the co-design activities internally of EBRAINS 2.0 project. The co-development approach and the integration of tools are ensured by regular meetings and discussions, based on technical needs. The proposed workflows extend far beyond WP3 and link brain atlas services in WP1, the healthy and clinical brain imaging data in WP2, data services in WP4, HPC services in WP5 and WP6 and communication strategy with WP7.

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

Goal	Action	Responsible for Action (Task, WP or Person)	Timeline (Project Month)	Indicators	Co-Design Partner / Stakeholder
Identify software and data required to connect the WPs	Make precise agreements on format, anatomical localisation, and brain coverage of the identified datasets Participation of internal co-design meetings	Task leaders/lead developers	M12	Meeting minutes	WP2, WP4
Identify software and data required to connect the WPs	Identify software dependencies Identify service dependencies Identify dependencies between tasks	Task leaders/lead developers	M10	Roadmap for implementation to provide to technical coordination	WP5
Enable transdisciplinary dialogue and local knowledge integration	Install communication channels – technology transfer assistance, internal education activities	Task Leaders	M24	Number of partners trained on using WP3 tools and workflows	WP7
Enhance the usability of the EBRAINS 2.0 modelling and simulation framework	Provide demonstrators, education and community outreach activities	Task Leaders	Project duration	Demonstrators, Meeting Minutes	WP7

Project internal alignment on management level	Leadership Board meetings	WP3 Leader (Viktor Jirsa) Deputy Leader (Lia Domide)	M10	Meeting Minutes	WP1, WP2, WP3, WP4, WP5, WP6, WP7
Project internal alignment on management level	WP managers meetings	T3.7 Leader (Lisa Otten) and Deputy Leader (Melany Gouello)	Bi-weekly	Meeting Minutes	WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
EBRAINS 2.0 Technical Coordination (TC)	Participation to TC meetings	Principal Investigators of WP3	Bi-weekly	Meeting Minutes	WP1, WP2, WP3, WP4, WP5, WP6
EBRAINS 2.0 co-design	Participation to co-design meetings organised by WP5 to facilitate EBRAINS 2.0 Co-Design activities	Principal Investigators of WP3	Monthly	Meeting Minutes	WP1, WP2, WP3, WP4, WP5, WP6, WP7
EBRAINS 2.0 Education Coordination	Participation to Education Working Group meetings organised by WP5	T3.7	Monthly	Meeting minutes and presentations available online to WG members	WP1, WP2, WP3, WP4, WP5, WP6, WP7
EBRAINS 2.0 Technical Handbook[5]	Contribution to WP5 (see D5.5)			https://gitlab.ebrains.eu/ri/tech-hub/content-sites/technical-handbook	WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8

The workflows in EBRAINS 2.0 are automated, semi-automated, or more manual in nature and are closely integrated with the tools and services of the science, platform and base infrastructure services. Four showcases have been identified and described in the grant agreement (Table 3). More comprehensive descriptions can be found in D6.5. Co-design actions related to showcases are supported and coordinated by T6.5.

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[5] A technical handbook is designed exclusively for current and future EBRAINS team members. It serves as a comprehensive guide to assist team members in performing their roles effectively (see D5.5).

Table 3: Overview of showcases identified in EBRAINS 2.0 and contribution from each WP.

Showcase	WP3 involvement
Atlas-driven analysis of multimodal feature maps	WP3 is not involved
QUINT[6] workflow for the analysis of rodent microscopy data	Contribution via visualization tools
Collaborative Brain Wave Analysis Pipeline (Cobrawap[7])	Contribution of synthetic simulation data
Personalised multi-scale brain models for the creation of digital twins in clinical applications	WP3 will provide model templates with guidelines and parametrization and will perform model integration across temporal and spatial scales, as well model validation and inference.

3.1.3 Co-design activities with project-external stakeholders

Table 4 exhibits the actions identified in order to ensure co-design activities with external stakeholders, identified as digital neuroscience community but also general public. The Task 3.4 is specifically dedicated to develop three demonstrators that will showcase the workflows and the integration of digital twins in EBRAINS.

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

Goal	Action	Responsible for Action	Timeline	Indicators	Co-Design Partner Stakeholder
Identify external stakeholders	Design and launch an internal and external stakeholder consultation process (e.g. focus group, complemented by	WP3 with the help of WP6, WP7[8] (T7.2, T7.3, T7.4, T7.6, T7.7)	M12	Number of Stakeholder events attended: target [mid target: 5, final target:10]	European consortium members in digital neuroscience domain

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[6] The QUINT workflow takes you through steps to quantify and analyse labelled features within a known atlas space. More information on the workflow is available at https://www.ebrains.eu/tools/quint-workflow

[7] The Cobrawap is an adaptable and reusable analysis pipeline for the multi-scale, multi-methodology analysis of cortical wave activity. More information on the pipeline is available at https://www.ebrains.eu/tools/cobrawap

[8] The tasks listed within WP7 are: Task 7.1 Education and training coordination; T7.2 EBRAINS Community building and engagement; T.7.3 Coordination with National Nodes, T.7.4 Facility Hub coordination and ecosystem realization, T7.5 Coordination of open calls, T.7.6 Innovation management and exploitation, Task 7.7 Management and dissemination.

	questionnaire), setting priorities, project selection and advance assessment; Identifying actions organisational decision-making and efficiency				
	Establish access to open-source code repositories, define external contribution guidelines and offer incentive for contributing	T3.5 with the help of WP7 (T7.6)	M36	Number of external commits into the open-source code repositories	User community in digital neuroscience
	Promote WP3 tools and workflows to educators (students, undergrad) and receive suggestion on how we can make the visualisations more accessible	Tools Owners (T3.5) with the help of T7.1	M36	Number of external suggestions on how to improve	User community in digital neuroscience
Identify registered users with interest in the co-design process and organise these in a Community Space based co-design collaboration group	Make use of the new Community News Channel to invite registered users to a "Group" and use this group as a future contact point for users interested in taking part in co-design.	A WP3 "open co-design responsible. Support in Group setup, activities and management T7.2.	M1-M36	Number of registered users willing to put in-kind time into co-design – and/or to fundraise for co-design	User community in digital neuroscience, EBRAINS 2.0 nodes, general public
Create media to exchange with stakeholders, providing space for the engagement of stakeholders in knowledge development and implementation	Create an open call to invite the community to use these tools and contribute to their development and evaluation.	T3.6 and T7.7	M5	Open call release	User community in digital neuroscience
Reach transfer knowledge of the digital twins' model within national nodes, into facility hubs, EBRAINS community ecosystem (including general public)	Co-design of future prospective, involvement with patients' association	WP3 and WP7 (T7.3, T7.4, T7.6, T7.7)	M1-M36	Meeting minutes	User community in digital neuroscience, EBRAINS 2.0 nodes, general public

Reach specific stakeholders linked to brain health	Reach European Partnership: Transforming Health and Care Systems (THCS) partnership and Innovative Health Initiative (IHI)	T3.7 and WP7 (T7.7)	M1-M36	Meeting minutes	European consortium members in digital neuroscience domain
Showcase the workflows and the integration of digital twins in EBRAINS 2.0	Deliver an embodied system capable of active sensorimotor object manipulation in a simulated physical environment. Illustrate how molecular tools can be used to investigate drug effects in the brain and identify candidate drug targets with relevance in particular for Parkinson's disease. Build a patient-specific digital brain twin and illustrate its use in epilepsy surgery.	T3.4	M34	Public DEM - Demonstrator, pilot, prototype	User community in digital neuroscience, EBRAINS 2.0 nodes, general public

4. Outlook

The project's co-design approaches are poised to play a pivotal role in achieving its overarching objectives. These strategies will be implemented at the project level through a combination of regular co-design meetings, strategic management perspectives, updates to co-design roadmaps, and continued support from the Science Support Team and/or WP7. Two important components will play a relevant role here.

1. Empowering the Consortium

To effectively empower the consortium to meet project goals, we will focus on the following key areas:

- Enhanced Co-Design Meetings: We plan to hold regular, more interactive co-design meetings to ensure alignment and foster collaboration among all stakeholders.

- Management Commitments: WP management will remain dedicated to tracking strategy implementation and ensuring that co-design processes are efficient and effective.

- Ongoing Monitoring: We will continue to monitor the consortium's perceptions to make real-time adjustments and improvements to our co-design strategies.

- Leveraging EBRAINS Community Space: We will make extensive use of the EBRAINS Community space as a collaborative platform for registered users. This will help establish a robust culture of collaboration, leveraging a well-defined space for co-design activities.

2. Emphasizing Impact

While our goals are clearly outlined, we recognise the importance of making the impact of our efforts visible and measurable. This will ensure our activities are not only goal-oriented but also impactful.

We will mobilise registered users to contribute in-kind resources for co-design activities. This mobilisation will support the establishment of a strong co-design culture within the EBRAINS Community, amplifying the project's overall impact.

Looking ahead, the integration of these strategies will be crucial in ensuring the success of our co-design approaches at the project level. Regular updates, continuous monitoring, and the strategic use of collaborative spaces like the EBRAINS Community space will be essential in empowering our consortium and achieving significant project impacts.