TECHNICAL ANNEX

1. S&T EXCELLENCE

1.1. SOUNDNESS OF THE CHALLENGE

1.1.1. DESCRIPTION OF THE STATE OF THE ART

Electroencephalography (EEG), discovered exactly 100 years ago[1], is the most widely used functional brain imaging modality worldwide, contributing to over 5,000 publications annually[2]. Its popularity is rooted in its ability to non-invasively measure brain activity with millisecond-level temporal resolution, offering insights into cognitive and neural processes at a relatively low cost.

Despite widespread use and significant potential for societal benefit (e.g. Brain-Computer Interfaces [BCIs] for motor rehabilitation, communication with locked-in syndrome, sleep tracking and a commonly used diagnostic tool in neurology), fundamental EEG research faces significant challenges that limit its application and translation[3–5]. The major issue is the substantial heterogeneity across laboratories at every step of the research pipeline- from differences in hardware, data acquisition protocols, and analytical steps to the interpretation of signals[6–8]. Overcoming this is crucial for enhancing the reliability of research and laying the foundations for delivering impact in clinical[9] and commercial contexts[10].

In response, several global led by European scientists have emerged over the past decade (Fig.1):

1. **#EEGManyLabs**[11]: involving >230 laboratories from 32 countries, this large-scale, high-powered, multi-site effort is employing Registered Reports[12] for methodological transparency in replicating 20 of the most influential EEG studies. It is set to generate >6,000 high-density recordings, marking a significant step toward establishing the replicability of commonly studied EEG phenomena.
2. **CuttingEEG**[13]: For the last 10 years, this community association has promoted cutting-edge methods through delivery of a **novel distributed conference model, CuttingGardens**, and workshops, supporting dialogue between neuroscientists, engineers & clinicians. Emphasizing open science practices, CuttingEEG is playing a critical role in nurturing a new generation of researchers.
3. **ARTEM-IS**[14]: Developed under the International Neuroinformatics Coordinating Facility (INCF), ARTEM-IS has created standardized reporting tools for EEG research. By providing easy-to-use web-based forms that guide researchers through essential experimental details, it supports transparency in reporting and facilitates machine-readable data for meta-analyses.
4. **FieldTrip**[15]: an open-source and widely used MATLAB software toolbox offering advanced analysis methods for event-related analysis, time-frequency analysis, source reconstruction, and connectivity analysis. FieldTrip has promoted methodological consistency and transparency.
5. **Cortex**: This leading international cognitive neuroscience journal pioneered the use of Registered Reports[12]. It is also the home of #EEGManyLabs outputs and is committed to improving reporting standards in the field, promoting transparency and rigorous methodology in EEG studies.
6. **EEGManyPipelines**[6]: 168 teams including 396 researchers from 37 countries are exploring variations in analytical procedures. By highlighting how different analysis decisions can impact results, this work is underscoring the need for standardized analysis to enhance reproducibility.

While each initiative contributes to key challenges, they operate independently, and the field risks further fragmentation. Each effort was created to address discrete challenges. As a result, there are inconsistencies in sharing practices of materials, limited opportunity for cross-initiative learning and pollination and most importantly, none possess the necessary community and coordination resources on their own to provide holistic solutions to the broadest issues facing the field. By building on such efforts, the **EEG101 COST Action** will create a network capable of addressing complex challenges that cannot be tackled by any single initiative alone and accelerate the production of replicable, reproducible, and robust EEG research.

Launching **101 years after the discovery of EEG**, this COST Action will integrate data sharing, standardized methodologies, comprehensive training, and collaborative networking into a cohesive framework. This unified network will enable collaborative problem-solving on an unprecedented scale to address **fundamental challenges** in the development and deployment of EEG in basic, clinical, and commercial settings. In doing so, it will establish Europe as a global leader in open EEG science.

Fig.1: Examples of existing initiatives that the EEG101 COST Action will seek to leverage.

1.1.2. DESCRIPTION OF THE CHALLENGE (MAIN AIM)

The primary challenge faced by the EEG community is the **lack of cohesion and standardisation**. This fragmentation limits collaboration, data sharing, and the reproducibility of research findings, thereby reducing the potential impact of EEG on neuroscience, clinical applications, and technological innovations. To address this overarching challenge, it is imperative to establish a coordinated, open, and collaborative network that can harmonise methodologies, improve data accessibility, and provide equitable training opportunities. Under this umbrella, several key sub-challenges emerge:

1. **Fragmentation in Data & Methodology:** The variability across different laboratories and the absence of standardized protocols leads to inconsistencies, making it difficult to replicate or compare findings. This fragmentation hinders cross-laboratory collaborations and meta-analyses - essential for building a cumulative body of knowledge and enhancing the rigour of EEG research.
2. **Limited Data Sharing & Accessibility:** Despite the vast amount of EEG data generated, much of it remains siloed and open FAIR-compliant (Findable, Accessible, Interoperable, Reusable[16]) sharing is rare. Despite several isolated efforts at creating such repositories, there remain substantial difficulties in access to large volumes of curated data, stifling collaboration & preventing large-scale meta-analyses that could validate and expand upon existing findings. This leads to inefficiencies, as valuable data remains underutilized, and efforts are duplicated across labs.
3. **Lack of Standardized Tools & Workflows:** The field lacks widely adopted, open-source tools and workflows for EEG data analysis. Many laboratories rely on custom-built solutions, resulting in inefficiencies and variations in data handling and analysis. This not only limits reproducibility but also restricts the ability to compare results across studies.
4. **Unequal Access to Resources & Training:** Research capacity varies significantly across Europe, with many laboratories—especially in Inclusiveness Target Countries (ITCs)—facing limited access to resources and advanced training. This disparity creates a gap in research quality and prevents some researchers from fully participating in the latest developments in EEG science.
5. **Barriers to Interdisciplinary Collaboration & Networking:** EEG research spans multiple disciplines, including neuroscience, psychology, engineering, and clinical sciences. However, structured opportunities for interdisciplinary collaboration are limited. This hampers the exchange of knowledge, methodologies, and innovations that could accelerate the development of new EEG applications. Building a collaborative network that bridges these disciplines is essential for tackling complex scientific questions and ensuring the growth and diversification of EEG science in Europe.

Consequently, the **main aim of EEG101** is to address these challenges through:

1. **Curated Data Repository:** By curating datasets from existing initiatives and openly available EEG datasets, EEG101 will overcome current fragmentation in data access. A meta-directory will provide a wealth of standardized data, facilitating large-scale analyses. The curated datasets will also serve as foundational material for specialized training courses offered by an EEG101 Summer School.

2. **Open Science Materials:** Through Working Groups, EEG101 will develop and distribute open-source tools for EEG data analysis, including templates for pre-registered studies and standardized workflows for data processing and reporting. By providing user-friendly, accessible tools, EEG101 will lower barriers to entry and encourage widespread adoption of best practices.
3. **Training Resources:** EEG101 will build upon existing educational materials (e.g. PURSUE[17], targeted at undergraduate students) to offer extensive training resources. Prioritising early-career researchers and those from ITCs, EEG101 will create a central electronic resource amalgamating best practices in EEG data collection, analysis, and open science. The COST Action will deliver conferences, launch a new podcast series, and provide asynchronous online resources. These efforts will ensure the next generation of researchers is equipped with the skills and knowledge to conduct high-quality, reproducible studies.
4. **Networking:** By bringing together scientists from different disciplines and countries, facilitated by Short-Term Scientific Missions (STSMs) & Virtual Mobility Awards (VMAs) and distributed conferences, EEG101 will promote the exchange of ideas, facilitate interdisciplinary projects, and help build a community dedicated to advancing open EEG science. Networking will extend to global collaborations, enhancing Europe's leadership role in the international EEG research community.

1.2. PROGRESS BEYOND THE STATE OF THE ART

1.2.1. APPROACH TO THE CHALLENGE & PROGRESS BEYOND THE STATE OF THE ART

A century after Hans Berger's discovery of EEG, we stand on the cusp of a transformative moment for EEG to impact science and society. Recent advances in open science, data sharing, and methodological standardisation are setting the stage for a new era in EEG research and its societal impact. **The EEG101 COST Action will provide the rocket fuel needed to drive this paradigm shift** to integrate data sharing, open resources, training, and networking. It will create a unified framework that, for the first time, systematically integrates data curation with standardized methodologies and comprehensive training. This approach goes above and beyond the remit and capability of existing efforts and will overcome the following key challenges that have hindered EEG science for decades:

1. **Enhancing Data Consistency, Reproducibility, & Provenance:** One of the most pressing issues is the variability introduced when researchers use different parameters for the same analytical methods. EEG101 will implement standardized workflows and promote rigorous data provenance practices, ensuring all analytical steps are traceable. Building on the foundation of existing initiatives, EEG101 will create an interactive web application that will allow users to: (i) **Document Complex Event-Related Potential (ERP) Designs** and detailed statistical analysis procedures; (ii) **Broaden Methodological Coverage** by extending the templates to cover a wide range of experimental approaches (e.g. time-frequency, connectivity measures); (iii) **Solicit Community-Driven Improvements** through member feedback; and (iv) **Provide educational Support**: Develop instructional materials tailored for beginners and advanced researchers.
2. **Reducing "Researcher Degrees of Freedom" through Standardized Pre-Registration & Analytical Workflows:** A key aspect of EEG101's mission is to minimize variability introduced by different data processing decisions, which can lead to divergent results. EEG101 will achieve this by expanding pre-registration templates and providing recommended preprocessing pipelines based on community best practices. Pre-registration ensures researchers commit to specific data analysis plans before accessing their data, reducing bias and promoting transparency. However, there are no widely agreed recommendation for reporting, making consistent application across studies challenging. EEG101 will introduce: (i) **Comprehensive Pre-Registration Templates** that include suggested preprocessing steps, complete with references to similar studies and commonly used parameters; (ii) **Interactive Analytical Tools** that suggest analysis parameters based on commonly used settings; and (iii) **Standardized Workflows** that harmonize data processing across laboratories. For example, researchers working on widely studied measures like frontal alpha asymmetry will be provided with interactive templates containing recommended preprocessing pipelines. This approach will harmonize data processing, minimize the risk of subtle variations compromising reproducibility, and ensure results can be compared with confidence.
3. **Solve Community Challenges STSMs & VMAs:** To address acute challenges, EEG101 will leverage STSMs and VMAs to foster collaboration and innovation. Project prioritisation will be determined through "challenges" identified by Working Groups and via engagement with neuroscience and psychophysiological societies and international journals.
4. **Harmonizing EEG Data Across Diverse Systems & Populations:** A significant challenge is the hardware variation introduced by numerous EEG device manufacturers. This diversity makes it difficult to compare EEG recordings, even when collected from the same population or under similar conditions. EEG101 will lay the groundwork for creating large international normative databases.

These databases will capture information on EEG systems, sociodemographic characteristics and age ranges. Harmonization algorithms will enable the development of age-dependent normative regression equations, resources that will be made widely available to the global EEG community.

1.2.2. OBJECTIVES

1.2.2.1. Research Coordination Objectives

EEG101's will address the fragmentation and variability in EEG research by focusing on **three key pillars**: **Standardize (S)**, **Integrate (I)**, and **Advance (A)**. By standardizing tools and methodologies, EEG101 will develop essential practices for consistency and reproducibility. Through integration, the Action will establish cohesive data-sharing and collaboration platforms, making EEG research more accessible and interoperable. Finally, by advancing open science and fostering innovation, EEG101 will promote knowledge dissemination and drive the field forward. EEG101 has the following specific, measurable, achievable, relevant, and timely (SMART) objectives:

Pillar	#	SMART Objective
Standardize	S1	**Launch standardized reporting tools** by Month 24 to support documentation of complex EEG designs and methods beyond ERPs. Aim for adoption in 100% of empirical EEG101-funded STSMs and VMAs.
	S2	**Provide pre-registered study templates and workflows** by Month 18, including recommended preprocessing pipelines based on community best practices, promoting methodological consistency. Aim for adoption in 50% of new studies by network members by Month 36**.**
Integrate	I1	**Establish a centralized online platform** by Month 12 that hosts: (i) a meta-directory of datasets, (ii) standardized pipelines utilizing open-source toolboxes, (iii) a forum for knowledge exchange, and (iv) a database of software and tools. Aim for 300 registered users by Month 24.
	I2	**Provide comprehensive data descriptions and metadata standards** for all datasets on the EEG101 platform by Month 18, ensuring 100% compliance to improve usability and facilitate comparisons across studies by Month 24.
	I3	**Develop conversion tools to harmonize data** from various devices by Month 24, enabling cross-laboratory research & facilitating the creation of large-scale normative EEG databases. Harmonize ≥10 datasets by Month 36.
Advance	A1	**Facilitate innovation through STSMs & VMAs** by organizing at least 15 community-driven projects focused on high-impact innovations between Months 6 and 42. Outcomes to be presented at annual conferences and in reports.
	A2	**Build partnerships with global EEG initiatives** by establishing formal collaborations with ≥3 initiatives by Month 24 to promote data harmonization and international impact. Engage in joint projects/publications by Month 48.
	A3	**Launch educational and outreach channels** by Month 12, including EEG101 social media channels and a podcast series, to provide educational content and engage the community. Produce regular content pieces aiming to reach 1,000 followers and 10,000 views by Month 42.

1.2.2.2. Capacity-building Objectives

EEG101's capacity-building objectives focus on empowering ECRs and ensuring equitable access to resources, particularly in Inclusiveness Target Countries (ITCs), following the same SMART framework:

Pillar	#	SMART Objective
Standardize	S3	**Develop comprehensive training materials by Month 24,** including tutorials and publications that consolidate best practices for data collection, analysis, and reporting. Make these resources accessible through the EEG101 platform. Aim for 500 downloads/accesses by Month 36.
	S4	**Deliver 3 Summer Schools** focused on state-of-art EEG methodologies and emerging topics between Months 18 and 48. Ensure participation of ≥100 ECRs and researchers from ITCs over the project duration.
Integrate	I4	**Build a collaborative interdisciplinary network** by Month 18, bringing together ≥100 researchers from various fields and geographies to promote joint research and knowledge exchange. Facilitate ≥5 joint research projects by Month 42.

	I5	**Provide access to training resources** by hosting all materials on the EEG101 platform by Month 18, ensuring they are freely accessible to researchers globally. Aim for >300 unique users accessing these resources by Month 36.
	I6	**Support research placements for ECRs** by facilitating ≥15 physical or virtual placements between Months 9 and 42, providing opportunities to conduct research with leading labs in Europe. Ensure ≥50% of placements involve ITCs.
Advance	A4	**Encourage inclusivity & ECR participation** through ≥30 **Travel & Caregiver Grants for** underrepresented groups to attend events throughout project duration. Target representation from ≥15 different ITCs by Month 48.
	A5	**Engage industry** for applied research and innovation by collaborating with at least five industry partners or start-ups by Month 24 through STSMs and VMAs. Facilitate ≥five industry-involved STSMs/VMAs by Month 42.
	A6	**Mentorship through VMA hosts**, matching ≥15 ECRs with experienced mentors by Month 42 to support career development and knowledge exchange. Ensure ≥50% of placements involve participants from ITCs.

2. NETWORKING EXCELLENCE

2.1. ADDED VALUE OF NETWORKING IN S&T EXCELLENCE

2.1.1. ADDED VALUE IN RELATION TO EXISTING EFFORTS AT EUROPEAN AND/OR INTERNATIONAL LEVEL

By aligning with and complementing established platforms EEG101 will avoid duplication of efforts while filling critical gaps in data sharing, reproducibility, and capacity-building.

1. Integrating & Advancing Existing European & Global Initiatives
The are several existing initiatives making contributions to open EEG science, but they **operate independently, limiting collective impact**. EEG101 will leverage this engagement, creating a network capable of addressing challenges that cannot be tackled by individual projects alone.

Developing Interaction Between Initiatives: EEG101 will strengthen the links between experts from established programmes and networks, fostering collaboration and cross-pollination. For example:

- **Integrating Data & Training**: Practical training in the Summer Schools will build on curated datasets from ongoing initiatives and provide access to high-quality, real-world datasets, enhancing learning experiences and promoting the application of standardized analysis methods.
- **Collaborative Expert Training**: EEG101 will facilitate joint training programs where experts from ongoing EEG initiatives related to analysis and reporting will be invited to collaborate to deliver comprehensive workshops and promote best practices across the community.
- **Shared Resources & Platforms**: A centralized platform will enable seamless access to tools, datasets, and documentation from various initiatives. This will encourage researchers to utilize and contribute to shared resources, fostering a culture of openness and collaboration.

2. Establishing Comprehensive EEG Software & Training Resources. EEG101 will develop a comprehensive repository of EEG software and training materials, including:

- **EEG Research Software**: Tools like MNE-Python[18], FieldTrip[15], EEGLAB[19], and Brainlife.io[20], accompanied by tutorials, user feedback, and best-practice guidelines.
- **Advanced Training Materials**: Resources that extend beyond basic processes, offering guidance on open science practices, data sharing, reproducibility, and advanced EEG methodologies.
- A repository will be particularly valuable for early-career researchers and those from ITCs, democratizing access to cutting-edge tools and fostering capacity-building.

3. Enhancing Global Impact Through International Collaboration by:

- **Engaging with Broader International Initiatives**: Connecting with projects that have broader remit, e.g. PublicnEUro[21], European Open Science Cloud (EOSC), EBrains[22] and the Global Brain Consortium[23] as well as specialist tools such as EEGNET[24] through building on open technical architecture, joint symposia and creation of cross-initiative working groups to leverage global efforts.
- **Implementing & Extending a Novel Distributed Conference Model Internationally**: Fostering synergies at European and international levels through keynote invitations, symposia and workshops that address global challenges, strengthening Europe's leadership in EEG research.

2.2. ADDED VALUE OF NETWORKING IN IMPACT

2.2.1. SECURING THE CRITICAL MASS, EXPERTISE AND GEOGRAPHICAL BALANCE WITHIN THE COST MEMBERS AND BEYOND

EEG101 will not only leverage the potential of established initiatives (**which engage >3,000 individuals)** and an initial Proposer Network comprising representation from 24 COST Full Member Countries, including 14 ITCs) but will further expand and strengthen by promoting inclusivity, gender equality, increased inter-sectoral collaboration, and directing funding to support geographical balance.

Strengthening Synergies and Fostering Collaboration. A core objective is to strengthen synergies between existing large-scale initiatives, fostering an environment where collaboration and knowledge exchange are the norms:

- **Unified Networks**: By building on the extensive networks of existing initiatives (engaging >3,000 scientists), EEG101 will create a comprehensive platform for EEG researchers across Europe.
- **Cross-Initiative Collaboration**: Encouraging interactions between experts from different initiatives will lead to sharing of best practices, standardization of methodologies, and joint problem-solving.
- **Enhanced Training & Resources**: A curated data directory of existing initiatives ready for use in practical training sessions will enrich educational programs & support real-world skill development.

Promoting Inclusivity and Geographical Balance

- **Gender Inequalities & Diversity Balance**: A recent survey of the EEG community[25] showed a fair balance of gender in early career (~47% female), but men hold substantially more (~75%) senior positions. Researchers from ITCs are under-represented across the career spectrum. Through establishing an Inclusivity Monitoring Committee and dedicated funding tracks for ECRs and ITCs and Care Givers, as well as VMAs for those unable to travel, EEG101 will contribute to increasing opportunities for members to engage with cutting-edge EEG research and innovation.

Expanding Beyond Europe. While strengthening European activity, EEG101 will broaden its horizons:

- **International Collaboration**: Developing connections with communities in North America, Asia, Latin America, & beyond will enhance the exchange of knowledge and methodologies.
- **Inter-Sectoral Partnerships**: Encouraging collaborations between academia and industry will facilitate the translation of basic science into practical applications, benefiting society at large.

Ensuring Sustainability & Long-Term Impact

- **Legacy of Unified Efforts**: By integrating large-scale initiatives with ready-made critical mass, EEG101 will ensure that the networks and collaborations established will endure beyond the Action.
- **Capacity Building**: Through training programs, resource sharing and dedicated funding tracks for STSMs and VMAs, EEG101 will develop the next generation of scientists, help reduce the underrepresentation of ITCs, securing the future of EEG research excellence in Europe.
- **Standardization & Open Science**: Adoption of standardized methods and open science practices will enhance reproducibility and transparency, solidifying Europe's leadership in EEG research.

2.2.2. INVOLVEMENT OF STAKEHOLDERS

1. Research Scientists & Academics

The primary stakeholders are the scientists actively involved in EEG research, including professors, lecturers, and laboratory directors. Many already participate in ongoing open science related EEG initiatives. Their expertise and commitment are crucial for the success of EEG101. By unifying existing networks, EEG101 will enable these researchers to:

- **Collaborate More Effectively & Advance Scientific Excellence**: Share resources such as data, pipelines, and analytical tools to enhance research outcomes and contribute to cutting-edge research and innovations.
- **Implement Standardized Methodologies**: Adopt consistent practices across Europe, improving the comparability and reliability of EEG studies.

2. Early-Career Researchers (ECRs)

Supporting the next generation of researchers and innovators is a core focus of EEG101. ECRs, including PhD candidates and postdoctoral fellows, are essential stakeholders who will both benefit from and contribute to the Action. EEG101 will provide:

- **Training Programs**: Access to workshops, seminars, and online resources focusing on advanced EEG methodologies, data analysis techniques, and open science practices.

- **STSMs & VMAs:** Allowing ECRs to conduct physical and virtual stays at leading laboratories within the network, gain hands-on experience, mentorship and foster long-term professional relationships.

3. Industry Partners & Developers
EEG101 will have a dedicated promotion track from Month 12 to engage with:
- **Software Developers**: Contributors to open-source EEG analysis tools will be included in EEG101 to ensure that training materials and methodologies reflect the latest technological advancements.
- **Industry Experts**: Professionals from start-ups and established companies will be invited to participate in training events, workshops, and the podcast series, providing insights into industry trends, innovations, and alternative career paths. They will also benefit from dedicated funding streams for STSMs and VMAs that involve industry partners.

4. Academic Journals & Publishers
An essential stakeholder is the academic publishing community, particularly journals committed to advancing open science and research transparency.
- **Improving Reporting Standards**. The COST Action will engage with an international journal to develop best practices for reporting EEG research, thereby setting a benchmark for the field.
- **Enhance Dissemination of Research**: Utilize publisher platforms to share significant findings, methodological advancements, and collaborative works emerging from EEG101 activities.
- **Influence Standards**: Engage with journals to influence editorial policies that support open science and reproducibility and lay the groundwork for the potential future development of a community-driven, academic-owned Diamond Open Access journal on EEG science.

5. Broader EEG & Open Science Communities
The wider EEG research community, including international organizations, ethics committees, and open science advocates, are vital stakeholders who will contribute to and benefit from EEG101's initiatives:
- **Manifesto for EEG Science**: Stakeholders will play a key role in developing and endorsing the manifesto, which will outline ethical principles, standards, and best practices for sustainable EEG research, minimising environmental harm and maximising societal benefit.
- **Data Sharing and Standardization**: Collaboration with international initiatives and platforms will enhance data harmonization and sharing on a global scale, benefiting the entire EEG community.
- **Public Outreach**: Through educational content and public engagement activities, EEG101 will raise awareness about EEG research, its societal impacts, and the importance of open EEG science.

6. Engagement Strategies
- **Regular Meetings & Events**: Hosting distributed conferences and Summer Schools to facilitate knowledge exchange, networking, and collaboration. These events will address both scientific topics and broader issues such as ethics and societal implications.
- **Training and Knowledge Transfer**: Providing accessible training resources, both online and in person, to equip researchers with advanced skills and promote best practices.
- **Flexible Participation**: Encouraging participation from researchers at all career stages and from diverse backgrounds, including those from ITCs and underrepresented groups.
- **Ring-Fenced Funding**: Dedicated VMAs and STSMs for ITC-based researchers and ECRs along with Caregiver Grants, offering opportunities to engage in collaborative projects across Europe, fostering interdisciplinary learning.
- **Outreach Initiatives**: Using the EEG101 podcast to highlight emerging scientists and deploying distributed conferences to disseminate knowledge and engage with communities across Europe.

7. Inclusivity & Diversity
- **Monitoring:** A dedicated Inclusivity Monitoring Committee will be created to track engagement and develop strategies for engagement with underrepresented groups.
- **Representation**: Actively promoting equal opportunities regardless of gender, ethnicity, or geography and promoting participation from underrepresented groups e.g. through dedicated ITC-funding & Caregiver Grants to support conference & summer school attendance.
- **Early-Career Support**: Focusing on the development of ECRs by providing dedicated funding opportunities, mentorship, training, and leadership roles within the Action.

3. IMPACT

3.1. IMPACT TO SCIENCE, SOCIETY AND COMPETITIVENESS, AND POTENTIAL FOR INNOVATION/BREAKTHROUGHS

3.1.1. SCIENTIFIC, TECHNOLOGICAL, AND/OR SOCIOECONOMIC IMPACTS (INCLUDING POTENTIAL INNOVATIONS AND/OR BREAKTHROUGHS)

Short-Term Impacts (Years 1–2):

- **Scientific Impact- Enhancing Reproducibility & Transparency:** In the initial phase, EEG101 will develop standardized protocols, tools, and methodologies to improve consistency in research across Europe. By building on existing initiatives and co-producing frameworks, the project will begin to address fragmentation, leading to more reliable and transparent research outcomes.
- **Access to Resources & Opportunities:** EEG101 will fill critical gaps by providing training on reproducible research practices, data sharing, and advanced analytical techniques through Summer Schools and online resources. ECRs and ITC-based researchers will gain immediate access.
- **Technological Impact- Development of New Tools:** EEG101 will initiate the creation of new tools for data collection, processing, and analysis. Collaboration with developers of existing platforms will ensure that the latest advancements are widely disseminated and can be readily adopted.
- **Promoting Industry Engagement:** By reserving at least **five funded projects** (STSMs/VMAs) for partnership with industry, EEG101 will lower barriers to entry for startups and small enterprises and support the growth of the neurotechnology sector.

Medium-Term Impacts (Years 3–4):

- **Scientific Impact- Expansion of Comparable Data Pools:** Standardization efforts will lead to a larger pool of comparable data, fostering more robust and generalizable findings. This will enhance research quality and enable large-scale studies across Europe.
- **Access to Resources & Opportunities- Empowering the Next Generation of Scientists:** By mid-project, EEG101 will have empowered ECRs, especially from ITCs, through dedicated funding, mentorship, and opportunities to engage in international collaborations. This will enrich the scientific community with diverse perspectives, enhancing creativity and innovation.
- **Clinical Impact:** The implementation of standardized protocols will enhance the quality and validity of multicentre studies and randomized controlled trials (RCTs) and facilitate the development and evaluation of treatments with the ultimate potential to improve patient outcomes in neurological care.

Long-Term Impacts (Beyond Year 4):

- **Scientific Impact- Sustained Open Science Culture:** The foundations laid by EEG101's outputs and community engagement will result in a lasting culture of open, rigorous, and collaborative EEG research. Continued standardization and data sharing will drive ongoing advancements in neuroscience.
- **Clinical Impact- Diagnosis to Intervention:** EEG101 will pave the way for the use of EEG in early detection and more precise classification of brain disorders, promoting the development of timely and accurate interventions, personalized neuromodulation therapies and BCI-based rehabilitation.
- **Innovation & Entrepreneurship:** The global neurotechnology market is expected to grow from USD$16b to USD$38b by 2032[26]. By providing open data and tools, EEG101 will lower the barriers to entry for startups and small enterprises developing neurotechnology products. This could lead to the creation of new companies specializing in medical devices, diagnostic tools, and therapeutic applications, boosting economic growth in the tech and healthcare sectors.

Potential Innovations & Breakthroughs: EEG101's efforts to standardize EEG methods and promote data sharing will pave the way for innovations and breakthroughs, including:

- **Development of International Normative Databases**: By harmonizing data across systems and populations, EEG101 will enable the creation of large-scale normative databases. Such databases have substantial potential to accelerate progress in fields such as neurodevelopmental disorders, and BCIs, allowing synergy between academia and industry, stimulating economic growth and promoting the translation of science into practical solutions.
- **Interdisciplinary Innovations**: By promoting collaboration between neuroscientists, engineers, clinicians, and industry partners, EEG101 will stimulate interdisciplinary innovations that transcend traditional research boundaries, supporting the development of novel technologies and applications that address complex challenges in neuroscience, healthcare and commercial EEG products.

3.2. MEASURES TO MAXIMISE IMPACT

3.2.1. KNOWLEDGE CREATION, TRANSFER OF KNOWLEDGE AND CAREER DEVELOPMENT

i) Knowledge Creation: EEG101 will generate significant new knowledge through a series of interdisciplinary discussions, lab exchanges, and coordinated research efforts. By collaborating across laboratories and sectors, we will lay the foundation for numerous future research directions. Specifically:

- **Enhancing Replicability & Rigour**: Building on existing replication efforts, we will establish benchmark datasets from healthy participants. These benchmarks will serve as foundational reference points for future clinical applications, enhancing the replicability of clinical studies.
- **Standardizing Processing Pipelines**: Building on existing expertise EEG101 will develop standardized analysis pipelines to improve reproducibility and replication. By integrating these tools into training materials and research projects (WGs & STSMs), EEG101 will accelerate new discoveries and promote more robust, reproducible research outcomes.
- **Establishing a Global Ethical Framework**: The Manifesto for EEG Science WG will establish the first-ever ethical framework for EEG research, incorporating principles of open science and research transparency to ensure EEG research is conducted with integrity, and is equitable and sustainable.

ii) Transfer of Knowledge: EEG101 will employ several strategies to ensure knowledge generated is shared widely with academics, industry professionals, policymakers, and the broader community:

- **Open-Access Publications**: Make findings publicly available via open-access journals and preprint servers to ensure accessibility including those from underrepresented regions and ECRs.
- **Digital Dissemination Platforms**: Share key research outputs through the **EEG101 website**, social media platforms, and the **podcast series**. Lay summaries will be created and disseminated via social media channels like X (formerly Twitter) and Instagram to reach broader audiences, including students and community members.
- **Media Engagement**: Engage with media contacts and through Network Proposer University Press Offices to generate interview opportunities and feature discussions, highlighting EEG's societal relevance and generating public interest.
- **Educational Materials**: Develop materials to be shared through partners and translated into multiple EU languages, ensuring inclusivity and broad access.
- **Internships & Knowledge Transfer**: Offer VMAs for scientists to engage with policymakers and charity organizations, focusing on knowledge transfer and communication strategies.
- **Industry Collaboration**: Create a space for industrial partners to share data and insights with researchers, enabling pre-competitive collaboration and fostering innovation.

iii) Career Development: EEG101 is deeply committed to the career development of ECRs, ensuring they have the tools, opportunities, and networks necessary to advance in both academic and non-academic sectors. EEG101 will support:

- **Summer School**: Covering technical skills (e.g., advanced EEG analysis) and professional development e.g. CV writing, grants, and networking strategies.
- **Transparent Authorship and Credit System**: Ensure a transparent credit system that recognizes the contributions of ECRs in publications and projects from this COST Action.
- **STSMs & VMAs**: Dedicated funding tracks allowing ECRs and ITC-based individuals to visit labs/mentors, gain experience with different methods and populations, and expand networks.
- **Leadership Opportunities:** Each WG and activity will have a minimum of 2 ECR "champions".

3.2.2. PLAN FOR DISSEMINATION AND/OR EXPLOITATION AND DIALOGUE WITH THE GENERAL PUBLIC OR POLICY

EEG101 aims to maximize impact through a strategy focusing on dissemination to the scientific community, exploitation of results for technological and clinical advancements in partnership with industry, and engagement with the public and policymakers.

- **Dissemination (Months 6–48):** Outputs will be published via open-access platforms to ensure immediate, unrestricted access. Presentations at international conferences and workshops will begin by Month 6 and continue throughout the project to further disseminate knowledge and foster collaborations. The website, serving as a central hub for sharing data, tools, protocols, and training materials and videos, will be launched by Month 12.

- **Educational Outreach (Months 6–42):** EEG101 will develop tutorials, webinars, and online materials covering foundational and advanced EEG topics beginning in Month 6. EEG101 Summer Schools will be conducted annually starting from Month 18 (i.e. in Months 30 and 42), providing immersive, hands-on training, promoting best practices, and fostering a skilled research community.
- **Public Engagement (Months 6–48):** Through social media (M6) and a podcast series launched by Month 12, EEG101 will communicate findings in accessible language, increasing public awareness and interest throughout the project duration. Interactive content, including infographics and videos, will be produced regularly (e.g., quarterly) starting from Month 6 to engage a broader audience.
- **Exploitation (Months 12–48):** Collaborations with clinicians and healthcare institutions will be established between Months 12 and 42 to facilitate the integration of standardized EEG protocols into basic and clinical research settings. Development of advanced diagnostic tools and software will be pursued with industry partners through funded projects (STSMs/VMAs) initiated between Months 20 and 42. All projects will require a collaborative agreement and Intellectual Property Rights plan, specifying ownership, any licensing terms, and usage rights for any jointly developed technologies or software to facilitate the translation of research findings into market-ready products.
- **Inclusivity & Accessibility (Months 6–48):** Educational materials will be translated into multiple EU languages between Months 36 and 42 to ensure broad access. Activities targeting ITCs and underrepresented groups will be implemented from Month 6 throughout the project to encourage participation. All content will meet accessibility standards to accommodate individuals with disabilities, with compliance ensured starting from Month 12 and maintained throughout the project.
- **Monitoring & Evaluation (Months 6–48):** Effectiveness will be assessed using metrics including citation counts, resource downloads, event attendance, and stakeholder feedback starting from Month 6. Regular reviews will be conducted every six months to refine strategies and enhance future efforts. Feedback mechanisms enabling stakeholder input will be implemented starting from Month 6 and maintained throughout the project.

4. IMPLEMENTATION

4.1. COHERENCE AND EFFECTIVENESS OF THE WORK PLAN

4.1.1. DESCRIPTION OF WORKING GROUPS, TASKS AND ACTIVITIES

The **Working Groups** (WG), **Short-Term Scientific Missions (STSMs) and Virtual Mobility Awards (VMAs)** will address community challenges and support the delivery of the Research Coordination Objectives (S1, S2, I1, I2, I3, A1, A2, & A3). The Management Committee (MC) will lead the coordination of the **Education, Dissemination, and Support** activities through a **Podcast**, **Summer School** and **Conferences** (Fig.2) to deliver Capacity-building Objectives (S3, S4, I4, I5, I6, A4, A5, & A6).

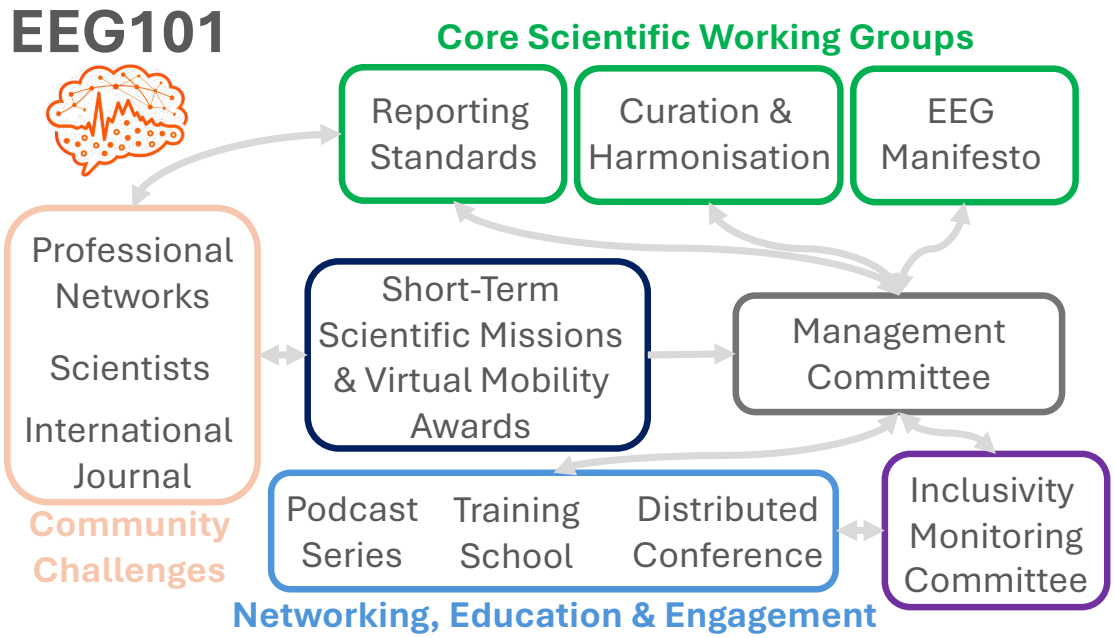

Fig.2: Work Plan Schematic

WG	Objectives	Tasks & Activities	Expected Outputs
Reporting Standards	Develop & disseminate standardized reporting guidelines & templates to promote transparency, reproducibility, & consistency across European EEG research community.	• Create standardized templates for reporting EEG studies, covering advanced experimental designs and methodologies.	• Comprehensive reporting templates that streamline the publication process. • Improved transparency and reproducibility
		• Support complex EEG designs & advanced analyses through community feedback • Develop instructional materials and user guides	• Better standardization and documentation practices across the EEG community.
		• Work closely with journal to pilot implementation of the reporting standards in submission process.	• Increased publication of EEG research adhering to standardized reporting practices
Curation and Harmonization	Curate and harmonize EEG data across different laboratories and equipment, developing standardized workflows and protocols to promote interoperability and facilitate large-scale collaborative research.	• Develop recommended pipelines for commonly studied EEG phenomena. • Implement pipelines in open-source software platforms • Provide interactive tools and documentation to assist adoption of workflows.	• Harmonized data processing methods across laboratories • Reduced variability in analysis results due to methodological differences. • Increased reproducibility of EEG studies.
		• Develop protocols and conversion tools to harmonize data collected from different devices and manufacturers. • Establish guidelines for data acquisition settings to minimize variability. • Conduct collaborative projects to test and refine harmonization methods.	• Standardized datasets enabling cross-laboratory & cross-device comparisons. • Enhanced ability to perform meta-analyses & normative studies. • Increased collaboration among researchers using different systems.
		• Curate and release an open-access EEG database adhering to FAIR principles. • Ensure data quality through standardized curation protocols.	• A publicly accessible database supporting reuse and collaboration. • Opportunities to conduct secondary analyses and large-scale studies.
Manifesto	Develop and promote a Manifesto for EEG Science, outlining ethical principles, standards, and best practices for EEG research, to foster a culture of transparency, openness, and reproducibility.	• Identify key issues through community consultation • Collaborate with stakeholders to ensure diverse representation.	• A foundational document guiding ethical and responsible EEG research practices.
		• Launch online platform for public pledges to the manifesto. • Engage with institutions, journals, and funding agencies to endorse and promote the manifesto	• Widespread recognition and adoption of the manifesto principles. • Increased commitment to ethical and open EEG research practices.
		• Develop training materials to assist in implementing the manifesto's principles. • Conduct workshops to educate on ethical practices and open EEG science.	• Empowered researchers equipped to conduct high-quality, ethical EEG research. • Increased adoption of best practices.

		• Design to influence global standards, offering a universal framework for ethical EEG research & collaborate with international initiatives to promote worldwide.	• International recognition and adoption of the manifesto. • Contributing to global advancement of EEG science standards.

The WGs connect with Community Challenges and initiatives proposed by associations, scientists, and international journals. To address these challenges, STSMs and VMAs will enable researchers to collaborate on specific projects that align with the objectives of the WGs. Dedicated funding tracks for ITC-based researchers and ECRs will facilitate geographical balance & implementation of best practices across the network, promote skill development and allow mentorship opportunities.

Underpinning EEG101 is a series of **education, dissemination, and support activities** coordinated through subcommittees of the MC. These activities leverage scientific outputs from WG1-3 and provide platforms for collaboration, innovation, and community building. All activities will be evaluated and guided by an inclusivity monitoring committee (IMC) responsible for tracking engagement, highlighting achievements and areas for improvement to the MC.

Activity & Description	**Integration Core Scientific WGs**	**Expected Outputs**
EEG101 Summer School providing intensive training for scientists with various levels of expertise in cutting-edge analysis. Offer instruction using open-source toolboxes and advanced methodologies.	• WG1: Incorporate training on standardized reporting & documentation practices developed by WG1. • WG2: Hands-on experience with data processing workflows & harmonization techniques. • WG3: Educate on principles & ethical research practices promoted by WG3	• Training of ~100 members per edition. • Enhanced skills & expertise among EEG researchers. • Accessible teaching materials and resources. • Strengthened network of EEG researchers and educators.
EEG101 Podcast Series: Online video interview series offering insights into the life of scientific labs, career stories, & narratives.	• WG1: Feature discussions on reporting standards. • WG2: Produce educational content featuring experts and emerging scientists. • WG3: Highlight Manifesto and impact on community	• Enhanced public engagement & understanding of EEG. • Career development resources & inspiration. • Increased visibility of initiatives and output
Annual Conference: Distributed, multi-centric meetings empower local communities to access and use new methods. Utilize hybrid format to maximize accessibility and participation.	• WG1: Sessions on standards and best practices. • WG2: Workshops on data curation, harmonization, and processing workflows. • WG3: Keynotes and discussions on ethical practices & sustainability.	• Reinforced network of labs, cities, and communities. • Creation of new scientific competencies in research groups within the network. • Video library of all talks for broader dissemination.
Inclusivity Monitoring Committee: Tracking & promoting diversity and reducing inequalities in community engagement.	• After each event and WG deliverable analyze participant demographics & develop strategies to address underrepresentation	• An annual inclusivity report highlighting achievements and areas for improvement for the Management Committee.

4.1.2. DESCRIPTION OF DELIVERABLES AND TIMEFRAME

Deliverable	**Timeframe**
D1.1. Standardized Reporting Templates	• Months 1-12: Development of templates and guidelines. • Months 13-18: Peer review & response to feedback • Month 24: Release Version 1.0 of the templates.
D1.2. Expansion of Reporting Framework	• Months 13-18: Development of new features. • Months 19-24: Beta testing and refinement.

	• Month 32: Official launch of new framework.
D1.3. Instructional Materials and User Guides	• Months 8-18: Creation of materials. • Month 20: Pre-print Publication and dissemination.
D1.4. Pilot Implementation with Journal	• Months 13-24: Engagement with journal editors and implementation planning. • Months 25-36: Pilot testing with selected journals.
D2.1. Standardized Preprocessing Pipelines	• Months 1-12: Development of pipelines. • Months 13-18: Testing and validation. • Month 24: Release of Version 1.0 pipelines. • Month 42: Release of Version 2.0 pipelines.
D2.2. Data Harmonization Protocols	• Months 12-21: Protocol development. • Month 24: Publication of harmonization protocols v1.0 • Month 25-36: Harmonize ≥10 datasets • Month 36: Publication of harmonization protocols v2.0
D2.3. Open-Access EEG Database	• Months 3-18: Initial curation of datasets. • Month 19: Launch dataset platform • Ongoing: Maintenance and integration of new datasets.
D3.1. Drafting the Manifesto	• Months 1-6: Drafting and stakeholder consultations. • Months 7-11: Public consultation and feedback. • Month 12: Finalization of the Manifesto.
D3.2. Online Platform for Pledges	• Month 10: Development and launch of the platform. • Ongoing: Maintenance and updates.
D3.3. Engagement with Institutions and Journals	• Months 11-15: Outreach to institutions, journals, and funding agencies.
D3.4. Generation of Training Materials and Workshops	• Months 12-18: Development of all resources • Months 18-24: Open release and promotion at events • Months 36-42: Translation into local languages
D3.5. Global Promotion of the Manifesto	• Months 39-48: Engage in international outreach and global collaborations.

4.1.3. RISK ANALYSIS AND CONTINGENCY PLANS

Risk	Chance	Impact	Mitigation Measures
Low Attendance at Networking Activities & Engagement in Wider Activities	Low	High	• **Engagement Strategy**: Develop comprehensive plan for diverse participants especially in ITCs. • **Delegation of Responsibilities**: Assign specific roles to Action members to enhance commitment & ownership. • **Targeted Outreach**: Utilize established networks to reach experts and professionals outside of EEG101. • **Inclusive Communication**: Ensure all communication is accessible and appealing to a broad audience. • **Family Friendly**: "Caregiver Grants" for people with a broad range of personal circumstances. • **Open Invitations**: Through established channels (social media, conferences, societies).
Intellectual property and competition	Medium	Medium	• **Data Sharing Agreements:** Develop clear data sharing agreements that outline ownership, access rights, and publication restrictions. • **Open Science Principles:** Educate & engage to encourage data sharing & collaboration. • **Incentives for Collaboration:** Provide incentives to collaborate and share data, such as joint publications or funding opportunities
Technical challenges	Medium	Medium	• **Cloud-Based Solutions:** Utilize existing cloud-based platforms for data storage, management, and analysis to address scalability and accessibility issues.

related to the online platform			• **Computational Infrastructure:** Include access to sufficient computational resources, such as high-performance computing clusters in budget.
Delay in Deliverable Release	Low	Medium	• **Regular Meetings**: Schedule frequent meetings among WG leaders to monitor progress. • **Clear Deadlines**: Establish clear deadlines & milestones for each deliverable annually & review.
Legal and Ethical Issues related to Data Sharing	Low	High	• **Expert Involvement**: Engage with legal & ethical experts specializing in privacy & GDPR through Network Proposer organisations. • **Existing Platforms:** Build on existing dedicated GDPR-compliant neuroimaging platforms.
Unequal Access to Training and Resources Across Regions	Medium	High	• **Inclusivity Measures**: Offer online training & resources accessible to all participants. • **Travel Grants**: Ring-fence grants for participants from underrepresented regions and groups. • **Monitoring Participation**: Assess participation rates and address gaps proactively through IMC.
Limited Adoption of Tools and Protocols by Community	Medium	High	• **Community Involvement**: Involve end-users in development of tools & protocols. • **Monitoring & Support**: Set measurable targets for adoption in project lifetime. Offer comprehensive and targeted training & support. • **Demonstrate Value**: Highlight success stories, and incentives via Podcast, Summer School & Conferences.
STSMs & VMAs Not Meeting Objectives	Low	Medium	• **Selection Criteria**: Establish stringent quality & feasibility criteria for selecting STSM & VMA proposals. • **Supervision & Support**: Assign mentors or supervisors to guide STSM and VMA participants • **Evaluation**: Conduct post-mission evaluations to assess impact and learn lessons.
Sustainability Beyond the COST Action Duration	Medium	Medium	• **Long-Term Plans**: Develop sustainability plan in Months 7-15 and evaluate in W4 of Years 2, 3 and 4. • **Alternative Funding**: Explore additional funding opportunities (e.g., Horizon Europe, national grants, organizations). • **Documentation & Legacy**: Ensure all resources are well-documented and accessible for future use.

4.1.4. GANTT DIAGRAM

Year	1				2				3				4			
Quarter	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Core Management Committee Tasks																
Quarterly Meetings																
Annual Progress Review																
EEG101 Central Online Hub																
Integrate Tools into Website																
Sustainability Planning																
Engage International Initiatives																
WG1: Reporting Standards																
Draft Templates & Guidelines																
Peer Review of Templates																
Expand feature set																
Beta Testing & Refinement																
Release v1.0 Templates																
Reporting Web Platform																
Instructional Materials																
Pre-Print & Dissemination																

Engage with Journal Editors																
Pilot Testing with Journal																
WG2: Curation & Harmonization																
Development of Pipelines																
Testing & Validation																
Release Pipelines v1.0																
User Feedback Integration																
Release Pipelines v2.0																
Curation of EEG Database																
Launch of EEG Database																
Harmonization Algorithms																
Publish Harmonization v1.0																
Harmonization of ≥10 datasets																
Publish Harmonization v2.0																
Ongoing Integration of data																
WG3: EEG Manifesto																
Drafting Manifesto																
Stakeholder Consultations																
Public Consultation																
Finalize Manifesto																
Launch Pledge Platform																
Monitor Pledge Platform																
Outreach & Promotion																
Summer School Materials																
Local Languages Translation																
International Promotion																
Summer School																
Establish Task Force																
Materials & Planning																
Summer School Delivery																
Evaluation																
Sustainability Planning																
Podcast Series																
Planning & Promotion																
Launch																
Ongoing Production																
Distributed International Conference																
Establish Task Force																
Planning & Promotion																
Conference Delivery																
Evaluation																
Sustainability Planning																
Short-Term Scientific Missions & Virtual Mobility Awards																
Community Challenges Call																
Promote to Industry Partners																
STSM & VM Cycles																
Project Reports																
Inclusivity & Engagement Monitoring																
Establish Committee																
Monitor Activities & WG																
ECR & ITC Travel Grants Call																
Caregiver Grants Open Call																
Annual Report to MC																