FAIRWAY for FAIR DATA: Implementing Electronic Lab Notebooks in Research Centers – The CIIMAR Case

FAIRway
A Pathway to Promote Open Science Through Research Data Lifecycle Management

Maria Paola Tomasino[1], Hassan Shoaib[2], António Muñoz[3], Nuno Fonseca[3], João Aguiar Castro[4]

[1]CIIMAR - [2]FEUP - [3]CIBIO-BIOPOLIS - [4]INESC TEC

Electronic Lab Notebooks (ELNs) are transforming research by replacing paper notebooks with secure, traceable, and shareable digital systems that enhance data integrity, reproducibility, and alignment with FAIR and Open Science principles.

The Interdisciplinary **Centre of Marine and Environmental Research (CIIMAR)** has begun its transition to digital research practices by implementing an open-source ELN

- ✔ to enhance collaboration, transparency, and reproducibility across its multidisciplinary teams
- ✔ to overcome issues caused by fragmented data stored across paper notebooks, personal computers, and local drives—which hinder access, sharing, and long-term preservation.

This transition streamlines data organization, strengthens integrity traceability, and supports a more efficient, transparent, and reproducible research environment.

FAIRWAY Project

The ELN implementation at CIIMAR is carried out within the FAIRway project, an initiative dedicated to strengthening Research Data Management and advancing Open Science. By supporting the integration of ELNs into research workflows, FAIRway helps establish a solid foundation for transparent, reproducible, and FAIR-aligned scientific practices

FAIR Principles

Findable · Accessible · Interoperable · Reusable

ELN implementation CIIMAR ACTION PLAN

Landscape Analysis
Survey 36 Research Groups, Evaluate ELN Readiness, Assess Workflows and Collaboration

ELN Tool Selection
Researcher Needs, System Compatibility, Integration, Licensing, Support & Sustainability

Pilot & Evaluation
Representative Groups, Tool Performance Testing, Feedback Collection & Analysis

Training Capacity Building
Seminars, Workshops, Tutorials & Templates, Helpdesk, Practice Sessions

ELN matrix comparison

Features	eLabFTW https://www.elabftw.net	RSpace https://www.researchspace.com	Chemotion https://chemotion.net	openBIS https://openbis.ch/
✓ Experiment documentation	Easy-to-use graphical user interface (GUI)	Suitable for medium to large research institutions and research centers.	Chemistry-focused tools with chemistry-specific functionality, including reaction management, chemical structure editing, spectral data handling, and automated stoichiometry calculations.	Designed for data-intensive biological research environments, including molecular biology, microbiology, genomics, proteomics, and cell-culture workflows.
✓ Inventory and sample management	Powerful experiment documentation tools, and resource management with templates, attachments, linking, and WYSIWYG/Markdown editors.	Good interoperability with extensive integrations (e.g., Dataverse, Figshare, Box, OneDrive, Git, and others).	Integrated Chemotion Repository with DOI publishing	Hybrid ELN + LIMS platform with a hierarchical data model (Projects → Experiments → Objects).
✓ User access control and permission settings	Centralized control through an "Instance Coordinator," who manages teams, admins, and users, and defines access to experiments and resources	Granular access control at group, project, and user levels, using multiple authorization approaches: Access Control Lists (ACL) with administrator oversight, and Role-Based Access Control (RBAC) for admins and team leaders.	Admin-controlled environment for user management, authentication, and permissions	Role-based administration, where the Instance Admin manages the full installation and the Space Admin controls roles and projects within each Data Space.
✓ Cost and expenditure	Fully open-source and free when self-hosted (no license cost); payment only required for the optional hosted "Pro-Hosting" service, which is competitive and affordable compared to other ELN platforms	Free Community Edition (with limited features), while the "Team" and "Enterprise" plans are paid and relatively costly, with pricing depending on institutional size.	Open-source and free to self-host, with no access or deposit fees for the Repository.	Open-source platform, with self-hosting options; cloud hosting offered by openRDM.swiss (free for Swiss institutions, paid for international users).

✔ eLabFTW

supports **FAIR** and **Open Sciences** principles by providing:

- Efficiency
- Organization
- Collaboration
- Improve documentation workflows
- Transparency and Reproducibility
- Audit Trails for Traceability & Compliance.
- Strengthens Data Integrity
- Robust Data Security
- Tracking (ChangeLog/Revisions)
- Timestamping
- Access control
- Encryption

This action plan will also guide the creation of best-practice guidelines for ELN adoption at CIIMAR. Developed as part of a Master's thesis during the pilot phase and delivered through the FAIRway project, these guidelines will provide the first structured framework for ELN implementation at the institute.

Guidelines will be openly shared with the scientific community, promoting rigorous, collaborative, and FAIR-aligned data management.

INESC TEC · ciimar · BIOPOLIS · FCCN · fct Fundação para a Ciência e a Tecnologia · PRR Plano de Recuperação e Resiliência · REPÚBLICA PORTUGUESA · Financiado pela União Europeia NextGenerationEU