PaNOSC is a European project financed by the INFRAEOSC-04 call for making FAIR data a reality in six European Research Infrastructures (RIs) for photon and neutron science, developing and providing services for scientific data, and connecting these to the European Open Science Cloud (EOSC).

# PaNOSC key achievements in the 1st implementation period (18 months)

## Data Policy & Stewardship

To make FAIR data a reality for research data produced by the photon and neutron facilities involved in PaNOSC and its sister project ExPaNDS, PaNOSC updated the **PaNdata data policy framework to be FAIR**[1]. The framework will be adopted by all partners to ensure they have FAIR data policies in place.

The updated framework has been then compared with the RDA FAIR Data Maturity Model[2] to evaluate the level of FAIRness.

## Data Catalogue

To make data **Findable** and **Accessible**, enabling domain-specific searches across the PaNOSC data repositories, a **search API** has been defined and developed.
All sites have also implemented the **OAI-PMH protocol** for indexing metadata and data by OpenAire and r3data.

To make data **Re-usable**:

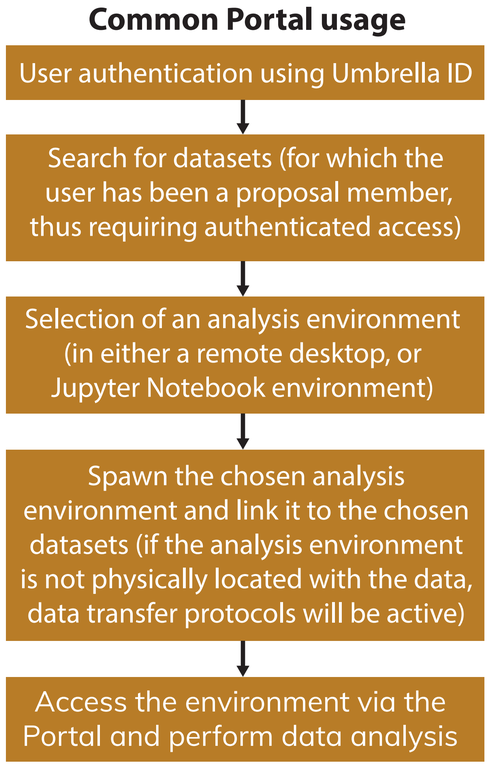
- Metadata harvesting endpoints have been deployed at all partners;
- NeXus has been promoted as community metadata standard for PaN sources;
- Electronic logbooks have been developed to capture what happens during experiments at few sites.

## Data Analysis Services

PaNOSC has been developing the **Common Portal for Data Analysis Services** to facilitate starting a data analysis session after a dataset of interest has been collected.
The Portal aims to provide access to both remote desktop environments and Jupyter Notebooks, enabling users to **remotely analyse data** from PaN facilities.

After initial deployment at facilities to provide remote analysis services to local data, the Portal will be deployed as part of the EOSC to provide federated data analysis of data across the facilities.

**Typical workflow for Common Portal usage**




### Milestones reached

- Existing data analysis requirements and solutions from all partner sites (including ExPaNDS) have been surveyed;[3,4]
- **All sites now provide remote desktop analysis services or remote Jupyter Notebook analysis services in a variety of states** (some in production with large user numbers);
- Provision of a citizen science prototype environment for remote and reproducible data analysis of COVID 19 infection data **OSCOVIDA** (https://oscovida.github.io).

### Common Portal - Achievements

- Possible **use cases of the Portal** have been listed[5];
- Definition of the **Portal Architecture** by adopting a microservices approach (foundation services, user services and compute services[6,7]), for more flexible integration into site-specific infrastructures.

## Simulation Data System

PaNOSC has been developing the **"Virtual Neutron and x-raY Laboratory" (ViNYL)**, to offer services for simulation and modelling of PaN sources, beamlines and experimental instruments, as well as start-to-end simulations to describe entire experiments at PaN facilities.

### Milestones reached

- All simulation codes and frameworks were added to the PaNdata software catalogue;
- Domain-specific extensions published, to the simulation metadata standard openPMD for coherent wavefront data, molecular dynamics, PaN raytracing.

## Sustainability

PaNOSC has been constantly interacting with stakeholders, and contributing to shape the EOSC. This is necessary to ensure, through the proper definition of costs and metrics, realistic **business models** for the sustainability of the services to be developed during the lifetime of the project and made available through the EOSC.
The partners also identifed possible areas of collaboration with other projects and initiatives.

## EOSC Integration

PaNOSC has been working towards setting up a **federated Authorization and Authentication Infrastructure (AAI)** for the users of PaN facilities, which will allow seamless access to data and data services. In close collaboration with GÉANT, the UmbrellaID management formally approved the introduction of eduTEAMS in the UmbrellaID infrastructure, and services have been set up to accept authentication through it.

## Staff & User Training

The e-learning platform e-neutrons.org has been migrated to ESS, where it is now operating under the domain name **pan-learning.org**. It will be used to provide training resources for both staff and users of PaN sources.
Various solutions for integration of Jupyter in the platform have been identified, and work has started to integrate federated AAI.
PaNOSC and ExPaNDS will add new content, and workshops for both PaN staff and users will take place to get acquainted with the features and functionalities of pan-learning.org.

[1] PaNOSC FAIR Research Data Policy Framework: https://doi.org/10.5281/zenodo.3862701
[2] FDMM: https://doi.org/10.15497/RDA00045
[3] https://www.panosc.eu/wp-content/uploads/2019/12/D4.1-Report-Data-Analysis-Capture.pdf
[4] https://confluence.panosc.eu/display/wp4/Task+4.1+-+Extended+Survey+Summary
[5] PaNOSC Use Cases Confluence page: https://confluence.panosc.eu/x/lwGm
[6] Specifications for each microservice: https://confluence.panosc.eu/x/lwCm
[7] Source code on Github, for microservices' development: https://github.com/panosc-portal

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**CONTACT**
Andy Götz (Project Coordinator)
andy.gotz@esrf.fr
+33 476 882131

https://panosc.eu
@Panosc_eu