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NETWORK MODEL FOR RESEARCH DATA MANAGEMENT SUPPORT IN THE NATIONAL ACADEMY OF SCIENCES OF UKRAINE: COMPETENCE CENTRES AND EOSC NODES

ABSTRACT. *The aim of the study is to substantiate a multi-level model of research data management support for institutions of the National Academy of Sciences of Ukraine under conditions of a shortage of specialised staff and the gradual development of interaction between research institutions and the EOSC Federation. Ways of organising competence centres in eight European countries were compared, and the research scenario of the MATSCI-NASU project, aimed at creating a thematic materials-science Node within EOSC, was analysed. It was established that the required competencies are already partially developed among researchers, library, and information professionals, IT specialists, and research data management professionals, but require coordinated interaction. The proposed model combines an institutional point of contact for users, thematic competence centres, and central coordination. MATSCI-NASU was used as a practical demonstrator of role distribution during the DFT → MLIP → MD process. The advantage of the network model is associated with the accessibility of support, disciplinary specialisation, scalability, and reduced duplication of full teams in each institution.*

KEYWORDS: *research data management; FAIR; competence centre; EOSC; National Academy of Sciences of Ukraine; MATSCI-NASU project.*

INTRODUCTION. Open Science is shifting from merely making individual results accessible to ensuring their reuse within a digital research environment. For data, software, models, and computational workflows, unambiguous description, information on provenance and transformation history, defined conditions for access and reuse, and the ability to link individual digital objects to one another are becoming increasingly important. The FAIR principles provide the general framework of findability, accessibility, interoperability, and reusability for such resources (Wilkinson et al., 2016; Wilkinson et al., 2025).

The practical challenge lies in the distribution of responsibilities. Researchers determine the scientific content of the data, the underlying methodology, and the criteria for result validity. Library and information professionals have competencies in metadata, identification, preservation, and access provision. IT specialists provide computing, storage, authentication, and the operation of digital services. Research data management (RDM) professionals facilitate the creation of metadata schemes for digital objects in disciplinary areas, including computational workflows, and reconcile all these requirements when preparing digital research objects for publication and reuse. Thus, a substantial share of the required competencies already exists within research institutions, though distributed across different professional groups. This distribution of roles corresponds to the European transition towards the professionalisation of RDM and the development of a system of data stewards (European Commission, 2018; Basalti et al., 2024).

For the National Academy of Sciences of Ukraine (NASU, NAS of Ukraine), this issue is directly related to resource constraints. Establishing a fully functioning RDM service within each institution would ensure local access to digital objects, yet require substantial specialised staffing. Conversely, a centralized coordination centre would reduce duplication at the risk of creating bottlenecks and losing disciplinary context. Therefore, the subject of this study is an organisational model in which routine questions are resolved close to the researcher, complex questions are referred to a specialist with the required competencies, and prepared solutions are retained for reuse. An additional prerequisite for discussing such a model is the updated Roadmap for Ukraine's Integration into the European Research Area, which provides for the development of professional training in RDM and competence centres (Ministry of Education and Science of Ukraine, 2025).

In this study, a Research Data Management Competence Centre (hereinafter the Competence Centre) is conceptualised as the organisational framework for providing researchers with methodological and technical support to create and publish FAIR digital objects in repositories. Within this approach, the researcher has a clear point of contact; a complex question may be referred to a specialist from another unit or institution; methodological solutions are accumulated in a shared knowledge base; and competence development is a permanent function of the EOSC Federation network. A Competence Centre may be a separate unit, a distributed team, or a function of a broader research infrastructure. Its value is determined by users' access to the required knowledge, competencies and practical results, rather than by the number of staff in its own establishment.

The aim of the study is to substantiate a multi-level RDM support model for NASU research institutions and to determine the conditions under which such a model has an advantage over a fully centralised or fully institutional approach. The authors' contribution is focused on three components: the operational distinction between a local RDM service and a networked Competence Centre, the model "institutional support — thematic Competence Centre — central coordination", and verification of the distribution of roles using the research scenario of the MATSCI-NASU project, which aims to create a thematic materials-science Node of the EOSC Federation within NAS of Ukraine. The concept of creating a network of thematic EOSC nodes at the NAS of Ukraine was proposed in (Zagorodny et al., 2026).

METHODS. The study combines a comparative analysis of European practices with an analysis of a practical scenario for the operation of Competence Centres. The purposive sample comprises eight countries – the Netherlands, France, Sweden, Germany, Austria, Spain, Finland, and Italy. The sample covers different ways in which Competence Centres organise RDM support, serving to typologise models of such centres rather than to statistically assess their prevalence in Europe.

Four features of the work of a Competence Centre were used for comparison: 1) a defined channel for user requests, 2) systematic development of researchers' competences, 3) an established procedure for referring complex requests to specialists with the required knowledge, and 4) shared methodological resources for creating metadata schemes for FAIR digital objects and their reuse. The following properties of the centres were also analysed: organisational level, host institution, networking model, and the relationship of professional support with digital infrastructure and the relevant EOSC Node. The set of features is aligned with the network approaches of the Skills4EOSC and OSCARS projects (Skills4EOSC, 2025; David et al., 2025). This approach makes it possible to compare Competence Centre structures with different names and legal forms according to how they actually organise work with users.

Four criteria were used to assess the suitability of the models for NAS of Ukraine conditions: 1) accessibility of initial support, 2) the possibility of engaging a disciplinary specialist, 3) scalability under staff shortages, and 4) the extent to which identical functions are duplicated across institutions. The conclusion concerning the advantage of a multi-level network applies specifically to these criteria and resource conditions, rather than constituting a universal assessment of all possible organisational models.

Practical verification was carried out using materials from the MATSCI-NASU project, which uses as the main digital object the DFT → MLIP → MD computational workflow which implements a sequence of density functional theory (DFT) calculations, training of a machine-learned interatomic potential (MLIP), and molecular dynamics (MD). By creating interconnected digital research objects, it enables tracing of who provides scientific content, who supplies computing infrastructure, and who documents relationships among the results. The project is used as a demonstrator of the organisation of user support and shows individual elements of the future interaction of thematic NASU EOSC Nodes with the EOSC Federation, rather than a completed Node architecture.

RESULTS AND DISCUSSION.

1. Practical Difference Between a Competence Centre and a Local RDM Service

The comparison showed that the service portfolio alone does not distinguish a Competence Centre from a strong institutional RDM service. Both structures may provide advice on data management plans, metadata, repository publication, application of the FAIR principles, and training. The distinction emerges in how a complex request is handled, including the creation of metadata schemas for complex digital objects. A local service provides assistance within the competences available in its own institution. A networked Competence Centre has a defined procedure for engaging a specialist from another level of the system and retains the prepared solution so that it can be reused by other researchers.

This provides a concrete practical definition of the functions of a Competence Centre: receive a request, clarify the problem, identify the knowledge required to solve it, engage the appropriate specialist, bring the work to a practical result, and formalise a reusable solution. This approach shifts the concept of a “competence centre” from an administrative description to a verifiable way of organising user support.

For a system with limited staff, this distinction is fundamental. The full set of competences does not need to be concentrated in every local team. An institutional contact person can resolve a routine question or refer it to the thematic level, to the appropriate Competence Centre, where a thematic specialist has the competence to work with disciplinary semantics, ontology, and a specialised workflow. Accordingly, this level maintains common rules, methodological resources, training, and a knowledge base. Thus, the network shares existing competences rather than duplicating them in every institution.

2. European Organisational Models and a Common Operating Principle

The analysis of European experience showed a diversity of organisational forms of Competence Centres. Four organisational types can be identified in the sample: 1) local-institutional, 2) a central coordination hub with local teams, 3) a thematic network, and 4) an integrated model in which the operator of digital

infrastructure also coordinates professional user support. The specific name of a Competence Centre as a structure, its institutional subordination, and its relationship with an EOSC Node differ across countries, as a single legal type of Competence Centre has not yet emerged.

Despite this diversity, one practical sequence recurs. The researcher receives initial assistance through an established channel. A question requiring deeper disciplinary or technical knowledge is referred to the appropriate specialist. A solution useful to other users is formalised as an instruction, template, metadata profile, checklist, or other methodological resource. It is this principle that is important for implementation in NAS of Ukraine, where reproducing a specific foreign legal arrangement is unnecessary.

The EOSC Federation adds an inter-organisational dimension to this model. An EOSC Node provides resources and services and connects to common federation functions. A repository provides publication, versioning, preservation, and access. A Competence Centre provides professional support for researchers: it assists users in formulating a request, preparing digital research objects, determining the necessary metadata schemes for digital objects, and finding the required services or specialists. A Competence Centre and an EOSC Node operator may be organisationally co-located, but this is not a prerequisite for these functions to be performed. (EOSC Association, 2026).

3. A Multi-Level Model for NAS of Ukraine

Based on the comparison, a Competence Centre model consisting of three interconnected levels is proposed for NAS of Ukraine. The institutional level provides a clear point of contact and assistance with routine RDM questions. It may be supported by a trained contact person, a small service, or an existing unit formally designated for this function. The task of this level is to resolve a standard question quickly, or determine to whom it should be referred for consultation.

At the second level, thematic Competence Centres bring together relevant specialists with knowledge in a specific scientific field. This level addresses disciplinary metadata profiles, specialised formats of computational workflows, research software, rules for documenting the provenance of data and workflows, their transformation history, and requirements for reuse. A thematic Competence Centre may operate as a distributed group spanning several institutions. Specialists remain in their own organisations, but their competence becomes accessible through a jointly agreed working procedure.

The central coordination level facilitates the establishment of thematic Competence Centres where necessary, maintains shared methodological resources, training for data curators and professional development of researchers in RDM, exchange of practices, a catalogue of available specialists, and interaction with repositories, digital infrastructures, and future EOSC Nodes within NAS of Ukraine. Central coordination is also required to prevent institutions from duplicating efforts and facilitate the transfer of successful solutions into a shared knowledge base.

The advantage of such a model becomes apparent under specific conditions. Compared with a single central Node, it preserves the proximity of initial support to researchers and the disciplinary context of work with digital objects. Compared with a full-function RDM service in each institution, this model reduces the need to duplicate specialised competences. Therefore, for NAS of Ukraine, a multi-level network is appropriate according to the criteria of accessibility, specialisation, scalability, and limitation of staff duplication. Given potential resource and organizational constraints, this conclusion should not be interpreted as a universally applicable model for all research systems.

4. The MATSCI-NASU Project as a Practical Demonstrator of Role Distribution

The MATSCI-NASU project, implemented within the EOSC Gravity programme, aims to establish a thematic NASU EOSC Node for materials science. The project is implemented by the Bogolyubov Institute for Theoretical Physics of the National Academy of Sciences of Ukraine (BITP), the Frantsevich Institute for Problems of Materials Science of the National Academy of Sciences of Ukraine (IPMS), and Kyiv

Academic University (KAU), and makes it possible to test the proposed logic on a specific computational workflow. The project uses the DFT → MLIP → MD computational workflow, which implements a sequence of density functional theory (DFT) calculations, training of a machine-learned interatomic potential (MLIP), and molecular dynamics (MD). To ensure the reusability of the final results, the provenance across computational stages must be maintained: the specific DFT data utilized for machine learning, the software version and configuration, the applied training parameters, and the integration of machine-learned interatomic potentials into MD calculations of physical properties. Workflow Run RO-Crate approaches are relevant for the formalised description of computational workflow execution (Research Object, 2026).

Roles in the project are distributed according to competences. IPMS is responsible for the disciplinary workflow and scientific interpretation. BITP provides the digital infrastructure environment, including computing, authentication and authorisation, and supports the operation of DataverseUA, the Open Data Repository of the National Academy of Sciences of Ukraine. Through the NASU FAIR Data Competence Center operating at KAU, KAU supports the development of metadata schemes, including those for computational workflows, preparation of documentation packages for the workflow and related data, preparation of digital research objects for reuse, and relevant researcher training. Scientific responsibility for the use of methods and the quality of results remains with the authors and disciplinary experts.

The project demonstrates that researcher support is needed throughout the entire process of documenting digital research objects up to the publication of research results in a repository. If computational workflow parameters, software versions, relationships between files, and the provenance of digital objects are recorded during workflow execution, they do not need to be reconstructed at the end of the research. In this scenario, the Competence Centre assists in specifying what information must be retained at each stage of the workflow, who is responsible for providing it, and how it should be structured within the documentation package. The infrastructure team provides the technical computing services, while the disciplinary group defines the scientific content of the workflow.

The MATSCI-NASU project confirms the practical need for coordination among disciplinary, information, and infrastructure competences in implementing a specific workflow. At the same time, this pilot does not demonstrate the effectiveness of the entire multi-level model of competence centres for NAS of Ukraine. Such a conclusion would require testing the model on several materials-science workflows and including other thematic areas, with quantitative indicators recorded.

5. Practical Results and Criteria for Further Verification

An organizational model for conducting research demonstrates value only when it mitigates repetitive tasks that researchers would otherwise be forced to perform. Therefore, the practical effect of a thematic Competence Centre should be assessed through concrete results of work with users: the time from a request to receipt of an answer or consultation; the share of user requests resolved at the institutional level; the time required to find a thematic specialist to prepare documentation for depositing a computational workflow; the number of reused templates and methodological solutions; the number of datasets and computational workflows that, after consultation, were published in a repository; the time required to enable reuse of digital objects deposited in a repository; and the number of trained data curators and training webinars for the professional development of researchers.

This approach also clarifies the expected contribution of Competence Centres to implementing the FAIR principles in the deposition of datasets and computational workflows. The Centre supports the publication readiness of digital objects by structuring their metadata, relationships, access rights, and provenance info, while guiding the selection of relevant metadata standards. While scientific and substantive responsibility remains with the researcher, the Competence Centre provides expert guidance on implementing the FAIR principles. For inter-Node EOSC scenarios, this is complemented by aligning the description of the digital object with the requirements of services that are expected to find, accept, or use it.

Semantic interoperability becomes a separate task. The transfer of a structured metadata file between two repositories with different deposition systems is enabled by technical exchange, but the meanings of fields and metadata relationships must be understood by both parties. This requires agreed metadata profiles, vocabularies and a data ontology, persistent identifiers, and rules for mapping between schemes (DataCite Metadata Working Group, 2024; European Commission, 2021; Baumann et al., 2026). A Competence Centre can coordinate the preparation of such rules together with disciplinary and technical specialists, while their software implementation is provided by the digital infrastructure.

Further verification of the Competence Centre model should cover at least several thematic areas within NAS of Ukraine. Evaluation should focus not on the volume of established centres or delivered consultations, but on structural changes in the research process: reduced data entry redundancy, faster access to metadata scheme specialists, increased reuse of methodological resources, and a lower administrative burden on researchers during digital object publication.

CONCLUSIONS. The comparative analysis demonstrates that RDM competence centres have different organisational forms but can be described through a common working procedure: a clear point of contact, referral of a complex question to a specialist with the required knowledge, competence development, and reuse of prepared solutions. This functional framework decouples the core role of Competence Centres from any single legal structure.

For NAS of Ukraine, a model of a multi-level network of thematic Competence Centres with central coordination and institutional support is proposed. Its advantage is substantiated for conditions of a shortage of specialised staff according to four criteria: accessibility, disciplinary specialisation, scalability, and reduced duplication. The model uses existing professional groups of research staff and the organisational infrastructure of NAS of Ukraine, and a full-function RDM team is not required in every institution.

The MATSCI-NASU project demonstrates how such coordination is implemented in the context of a specific DFT → MLIP → MD computational workflow. Here, disciplinary researchers define the scientific content and are responsible for the result, the infrastructure team provides computing and digital services, and the Competence Centre develops a metadata scheme for the workflow, formulates provenance and relationships between digital objects, and facilitates the preparation of documentation for reuse. The project reveals how elements of the future model operate and provides a vision of the structure of a NASU materials-science EOSC Node.

The next stage of the study is to test the model across several thematic areas and quantitatively assess its effect for the researcher. Future institutional developments must focus on mitigating manual workload redundancy and accelerating access to expert support, instead of prioritizing the physical establishment of new organizational units.

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МЕРЕЖЕВА МОДЕЛЬ ПІДТРИМКИ УПРАВЛІННЯ ДОСЛІДНИЦЬКИМИ ДАНИМИ В НАЦІОНАЛЬНІЙ АКАДЕМІЇ НАУК УКРАЇНИ: ЦЕНТРИ КОМПЕТЕНЦІЙ ТА ВУЗЛИ EOSC

АНОТАЦІЯ. Метою дослідження є обґрунтування багаторівневої моделі підтримки управління дослідницькими даними для установ Національної академії наук України в умовах дефіциту спеціалізованого персоналу та поступового розвитку взаємодії між дослідницькими установами та Федерацією EOSC. Було порівняно способи організації центрів компетенцій з управління дослідницькими даними у восьми європейських країнах, а також проаналізовано дослідницький сценарій проекту MATSCI-NASU, спрямований на створення тематичного вузла матеріалознавства в рамках EOSC. Було встановлено, що необхідні компетенції вже частково присутні серед дослідників, фахівців з бібліотечної та інформаційної галузі, IT-фахівців та фахівців з управління дослідницькими даними, але потребують скоординованої взаємодії. Запропонована модель поєднує інституційну точку контакту для користувачів, тематичні центри компетенцій та централізовану координацію. MATSCI-NASU було використано як практичний демонстратор розподілу ролей під час робочого процесу $DFT \rightarrow MLIP \rightarrow MD$. Перевага мережевої моделі пов'язана з доступністю підтримки, дисциплінарною спеціалізацією, масштабованістю та зменшенням дублювання повних команд у кожній установі.

КЛЮЧОВІ СЛОВА: управління дослідницькими даними; FAIR; центр компетенцій; EOSC; Національна академія наук України; MATSCI-NASU project.