

Data Integration and Semantic Alignment Across Disciplines with NFDIcore

Tabea Tietz, Shiva Nahani, Dilek Yargan, Alsayed Algergawy,
Jörg Waitelonis, and Harald Sack

FIZ Karlsruhe – Leibniz Institute for Information Infrastructure, Hermann-von-Helmholtz-Platz 1,
76344 Eggenstein-Leopoldshafen, Germany
firstname.lastname@fiz-karlsruhe.de

Core ontologies play a fundamental role in data interoperability, particularly when data and metadata originate from heterogeneous sources across disciplines, such as in the National Research Data Infrastructure (NFDI)¹. They provide a shared, minimal, and stable semantic backbone that enables disciplines to communicate, understand, and integrate data consistently.

To support interoperability between NFDI domains, NFDIcore has been developed as a mid-level ontology and represents metadata about NFDI resources, including research data, agents, projects, services, and guidelines [1]. The ontology provides a structured, unified framework to streamline the management, organisation, and integration of research data across scientific fields, facilitates sharing and promotes reuse, fostering more efficient collaboration and sustainable data practices within the broader research community. With its modular architecture (cf. Fig. 1), NFDIcore also provides the basis for various application and domain ontologies, allowing for a focused approach to domain-specific research questions through flexible extensions [2]:

- NFDI4Culture Ontology (CTO)²: Research data of the culture community within a research data index, i.e. a single point of access to decentralised cultural heritage research resources [3,4].
- NFDI4Memory Ontology (MEMO)³: Concepts from the historical sciences, including the harmonization of metadata and the detailed representation of provenance [5].
- NFDI4DataScience Ontology (DSAI)⁴: The AI research lifecycle, bridging the gap between raw datasets, code repositories, machine learning models, and scientific publications [6].
- NFDI-MatWerk Ontology (MWO)⁵: Supports the annotation and integration of data related to the materials science lifecycle [7].

¹ <https://www.nfdi.de/>

² <https://nfdi.fiz-karlsruhe.de/4culture/ontology/>

³ <https://github.com/ISE-FIZKarlsruhe/memo>

⁴ <https://github.com/ISE-FIZKarlsruhe/NFDI4DS-Ontology>

⁵ <https://nfdi-matwerk.pages.rwth-aachen.de/ta-oms/mwo/docs/index.html#>

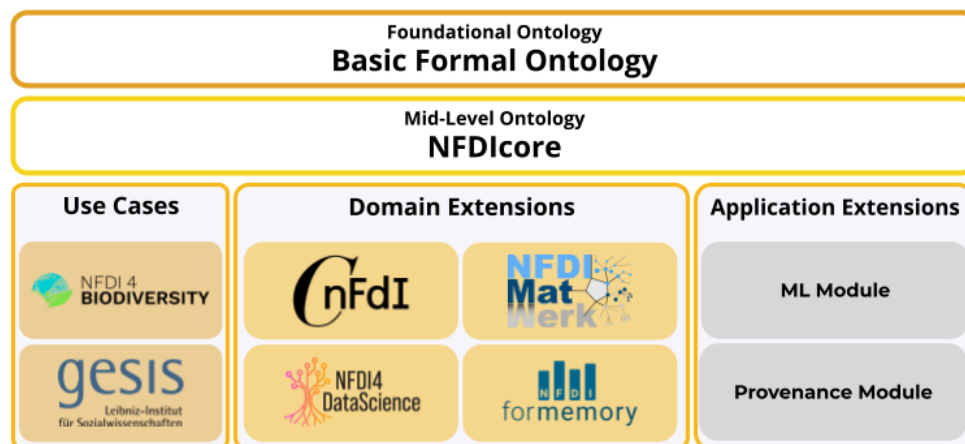


Fig. 1: NFDIcore's modular approach

NFDIcore is also expanding through mappings and alignments, including a work-in-progress mapping to DCAT-AP+. The Data Catalog Vocabulary (DCAT) has been extended to DCAT Application Profile (DCAT-AP) for data portals, and DCAT-AP+ adds a provenance layer [8]. This mapping will enable applications of DCAT-AP+ for NFDIcore-compliant ontologies, broaden its use within NFDI projects, and support interdisciplinary data reuse and knowledge transfer with provenance details.

Acknowledgement:

This joint project received funding by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) – project numbers: NFDI4Culture (441958017), NFDI-MatWerk (460247524), NFDI4DataScience (460234259), NFDI4Memory (501609550).

- [1] Waitelonis, J., et al., (2025) NFDIcore Ontology, 2025.
<https://nfdi.fiz-karlsruhe.de/ontology/3.0.3>
- [2] Sack, H., et al., (2023) Knowledge Graph Based RDM Solutions: NFDI4Culture - NFDI-MatWerk - NFDI4DataScience', Proc Conf Res Data Infrastr, vol. 1, 2023, DOI: [10.52825/cordi.v1i.371](https://doi.org/10.52825/cordi.v1i.371)
- [3] Tietz, T., Posthumus, E., Söhn, L. C., Steller, J. J., Bruns, O., Waitelonis, J., Schrade, T., & Sack, H. (2025). Knowledge Representation and Discovery for Cultural Heritage Research Data with CTO and SHMARQL. In Proceedings of the 5th International Workshop on Scientific Knowledge: Representation, Discovery, and Assessment, Nara, Japan: CEUR Workshop Proceedings (CEUR-WS.org), <https://doi.org/10.5281/zenodo.17509231>
- [4] Tietz, T., Söhn, L. C., Bruns, O., Waitelonis, J., Steller, J. J., Schrade, T., & Sack, H. (2025). From Culture to Core: Integrating Cultural Heritage Data into Cross-Domain Research Infrastructures. Joint Proceedings of Industry, Doctoral Consortium, Posters and Demos of the 24th International Semantic Web Conference (ISWC 2025), 4085, 345–350.
<https://doi.org/10.5281/zenodo.17519869>
- [5] Ondraszek, S. R., Tietz, T., Waitelonis, J., Sack, H., (2025) Interlinking Research Data and Services in the Historical Sciences with MemO and the NFDI4Memory Knowledge Graph In

Proceedings of the 5th International Workshop on Scientific Knowledge: Representation, Discovery, and Assessment, Nara, Japan: CEUR Workshop Proceedings (CEUR-WS.org), doi: <https://doi.org/10.5281/zenodo.17376359>

- [6] Gesese, G., Waitelonis, J., Chen, Z., Schimmler, S., Sack, H. (2024) [NFDI4DSO: Towards a BFO Compliant Ontology for Data Science](#) , in Proc. of 20th Int. Conf. on Semantic Systems (SEMANTICS 2024), Poster & Demo Track
- [7] Beygi Nasrabadi, H., Norouzi, E., Hubaiev, K., Waitelonis, J., Sack, H., (2025) Advanced Engineering Materials, e202502331. <https://doi.org/10.1002/adem.202502331>
- [8] Strömert, P., et al., (2025) DCAT Application Profile for Providing Links to Use-case Specific Context (DCAT-AP+), Available on <https://nfdi-de.github.io/dcat-ap-plus/pr-preview/pr-41/>