NFDI4Objects
Research Data Infrastructure for the Material Remains of Human History

1 Binding letter of intent as advance notification of a full proposal

X	Binding letter of intent (required as advance notification for proposals in 2021)

2 Formal details

Planned name of the consortium

Research Data Infrastructure for the Material Remains of Human History

Acronym of the planned consortium

NFDI4Objects

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3. Objectives, work programme and research environment

Research area of the proposed consortium (according to the DFG classification)

Review Board 101 Ancient Cultures with relations to:

106 Social and Cultural Anthropology, Non-European Cultures, Jewish Studies and Religious Studies:
201 Basic Biological and Medical Research:
202 Plant Sciences:
203 Zoology
205 Medicine
207 Agriculture, Forestry and Veterinary Medicine
314 Geology and Palaeontology
315 Geophysics and Geodesy:
316 Geochemistry, Mineralogy and Crystallography
317 Geography:
410 Construction Engineering and Architecture

Concise summary of the planned consortium's main objectives and task areas

NFDI4Objects aims to create a user-oriented infrastructure for the needs of researchers and practitioners working on the material heritage of around three million years of human and environmental history. The term "object" covers the entire spectrum of traces and material legacies of past human activities: artefacts, architecture, archaeological findings and anthropogenically shaped landscapes, as well as biological or ecological remains. This legacy represents the fundamental source of knowledge about the cultural and biological development of humankind, and poses a particular challenge for research data management due to the diversity of data types, very disparate contexts and complex (object) biographies.
Driven by common needs, the initiative NFDI4Objects unites a broad range of fields, disciplines, institutions and communities from the humanities and sciences, and thus reflects the digital redefinition of traditional academic boundaries. NFDI4Objects strengthens the NFDI as a whole by providing unique multidisciplinary expertise in the management of digital research data related to physical objects.
The consortium associates eight different archaeological disciplines, specialised fields of research in the biosciences (anthropology, archaeobotany, archaeozoology, archaeogenetics, paleopathology) and geosciences (geoarchaeology, geophysics, geology, mineralogy and petrology, physical geography, landscape archaeology, paleoclimatology), together with the various other sub-disciplines in the field of archaeometry, as well as architectural history (building research), restoration and archaeological conservation. NFDI4Objects aims for interoperability of data collected at different times and places during often lengthy object histories.
NFDI4Objects plans actionable measures for the introduction and deeper anchoring of research data management with a particular focus on the long-term preservation and FAIR availability of research data. Already in the pre-operational phase, community building and the

broad discussion of the necessary measures has had a wide impact. This includes the organisation of quality-oriented processes for the participatory and community-driven development of standards and specifications, as well as the further development of standardised data, visualisation, retrieval and analysis services, and distributed tools for the verification, long-term archiving and publication of research data. NFDI4Objects will primarily build on existing infrastructure components and expand and consolidate their functions, services and standards in a demand- and consensus-oriented manner – but most importantly, it will improve them and embed them deeply in the research practice of the community. The portfolio will be completed by the provision of a complementary range of consulting, education and training services, which, supported by incentive systems, will contribute to the sustainable promotion of a change in digital culture within the professional community.
A particular challenge for digital data management arises from the biographies of the research objects: these are not static, but are changed through use, transport, decay, deposit, rediscovery and restoration, recombined in collections and constantly reinterpreted through changing research approaches. It is essential to combine the object with its contextual information, especially its provenance, its association with other finds, its socio-cultural embedding, and the sometimes complex transformation processes it may have undergone. The objects addressed by NFDI4Objects are unique material sources that cannot be reproduced in laboratories but are altered, decontextualised, or even physically destroyed (e.g. by excavation) by the research process. There is still no answer in the form of national research data management to these specific and exponentially growing challenges (archaeological excavations in Germany alone add several million new objects every year to the existing collections of heritage management systems). NFDI4Objects will therefore address a major desideratum of the entire scientific community and make an important socio-political contribution by rendering human heritage digitally accessible.

Task Areas:
TA1 Documentation covers all needs arising from exploring, collecting and documenting primary data sources (documentation of excavations, artefacts, archaeological sites and monuments, etc.).
TA2 Collecting will establish an integrated research data infrastructure and quality-oriented data management processes that meet the complex requirements of artefact collection and contextualisation.
TA3 Analytics and Experiments will cover platforms, standards and services for desktop-based research, controlled experiments and laboratory-based object analysis.
TA4 Protecting will address applications and data management issues that focus on the complex requirements of protection, conservation, restoration, and related work and research.
TA5 Storage, Access and Dissemination will provide comprehensive technologies and standards for meta data harmonisation, terminologies and long-term archiving of research data, taking into account all aspects of the FAIR principles.
TA6 Commons and Qualification addresses the requirements related to data management for multidisciplinary data analysis processes, the development and maintenance of NFDI4Objects' own commons, and the development of tailored qualification.
TA7 Support and Coordination manages the administration as well as the structural and content-related development of the consortium, both internally and externally. It coordinates

the processes between the fields of activity, and ensures the continued scientific and community-driven development of the consortium.

Brief description of the proposed use of existing infrastructures, tools and services that are essential in order to fulfil the planned consortium's objectives

NFDI4Objects can build on extensive preparatory work and existing infrastructures realised in different co-applicant or participating institutions. The DFG project IANUS[1] developed a technical and organisational concept for the operation of a national research data centre for ancient studies. It hosts a service for long-term preservation of data collections and provides IT recommendations regarding data management, formats, tools and documentation processes. Furthermore, NFDI4Objects draws on comprehensive analyses of the state of digitisation in museums and university collections, as well as international surveys of demand. Within the German research landscape several successful services for Research Data Management exist, though they are thematically and geographically limited, for example the subject-specific services of the Verbundzentrale Göttingen (VZG), such as, for example, Dante, kuniweb, naniweb or KENOM[2]. The VZG develops and operates central services for the indexing, publication and archiving of research data from the state's memory institutions and runs several different services in the field of material culture research. These services will be incorporated into the service portfolio of NFDI4Objects. In addition to the existing sustainable services, NFDI4Objects has identified a selection of complementary components that are currently being developed and will be integrated into the NFDI4Objects service portfolio as long-term infrastructure offerings operated by major research institutions. To name only two, the Department of Archaeogenetics at the Max Planck Institute for Evolutionary Anthropology in Leipzig will contribute Poseidon, a framework to pave a standardized way to store and share archaeogenetic genotype datasets with context information[3]. The Institute for Historical Coastal Research (NihK) and Kiel University currently migrates ArboDat, an established database solution for registering and importing data of archaeobotanical analyses[4], into a state-of-the-art software environment including an interface to the information system PANGAEA aimed at archiving, publishing and distributing georeferenced data from earth system research connected to NFDI4Earth.
These components, as well as iDAI.world[5], the extensive online infrastructure and portal for digital archaeological knowledge of the German Archaeological Institute (including, among others, the services iDAI.chronontology and iDAI.gazetteer), already cover a significant part of the relevant data categories. NFDI4Objects' principal interest in strengthening existing infrastructure will be guided by a thorough analysis and lead to the resolution of technological and conceptual upscaling issues.

Interfaces to other proposed NFDI consortia: brief description of existing agreements for collaboration and/or plans for future collaboration

NFDI4Objects plans to serve the needs of a community that includes on the one hand highly specialised fields and on the other hand subjects with interdisciplinarity at their very core.
Therefore, NFDI4Objects interfaces not only with other humanities, cultural and social science initiatives, but also with many science-oriented consortia. Within the humanities, NFDI4Objects is involved in intensive processes to identify specific user needs, the results of

which are documented in a Memorandum of Understanding with the initiatives NFDI4Text+, NFDI4Memory and NFDI4Culture. Together, we are continuously coordinating the activities planned, and updated [6] the Memorandum of Understanding initially signed in 2019. In this NFDI4Objects plans to develop and implement all necessary measures to cover the needs of all humanities disciplines working with high demands on the contextualisation of material objects.
Numerous archaeological disciplines and methods have their origins in the geo-sciences and have been continuously developed to adapt them to the requirements of the archaeological community. Since then, the disciplines have been linked by a long and mutually enriching research tradition, and consequently NFDI4Objects has established close interaction with the consortia NFDI4BioDiversity and NFDI4Earth. Hence, there are many opportunities for innovation and research-driven collaboration. We see common tasks in the promotion of the acceptance of open specifications and architectures for (spatial) data infrastructures: the preparation and quality assurance of vocabularies and reference systems (ontologies), the harmonisation of specific data models and exchange formats, the elaboration of transdisciplinary case studies, the inclusion of government data and services, and the opening of industrial standards for reproducible research. NFDI4Objects will strengthen these initiatives with existing services for the profound spatial-temporal indexing of datasets (chrono- and geo-gazetteers). We are also exploring the options for a close cooperation with FAIRAgro, where the main focus is on the exchange of experience and knowledge on the management of research data on soil archives.
NFDI4Objects has scheduled a series of strong measures that will continuously expand and intensify contacts to these and further initiatives. A set of pilot projects that are currently being formulated and published online as well as the envisaged clusters will flesh out in detail the joint projects already agreed with other consortia.

4. Cross-cutting topics

The community work of NFDI4Objects has identified needs in fields identified by the strategy workshop on cross-cutting topics of the NFDI in August 2020[7]. NFDI4Objects joined 26 other consortia in the "Leipzig-Berlin Declaration". It thereby confirms it is working jointly and in consultation with the Directorate and NFDI committees on the cross-cutting issues and fields of action named therein[8]. Due to its immanent interdisciplinarity, NFDI4Objects contributes through existing expertise and services, especially in the areas of terminologies, quality management and assurance, interoperability and training and education.
In particular in the field of data quality, there is experience not only in data quality management and user involvement, but also in identifying data domain-specific challenges (this applies to raw data, processed data and metadata, as well as norm data) and in specifying criteria addressing accuracy, precision, consistency and integrity.
Professional training and education is deeply embedded in the structure of the consortium. Modular Open Educational Resources for well-defined qualification profiles, which are anchored in an overarching competence framework, will be further developed in cooperation with the numerous existing programmes, and used in different scenarios at all levels. These multifaceted measures, which are adapted to changing needs, are a central tool for supporting cultural change and the acceptance of the NFDI in the community.

With regard to software curation, there is agreement on the principles of sustainable software development and the open source principles, as well as on the reuse of software and its management. NFDI4Objects will promote and consolidate the acceptance of these principles in its communities.
NFDI4Object strives to develop single sign-on solutions and platform(s) to foster digital science and consortial cooperation. We will develop concepts for federated search based on consortium-specific retrieval systems, and are committed to identifying best common technical practices for interfaces for online services.
In order to promote and anchor open standards, interoperability and the use of existing infrastructures, we will focus on the development of targeted, open and transparent processes for the definition of standards and specifications in cooperation with international consortia that are already working on these issues. We support the elaboration of interoperable data formats and service architectures. For NFDI4Objects, the development of measures for legally compliant linkage between the existing infrastructures of state, private and scientific institutions has the highest priority. The same applies to the recovery, backup and processing of scattered legacy data from research projects that have been completed in the last decades.