

# Terminologies in RDM for Engineering – a Service Approach

## NFDI4Ing Terminology Service

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## 1. Background

The European Commission Expert Group on FAIR Data stated in their action plan in 2018 that “*Semantic technologies are essential for the interoperability and need to be developed, expanded and applied both within and across disciplines*” [1]. As a result, semantic artefacts such as terminologies, ontologies and their respective registries developed among various scientific disciplines. Examples include FAIRsharing [2], BioPortal [3], BARTOC [4], Research Vocabulary Australia [5] and NERC Vocabulary Service [6]. Despite these examples, many disciplines, including large parts of the engineering domain, follow a practice of using ambiguous words, phrases or even incomprehensible abbreviations to annotate data.

To support the coordinated development of RDM services, the National Research Data Infrastructure for Engineering Sciences (NFDI4Ing) provides a Terminology Service. We define a ‘Terminology Service’ (TS) as a web-based platform, which can support the take-up and standardisation of terminologies and ontologies. A controlled terminology thereby is a normative collection of terms whose spelling is fixed and for which additional information such as a definition, synonyms, an editor, a version, and a license can be provided. An ontology on the other hand is a formal representation of the knowledge of a domain, in which concepts are structured and terms are related to each other. A TS may be used in the research data life cycle:

- For findability: Using standardized terminologies, researchers may improve the discoverability of their data;
- For standardization: Terminologies enable researchers to use a common set of terms to describe their data, making it easier to compare and analyse results;
- For integration: Terminologies help to integrate data from different sources by providing a common language for describing data elements and concepts;
- For analysis: Terminologies foster meaningful analyses by ensuring that data is described consistently and unambiguously;
- For sharing and reuse: By using standardized terminologies, researchers can make their data more easily shared and reused by others.

## 2. The NFDI4Ing Terminology Service

To address the challenge of alignment and reuse of established ontologies and terminologies, a TS was set-up for the NFDI4Ing initiative: <https://terminology.nfdi4ing.de>. The NFDI4Ing TS (**Figure 1**) is a curated resource of terminologies and ontologies for the engineering domain and provides a single point of access to research concepts. In this context, terminologies offer the building blocks for (meta-) data schemata and data annotation. The NFDI4Ing TS enables researchers to browse engineering-related terminologies either through the website or via the Rest API.

The NFDI4Ing TS features more than 50 ontologies, 147,000 terms and over 5,800 properties. An example is the Metadata4Ing (m4i) ontology [7], which enables a process-based description of research activities and their results, focusing on the provenance of both research data and material objects: <https://terminology.tib.eu/ts/ontologies/m4i>. As an open source platform, the NFDI4Ing TS supports the adoption and standardization of ontologies by providing data and knowledge management capabilities for accessing, maintaining, and subscribing to engineering-related terminologies.

The screenshot displays the NFDI4Ing Terminology Service interface. At the top, there is a navigation menu with links for HOME, ONTOLOGIES, HELP, DOCUMENTATION, USAGE, and ABOUT. A search bar contains the text "electric vehicle" and a "Search" button. Below the search bar, the text "Examples: electric vehicle, agent" is visible. The main content area is divided into two sections: "Filter Results" on the left and "1617 results found for 'electric vehicle'" on the right. The "Filter Results" section includes a "Clear All Filters" button and two filter categories: "Type" and "Ontologies". Under "Type", there are four options: "class" (1424), "individual" (174), "property" (18), and "ontology" (1). Under "Ontologies", there are three options: "TEMA" (1122), "OM" (100), and "BATTINFO" (91). The "1617 results found for 'electric vehicle'" section displays two search results. The first result is "[class] Electric Vehicle" with the URI "http://schema.mobivoc.org/#ElectricVehicle" and a description: "Vehicle that uses one or more electric motors or traction motors for propulsion." The second result is "[class] electric vehicle" with the URI "http://openenergy-platform.org/ontology/oeo/OEO\_00000146" and a description: "An electric vehicle (abbreviated as EV) is a vehicle that uses one or more electric traction motors." Both results include an "Ontology" label with a corresponding icon.

**Figure 1.** The NFDI4Ing Terminology Service provides a single point of access to relevant engineering-related terminologies.

The NFDI4Ing TS provides concepts, terms, relations, their definition and other types of information, from a range of engineering-related terminology collections. Each concept is represented by a Uniform Resource Identifier (URI), which allows the persistent reference to concepts and terms. The NFDI4Ing TS functionalities include a free text search (for- and within ontologies), browsing and filtering, as well as machine-to-machine communication (REST interface). The NFDI4Ing TS is developed and maintained as part of the TIB Central Terminology Service. The Central TS provides other domain-specific terminology collections and is based on the Ontology Lookup Service (OLS) provided by EMBL-EBI [8].

## 3. Challenges and Outlook

As introduced above, terminologies play a crucial role in ensuring consistency, accuracy, and interoperability of research data. Depending on the research discipline, the availability and quality of terminologies is still limited. With the NFDI4Ing TS, we take a first step to index

available terminologies and ontologies in the engineering domain. The uptake and use of a TS by scientific communities, however, is influenced by many factors and interests, which are more often than not out of the area of influence of the TS providers. The frameworks which have been established since the start of the NFDI provide a chance to align Terminology Services and their management, especially when it comes to questions of quality insurance, versioning, long-term availability, naming conventions, usage of labels and others. Within NFDI, we hope for discussions on these and other topics, and aim to provide trust measures for the NFDI4Ing TS in the future (e.g., labelling of terminology popularity, FAIRness, quality, and new ways of collaborative terminology creation).

## Data Availability Statement

The NFDI4Ing Terminology Service including all referenced terminologies is available at <https://terminology.nfdi4ing.de>.

## Author Contributions

Angelina Kraft: Conceptualization; Writing – initial draft. Felix Engel and Axel Klinger: Methodology; Supervision; Writing – review and editing.

## Competing Interests

The authors declare that they have no competing interests.

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