FAIR Building Blocks

Definition

The FAIR building blocks are the principal implementation elements of the Road-to-FAIR Strategy. They translate the strategy's objectives into concrete technical, semantic, organizational, and procedural measures that support the Findability, Accessibility, Interoperability, and Reusability of research data.

Within the Helmholtz Research Field Earth and Environment, existing infrastructures provide comparatively mature support for Findability and Accessibility. The main implementation challenges therefore concern Interoperability and Reusability. Registry services such as re3data.org, FAIRsharing.org, and OpenAIRE facilitate the discovery of disciplinary repositories and relevant research data resources. Their effectiveness, however, depends on the continuous maintenance of accurate, complete, and up-to-date information.

Open-access policies have further improved access to research data held in repositories. Where unrestricted access cannot be provided, for example because of legal, ethical, contractual, or security-related constraints, the publication of comprehensive metadata can nevertheless enable users to discover relevant data and determine the conditions under which access may be granted.

The following building blocks primarily support **Interoperability**:

* Common and agreed procedures for referencing systematically described entities through the use of **persistent identifiers (PIDs)**. PIDs reduce ambiguity and redundancy, enrich contextual information, and improve the consistent identification of entities such as people, organizations, instruments, samples, publications, and datasets.

* A shared understanding across systems and disciplines through the coordinated use of **semantic artefacts**. Controlled vocabularies, terminologies, taxonomies, and ontologies support the consistent description of metadata concepts and reduce semantic ambiguity.

* Common methods for structuring and exchanging data and metadata through the application of **interfaces, protocols, exchange formats, and schemas**. Their coordinated implementation enables reliable metadata exchange and supports the integration of heterogeneous information systems.

* Consistent approaches to data dissemination through **self-describing data packages**, such as FAIR Digital Objects and RO-Crates. Such packages combine data, metadata, identifiers, and contextual information in portable structures that facilitate machine actionability and reuse across systems.

The following building blocks primarily support **Reusability**:

* The inclusion of **provenance information** describing the origin of data, the processes and transformations applied to them, and the agents responsible for their creation and management. Provenance information makes data lineage transparent and supports the assessment of reliability, authenticity, and reproducibility.

* Standardized procedures for documenting and assessing **data quality**. Relevant information may include uncertainty, validation procedures, completeness, accuracy, consistency, and versioning. Such information enables potential users to determine whether a data product is suitable for a particular purpose.

* The clear description of **access and use constraints** through standardized and, wherever possible, machine-readable methods. This includes the application of recognized licences and the explicit documentation of legal, ethical, contractual, or institutional restrictions, thereby improving transparency and legal certainty.

Together, these building blocks provide the structural foundation for the detailed recommendations documented in this wiki, which are complemented by practical guidance for implementing these recommendations, examples of established practices, and successful use cases.

The wiki also provides guidance for the different stakeholder groups involved in, supporting, or responsible for implementating FAIR research data practices.

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Last update: **2026/08/19 12:28**