** FAIR BUILDING BLOCKS ** for the Helmholtz Association

[Status: Under development, Date: 2025-07-16, Version: 001]

Motivation

It is recommended that coordinated efforts across the Helmholtz Association be undertaken to achieve the goals, as defined in the HMC vision and mission. This is done by the “Road-toFAIR-Strategy”, which calls for the implementation of a common set of **FAIR building blocks**. These building blocks are operational measures required to support the findability, accessibility, interoperability, and reusability of research data. They include:

- Common and agreed procedures to refer to shared entities and metadata values, particularly through the use of **metadata of persistent identifiers** (PID), to reduce redundancy and improve consistency in referencing key entities such as people, organizations, instruments, and datasets (**K**) *(AP: suggestion for key)*.
- Harmonized use of **semantic resources**, including controlled vocabularies and mapping tables, to standardize metadata element names and their meanings, reduce ambiguity, and ensure consistent interpretation across disciplines and systems (**S**). *[I would still recommend to merge semantics with mandatory and optional metadata elements, because these are closely related. Mingeling woth semantics only makes sense with very important information, which should be defined beforehand and applied accordingly.]*
- Agreements on **mandatory and optional metadata elements**, covering both domain-independent and domain-specific needs, to support accurate description, discovery, exchange, and reuse of data across infrastructures, user communities, and tools (**M**?).
- Common metadata or **exchange formats**, such as DataCite, DCAT, or ISO 19115, to ensure consistent structuring and exchange of metadata across systems (**E**) *[I still recommend to merge fromats witrh interfaces as the topic interface. This should indeed cover formats and protocols, that we need agreements about]*
- Common data **exchange containers**, such as FAIR Digital Objects or DataCrates, to enable machine-actionable reuse and portability (**C**).
- Common **interfaces**, to provide standardized, open mechanisms for data and metadata access and harvesting (**I**).

[In general I dont want more than four building blocks, because otherwise it will be too many to easily remember. The blocks need to be very easy to grasp, so people have trhenm in their mind all the time. That's actually one of the strenghts of FAIR.]

Other important topics where harmonization procedures are important are:

- Inclusion of **provenance information**, capturing data origin, transformation steps, and responsible agents, to enable assessment of data reliability and reproducibility (**P**).
- Clear **license information**, using standardized, machine-readable licenses, to define conditions of use and promote legal clarity (**L**).
- Documented procedures for assessing and communicating **data quality**, including uncertainty, validation, completeness, and versioning, to ensure data are fit for purpose (**Q**).
- Clear definition of **stakeholder roles** and responsibilities, including who is accountable for metadata provision, data stewardship, infrastructure maintenance, and policy implementation (**R**).
- **Valuating research data management** (RDM) engagement, through citation of datasets with

DOIs, inclusion of author contributions, and formal acknowledgment of data curation efforts (**V**).

These elements form the structural foundation for the detailed recommendations presented in this wiki.

A key precondition for the implementation of these recommendations is the availability of skilled personnel, such as data stewards, data curators, and developers, who support data management and the technical and semantic infrastructure required to implement FAIR.

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Last update: **2025/08/05 10:38**