Preface

The publication of **The FAIR Guiding Principles for Scientific Data Management and Stewardship** [1] addressed a persistent challenge within the research data management community. Although the importance of responsible research data management was widely recognized among data professionals, its objectives and benefits often remained difficult to communicate to researchers, decision-makers, and other stakeholders outside dedicated RDM teams. In particular, data managers frequently encountered uncertainty regarding the value of data documentation, the manner in which such documentation should be structured, and the benefits that systematic data stewardship could provide.

The FAIR Guiding Principles offered a concise and broadly applicable framework through which these objectives could be articulated. By defining four high-level properties—Findability, Accessibility, Interoperability, and Reusability—the principles provided a common vocabulary for describing the intended outcomes of research data management. These overarching objectives were complemented by 15 numbered elements of the FAIR framework—F1–F4, A1–A2, I1–I3, and R1–R1.3—which describe characteristics and practices intended to support their realization.

The FAIR framework was readily adopted by the RDM community and increasingly informed the development of data infrastructures, services, and research data ecosystems. In many cases, these systems were designed or adapted to satisfy the more detailed FAIR sub-principles. However, the principles were deliberately formulated at a high level and therefore present several limitations for their practical implementation:

1. FAIR is not an implementation standard. The principles describe desired characteristics of digital research objects, but they do not prescribe a technical architecture, metadata schema, file format, protocol, vocabulary, or software solution. Wilkinson et al. explicitly state that the principles are neither a standard nor a specification.

2. The principles do not explain exactly how FAIRness should be achieved. Because they deliberately “precede implementation choices,” considerable interpretation is required. Communities and repositories must decide which identifiers, metadata schemas, ontologies, protocols, licenses, and provenance models to use. Consequently, two implementations may both claim to follow FAIR while remaining technically incompatible.

3. FAIR depends on community agreement outside the principles themselves. Principle R1.3 requires compliance with domain-relevant community standards, but FAIR does not define which standards are authoritative or how communities should agree on them. The practical interoperability of data therefore depends on consistent implementation of shared standards, not merely on declaring adherence to FAIR.

4. FAIRness is gradual rather than binary. The principles are independent, separable, and can be implemented incrementally or in different combinations. A resource may therefore be highly findable but poorly interoperable or reusable. The label “FAIR” alone does not communicate which principles have actually been satisfied or to what degree.

5. Complete machine actionability may be unattainable. Wilkinson et al. describe machine actionability as a continuum. A machine might identify an object but be unable to parse its format, interpret its semantics, determine its license, or decide how it may be reused. They acknowledge that

the ideal situation in which machines fully understand and autonomously operate on a digital object is rarely achieved.

6. Rich metadata do not automatically guarantee meaningful interoperability. Metadata may exist and use formal representations while still employing incompatible terminologies or ambiguous relationships. Principles I1–I3 indicate what interoperable metadata should possess, but they do not ensure semantic alignment across disciplines or infrastructures.

7. FAIR does not mean open or unrestricted. Data may be FAIR while requiring authentication or authorization. Sensitive data can remain restricted as long as its metadata, access conditions, and procedures are adequately described. FAIR, therefore, improves the ability to discover and assess data access but does not itself guarantee access.

8. The framework primarily concerns discoverability and reuse, not every dimension of responsible data stewardship. The original principles do not constitute a comprehensive framework for evaluating scientific quality, correctness, ethical acceptability, long-term preservation, social justice, governance, or trustworthiness. These matters may affect reuse, but they are not specified as independent FAIR requirements. This is a boundary of the framework rather than an explicit criticism made by the authors.

FAIR thus defines the properties that a well-managed digital research object should exhibit, but it does not provide the common standards or coordinated implementation required to produce those properties. Its practical success depends on research communities agreeing upon and consistently applying persistent identifiers, metadata schemas, semantic vocabularies, protocols, provenance practices, and licenses.

This wiki seeks to address this implementation gap by supporting the coordinated application of FAIR practices across the Helmholtz Association. It provides guidance on the selection and consistent use of relevant standards, technologies, and community practices, with the aim of enabling research data products to attain the highest practicable level of FAIRness.

References

[1] Wilkinson, M. D. et al. The FAIR Guiding Principles for scientific data management and stewardship. Sci. Data 3:160018 doi: 10.1038/sdata.2016.18 (2016)