

FAIR4RS Roadmap Report

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This report provides a summary of progress on the [Research Software Alliance](#) (ReSA) project to map existing FAIR (Findable, Accessible, Interoperable Reusable) for research software (FAIR4RS) projects into a longer-term framework to improve strategic alignment and potential collaborators/leads for parts of the FAIR4RS Roadmap. The FAIR4RS Roadmap aims to make implementation of the [FAIR4RS Principles](#) a reality. Progress in this area will fast-track the adoption of the FAIR4RS Principles to support the significant cultural change needed across the research community to gain the benefits of recognition of a wider range of research outputs.

Aims

Research software is a critical component of the open research system, and an increased focus on research software challenges is needed to maximise research outcomes. The 2018 European Commission report, [Turning FAIR into Reality](#), concluded that FAIR digital objects (including software) need to be supported by metrics, incentives, skills, FAIR services that provide persistent identifiers, metadata specifications, stewardship and repositories, actionable policies and Output Management Plans. Almost all of these are still to be created for research software, to complement the significant FAIR data initiatives to improve use of research outputs, to increase reproducibility and to increase efficiency in research. The creation of these for research software would maximise the impact of funders' investments in both research and open science, as both depend heavily on research software.

This project aimed to deliver Phase 1 of the FAIR4RS Roadmap through consultation with key organisational stakeholders to enable the following outcomes:

- Mapping of existing projects that apply some of the elements of the FAIR principles to research software into a longer-term framework to improve strategic alignment and identify potential collaborators/leads for parts of the FAIR4RS Roadmap.
- Identification of opportunities for existing FAIR data initiatives to incorporate a focus on FAIR research software.
- Identification of FAIR4RS Roadmap elements that are specific (or that apply in a different way to) to research software and that have not been covered by FAIR data initiatives.

Activities

ReSA facilitated consultation throughout 2021 with key initiatives to identify potential partners, building on engagement in 2020 to road-test the [Roadmap approach](#). This ensured that the FAIR4RS Roadmap built on the efforts of organisations and programs already leading the way in implementation of elements of the FAIR4RS Principles in their areas of focus. The consultations focused on development of working groups and included the following events:

- February 11 2021: FAIR4RS Roadmap metrics scoping discussion ([summary, video and slides](#)) that resulted in agreement to form a working group with this focus
- March – August 2021: Meetings of FAIR4RS Metrics Working Group Steering Committee to develop a [charter](#) and respond to funding opportunities
- April 2021: Discussions on the formation of a [Life Sciences Working Group](#) with ELIXIR
- May – August 2021: Discussions on FAIR and science gateways, leading to the formation of [FAIR for Virtual Research Environments \(VREs\) Working Group](#)

- July 19 2021: [Best Practices for FAIR Research Software](#) session at the [Earth Sciences Informatics Partners \(ESIP\) Summer Meeting \(slides\)](#) to consider formation of a working group in this research discipline
- November 3 2021: [Skills and training curriculums to support FAIR for Research Software](#) session at [Research Data Alliance \(RDA\) Virtual Plenary 18 \(slides and notes\)](#) to consider formation of a working group with this focus
- November 9/10 2021: [FAIR for VREs Working Group](#) session at the [RDA Virtual Plenary 18 \(notes\)](#)
- October - November 2021: Discussions on progress of the [Life Sciences Working Group](#)

These consultations engaged both research software initiatives interested in applying the FAIR4RS Principles to their focus area, and FAIR data initiatives considering extending to include FAIR software. The FAIR4RS Roadmap was also highlighted at a range of other venues to raise awareness of this work, including:

- Many of the [30+ public events](#) conducted by the [FAIR4RS Working Group](#) throughout 2021
- The [draft FAIR4RS Principles](#) released in June 2021
- Monthly [ReSA newsletters](#)

Outcomes

A number of initiatives have now been formed to progress particular elements of the FAIR4RS Roadmap. In addition to the working groups listed below, there are a number of early adopters of the FAIR4RS Principles who are also facilitating adoption by their own organisations and communities. These early adopters include national research organisations, national eInfrastructure research organisations, universities, international and national disciplinary groups, national Research Software Engineering initiatives, publishers, and funders. The FAIR4RS WG is collating information on early adopters for release in early 2022.

1. [Metrics Working Group](#) to develop metrics to complement the FAIR4RS Principles through activities such as:

- Iterative tool and metrics design and development in collaboration with the community.
- Development of training on the tools that demonstrates the benefits to the software community of their adoption.
- Delivery of training to pilot communities with iterative deployment and testing, in order to increase awareness of the metrics, and increase the adoption of the best practices towards achieving them.
- Evaluating the ability of the tools to incentivise software accessibility and reusability.

This has resulted in four grant submissions, one of which was successful. The [Fair Metrics for FAIR Software project](#) funded by the Dutch Research Council (NWO) Open Science Fund will evaluate suggested FAIRness metrics for software while focusing on their incentivization potential.

2. [Life Sciences Working Group](#) to support the implementation of the FAIR4RS Principles in the life sciences community, with ELIXIR providing a pilot use case. The Working Group aims to facilitate adoption of the FAIR4RS principles through activities such as:

- Connection of the FAIR4RS Principles to the ELIXIR Software Best Practices guidelines and the [Software Management Plan](#) definition.

- Production of training material on FAIR Research Software, that will be registered and findable also through the ELIXIR Training Platform ([TeSS](#)).
- Connection of the efforts of ELIXIR [OpenEBench](#) and the Software Observatory to the FAIR4RS Principles, in order to define relevant metrics around FAIR software.
- Alignment and advancing the efforts of the [ELIXIR Software Development Best Practices Working Group](#), connecting also to the ELIXIR Training Platform.
- Establishing a wider Community of Practice with ELIXIR at its core, in order to share resources and learnings with the broader life sciences community, with a goal towards maintaining research software best practices, including the FAIR4RS Principles.

3. [FAIR for VREs Working Group](#) to enable coordination between existing communities working with VREs, science gateways, platforms and virtual labs, to define what it means for VREs to be and enable FAIR, and to provide guidance to VRE developers in achieving this. The Working Group will:

- Investigate how the existing application of the FAIR principles to data, software, workflows, computational notebooks, training materials, AI and machine learning enable VREs to enable FAIR digital objects, and themselves be FAIR, and identify any gaps in the existing work.
- Produce guidance on and examples of how VRES can and should be FAIR.
- Produce guidance on and examples of how VREs can and should enable FAIRness for other digital objects.

4. [FAIR4RS skills and training curriculums](#) may form into a working group to coordinate discussion on the opportunity for the training and research software communities to advance identification of FAIR research software skills and curriculums, building on both existing work on research software training for researchers and the growing body of FAIR data work in this area.

Next steps

This project has engaged the research software community in working together to apply the FAIR4RS Principles. This is helping accelerate the development of an open research system that recognises and supports research software. This will, in turn, provide researchers with the skills and resources they need to fully utilise research software, through development of a system where policy makers and funders value and promote research software, and where research organisations adequately reward the people whose research contribution is to develop software.

Both the FAIR4RS Roadmap and broader work of the FAIR4RS WG to engage the community have resulted in a range of initiatives that will assist in making implementation of the FAIR4RS Principles a reality. However, additional resources are needed in some areas (such as metrics development) and there are a range of [other areas](#) where the formation of working groups to apply the FAIR4RS Principles would be useful, such as metadata, interoperability, preservation and archiving; and in a range of research disciplines.

It is often difficult to find funding for initiatives that address cross-cutting international issues such as these. Whilst liaising with funders comprised part of this work, there are few funders that invest in this kind of international effort. However, the importance of FAIR4RS is becoming more recognised by funders, with a [Horizon Europe call](#) opening in January 2022 that focuses support for initiatives helping to generate global standards, specifications and recommendations for open sharing of FAIR research data, publications and software. There is increasing recognition of this need. For example, the third FAIRsFAIR Synchronisation Force workshop in April/May 2021 aimed to survey the current state of activity towards implementing the recommendations outlined in [Turning](#)

[FAIR into Reality](#), and to provide indicators of the amount of activity being undertaken. The [report](#) on this work includes recommendation 16: Apply FAIR broadly FAIR should be applied broadly to all objects (including metadata, identifiers, software and DMPs) that are essential to the practice of research, and should inform metrics relating directly to these objects.

This project originally envisaged that there would be a Phase 2 of the Roadmap in 2022 and beyond to focus on implementation of the plan outlined in Phase 1. Phase 2 was planned to enable the adoption and implementation of the FAIR4RS Principles to be fast-tracked in an efficient manner across the research community, with high-level coordination from its early stages to avoid duplication and divergent approaches. This would maximise investment outcomes, which is essential if FAIR for research software investments shadow the increasing FAIR data investments, such as the European Commission's €10 million, 3-year [FAIRsFAIR](#) initiative. At present there is no resourcing to enable this coordination to occur; however, it is heartening that a number of individual initiatives are progressing, and some loose coordination will still occur due to the overlap of individuals in these initiatives.