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D1.6 SUSTAINABILITY PLAN

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Disclaimer

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Abbreviations and Acronyms

CC	Creative Commons
CODATA	Committee on Data for Science and Technology
CSC	IT Centre for Science Ltd
DANS	Data Archiving and Networked Services
DCC	Digital Curation Centre
EGFC	European Group of FAIR Champions
EOSC	European Open Science Cloud
EUA	European University Association
ESFRI	European Strategy Forum on Research Infrastructures
FAIR	Findable, Accessible, Interoperable, Reusable
HEIs	Higher Education Institutions
HLAC	High Level Advisory Committee
KER	Key Exploitable Resource
KF	Key Function
KO	Key Output
STFC	Science and Technology Facilities Council
TFiR	Turning FAIR into Reality

Executive Summary

FAIRsFAIR - Fostering FAIR Data Practices in Europe - was a project that ran between March 2019 and February 2022. It involved 22 partners from 8 EU member states with 6 core partners (DANS, CSC, DCC, TrustIT, STFC, EUA). The project was designed to supply practical solutions for the use of FAIR data principles throughout the research data lifecycle. The work on the project was guided by commitments to openness, FAIR-ness and long-term sustainability of project outputs.

This report describes the sustainability planning for 21 project outputs deemed of particular importance, both to EOSC and to the global research community. These outputs were categorized using the Horizon 2020 categories of Key Exploitable Resource, Key Output and Key Function. These outputs were highly diverse and ranged from frameworks and written reports to practical FAIR tools and stakeholder networks. The range of different outputs are illustrated in the figure below.

Summary of FAIRsFAIR project outputs

This diversity necessitated highly detailed and specific sustainability planning according to the characteristics of the output. The outputs, such as reports or frameworks, that were intended to continue as static resources were deposited into a FAIRsFAIR Zenodo community (as well as into GtHub where appropriate). For outputs that were embedded into FAIR work flows, sustainability planning was more diverse. In some cases the project partners committed to taking forward maintenance of the outputs, while in others community groups (such as the Research Data Alliance working groups) took ownership of the output. The different sustainability plans are detailed in the table below.

The outputs of the FAIRsFAIR project have the potential to make important contributions both to EOSC as well as to the global research community. This report outlines how the sustainable project outputs can directly contribute to improving the FAIR-ness of EOSC. It also highlights how these outputs can contribute to researcher support, policy development and FAIR-expertise capacity building.

In addition to outlining the FAIRsFAIR outputs, this report also serves as a case study for future research projects wishing to engage meaningfully in long-term output sustainability. It outlines considerations for sustainability planning and suggestions for good practice.

Type of output	Name of output	Output category	Brief description	Sustainability plan
FAIR guidance	FAIR implementation stories and guidance	KER	A descriptive template for 'Implementation Stories', which describe implementation of FAIR enabling activities by Research Producing Organisations (RPOs) and Research Data Infrastructures (RDIs). It is accompanied by a set of such stories demonstrating how organisations have taken actions consistent with the recommendations of TFiR	The collection of 23 Implementation Stories and the Implementation Story templates were published in the FAIRsFAIR Zenodo community under CC-BY license to ensure that the outputs will be findable, accessible and reusable.
	FAIR adoption handbook for universities	KER	A handbook to help universities to apply the competence framework to their specific situation and needs. It does so by providing ready-to-use model lesson plans on a variety of topics, including FAIR data, Data Management Plans (DMPs), repositories, data creation and reuse. The handbook also offers FAIR competence profiles and learning outcomes for the bachelor, master and doctoral levels, as well as information	The open access handbook has been published on the project website and in Zenodo. The University of Minho has committed to the publication of an Open Access version of the handbook and a print version. A GitBook version of the handbook will also be ready by the end of the project. The Universities of Minho and Göttingen have committed to maintaining the Gitbook for 7 years and monitor its use/re-use (ie. translations).

			on course design and the implementation of the FAIR principles at the institutional level.	
	FAIR data policy checklist and structured policy description template	KER	A checklist to enable policymakers to self assess whether their data policies are FAIR-enabling and a template to support them to describe the content of their policies in a structured and comparable way.	The checklist, template and related guidance are openly available via the FAIRsFAIR Zenodo community under a CC-BY licence.
	Framework for assessing FAIR-enabling services	KO	Framework covering services instrumental in implementing the FAIR principles. The framework aligns to other certifications and assessments and explains their relations.	The framework is available in the FAIRsFAIR Zenodo community and has been promoted through the FAIRsFAIR network. This work has also fed into the report titled "Recommendations on certifying services required to enable FAIR within EOSC".
	Recommendations for FAIRness of research software	KO	Milestone report providing an analysis and recommendations regarding FAIRness of research software.	Work has been successfully handed over to the RDA working group "FAIR 4 Research Software" (FAIR4RS).
	FAIR competence framework	KO	The "FAIR Competence Framework" is the basis for "FAIR Adoption Handbook for Universities" and subsequently "Good Practices in FAIR Education".	The "FAIR Competence Framework" was published OA and with PID and is available via the project website and Zenodo. The dataset informing the framework has also been deposited on Zenodo, and a Python notebook has been prepared to assist re-use. The EDISON Data Science Framework (EDISON-EDSF) community, which is supported by the University of Amsterdam, has committed to ensuring that this framework is complementary to, or can function as, an extension to existing and adopted data science and other competence frameworks. A similar role for others such as the RDA is being explored.
	Recommendations on FAIR semantics	KO	Documentation surrounding recommendations for FAIR semantics.	Recommendations have been deposited into the FAIRsFAIR Zenodo community. These recommendations have been integrated into the activities of the RDA VSSIG interest group (Vocabulary and Semantic Services Interest Group). The recommendations have also been discussed in different organisations and initiatives such as GOFAIR INTER, IOF and projects such as OntoCommons.

FAIR tools	Capability model for FAIR-enabling organizations (ACME-FAIR)	KER	ACME-FAIR capability guide is designed to support research performing organisations to become more FAIR enabling, by supporting their data producer communities in delivering FAIR data.	The framework is published The DCC will be the main partner taking on the sustainability of this output. The FAIRsFAIR Zenodo community under a CC-BY licence. Discussion has begun regarding the formation of a RDA Community of Practice in the context of the Professionalising Data Stewardship IG.
	FAIR-Aware	KER	The FAIR-Aware tool provides practical information and resources to (further) develop skills for FAIR, and is meant to incentivise researchers to make their data FAIR. This tool can be used both as a teaching tool and as a resource for researchers and data stewards.	Since the creation of the tool, DANS has been hosting FAIR-Aware and will continue to do so after the completion of the FAIRsFAIR project. DANS continues to play a key role in the maintenance of the tool by conducting regular updates.
	F-UJI	KER	F-UJI is a practical tool developed by the project that uses FAIR data metrics to perform the assessments of research data objects.	F-UJI source code is available within GitHub for co-development and/or forking and re-use. PANGAEA has committed to the long-term hosting and updating of the F-UJI tool. This will include continuing to coordinate the Open Source development of F-UJI's program code via GitHub and contributing to Open Source community development efforts.
	FAIR-enabling repository finder	KER	A discovery service for FAIR-enabling repositories	Re3data and DataCite have been involved in the creation of this tool, and will continue to expand it after the end of the project.
	Reference implementation of FAIR Data Point	KER	Work done to expand on the requirements of developing a FAIR Data Point system, and to investigate its use in FAIR Data Stations	The code developed during the FAIRsFAIR project is stored both in the GO-FAIR and in the FAIRsFAIR repositories. The work package has already negotiated a long-term commitment for the continuous development of the FAIR Data Point from the GO-FAIR community.
	FAIRdata forum	KO	The FAIRdata Forum has been used as a training tool during the FAIRsFAIR project.	The forum will persist as an open but static resource after the end of the project. This static resource will be hosted by STFC.
	CoreTrustSeal + FAIR certification	KO	The CoreTrustSeal+FAIRenabling Capability Maturity Model emerged from open collaborative feedback and testing with the FAIRsFAIR repositories.	Version 1.0 of the CoreTrustSeal+FAIRenabling Capability Maturity Model can already be utilized by repositories. There are plans in place to conduct intermediate testing of the CoreTrustSeal+FAIRenabling Capability Maturity Model through a CTS sub-group. This will provide necessary FAIRsFAIR feedback to the CTS revisioning.
	European network of	KF	A number of repositories were involved in FAIRsFAIR work on certification and	The EOSC Association and the European Commission through the EOSC Partnership can

	FAIR-enabling trusted digital repositories		form the basis for a European network of FAIR-enabling trusted digital repositories. The outline for such a network was described in the Coordination Plan for a sustainable network of FAIR-enabling Trustworthy Digital Repositories.	play a critical role in incentivizing the network and encouraging its sustainability.
FAIR training	Training materials	KO	A searchable training library of materials integrated into the FAIRsFAIR website.	Training materials as key outputs of the project have been deposited in both GitHub and the FAIRsFAIR Zenodo community under CC-BY licenses. The training materials are accompanied by a CSV file that enables the FAIRsFAIR library to be imported into other training catalogues. This will enhance re-usability of these resources.
	Good practices in FAIR education	KO	A report that synthesises examples of successful integration of Research Data Management (RDM) and FAIR data-related skills in university curricula and training to provide an up-to-date perspective on how these skills are being implemented by higher education institutions.	The report has been published in the FAIRsFAIR Zenodo community as well as on the project website. Discussions are underway with EUA to publish output as OA publication and take ownership of curation, as well as hosting the report on its website.
	Data steward Schools	KO	CODATA-RDA Schools for Research Data Science and Data Stewardship have generated three key outputs, namely a network of trainers and alumni, open access training materials (slides, videos and training materials) available on Zenodo, and Virtual Learning Environment (VLE) versions of the ECR school and Instructor training.	Sustainability efforts for these two training events are in two key areas: hosting of the events after the end of the project, and maintenance of training materials. Discussions about the future of the school network are currently underway with key stakeholders, including CODATA and RDA. An advisory board has been appointed to guide these discussions. Key action still required is the development of a viable model for financial sustainability.
FAIRsFAIR project tools	Project deliverables	KO	Over 160 project outputs. These include deliverables and underlying data, milestone documents, intermediary results and intermediary data, code, reports and working documents.	Work Package and Task Leaders were responsible for depositing the outputs in Zenodo as they become available as part of the project's compliance with the ORDP (Open Research Data Pilot). The Zenodo deposits were ordered using a FAIRsFAIR community. This ensures that all the materials are linked and easily findable. The FAIRsFAIR community will not be added to after the end of the project, but could be linked to ongoing FAIR-related communities. All software outputs were deposited into GitHub. At the end of the project the selected assets were

				deposited in the CoreTrustSeal-certified trustworthy data repository EASY (DANS) for long-term preservation.
	Coordination and synchronization	KF	FAIRsFAIR has established several expert groups, including FAIR Experts & Ambassadors, FAIR Champions, HLAC, The Synchronisation Force core team that ran until the end of the project in Feb 2022.	It is possible that EOSC can capitalize on these groups by integrating the members into existing task forces or affiliated groups within the EOSC Association. The FAIRsFAIR Synchronisation Force report and affiliated documentation is available on Zenodo under a CC-BY license. While the document is not intended to be a living document, it provides future projects with important information regarding lessons learned. The FAIRsFAIR Roadshows have been a successful initiative through which to share information about the project to researchers around Europe. At the end of the project a guidance document will be prepared that will serve as a "blueprint" for future events.
	FAIRsFAIR website	KF	The website hosts all project related information.	The website will be maintained online after the end of the project as a static resource for 5 years after the end of the project. Trust-IT Services will ensure access to information on the website. The website will be maintained with minimal technical effort, credentials to access and manage the platform could be given to other people indicated by the EC.

Summary of FAIRsFAIR project outputs and sustainability planning

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1. Sustainability approach and lessons learned

FAIRsFAIR[1] - Fostering FAIR Data Practices in Europe - was a project that ran between March 2019 and February 2022. It involved 22 partners from 8 EU member states with 6 core partners (DANS, CSC, DCC, TrustIT, STFC, EUA). The project was designed to supply practical solutions for the use of FAIR data principles throughout the research data lifecycle. There was a particular emphasis on fostering FAIR data culture and the uptake of good practices in making data FAIR. Through the activities of the project, a wide range of different outputs were produced. These form the basis of an overall knowledge infrastructure on academic quality data management, procedures, standards and metrics and related matters, based on the FAIR principles. The outputs of the project provide a basis for using and implementing FAIR principles in the day-to-day work of research data providers and repositories.

Planning for the long-term sustainability of project outputs was central to the FAIRsFAIR project. In order to achieve sustainability of the project outcomes, activities were woven throughout all the work packages in the project. The sustainability approach consisted of developing various measures and activities during the lifetime of the project as well as preparing the ground for the period after the end of the project. This planning involved two key areas of action. First, to ensure that all project materials (documents, code, meeting notes, presentations etc) were responsibly curated according to the FAIR data principles. Second, to identify key project outputs using the EU designation[2] of Key Exploitable Resource (KER), Key Output (KO) and Key Function (KF) and to elaborate sustainability plans that would ensure the long-term usability of each.

1.1. Inventory of project outputs

The development of an inventory of project outputs requiring sustainability measures was the first step in formalising a sustainability plan for the project. It was used to document sustainability actions already taken, as well as to plan and implement actions during the project period. In this inventory, key project outputs were categorised into three types:

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[1] https://fairsfair.eu/the-project (accessed 10/02/2022).

[2] https://webgate.ec.europa.eu/funding-tenders-opportunities/display/IT/Managing+Project+Results+in+the+Horizon+Results+Platform (accessed 10/02/2022).

1. **Key Exploitable Result (KER):** as defined in the Horizon 2020[3] context i.e. an identified main interesting result which has been selected and prioritised due to its high potential to be "exploited" – meaning to make use and derive benefits - downstream in the value chain of a product, process or solution, or act as an important input to policy, further research or education.

2. **Key Output (KO):** important project results which require sustainability measures during and after the project not selected as a KER.

3. **Key Function (KF):** important functions performed by the project which would require continuity and a sustainability plan for example in the context of building EOSC.

These project outputs were also mapped against the pillars identified in the report Turning FAIR into Reality (TFiR).[4] The final list of project outputs were varied, including KERs, KOs and KFs. Moreover, these outputs were varied in their formats (documents, code, tools, networks) and their area of focus. In figure 1 below the different outputs of the FAIRsFAIR project are grouped according to category and area of focus.

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[3] According to the Annotated Model Grant Agreement for Horizon 2020 grants (article 26.1), a result is defined as: "Any tangible or intangible output of the action, such as data, knowledge and information whatever their form or nature, whether or not they can be protected, which are generated in the action as well as any attached rights, including intellectual property rights".
https://webgate.ec.europa.eu/funding-tenders/opportunities/content/article-26-%E2%80%94-ownership-results_en (accessed 10/02/2022).

[4] Hodson, Simon, Jones, Sarah, Collins, Sandra, Genova, Françoise, Harrower, Natalie, Laaksonen, Leif, Mietchen, Daniel, Petrauskaité, Rūta, & Wittenburg, Peter. (2018). Turning FAIR data into reality: interim report from the European Commission Expert Group on FAIR data. https://doi.org/10.5281/zenodo.1285272.
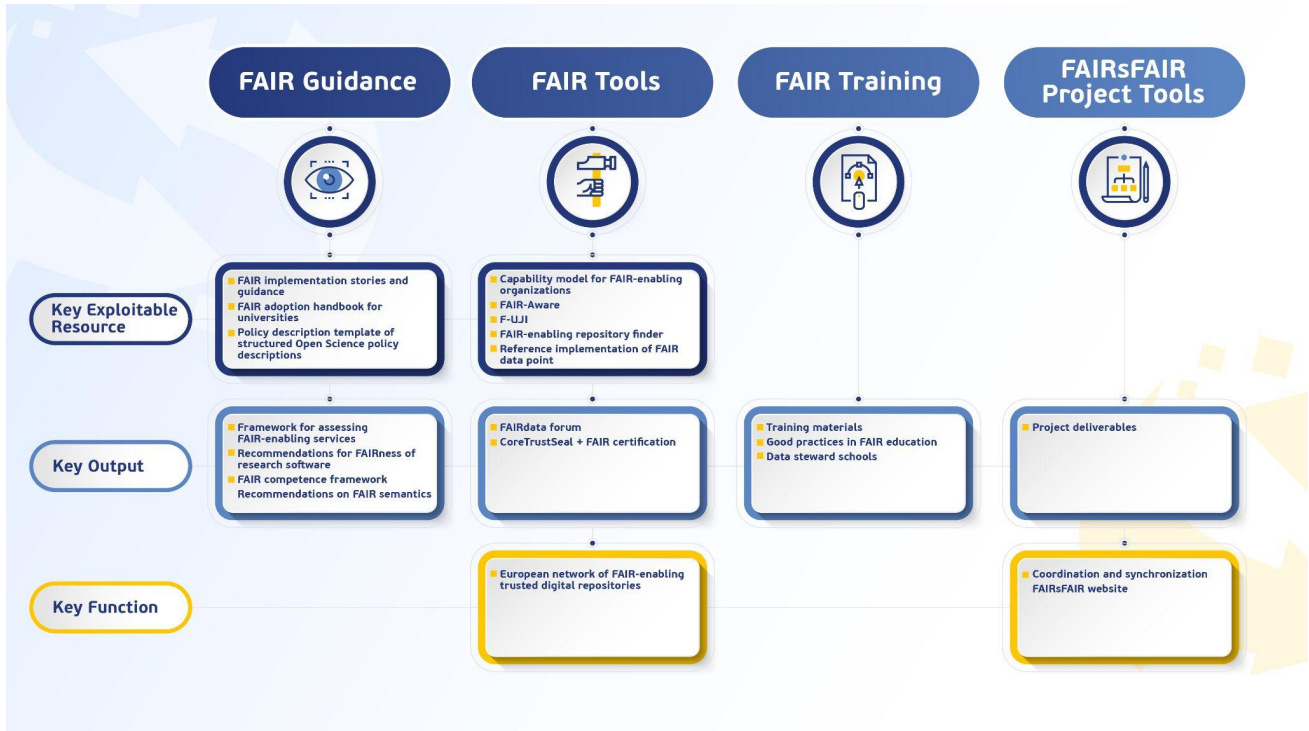
Figure 1: summary of the outputs of the FAIRsFAIR project.

1.2. Implementing sustainability plans for project outputs

Each work package was responsible for elaborating, planning and implementing the necessary actions to ensure that the sustainability of the project outputs were appropriately considered and addressed. These sustainability measures were described and continuously monitored as part of an inventory of project outputs described in section 2. The sustainability measures formed the main part of the Sustainability Plan (D1.6) described in this report. Planning for sustainability of each project output followed the set of key questions that are listed below.

- What is the sustainability/exploitation plan/scenario for the output/function?

- Who is involved in sustainability of the results (organisations, stakeholders etc.)?

- What are the sustainability actions already taken (including impact, influence, adoption, endorsement etc.) ?

- What other sustainability actions are needed?

- Could you map the KER/KO/KF to the TFiR pillars?

- Do other stakeholders depend on parts of the KER/KO/KF?

- How is the KER/KO/KF important in the EOSC or FAIR ecosystem as a whole?

The sustainability of the FAIRsFAIR outputs and deliverables is dependent to a considerable extent on their adoption by the EOSC Partnership, by the project's stakeholders, and most importantly, by EOSC-related projects funded by the EC. The sustainability is also assisted by the international FAIR support and research community. The promotion of these outputs in order to achieve this through engagement with stakeholder communities is described in section 3.

As part of the Synchronisation Force activity, the FAIRsFAIR project disseminated its deliverables and outputs as input to the work of the relevant Working Groups established by the EOSC Governance in 2019-2021. This effort was continued in 2021 and until the end of the project by connecting with the EOSC Association and its Advisory Groups and Task Forces. In addition, project outputs were also presented in several European countries and articulated in a national context as part of the FAIRsFAIR Roadshow.

The main recommendations from the Synchronisation Force activity regarding FAIR implementation in EOSC are communicated as a Whitepaper (D5.7)[5] to the EOSC Association and the Partnership. A summary of recommendations related to the sustainability of FAIRsFAIR outputs is also presented in section 4 of this document.

1.3. Challenges and opportunities for sustainable planning

Categorising the outputs and ensuring that they had clear sustainability plans in place at the end of the project required continuous discussion and monitoring. The planning discussions needed to include a variety of different considerations, including the key ones listed below.

- Key values/principles: commitment to openness and equitable access as well as EOSC guiding principles shape storage and curation decisions

- Responsibility and resources: who will take ownership of post-project output hosting/management/curation? What resources are needed in the long-term?

- Time: short, mid and long-term and decisions of which outputs need to be curated according to what timescale. Is there a future point at which outputs should be archived or closed?

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[5] Dillo, Ingrid, Hodson, Simon, Pittonet Gaiarin, Sara, & Grootveld, Marjan. (2021). D5.7 Recommendations for a FAIR EOSC - White Paper FAIRsFAIR Synchronisation Force 2021 (Version 1.0 DRAFT). Zenodo. https://doi.org/10.5281/zenodo.5793105.

- Scale: extent of project outputs maintained

- Scope: access and usability within and beyond the EU

- Integration: connections between project resources and similar resources, interoperability of resources

- Metrics and monitoring: assessment of re-use of project resources

- FAIRness and Openness: in long-term project output plans

Key drivers in developing appropriate sustainability plans for each output included, stakeholders taking responsibility for post-project ownership of outputs, clear sources of funding (where necessary) to support upkeep, links between outputs and future projects, and existence of communities of practice or interest relating to the output.. These factors led to a variety of different sustainability plans, each tailored to a specific output.

2. Sustainability of project outputs

As described in section 1 above, the project outputs were categorised as KER, KO and KF. The project outputs are listed below according to these designations. However, they can also be understood according to focus (as illustrated in figure 1 above) or to EOSC activities (as illustrated in table 2, as well as figures 2 and 3 below).[6]

2.1. Key Exploitable Results

2.2.1. FAIRsFAIR reference implementation of the FAIR data point

This output can be mapped to the following TFiR pillar: Define/Concepts for FAIR Implementation (rec. 2 & 3) and Implement/FAIR Culture (Rec. 4) and FAIR Ecosystem (Rec. 7 & 8)

What needs to be sustained:

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[6] Poster summaries of the different outputs used in the January 27 (2022) sustainability workshop can be viewed at Bezuidenhout, Louise. (2022, February 21). Posters of FAIRsFAIR outputs detailing sustainability plans. Zenodo. https://doi.org/10.5281/zenodo.6204596.

The FAIR Data Point is a FAIR metadata repository. It enables the provisioning of metadata about different types of digital objects including those that may be hosted elsewhere. During the project work was done to expand on the requirements of developing a FAIR Data Point system, and to investigate its use in FAIR Data Stations.

The work conducted during the FAIRsFAIR project contributes to the development of a FAIR Data Point system and the broader knowledge about it in the community of repository providers. It is thus of value to the work going forward. It is available as free and open-source software and documented.

Why it needs to be sustained:

FAIR Data Points will address three goals:

1. It will allow a repository or any other holder or editor of data to expose metadata in a FAIR manner, with a strong focus on the F, A, and R as described in the FAIR Principles (Wilkinson et al., 2016)

2. It will enable a consumer or viewer of the data to discover information that is stored in it.

3. It will optimise the interaction between humans and machines.

It is envisioned that FAIR Data Points will be integrated into FAIR Data Stations. These will not only provide metadata, but also support interaction with its content, enforcing privacy and security, when applicable. A FAIR Data Point system can be used to create a layer of semantic interoperability within the EOSC service ecosystem. This would make content visible and machine actionable. The solution is based on semantic metadata standards (mostly DCAT2) and is combined with the Linked Data Platform (LDP), and based on the REST philosophy. It offers a standardised way to present interoperable metadata.

This reference implementation offers an example of how implementing linked open data can be done. It also highlights the need for stable and interoperable ways of creating technical solutions to this end. A number of other stakeholders are working on the further development of the FAIR Data Point system. The work done by FAIRsFAIR will enrich this ongoing work.

How it is/will be sustained:

The development of the FAIR Data Point reference implementation within the FAIRsFAIR project utilized resources from a number of different projects such as FAIR-dICT, ODEX4All, EJP-RD, FAIRsFAIR, Personal Genetic Locker, VODAN, and others. The reference implementation followed the FAIR Data Point specifications, which has produced other implementations such as Molgenis, Castor EDC and SURF's FDP. The code developed during the FAIRsFAIR project is stored both in the GO-FAIR

and in the FAIRsFAIR repositories. The reference implementation of the FDP is maintained in a GO-FAIR/DTL repository and available for reuse.

The work done by FAIRsFAIR on the reference implementation will continue through other related projects, and through other implementations of the FDP specifications that continue to emerge as more solution developers become interested in adjusting their applications to expose data in a FAIR way. The work package has already negotiated a long-term commitment for the continuous development of the FAIR Data Point from the GO-FAIR community.

Communication and cooperation between developers is a key element to the sustainability of the Reference implementation of the FAIR Data Point. This will require the creation of further working groups, such as an RDA DCAT-interoperability working group. The coordination with the stakeholders involved in building the EOSC is vital for ensuring interoperability within EOSC infrastructure. This output is related to the the work on semantic interoperability and services for semantic artefacts.

2.2.2. FAIR data policy checklist, structured description template and related guidance

This output can be mapped to the following TFiR pillar: Define/Concepts for FAIR implementation (Rec.17)

What needs to be sustained:

TheFAIR data policy checklist aims to help policy-makers self-assess whether their policies are FAIR-enabling and provides practical recommendations on supporting alignment with FAIR Principles. We created a template that enables policy makers to create a structured version of their data policy by selecting from a set of pre-defined options to describe their policy against each of the FAIR data pelements. By creating structured descriptions, depositing them with a repository, and making them visible through registry services, the community can support a more efficient and comparable means of assessing the policy landscape over time such as that envisaged by the EOSC Strategic Research and Innovation Agenda[7]. FAIRsFAIR has developed related guidance to help policy makers to work through the process.

Why it needs to be sustained:

The current lack of availability of a body of structured policy descriptions is a challenge for the roll-out of Open Science and implementation of FAIR within research institutions and communities. The development of dashboards to monitor the Open Science policy landscape across Europe (for

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[7] https://www.eosc.eu/sria

instance the dashboard described in EOSC Partnership report as a means of assessing EOSC readiness during the first phase of implementation) is thus of considerable importance. During this activity, FAIRsFAIR identified a set of 42 policy elements within the policies analysed, but noted that there was considerable variation. The policy template, together with the documentation detailing the discussion on which elements to include are an important resource for future work on Open Science policies. It serves as a standard-setting instrument for FAIR and promotes policy alignment on FAIR. This resource will support the development of research data policies by stakeholders (e.g., national level, funders, HEIs, research infrastructures), as well as supporting consensus discussions. The availability of structured Open Science policy descriptions is also a valuable first step for making policies machine readable.

How it is/will be sustained:

The policy description template, together with the dataset of 42 structured Open Science policy descriptions that were analysed as part of FAIRsFAIR's landscape assessment, form the output of thie KER. This KER built on previous efforts, such as those carried out by the RDA data policy standardisation and implementation IG.

The template, policies and descriptions detailing discussions are openly available via the FAIRsFAIR Zenodo community under a CC-BY licence.[8] Stakeholders are encouraged to continue to upload their policy descriptions using the provided template in a machine readable format (csv) and to assign a DOI. Stakeholders are also encouraged to submit on FAIRsharing.org, which will assign submissions a second DOI. It is anticipated that this will continue beyond the lifespan of the project, as the depositor is in total control of the deposit and able to update as needed without mediation from FAIRsFAIR. Depositors are encouraged to make their structured description visible from their websites using schema.org tags. This will ensure that these descriptions can be found and used in machine-actionable pipelines as needed. In future there is the potential to align the FAIRsFAIR policy elements with ongoing FAIRsharing metadata review.

In order to ensure long-term sustainability, more work is needed to ensure that policymakers support the programme and are aware of their role in owning and updating these structured descriptions over time. These policymakers have been engaged via a number of avenues, including direct communication, a general meeting in January 2022 and through the sustainability workshop in January 2022. Guidance on maintaining and publishing updates is provided on Zenodo so that those policymakers engaged in the support programme are aware of when and how to update their structured policy description. However, further work is needed to agree on standards that may be useful for making policy content visible to machines (e.g., schema.org) and there may be a need to

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[8] Joy Davidson, Claudia Engelhardt, Vanessa Proudman, & Lennart Stoy. (2019). FAIRsFAIR Policy Characterisation Data for D3.1 (1.0) [Data set]. Zenodo. https://doi.org/10.5281/zenodo.3550544.

adapt the checklist and collection over time, so this output would benefit from the creation of a working group to oversee these activities.

2.2.3. FAIR implementation stories

This output can be mapped to the following TFiR pillar: Implement / FAIR Ecosystem (Rec. 24)

What needs to be sustained:

This output is a descriptive template for 'Implementation Stories', which describe implementation of FAIR enabling activities by Research Producing Organisations (RPOs) and Research Data Infrastructures (RDIs). It is accompanied by a set of such stories demonstrating how organisations have taken actions consistent with the recommendations of TFiR, and with related deliverables from this work package, including the FAIR Data Practice Analysis,[9] Policy Enhancement Recommendations,[10] and Recommendations on practice to support FAIR data principles.[11]

Why it needs to be sustained:

The Implementation Stories are an information and guidance resource for organisations wishing to take steps to support FAIR implementation. As a suite of real-life examples they are a valuable resource for providers of services to (and from) RPOs and RDIs to illustrate how use cases have been fulfilled. The Implementation Story format plays an influential role in disseminating good practises within the EOSC community through the EOSC marketplace.

Adding to this output will be valuable for data stewards, research software engineers (and related EOSC actors). The format makes it possible to submit stories for peer review or publish them as an educational resource. These would illustrate how the provided service or resource has been used to address specific research challenges and provide benefits to society, and to demonstrate how the EOSC Rules of Participation have been followed. Providing implementation stories in this way will ensure that creators receive credit for their actions to deploy EOSC services and resources for demonstrable benefits to research, or to illustrate challenges to implementation of FAIR. However,

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[9] Whyte, Angus, Engelhart, Claudia, Bangert, Daniel, Kayumbi-Kabeya, Gabin, Lambert, Simon, Thorley, Mark, O'Connor, Ryan, Herterich, Patricia, & Davidson, Joy. (2019). D3.2 FAIR Data Practice Analysis (1.0). Zenodo. https://doi.org/10.5281/zenodo.5362079.

[10] Davidson, Joy, Grootveld, Marjan, Whyte, Angus, Herterich, Patricia, Engelhardt, Claudia, Stoy, Lennart, & Proudman, Vanessa. (2020). D3.3 Policy Enhancement Recommendations (1.0). Zenodo. https://doi.org/10.5281/zenodo.5362183.

[11] Molloy, Laura, Nordling, Josefine, Grootveld, Marjan, van Horik, René, Whyte, Angus, Davidson, Joy, Herterich, Patricia, Martin, Ivan, Méndez, Eva, Principe, Pedro, Vieira, André, & Asmi, Ari. (2020). D3.4 Recommendations on practice to support FAIR data principles (1.1). Zenodo. https://doi.org/10.5281/zenodo.5357329.

further incentivisation for the creation of these usage scenarios from EOSC service or resource providers (e.g. Research Data Infrastructures) would be beneficial.

How it will be sustained:

The collection of Implementation Stories [12] plus the Implementation Story template [13] were published in the FAIRsFAIR Zenodo community under CC-BY license to ensure that the outputs will be findable, accessible and reusable. They were also publicised through the FAIRsFAIR communication channels, WP3 partners and stakeholders (RDA Working Groups (Active DMP IG, Professionalising Data Stewardship IG, Education & Training in Data handling IG), GO-FAIR network, Danish e-Infrastructure Consortium). The final documents were promoted in the January 2022 sustainability workshop to which many additional stakeholders and key organisations were invited.

In order to cross-link relevant outputs from different work packages, the Implementation Stories are available through the FAIRsFAIR Competence Centre knowledge base. They are also linked to KER3 'Framework for Assessing Capability Maturity and Engagement with FAIR-enabling Practices (ACME-FAIR)' to illustrate examples covering the relevant practice areas, and motivate adoption of both the stories and this capability model.

There are opportunities to further increase the impact of this project output that should be considered by interested parties including, for example, the translation of the Implementation Stories into different languages to increase their reach. In addition, there is the possibility that the Implementation Stories format could be adopted as a form of 'brief report' by academic journals that have FAIR implementation in their subject scope, such as the International Journal of Digital Curation. While this output is a static resource, meaning that no further cases will be added, there is the potential for future projects and/or organisations to write up their experiences using the Implementation Story template provided in this output. The Stories may also be used as reference materials for training purposes, and registered in the forthcoming EOSC Futures catalogue of training materials.

2.2.4. Capability model and guidance for FAIR enabling organisations (ACME-FAIR)

This output can be mapped to the following TFiR pillar: Implement / FAIR Ecosystem (Rec. 23 & 24)

What needs to be sustained:

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[12] E.g. Marjan Grootveld and Maaike Verburg. 'Two links in the research data life cycle: collaboration between a university and long-term repository' Zenodo. https://doi.org/10.5281/zenodo.6108876
[13] Angus Whyte, Josefine Nordling, & Ricarda Braukmann. (2022). Implementation story template (1.0). Zenodo. https://doi.org/10.5281/zenodo.6206620

FAIRsFAIR identified a need for a capability model to guide organisations in planning their actions in line with the TFiR recommendations. The ACME-FAIR capability guide is designed to support research performing organisations to become more FAIR enabling, by supporting their data producer communities in delivering FAIR data. In short, it facilitates self-assessment of the extent to which an institution or other Research Performing Organisation is 'FAIR-enabling'.

The ACME-FAIR guidance connects with recently published and longer established capability models. Recent models include the Science Europe 'Maturity Matrices for Sustainable Access to Research Data[14] and their Long-term Preservation', and Dutch National Platform for Open Science 'Do I-Pass for FAIR'.[15] Longer-established sources include the DCC RISE framework,[16] the TFiR report and the FAIR Working Group Six Recommendations for Implementation of FAIR Practice.[17]

Before it was finalised, an evaluation of ACME-FAIR was carried out by University of Helsinki (UHI), who coordinated its testing in three real-life settings. These involved the national-level DMP support service (DMP Tuuli Office), a national forum for data stewardship, and the UHEL group developing institutional policy. The ACME-FAIR guides were also open for public comment, seeking to ensure that the final document reflected the requirements of the future user community. A summary of evaluation results is appended to the D3.8 report.

Why it needs to be sustained:

Guidance on how to apply the recommendations of TFiR is a valuable tool for the further expansion of the number of FAIR-enabling institutions, both within the EOSC community and beyond. The EOSC Association, and coordination fora at international (e.g. RDA, CODATA) and national levels, could apply the framework to assist in developing capability building programmes. The framework would also be of use to research organisations directly, as well as to research departments and teams.

The framework fulfils following three main use cases.First, it assists in self-assessing readiness to support FAIR, by establishing the organisation's current and desired levels of maturity of the relevant capabilities, and the extent of community engagement with these. Second, it supports a shared understanding of the range of capabilities needed, to scope further training and dialogue

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[14] Boccali, Tommaso, Sølsnes, Anne Elisabeth, Thorley, Mark, Winkler-Nees, Stefan & Timmermann, Marie. (2021). Practical Guide to Sustainable Research Data. https://doi.org/10.5281/zenodo.4769703.

[15] Ringersma, J. and Miedema, M., 2021. Do I-PASS for FAIR? Measuring the FAIR-ness of Research Organizations. Data Science Journal, 20(1), p.30. DOI: http://doi.org/10.5334/dsj-2021-030.

[16] Rans, Jonathan & Whyte, Angus. (2017). 'Using RISE, the Research Infrastructure Self-Evaluation Framework' v.1.1 Edinburgh: Digital Curation Centre. www.dcc.ac.uk/guidance/how-guides

[17] European Commission, Directorate-general Research en Innovation (2020). Six Recommendations for implementation of FAIR practice by the FAIR in practice task force of the European open science cloud FAIR working group, Publications Office. https://data.europa.eu/doi/10.2777/986252 further examples of this use can be found here https://sparceurope.org/evaluate-your-rdm-offering/

within organisations, and inform their development roadmap. Finally, it facilitates mutual awareness among peer organisations of the current levels of maturity and community engagement around FAIR-enabling practices. Stakeholders that apply the framework to plan their implementation activities may wish to revisit the framework as they periodically update their plans.

How it is/will be sustained:

The framework is published in the FAIRsFAIR Zenodo community under a CC-BY licence. It has been promoted through FAIRsFAIR communication channels and at the January 2022 sustainability workshop. FAIRsFAIR partners DCC, DANS, UHI, CODATA, UMINH, EUA, STFC and SPARC Europe are all involved in promoting the output and identifying additional avenues for re-use. The DCC will be the main partner taking on the sustainability of this output.

Science Europe has produced a Practical Guide to Sustainable Research Data', which includes complementary maturity matrices for RPOs, funders, and infrastructures.[18] FAIRsFAIR WP3 has engaged with them regarding the alignment of these two frameworks. Science Europe has already promoted the output in a workshop on Maturity Matrices. It is salient to note that this alignment has been supported by FAIRsFAIR team members who have roles within Science Europe. This demonstrates how the framework contributes to broader efforts to foster "FAIR mature" institutions across Europe.

There is potential for ACME-FAIR to be further developed as a next step in the evolution of the RISE tool developed by the Digital Curation Centre.[19] This will require additional resources, and will be taken forward by the Digital Curation Centre, potentially in collaboration with others.

The framework is reusable by stakeholders without restriction. It is not, however, intended as a living document and any further maintenance and updating would require further community input and valorisation. Discussion has begun regarding the formation of a RDA Community of Practice in the context of the Professionalising Data Stewardship IG. This may take forward maintenance and further development of the framework, and potentially other related frameworks for guiding and incentivising implementation of FAIR support, engagement and training.

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[18] Boccali, Tommaso, Sølsnes, Anne Elisabeth, Thorley, Mark, Winkler-Nees, Stefan & Timmermann, Marie. (2021). Practical Guide to Sustainable Research Data. https://doi.org/10.5281/zenodo.4769703.

[19] Rans, J and Whyte, A. (2017). 'Using RISE, the Research Infrastructure Self-Evaluation Framework' v.1.1 Edinburgh: Digital Curation Centre. Available at www.dcc.ac.uk/guidance/how-guides

2.2.5. FAIR-Aware

This output can be mapped to the following TFiR pillar: Implement / FAIR culture and Skills for FAIR. Embed and Sustain / Incentives and metrics for FAIR data & services (Rec. 25)

What needs to be sustained:

The FAIRsFAIR project identified the need for a FAIR practical self-assessment tool for researchers. The resultant FAIR-Aware tool provides practical information and resources to (further) develop skills for FAIR, and is meant to incentivise researchers to make their data FAIR. This tool can be used both as a teaching tool and as a resource for researchers and data stewards to assess and increase their knowledge on how to make a dataset FAIR before depositing it in a repository.

Why it needs to be sustained:

The FAIR-Aware tool provides an accessible entry into FAIR discussions, and has the potential to be highly influential in raising FAIR awareness. Through a series of practically-based questions, the tool helps researchers see how the FAIR principles apply to their research. This enables them to better understand the FAIR principles and how making data FAIR can increase the potential value and impact of their data. The tool is also useful for FAIR education, and data stewards can use the tool to explain the need for FAIR data to others and showcase the steps to achieve that.

As a FAIR "checklist" the tool is also of use to repositories, who can benefit from the tool given their important role in data curation and long-term preservation. Similarly, this tool can be useful for publishers to guide authors in submitting FAIR data underlying their papers.

How it is/will be sustained:

Since the creation of the tool, DANS has been hosting FAIR-Aware[20] and will continue to do so after the completion of the FAIRsFAIR project. DANS continues to play a key role in the maintenance of the tool by conducting regular updates. There have been two updates since the launch of the tool, one in June 2020 and another November 2021. The November 2021 update introduced new functionality for use of FAIR-Aware in training activities. It allows trainers to download the self-assessment results of their course/training participants. By having an overview of such results, trainers are able to analyse the results and tailor their training activities accordingly.

DANS has committed to monitoring and integrating user feedback. This is key to ensuring that FAIR-Aware and related information resources supporting the tool do not become outdated and irrelevant to target audiences. Existing feedback from users has demonstrated that 81% found the tool useful in raising their awareness of FAIRness of data. In particular, the feedback highlighted the

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[20] Fairaware.dans.knaw.nl (accessed 10/02/2022).

value of clear guidelines and relevant examples that facilitate an understanding of the FAIR data principles in practice.

The tool has been promoted for adoption globally, and has already been integrated into a number of training events. For example, the FAIR-Aware tool is being used in the FAIRsFAIR/CODATA/RDA Data Steward training discussed later in this document. It is anticipated that promoting this tool within data steward communities will increase the impact of the output and coalesce the research community around the tool. The use of this tool in data steward training has been outlined in a recent blog.[21]

The FAIR-Aware tool is developed using open source standards and distributed under an open licence (as per the project DMP) to facilitate reuse and adoption. The technology and design have been kept as simple as possible in order to facilitate the reuse and adoption by other organisations or networks who may wish to create new instances of the tool. It is anticipated that the tool could be translated or adapted to suit disciplinary/institutional requirements. For example, a successful collaboration with research communities in France already produced a French version of FAIR-Aware in July 2021 which is hosted by INIST.[22] Further discussions are underway regarding translation into other languages. To ensure responsible re-use there is a need to develop metrics to assign credit for the re-use of the tool. This responsibility will be taken forward by DANS.

Key to the long-term sustainability of FAIR-Aware is a need for a community of practice to form around the tool. While a number of organisations already use and promote the tool, more can be done to grow this community. In particular, it is necessary to link this output to future training-focused projects such as EOSC Future to ensure that it is embedded within the EOSC community.

2.2.6. F-UJI automated FAIR data assessment

This output can be mapped to the following TFiR pillar: Implement / FAIR culture (Rec. 6, Rec. 19, Rec. 21), FAIR ecosystem (Rec.8) and Skills for FAIR. Embed and Sustain / Incentives and metrics for FAIR data and services (Rec. 12 and 25)

What needs to be sustained:

F-UJI[23] is a practical tool developed by the project that uses FAIR data metrics to perform the assessments of research data objects. Each assessment can contribute to a verifiable "FAIR status",

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[21] Linas Cepinskas (2021). New functionality of the FAIR-Aware tool: hands-on examples.
https://www.openaire.eu/blogs/2021-12-02-13-14-01 (accessed 10/02/2022).
[22] FAIR-Aware in French: https://doranum.fr/enjeux-benefices/outil-fair-aware/ (accessed 10/02/2022).
[23] https://www.fairsfair.eu/f-uji-automated-fair-data-assessment-tool (accessed 10/02/2022).

and the outputs indicate areas for measurable improvement. Similarly, the identified FAIR gaps can serve to create a general awareness of the FAIR culture and its practical implementation.

Why it needs to be sustained:

The use of F-UJI is intended to increase awareness on the FAIR principles and how the FAIRification of data can potentially make data more valuable and impactful. F-UJI can be used within FAIR consultations as well as FAIR education by identifying FAIR gaps as well as improvement opportunities.

F-UJI has the potential to become an integral part of the FAIR ecosystem. It is one of the few tools that enable practical FAIR data assessments based on the FAIR data metrics that are endorsed by larger parts of the scientific community. It is already an integral part of some FAIRification processes within EOSC such as EOSCNordic and ARCHIVER.

F-UJI has demonstrated that automated FAIR assessments are possible. The use of the tool in combination with an iterative FAIR consultation process thus provides an accessible pathway to increasing FAIR awareness. The tool has the potential to be of use to a wide range of stakeholders within the research landscape, including publishers, funders and repositories.

How it is/will be sustained:

The F-UJI tool is live and already in use. This work is being led by PANGAEA at the University of Bremen. In addition to a free tool, F-UJI source code is available within GitHub[24] for co-development and/or forking and re-use. The code is published under a very inclusive MIT licence which allows a broad range of applications including commercial use. F-UJI's GitHub repository is also linked to Zenodo, which allows the assignment of DOIs to the software. This enables citation of the product and ensures credits to the developers. This will facilitate the spread of the tool within the scientific community, and assist in establishing the tool as a core part of the EOSC FAIR ecosystem. It is anticipated that the accessibility of the Open Source code will assist in the emergence of an active user and developer community.

After the end of the FAIRsFAIR project, PANGAEA has committed to the long-term hosting and updating of the F-UJI tool. This will include continuing to coordinate the Open Source development of F-UJI's program code via GitHub and contributing to Open Source community development efforts. The long-term maintenance will also involve monitoring the development of alternative FAIR data assessment tools, such as those developed by other research groups.[25]

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[24] https://github.com/pangaea-data-publisher/fuji/issues (accessed 10/02/2022).
[25] And example is the work done by Mark Wilkinson http://fairdata.systems/ (accessed 10/02/2022).

A broad user community currently is forking the Github repository or otherwise contributing to F-UJI via the GitHub issue ticket system. Some are already using F-UJI for FAIR assessments whilst others are evaluating F-UJI for their own purposes. This community includes some important EOSC players, such as EOSCNordic, EOSCSynergy, ARCHIVER, and the European Commission DG for Research and Innovation - European Research Data Landscape project. The main developers located in Europe and Australia have also been promoting F-UJI globally in parallel to the FAIRsFAIR project.

A number of conferences and workshops (e.g. AGU2020, FAIR convergence symposium, STM Research Data Year) have promoted the tool within user communities, while also providing the opportunity to hold focus groups to test and contribute to the tool. Further, two scientific publications have already been published that demonstrate the potential of the tool to increase FAIRness of research data. Further publications are currently prepared and will promote sustainability by involving the scientific community as users as well as contributors to the tool.

While the F-UJI tool is already well-established within the FAIR ecosystem and has clear plans for sustainability, more can be done to enhance the impact of this output. In particular, the development of legal documents (service level agreements, terms of use etc.) will serve as a valuable resource for any further commercial or integrated EOSC activities. Moreover, the development of a business model for longer term sustainability will be helpful for the planning of post-project hosting. The EOSC Association Task Forces (such as the task force on FAIR metrics) are well-placed to lead these discussions, and preliminary discussions have already taken place. It is important to note that a number of funders have already expressed interest in the tool. Indeed, an MoU exists between FAIRsFAIR and the Wellcome Trust to support the FAIRAware project. Similarly, commercial repositories, such as Figshare, have expressed interest in assessing and demonstrating the FAIRness of their data holdings. These existing links will be helpful in future discussions on sustainability and long-term financial support.

Key to the long-term sustainability of F-UJI will be its integration into the EOSC service catalogue and computational environment, including service level agreements with key stakeholders such as EGI or other EOSC core service providers. This will assist with the deployment of the tool on EOSC platforms, as well as its integration with EOSC authentication and authorization systems. It will also ensure that the tool does not contend with sustainability challenges such as vendor locking in the future. Such efforts will be further enhanced by the coordinated uptake of the tool by national as well as regional data infrastructure initiatives, such as the Flemish ECOOM and German NFDI initiatives. This will maximise the exposure of researchers to the tool and support its use in training initiatives. It is also possible that FAIR scores and badges can motivate the creation of an optimised FAIR status for repositories.

A final consideration for the F-UJI tool is the role it could play as a data producer. As the number of F-UJI assessment outputs grows, this dataset could prove a valuable resource for further

understanding key areas for FAIR support and training. How such data could be collated and re-used is a topic that the existing user community could take forward after the end of the project.

2.2.7. FAIR-enabling and certified repository finder

This output can be mapped to the following TFiR pillar: Define / Concepts for FAIR implementation. Implement / FAIR Culture (Rec. 6 & 20) and FAIR Ecosystem (Rec. 8)

What needs to be sustained:

This resource is a discovery service for FAIR-enabling repositories. It also links related research outputs to the repositories, including support services and tools such as F-UJI. This links two key areas, namely a repository finder in DataCite Commons and the extension of the re3data repository schema to include additional properties to capture FAIR-enabling repositories.

The DataCite Commons repository search will enable users to find repositories - particularly FAIR-enabling ones, and connected PIDs. These include organisations via ROR, people via ORCID, articles, software etc via DOIs. The integration of FAIR into the re3data schema adapts a common and highly utilized tool used by researchers as a guide in the repository landscape.

Why it needs to be sustained:

Researchers and other stakeholders services of DataCite, such as data stewards, journals, infrastructure and service providers, have expressed the need for easy discovery of FAIR and FAIR-enabling entities in the research data landscape to make use of the proposed added values of the FAIR principles. It is anticipated that making FAIR-enabling provision visible will create incentives for repositories to implement FAIR enabling functions and get certified. This will enhance their overall visibility and ensure that they are promoted as FAIR-enabling in DataCite Commons and re3data, as well as more generally within scientific communities.

How it is/will be sustained:

Re3data and DataCite have been involved in the creation of this tool, and will continue to expand it after the end of the project. Planning for long-term sustainability has been assisted by a series of stakeholder engagement workshops. The planned changes to the DataCite Commons have already been incorporated in the roadmaps of DataCite and re3data. The community can engage and follow with the DataCite Commons repository search development activities.[26]

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[26] https://datacite.org/roadmap.html (accessed 10/02/2022).

The tool has been transitioned to DataCite Commons, which is DataCite's integrated discovery service for PIDs. This will enable users to search for FAIR-enabling repositories and connected PIDs within DataCite Commons. DataCite will also continue to maintain the code that is available via GitHub (https://github.com/datacite/akita).

The tool will continue to be updated by DataCite using the repository information provided by re3data. This work will be maintained by re3data which is based at the Karlsruhe Institute of Technology. Re3data will continue to update its repository metadata schema to include additional properties to capture FAIR enabling repositories.

In addition to the activities of re3data and DataCite, CoreTrustSeal, repository managers, organizations (e.g. AGU, funders etc.), future project partners and scientific communities are expected to contribute to the service as stakeholders and users of the provided services. It is anticipated that these stakeholders will assist with the future adoption and upcoming development that will result in the advancement of the platform.

2.2.8. Knowledge Base

This output can be mapped to the following TFiR pillar: Implement / Skills for FAIR (Rec. 10 & 11).

What needs to be sustained:

The knowledge base, as part of the Competence Centre, includes the FAIRdata Forum and a searchable training library of materials integrated into the FAIRsFAIR website. The latter pulls together material from FAIRsFAIR and other related projects to provide a resource on FAIR. The FAIRdata Forum has been used as a training tool during the FAIRsFAIR project and will continue as a static resource after the end of the project. The training materials library will continue to be available under CC-BY licenses, and a CSV file will enable their integration into future training catalogues.

Why it needs to be sustained:

Data Stewardship is an emerging field within the research ecosystem. There is still a need for training and training resources that can facilitate upskilling of individuals filling these roles within institutions. Better training for data stewards will strengthen both EOSC and FAIR ecosystems and support the efforts of the EOSC Working Group on Skills and Training. Moreover, increasing the number of individuals able to train ECRs in FAIR skills will benefit the same ecosystems.

The FAIRdata Forum was used as an entry point to all FAIR related materials, assets and outputs released by the FAIRsFAIR project. While it will not persist as a live resource after the end of the

project, it will provide a template for future projects wishing to implement a similar tool. The training materials are already in use by the data steward schools (mentioned later in the document), and provide an important resource for future training both within the schools and more broadly.

How it is/will be sustained:

Training materials as key outputs of the project have been deposited in both GitHub and the FAIRsFAIR Zenodo community under CC-BY licenses. The training materials are accompanied by a CSV file that enables the FAIRsFAIR library to be imported into other training catalogues. This will enhance re-usability of these resources.

The individual instructors who are the authors of the instructor training materials have a role to play in the sustainability of the materials. The materials used in the schools are already maintained on an ongoing basis by the CODATA-RDA school instructors. Whilst it is possible for a third party to deposit the materials into Zenodo it is preferable for the instructors to do so as updates to metadata or new versions can only be performed on an item in Zenodo by the person originally uploading the item.

There are ongoing efforts to make the materials FAIR in respect of Findable, Accessible and Reusable. The reusability of the training materials will be enhanced by their annotation using the terms4FAIRskills terminology (v0.1) to improve findability. Together with the EOSC 5B projects, this work package has run two workshops focusing on the interoperability and harmonisation of training materials and catalogues. The EOSC Future project is looking at developing the criteria for an EOSC training catalogue which depending on the criteria and timing may be a source of long term metadata for the FAIRsFAIR training outputs.

While the forum was used in training throughout the FAIRsFAIR project, low general usage meant it was not feasible to maintain as a live resource after the end of the project. It was decided that the forum would persist as an open but static resource after the end of the project. This static resource will be hosted by STFC.

2.2.9. ECR School and Data Steward instructor training

This output can be mapped to the following TFiR pillar: Implement / Skills for FAIR (Rec. 10 & 11).

What needs to be sustained:

The CODATA-RDA schools for research data science have run since 2016. The emphasis for these schools is to provide early-career researchers (ECRs) with a broad foundation in the principles of Data Science and to be more efficient and effective in their research. In 2019 components of the curriculum were adapted to create a separate stream of instructor training designed for data

stewards. These ECR schools and instructor training have generated three key outputs, namely a network of trainers and alumni, open access training materials (slides, videos and training materials) available on Zenodo, and Virtual Learning Environment (VLE) versions of the ECR school[27] and Instructor training.[28]

Why it needs to be sustained:

The ECR schools provide an important source of training for early career researchers wishing to upskill in data-focused research. In contrast to most other trainings, the schools provide a "broad and shallow" introduction to data science skills that forms a solid foundation for future training. While the schools were initially developed for low/middle-income ECRs, the interest from high-income country ECRs has demonstrated that there is a critical need for such training in general.

The ECR school network is well-established and has already educated over 500 students. The curriculum for the schools has been recognised as an official output of the RDA. During the FAIRsFAIR project the ECR schools were run annually from 2019-2021. These were hosted by the ICTP in Trieste, Italy. The first school in 2019 was run in person and the remainder were run virtually due to the COVID-19 pandemic.

The instructor training responds to a recognized need for targeted training of individuals in data steward roles. It is recognized that many individuals occupying data steward positions within their institutions are both new to their roles, and working alone or in very small teams. Building up a network of data stewards that can themselves act as instructors allows for the scaling up of the overall number of data stewards as well as the strengthening of data management practices across institutions. Correspondingly there is also a need to continue to deliver the training developed by the CODATA-RDA schools to ECRs. This will support the EOSC and FAIR ecosystems.

Data steward instructor training has been run as virtual events since 2019. To date, training has been run in Trieste, Manchester, Ghent, Ireland (NORF), and Gdańsk. Two instructor training events that were open calls were also run at the end of 2021. Further instructor training was run in San José, Costa Rica in 2020 and Gaborone, Botswana in 2021. This demonstrates not only the broad applicability of the curriculum, but also the potential for considerable upscaling of delivery.

The training provided by the ECR schools and instructor training, together with the accessible training materials, provides an important resource for expanding data stewardship expertise and foundational data skills for ECRs within research ecosystems. Ensuring that both of these types of

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[27] Bezuidenhout, Louise, Peterson, Bianca, Alfaro Córdoba, Marcela, El-jadid, Sara, Okorafor, Ekpe, Barlow, Roger, Venkataraman, Shanmugasundaram, Diggs, Stephen, Fischer, Daniel, Short, Hannah, Shanahan, Hugh, Quick, Rob, Cobé, Raphael, Costantini, Alessandro, Seyffert, Bertie, Makhafola, Lesego, Gcnukmana, Sipetheile, van Deventer, Martie, & Onime, Clement. (2021, December 20). The 2021 CODATA RDA Research Data Science Summer School - ICTP Trieste moodle image. Zenodo. https://doi.org/10.5281/zenodo.5792933.

[28] https://moodle.learn.eosc-synergy.eu/course/view.php?id=132 (accessed 10/02/2022).

training run after the end of the project, and that the materials continue to be updated and enriched, is key to attaining this intention.

How it is/will be sustained:

Sustainability efforts for these two training events are in two key areas: hosting of the events after the end of the project, and maintenance of training materials. Discussions about the future of the school network are currently underway with key stakeholders, including CODATA and RDA. An advisory board has been appointed to guide these discussions. Key to the long-term sustainability of the school network is the development of a financial sustainable model. The most likely model to succeed is one based on institutional subscriptions from HEIs and professional bodies. There has been commitment by the range of stakeholders involved in the schools to continue these discussions and identify a workable sustainability model. The newly instituted advisory board will be an important asset in defining this model for the future.

The training materials developed for the schools represent an important resource for the data steward community. Key to sustainability planning for this resource is the promotion of these materials. The materials are deposited in the FAIRsFAIR Zenodo community under a CC-BY license. The materials have been promoted within the FAIRsFAIR networks, as well as being showcased in the January 2022 sustainability workshop. The materials and schools have also been promoted through the CODATA-RDA data science school alumni network in newsletters and on the website.

Both the ECR schools and the instructor training have been presented at a number of conferences, including the IDCC 2020 and the 2021 RDA plenary. Descriptions of the models have also been published in a number of academic papers. There has been considerable interest by partners around the globe regarding co-hosting future schools. In addition, a number of organizations such as Elixir have expressed interest in reusing the model in a wholesale fashion. It is anticipated that the new VLEs for the schools will facilitate this.

The ECR school materials and the VLE are available on Zenodo for re-use. The data steward instructor training VLE was created by FAIRsFAIR project partners STFC and DANS. This Moodle will be live by the end of the FAIRsFAIR project, and represents an important resource for the data steward community. The Moodle will be hosted on the EOSC Synergy platform, ensuring its long-term sustainability. It will also be promoted through FAIRsFAIR networks and within EOSC.

The schools have been taken up outside of Europe. Since 2019 two ECR schools have been run in Pretoria, South Africa, and one in Addis Ababa, Ethiopia. Instructor training has been run in Gaborone, Botswana and San Jose, Costa Rica. This demonstrates the global applicability of the materials and the potential for expansion beyond the EU. The planned translation of the training materials into French, Spanish and Portuguese will increase the re-usability of the materials and

enhance global impact. Improving the global reach of the training materials is a priority for the CODATA-RDA school network.

The long-term sustainability of the schools will require growing the instructor pool. There are ongoing discussions about running train-the-trainer events to facilitate this. It is anticipated that future promotion within the EOSC Association will be done by the Task Force on Research Careers and Curricula (data stewardship curricula and career paths[29] and upskilling countries to engage in EOSC[30] will also be useful to support these activities.

2.2.10. FAIR Adoption Handbook for Universities

This output can be mapped to the following TFiR pillar: Implement / Skills for FAIR (Rec. 10 & 11).

What needs to be sustained:

The adoption handbook "How to be FAIR with your data - A teaching and training handbook for higher education institutions" has been developed for HEIs. The aim of this tool is to help universities to apply the competence framework to their specific situation and needs. It does so by providing ready-to-use model lesson plans on a variety of topics, including FAIR data, Data Management Plans (DMPs), repositories, data creation and reuse. The handbook also offers FAIR competence profiles and learning outcomes for the bachelor, master and doctoral levels, as well as information on course design and the implementation of the FAIR principles at the institutional level.

To ensure that the handbook was developed in accordance with the needs of the community, relevant actors such as representatives from higher education institutions, research infrastructures and national agencies were involved in the creation of the deliverable. In June 2021, the project, under the lead of the University of Göttingen, organised a booksprint[31] which brought together a variety of experts in the field of RDM and FAIR data to develop a first draft for the handbook. Participants of the booksprint were 38 experts from 14 European countries as well as the United States and Canada. Moreover, the draft handbook resulting from these collaborative efforts

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[29] Task Force charter Data stewardship curricula and career paths
https://www.eosc.eu/sites/default/files/tfcharters/eosca_tfdatastewardshipcurriculaandcareerpaths_draftcharter_20210614.pdf (accessed 10/02/2022).

[30] Task Force charter Data stewardship curricula and career paths
https://www.eosc.eu/sites/default/files/tfcharters/eosca_tfdatastewardshipcurriculaandcareerpaths_draftcharter_20210614.pdf (accessed 10/02/2022).

[31] https://www.fairsfair.eu/events/booksprint-fair-adoption-handbook-universities (accessed 10/02/2022).

underwent a community review[32] in July/September 2021 to gather feedback and input from the broader higher education and research community.

Why it needs to be sustained:

The FAIR Adoption Handbook for Universities is an essential part of the "practical turn" to implementation for the FAIR ecosystem and EOSC. The work in this work package, as well as other landscaping efforts, have shown that there is still a lack of RDM and FAIR education in current teaching in HEIs. By providing a means that helps universities to implement relevant content into their curricula, the Adoption Handbook strengthens the teaching of these topics, leading in turn to better RDM and FAIR-related skills and knowledge of students (i.e. future researchers and members of the workforce) as well as fostering the general culture shift towards more openness and FAIRness in the research ecosystem.

How it is/will be sustained:

The open access handbook has been published on the project website and in Zenodo. The University of Minho has committed to the publication of an Open Access version of the handbook and a print version. A GitBook version of the handbook will also be ready by the end of the project. The Universities of Minho and Göttingen have committed to maintaining the Gitbook for 7 years and monitor its use/re-use (ie. translations). Discussions are currently underway with EOSC and the RDA regarding future updates to the handbook.

The handbook has already been heavily publicised through FAIRsFAIR and partner networks. It has also been promoted at the Estonian and Portuguese National Roadshows. The handbook will also be promoted at the January 2022 sustainability workshop.

2.3. Other Key Outputs

2.3.1. Long-term preservation of project deliverables & data

This output can be mapped to the following TFiR pillar: Implement / FAIR Culture (Rec. 20).

What needs to be sustained:

The FAIRsFAIR project generated considerable documentation (over 160 project outputs). These include deliverables and underlying data, milestone documents, intermediary results and intermediary data, code, reports and working documents. In particular, documentation that

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[32] https://www.fairsfair.eu/news/community-review-teaching-and-training-handbook-fair-principles-now-open accessed 10/02/2022).

supported the KERs, KOs and KFs has been preserved to provide background and supporting information to the key project outputs. The materials to be preserved were selected by the project executive committee and coordinating office. Work package leaders undertook to prepare and deposit the outputs in Zenodo. The plan for disseminating and exploiting project deliverables and data has been guided by the FAIRSFAIR Communication, Marketing & Engagement Plan.[33]

Why it needs to be sustained:

Stakeholders across the entire spectrum of the digital landscape increasingly recognise the role of enabling FAIR as a driver of innovation, productivity and competitiveness. That is why FAIR can be seen referenced in resources such as the European Data Strategy, the EU Manifesto for Covid-19 Research, and the digitalisation strategies of pharmaceutical giants such as Roche. The FAIRsFAIR recommendations and resources are therefore expected to remain highly relevant for a considerable time after the project ends.

How it is/will be sustained:

Work Package and Task Leaders were responsible for depositing the outputs in Zenodo as they become available as part of the project's compliance with the ORDP (Open Research Data Pilot). The Zenodo deposits were ordered using a FAIRsFAIR community. This ensures that all the materials are linked and easily findable. The FAIRsFAIR community will not be added to after the end of the project, but could be linked to ongoing FAIR-related communities.

All software outputs were deposited into GitHub.[34] Releases created in Github were added to FAIRsFAIR Zenodo community. Outputs are deposited under the CC-BY 4.0 (Attribution 4.0 International) licence, or MIT licence (code), and using recommended file formats.

At the end of the project the selected assets were deposited in the CoreTrustSeal-certified trustworthy data repository EASY (DANS) for long-term preservation. This ensured that all documentation has Dublin Core metadata. In the repository each dataset has a unique and persistent identifier. Selected software artefacts were preserved using the Save Code Now[35] feature provided by Software Heritage (INRIA).[36]

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[33] Meneses, Rita, Pittonet, Sara, Proudman, Vanessa, O'Connor, Ryan, Whyte, Angus, Davidson, Joy, von Stein, Ilona, Grootveld, Marjan, Newbold, Elizabeth, Stoy, Lennart, L'Hours, Hervé, & Coen, Gerard. (2021). D5.4 FAIRSFAIR Communication, Marketing & Engagement Plan (Final Version) (V1.0_DRAFT). Zenodo. https://doi.org/10.5281/zenodo.4476767

[34] https://github.com/FAIRsFAIR (accessed 10/02/2022).

[35] https://archive.softwareheritage.org/save/ (accessed 10/02/2022).

[36] https://www.softwareheritage.org/2019/08/05/saving-and-referencing-research-software-in-software-heritage/ (accessed 10/02/2022).

Project outputs would be more easily findable after the project ends if they were labelled using a semantic artefact (ontology, taxonomy, terminology, controlled vocabulary, glossary, etc.). There has been ongoing activity within the work package regarding the harmonisation of training materials. Key to these activities is the identification of the metadata required to describe training materials in training catalogues. This work has been done together with other work packages, including Terms4FAIRskills which is "building a terminology for the skills necessary to make data FAIR and to keep it FAIR". Terms4FAIRskills has received EOSC Co-Creation funding to develop the terminology further and FAIRsFAIR have been annotating training materials with the terms as one of the use cases for testing and developing the terminology (terms4FAIRskills, the hackathon competencies, skills and knowledge associated with making and keeping data FAIR | FAIRsFAIR).[37] This work will continue after the end of the project and it is anticipated that the materials will be annotated once a vocabulary is developed. This will ensure that the documents are annotated to support their long-term findability and re-use.

The partners in the project consortium have direct connections with many stakeholders in the EOSC and FAIR ecosystems, and many are working in EOSC-related projects, including the ESFRI cluster projects, INFRAEOSC-05 projects, and other H2020 EOSC initiatives. Such direct links facilitate the flow of information (data and deliverables) between stakeholders and domains working on aspects of FAIR and the FAIRsFAIR project. This is further amplified by the vast range of community engagement activities the project undertakes for the dissemination and communication of outputs including the activities of the Synchronisation Force[38] and the work of the European Group of FAIR Champions[39] who act as ambassadors for the project.

2.3.2. Recommendations for FAIR semantics

This output can be mapped to the following TFiR pillar: Define / Concepts for FAIR implementation (Rec. 1 & 3), Implement / FAIR Culture (Rec. 4) and FAIR Ecosystem (Rec. 7)

What needs to be sustained: The recommendations for FAIR semantics have been produced and deposited into the FAIRsFAIR Zenodo community. These recommendations have been integrated into the activities of the RDA VSSIG interest group (Vocabulary and Semantic Services Interest Group).[40] The recommendations have also been discussed in different organisations and initiatives such as GOFAIR INTER, IOF and projects such as OntoCommons.

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[37] Molloy, Laura & McQuilton, Peter. (2020). FAIR Data Terms Refined in Terms4FAIRskills Hackathon. https://www.fairsfair.eu/articles-publications/fair-data-terms-refined-terms4fairskills-hackathon (accessed 10/02/2022).
[38] https://fairsfair.eu/advisory-board/synchronisation-force (accessed 10/02/2022).
[39] https://fairsfair.eu/advisory-board/egfc (accessed 10/02/2022).
[40] https://www.rd-alliance.org/groups/vocabulary-services-interest-group.html (accessed 10/02/2022).

Why it needs to be sustained:

Successful implementation of interoperability is of considerable importance for efficient research infrastructures. Benefits that will be derived from semantic interoperability include, for example, parallel searching across multiple repositories. Developing semantic interoperability requires community engagement and continual updating in order to reflect changing research environments. This is done by creating and upholding shared best practice and agreed recommendations. All service providers should be engaged in semantic interoperability. There is a great need to keep the growing community involved and actively bring it together for a common discussion and agreement on shared best practice. This FAIRsFAIR project output provides the basis for these discussions.

How it is/will be sustained:

The recommendations for FAIR semantics have been integrated into the activities of the RDA VSSIG and would best continue as a RDA Working Group. This would guarantee the improvement and maintenance of this output and support a broad adoption of the recommendations. One objective of the WG would be to engage with key organizations to foster the adoption. The initial preparation for the creation of this working group is underway. Initial efforts to find some preliminary funding to support the creation of a semantic web community are underway.

As RDA work is not funded and relies on volunteer activity, it is also important that some of this future work be integrated into Horizon Europe projects. This would provide the necessary resources to pursue this work. As a number of organizations, such as GOFAIR INTER, and IOF, have already been engaged with this output, it is possible that these organizations could lead on future funded projects.

In order to take this work forward, it is important to start discussions with global initiatives to gather support and endorsement. These initiatives should be local i.e. EOSC, GAIA-X, ESFRIs to guide the development of the semantic interoperability proposed in the EOSC Interoperability Framework. However, the work should be kept linked to the ESOC and ESFRIs to ensure interoperability and sustainable solutions not only for EOSC core services, but also the management, government and updating of guidelines and documentations to support a positive development over time, i.e. expert work around semantic services regarding implementation and guidelines.

2.3.3. Framework for assessing FAIR-enabling services

This output can be mapped to the following TFiR pillar: Implement / FAIR Ecosystem (Rec. 9)

What needs to be sustained:

This framework covers services instrumental in implementing the FAIR principles. The framework aligns to other certifications and assessments and explains their relations.

Why it needs to be sustained:

This output serves as a resource to research communities and infrastructures wishing to develop their FAIR capability. It also serves as a tool through which to assess the readiness of current research ecosystems. It is therefore important for the EOSC community as a resource to support onboarding and good practice.

How it is/will be sustained:

The framework is available in the FAIRsFAIR Zenodo community and has been promoted through the FAIRsFAIR network. A number of webinars have also been hosted to raise awareness about the resource. This work has also fed into the report titled "Recommendations on certifying services required to enable FAIR within EOSC".[41]

In order to ensure that this project has maximal impact after the end of the project, it is important that this work is continued in conjunction with EOSC. This will ensure that it remains a living document and reflects the changing infrastructure landscape. The resource could be enriched by the development of iterations that focus on different assessment and validations frameworks. Such iterations could review the functions and coverage to guide service providers in choosing the best tools for quality enhancement.

2.3.4. Recommendations for FAIRness of research software

This output can be mapped to the following TFiR pillar: Define / Concepts for FAIR implementation (Rec. 16)

What needs to be sustained:

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[41] European Commission, Directorate-General for Research and Innovation, Slavec, A., Jones, S., Aronsen, J., et al., (2021). Recommendations on certifying services required to enable FAIR within EOSC, Genova, F.(editor), Publications Office. https://data.europa.eu/doi/10.2777/127253.

The working group produced a milestone report that provides an analysis and recommendations regarding FAIRness of research software.[42] This report, together with additional documentation has been deposited in Zenodo.

Why it needs to be sustained:

Research software is an essential (FAIR) digital object alongside research data sets, methodologies, semantic artefacts, etc. It plays a critical and pervasive role in the research enterprise - as a tool, a research output and an object of study. Discussions around the FAIR-ness of research software are relatively new, and thus reports such as the one produced in the project provide a key basis for future work.

How it is/will be sustained:

The report and activities of this group have been promoted through the FAIRsFAIR network. There has also been engagement with relevant communities through a public consultation process, including a well-attended webinar organized through FAIRsFAIR.[43]

The activities of this output have been successfully handed over to the RDA working group "FAIR 4 Research Software" (FAIR4RS).[44] This working group will take forward work on this topic and drive further development. The work of this group will build on the analysis and recommendations delivered by FAIRsFAIR. It is anticipated that this working group will liaise with the EOSC Task Force that focuses on software to ensure the alignment of recommendations and best practice.

2.3.5. CoreTrustSeal+FAIR certification

This output can be mapped to the following TFiR pillar: Implement / FAIR Ecosystem (Rec. 9)

What needs to be sustained:

The repository standardisation offered by CoreTrustSeal provides a basis for interoperability frameworks that can be aligned with data managed through DMPs. A range of research infrastructures, including but not limited to CESSDA and CLARIN have directly adopted the CoreTrustSeal as a central standard for members and their existing alignment with FAIR and EOSC.

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[42] Gruenpeter, Morane, Di Cosmo, Roberto, Koers, Hylke, Herterich, Patricia, Hooft, Rob, Parland-von Essen, Jessica, Tana, Jonas, Aalto, Tero, & Jones, Sarah. (2020). M2.15 Assessment report on 'FAIRness of software' (1.1). Zenodo. https://doi.org/10.5281/zenodo.4095092.

[43] https://www.fairsfair.eu/events/fair-software-decoding-principles (accessed 10/02/2022).

[44] https://www.rd-alliance.org/groups/fair-research-software-fair4rs-wg (accessed 10/02/2022).

Within a FAIR culture, the additional standardisation offered by CoreTrustSeal+FAIR provides a basis for interoperability frameworks that connect FAIR principles with repository practices. This framework is in line with the proposed FAIR Digital Object model and extends metrics for certifying FAIR enabling (repository) services. It clearly supports prioritisation of FAIR digital objects and prioritisation of Trusted Digital Repositories. It is a key component for future certification that incentivises research infrastructures to support FAIR data.

The CoreTrustSeal+FAIRenabling Capability Maturity Model emerged from open collaborative feedback and testing with the FAIRsFAIR repositories. The capability-maturity modelling approach is based on a design document agreed across FAIRsFAIR partners and in cooperation with Science Europe on their own maturity matrices. Through this consultation a minimum viable scenario was identified for managing the ongoing alignment of CoreTrustSeal Requirements to the FAIR Data Principles. This took into account both the prioritised FAIR Data Metrics (RDA) and the user experience of those using the CoreTrustSeal for self-assessment whether for ongoing development or for certification.

Why it needs to be sustained:

FAIR enabling Trustworthy Digital Repositories provide a key node of quality assurance, integrity and provenance at the heart of the research data lifecycle. As data services, the repositories are a key stakeholder and are essential components of the FAIR ecosystem and interact directly with most other stakeholders including research communities, standards bodies, coordination fora, policy makers, research funders and research performing organisations.

The work to identify metrics for FAIR digital objects rapidly identified the challenges of doing so without understanding their context. The mission of repositories is to deliver that contextual information through mature and standardised processes that pre-date the FAIR Principles. The alignment of this data deposit, curation, preservation, discovery, access and usage support coverage from repositories with the emerging expectation of FAIR data is the only practical approach to delivering a cornerstone of the FAIR ecosystem. The CoreTrustSeal+FAIRenabling Capability Maturity Model provides a tool through which repositories can start preparing for the integration of FAIR into their design.

How it is/will be sustained:

Version 1.0 of the CoreTrustSeal+FAIRenabling Capability Maturity Model can already be utilized by repositories. There are plans in place to conduct intermediate testing of the CoreTrustSeal+FAIRenabling Capability Maturity Model through a CTS sub-group. This will provide necessary FAIRsFAIR feedback to the CTS revisioning (beginning in 2022). This would include the alignment of CTS requirements with the wording of FAIR, and restructuring through lessons learnt from the FAIRsFAIR repository certification support. These issues will be detailed in blog posts that

will be published on the FAIRsFAIR website. As there are a number of FAIRsFAIR members on CoreTrustSeal board they will be well-placed to support the review.

It is important to recognize that this, and future adoption activities are dependent on community involvement. There is a need for more work to explore "ideal" (ie. assessing repositories with CTS +FAIR elements) and "contingency" options (ie. self declaration or other authoritative bodies such as GoFAIR and OpenAIRE granting certification). A good avenue for generating and sustaining community involvement will be to create an RDA interest group for trusted digital repositories.

Sustainability actions will be enhanced standardised mapping, versioning and consultation approaches that will align with the CoreTrustSeal periodic revision and review by community members. This community engagement will also enable associated topics such as monitoring machine-actionable repository certification aspects (re3data) and object assessment. Moreover, case studies that detail the direct impact of benefit to both CoreTrustSeal and FAIR through ongoing communications and engagement will be beneficial to EOSC and the broader community.

2.3.6. FAIR Competence Framework

This output can be mapped to the following TFiR pillar: Define / Concepts for FAIR implementation and implement/skills for FAIR

What needs to be sustained:

The "FAIR Competence Framework" is the basis for "FAIR Adoption Handbook for Universities" and subsequently "Good Practices in FAIR Education". The competence framework was informed by discussion at a number of community events organised by the FAIRsFAIR project. The competence framework was presented during the online workshop "FAIR data competences in doctoral education programmes"[45] on 26-27 May 2021, providing insights and points for reflection for the integration of the framework in university programmes at the doctoral level. Furthermore, on 15 September 2021, the competence framework was presented and further discussed during the online workshop "Training the trainers: Data Management and FAIR data principles in university curricula",[46] with a special focus on the framework's body of knowledge, its learning outcomes and learning units for FAIR data education in university curricula across levels.

Why it needs to be sustained:

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[45] https://www.fairsfair.eu/events/fair-data-competences-doctoral-education-programmes (accessed 10/02/2022).
[46] https://www.fairsfair.eu/events/fairsfair-event/training-trainers-data-management-and-fair-data-principles-university (accessed 10/02/2022).

Other stakeholders do not depend on the "FAIR Competence Framework", but it does provide the basis for other deliverables mentioned above, and links to the RDA, Terms4FAIRskills, etc. in terms of ensuring complementarity.

How it is/will be sustained:

The "FAIR Competence Framework" was published OA and with PID and is available via the project website and Zenodo. At the time of publication, it was disseminated through the project's social media and other channels, as well as those of the European University Association. The dataset informing the framework has also been deposited on Zenodo, and a Python notebook has been prepared to assist re-use.

The University of Amsterdam has led the development and sustainability/exploitation of the "FAIR Competence Framework" in close collaboration with WP7 project partners. The EDISON Data Science Framework (EDISON-EDSF) community, which is supported by the University of Amsterdam, has committed to ensuring that this framework is complementary to, or can function as, an extension to existing and adopted data science and other competence frameworks. A similar role for others such as the RDA is being explored.

National RDM networks will also be important in facilitating the uptake of the framework and handbook. These networks have already been engaged through a number of workshops and are aware of the outputs. These include NORF (Ireland), ForunGDI (Portugal), OS working group from Couperin.org (France), Swissuniversities (Switzerland), University of Cologne (Germany), and Serbia. These networks were also engaged via the national roadshows as well as the January 2022 sustainability workshop.

2.3.7. Good Practices in FAIR Education

This output can be mapped to the following TFiR pillar: Implement / Skills for FAIR (Rec. 10 & 11)

What needs to be sustained:

"Good practices in FAIR Competence Education" is a report that synthesises examples of successful integration of Research Data Management (RDM) and FAIR data-related skills in university curricula and training to provide an up-to-date perspective on how these skills are being implemented by higher education institutions. The case study analysis provides universities with advice on embedding FAIR competences in their curricula and research training programmes, thus facilitating the "practical turn" to implementation for the FAIR ecosystem and EOSC.

Why it needs to be sustained:

"Good practices in FAIR education" analyses case studies in FAIR competence education provides practical examples on how FAIR education has been successfully integrated into a range of different institutional settings. This provides an important resource for institutions wishing to start planning similar activities. The report gathers and structures the lessons learned from the case studies in order to demonstrate how to take practical, short-term steps to raise awareness and build capacity among students, doctoral candidates and academic and other staff to follow the FAIR principles when working with research data. It is anticipated that this report will serve to inspire the implementation, embedding and sustaining of these practices elsewhere.

How it is/will be sustained:

"Good practices in FAIR education" has been published in the FAIRsFAIR Zenodo community as well as on the project website. At the time of publication, it was disseminated through the project's social media and other channels, as well as those of the EUA. The EUA will also include this report in communicating the work package's overall results to its university members across Europe. Discussions are underway with EUA to publish output as OA publication and take ownership of curation, as well as hosting the report on its website.

The report's longer-term exploitation will be linked to that of "FAIR data competence framework" and "Development of FAIR model courses and curricula", which provide the holistic framework of which the collected practices reflect specific elements. These resources will be enriched by the ongoing work by the EUA to explore the topic through other publications, such as the EUA Open Science survey.

2.4. Key functions

2.4.1. FAIRsFAIR website

This output can be mapped to the following TFiR pillar: N/A

What needs to be sustained:

The FAIRsFAIR website has been online since early 2019 and hosts all project related information. The website will be maintained online after the end of the project as a static resource.

Why it needs to be sustained:

The website has acted as an entry point to all these services, providing information and ensuring traffic. Maintaining these entry pages live and ensuring a clear access to all the project outputs is therefore important to ensure uptake after the project ends.

How it is/will be sustained:

The FAIRsFAIR website will be available online for 5 years after the end of the project. Trust-IT Services will ensure access to information on the website. The website will be maintained with minimal technical effort, credentials to access and manage the platform could be given to other people indicated by the EC.

The website data controllers and data processors will be in charge of managing the website. Focusing on the management of personal data, DANS-KNAW, as a data controller, will keep defining the purposes for which and the means by which personal data is processed. Trust-IT Services, as a data processor, will process personal data only on behalf of the controller.

Maintaining the pilot websites/services developed as part of the project such as the FAIR-Aware pilot, the FUJI demo website, the re3data Repository finder (to be integrated into the DataCite Commons) and the FAIR Data Forum will be considered on a case by case basis. We will take their sustainability plans into consideration and explore how they might become a part of the EOSC marketplace or EOSC Pillar Training Catalogue for example.

2.4.2. Coordination, collaboration and knowledge-exchange

This output can be mapped to the following TFiR pillar: N/A

What needs to be sustained:

FAIRsFAIR has established several expert groups, including FAIR Experts & Ambassadors, FAIR Champions, HLAC, The Synchronisation Force core team that ran until the end of the project in Feb 2022**.** A key challenge for FAIRsFAIR has been to ensure that project activities dovetail with guidelines of the EOSC key governance bodies (i.e. the EOSC Working Groups[47] and the recently established EOSC Association) and that they feed into and complement the activities of other projects in the research data and FAIR space.

The FAIRsFAIR Synchronisation Force was set up to maintain a dialogue across the EOSC and FAIR ecosystems so as to maximise collaboration, minimise duplication, and promote adherence to Turning FAIR into Reality,[48] the final report and action plan from the European Commission expert group on FAIR data. The Synchronisation Force organised and documented the outcomes of this activity during two workshops with FAIR stakeholders in 2019 and 2020 and plans a third one in

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[47] https://www.eoscsecretariat.eu/eosc-working-groups (accessed 10/02/2022).

[48] European Commission, Directorate-General for Research and Innovation. (2018). Turning FAIR into reality : final report and action plan from the European Commission expert group on FAIR data, Publications Office. https://data.europa.eu/doi/10.2777/54599.

2021. A series of events "FAIR National Roadshows" were organised in 2021-2022 with the aim to accelerate FAIR adoption in different European countries whilst connecting to national initiatives.

The final synchronization report, together with the documentation on the workshops and roadshows will be sustained after the end of the project.

Why it needs to be sustained:

Future EOSC projects and FAIR policymakers and practitioners who need sounding boards, partners or to share knowledge can benefit from the networks developed during the project. The expertise gathered together in the FAIR Experts & Ambassadors, FAIR Champions, HLAC, The Synchronisation Force core team have facilitated considerable networking and knowledge exchange. Maintaining one or more of these groups will ensure the continuity of knowledge on FAIR, and will build continued FAIR intellectual capacity and connect people from a range of disciplines and cultures across Europe.

Alignment on FAIR is important for a more integrated and interconnected FAIR service infrastructure and to increase FAIR research data. The national roadshows played an important part in achieving this alignment, by providing generally-applicable, yet locally-appropriate information on FAIR. This was done by hosting national events or activities in the local language, being mindful of the local context whilst amplifying the FAIR goal in one unified voice. The lessons learnt and best practice advice accrued from these events will be important for future projects.

The information about the synchronization task force, the workshops and the roadshows demonstrate how they positively contributed to the success of the FAIRsFAIR project. These resources will be valuable for future projects considering similar initiatives. In particular, it will provide an important resource for the European Commission to guide coordination around FAIR among funded projects as part of the GA signed for the Horizon Europe contracts, for instance via collaboration agreements.

How it is/will be sustained:

The terms of service for the FAIR Experts & Ambassadors, FAIR Champions, HLAC, and The Synchronisation Force core team end at the end of the FAIRsFAIR project. At the end of the project, FAIRsFAIR will officially recognise the work done by these people by providing them with a visual sign of recognition such as a "FAIR Champion" or "FAIR Expert" for use on their online profiles for example. This will be accompanied by a letter sent by post thanking them for their practical contribution to the uptake of FAIRsFAIR outputs and for the implementation of FAIR practices in their environments.

The expertise gathered together in these groups will be valuable for the future development of both FAIR and EOSC ecosystems. For maximal impact it would be necessary for these individuals to be involved in some form or another. It is possible that EOSC can capitalize on these groups by integrating the members into existing task forces or affiliated groups within the EOSC Association. It is important to highlight that maintaining the groups in their current form is not of vital importance. Rather, the expertise represented by these groups should feature in knowledge-exchange planning.

The FAIRsFAIR Synchronisation Force report and affiliated documentation is available on Zenodo under a CC-BY license. While the document is not intended to be a living document, it provides future projects with important information regarding lessons learned. The report will be promoted within the FAIRsFAIR and affiliated stakeholder networks. It will also be promoted in the sustainability workshop in January 2022.

The FAIRsFAIR Roadshows have been a successful initiative through which to share information about the project to researchers around Europe. At the end of the project a guidance document will be prepared that will serve as a "blueprint" for future events. This will include lessons learnt including what we would have liked to have encountered setting out, what we would have done differently, the counterfactual/opportunity cost of what the state would be if FAIRsFAIR synchronisation activities had not taken place, what the FAIRsFAIR activities achieved. FAIRSFAIR could also stimulate further national events after the end of its project to further roll out FAIR. The document will be stored on Zenodo and promoted via the FAIRsFAIR and stakeholder networks. This resource could be enriched by reports on future national events.

2.4.3. European network of FAIR-enabling Trustworthy Data Repositories

This output can be mapped to the following TFiR pillar: implement/skills for FAIR

What needs to be sustained:

FAIRsFAIR engaged several data repositories into a "Support programme" comprising multiple activities. In WP4, ten data repositories were selected and incentivised to help identify and align with FAIR-enabling practices, and undertake the CoreTrustSeal trustworthiness certification. In WP2, twelve data repositories were selected to help design and test technical implementations that will enable and increase repository interoperability to enable FAIR. In WP3, a pilot trialled the integration of metadata catalogues to support cross-disciplinary FAIR uptake with invited repositories and research Infrastructures. Finally, a transition support programme – building on and feeding into WP2 and WP4 work – was also initiated. Together, these repositories represent the core of a potential European network of FAIR-enabling Trustworthy Data Repositories. The outline for

such a network was described in the Coordination Plan for a sustainable network of FAIR-enabling Trustworthy Digital Repositories.[49]

Why it needs to be sustained:

The success of EOSC depends on the capacity of European digital repositories to coordinate their efforts and to comply with trustworthiness standards to ensure long term digital preservation and support FAIR data management. Coordination networks for digital repositories exist in disciplinary contexts (for e.g. CLARIN or ELIXIR) or in a regional/national context (for e.g. the Nordic e-Infrastructure Collaboration NeIC or Research Data Netherlands RDNL) but not at a cross-disciplinary European level.

Europe has also the largest number of certified Trustworthy Data Repositories (70 certified as CoreTrustSeal in July 2021)[50]. The 10 repositories engaged in FAIRsFAIR prefigure a nucleus of the proposed European network of FAIR-enabling Trustworthy Data Repositories that should be coordinated, connected and nurtured as part of the EOSC FAIR-enabling ecosystem to ensure long term digital preservation of data made available in EOSC. This coordination function would enable the connection and active participation of trustworthy repositories in EOSC by providing, for example, an automated ingest of key data holdings identified for preservation and shared within EOSC. This links closely with the Charter for the EOSC Task Force on Long Term Data Preservation (EOSC TF LTP).

During the project this work package collaborated on FAIR alignment with research infrastructures (such as CESSDA and CLARIN) and EOSC projects (such as SSHOC and EOSC-Nordic) which have adopted CoreTrustSeal as a standard for repositories certification. This collaboration has assisted in the dissemination and diffusion of the CoreTrustSeal+FAIR approach. It has also helped by strengthening the contribution of disciplinary and regional repository communities and alignment with the EOSC RoP.

The project has also collaborated with the Archiver project, as the services it is helping procure as part of the EOSC portfolio are expected to benchmark against CoreTrustSeal certification and to enable FAIR data management. Collaboration includes FAIR data assessment with the F-UJI tool and benchmarking against the CoreTrustSeal+FAIR maturity model. However, Archiver services are not expected to include expert curation and stewardship. Therefore connecting the TDR services and network to these services is critical. These technology service providers can support trustworthy digital repositories by lifting the technological challenges of storage and digital preservation. Other

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[49] von Stein, Ilona, L'Hours, Hervé, Cepinskas, Linas, Mathers, Benjamin, Dillo, Ingrid, Verburg, Maaike, Mokrane, Mustapha, Herterich, Patricia & Rouchon, Olivier. (2021). D4.4 Coordination Plan for a sustainable network of FAIR-enabling Trustworthy Digital Repositories (1.0_DRAFT). Zenodo. https://doi.org/10.5281/zenodo.5726691.

[50] https://www.coretrustseal.org/why-certification/certified-repositories/ (accessed 10/02/2022).

collaboration is ongoing with EOSC-hub and the DICE projects for the technical linking of TDRs with the EOSC core data services.

How it is/will be sustained:

FAIRsFAIR worked with a group of European digital repositories to support their trustworthiness certification route and adapt their policies and practices to maximize FAIR data management. Trustworthiness certification was recognized to be a long term commitment, yet most of the repositories achieved certification by the end of the project. They also committed to continuing the process and renewing their certification every three years. The work with these repositories informed both the capability model and a number of related outputs.[51]

In January 2022 FAIRsFAIR hosted a workshop to discuss a European Network of Trusted Digital Repositories.[52] Participants included representatives from FAIRsFAIR, FAIRsFAIR-supported repositories, SSHOC, EOSC Nordic, EC, European certified repositories, CTS and EOSC.

The EOSC Association and the European Commission through the EOSC Partnership can play a critical role in incentivizing the network and encouraging its sustainability. However, several stakeholders are directly involved in the sustainability and coordination of a future European network of FAIR-enabling Trustworthy Data Repositories. First, the presence of trustworthy digital repositories within the EOSC ecosystem needs to be strengthened. Repositories should be incentivised to contribute and align with the RoP including enabling FAIR data management. We are concerned here specifically with repositories ensuring long term digital preservation including the stewardship and curation of data holdings. Second, the EOSC Partnership needs to include the long term digital preservation more explicitly as part of the planning and the EOSC ecosystem with digital repositories playing a key role. The coordination of these repositories is critical to build and sustain the EOSC ecosystem.

The CoreTrustSeal Board manages the CoreTrustSeal certification of trustworthy digital repositories which was identified and recommended as a starting point for FAIR assessment in the EOSC (TFiR report). The CoreTrustSeal+FAIR approach discussed above will enable FAIR data management that will be critical to the expansion of EOSC.

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[51] Grootveld, Marjan, Whyte, Angus, Davidson, Joy, Herterich, Patricia, Nordling, Josefine & van Horik, Rene. (2020). M3.5 Draft Description of FAIRsFAIR's Transition Support Programme for Repositories (0.5). Zenodo. https://doi.org/10.5281/zenodo.5470629.
[52] https://www.fairsfair.eu/events/fairsfair-event/workshop-network-fair-enabling-trustworthy-digital-repositories-tdrs (accessed 10/02/2022).

2.5 Summary of sustainability activities

Type of output	Name of output	Output category	Brief description	Sustainability plan
FAIR guidance	FAIR implementation stories and guidance	KER	A descriptive template for 'Implementation Stories', which describe implementation of FAIR enabling activities by Research Producing Organisations (RPOs) and Research Data Infrastructures (RDIs). It is accompanied by a set of such stories demonstrating how organisations have taken actions consistent with the recommendations of TFiR	The collection of 23 Implementation Stories and the Implementation Story templates were published in the FAIRsFAIR Zenodo community under CC-BY license to ensure that the outputs will be findable, accessible and reusable.
	FAIR adoption handbook for universities	KER	A handbook to help universities to apply the competence framework to their specific situation and needs. It does so by providing ready-to-use model lesson plans on a variety of topics, including FAIR data, Data Management Plans (DMPs), repositories, data creation and reuse. The handbook also offers FAIR competence profiles and learning outcomes for the bachelor, master and doctoral levels, as well as information on course design and the implementation of the FAIR principles at the institutional level.	The open access handbook has been published on the project website and in Zenodo. The University of Minho has committed to the publication of an Open Access version of the handbook and a print version. A GitBook version of the handbook will also be ready by the end of the project. The Universities of Minho and Göttingen have committed to maintaining the Gitbook for 7 years and monitor its use/re-use (ie. translations).
	FAIR data policy checklist and structured policy description template	KER	A checklist to enable policymakers to self assess whether their data policies are FAIR-enabling and a template to support them to describe the content of their policies in a structured and comparable way.	The checklist, template and related guidance are openly available via the FAIRsFAIR Zenodo community under a CC-BY licence.
	Framework for assessing FAIR-enabling services	KO	Framework covering services instrumental in implementing the FAIR principles. The framework aligns to other certifications and assessments and explains their relations.	The framework is available in the FAIRsFAIR Zenodo community and has been promoted through the FAIRsFAIR network. This work has also fed into the report titled "Recommendations on certifying services required to enable FAIR within EOSC".

	Recommendations for FAIRness of research software	KO	Milestone report providing an analysis and recommendations regarding FAIRness of research software.	Work has been successfully handed over to the RDA working group "FAIR 4 Research Software" (FAIR4RS).
	FAIR competence framework	KO	The "FAIR Competence Framework" is the basis for "FAIR Adoption Handbook for Universities" and subsequently "Good Practices in FAIR Education".	The "FAIR Competence Framework" was published OA and with PID and is available via the project website and Zenodo. The dataset informing the framework has also been deposited on Zenodo, and a Python notebook has been prepared to assist re-use. The EDISON Data Science Framework (EDISON-EDSF) community, which is supported by the University of Amsterdam, has committed to ensuring that this framework is complementary to, or can function as, an extension to existing and adopted data science and other competence frameworks. A similar role for others such as the RDA is being explored.
	Recommendations on FAIR semantics	KO	Documentation surrounding recommendations for FAIR semantics.	Recommendations have been deposited into the FAIRsFAIR Zenodo community. These recommendations have been integrated into the activities of the RDA VSSIG interest group (Vocabulary and Semantic Services Interest Group). The recommendations have also been discussed in different organisations and initiatives such as GOFAIR INTER, IOF and projects such as OntoCommons.
FAIR tools	Capability model for FAIR-enabling organizations (ACME-FAIR)	KER	ACME-FAIR capability guide is designed to support research performing organisations to become more FAIR enabling, by supporting their data producer communities in delivering FAIR data.	The framework is published The DCC will be the main partner taking on the sustainability of this output. The FAIRsFAIR Zenodo community under a CC-BY licence. Discussion has begun regarding the formation of a RDA Community of Practice in the context of the Professionalising Data Stewardship IG.
	FAIR-Aware	KER	The FAIR-Aware tool provides practical information and resources to (further) develop skills for FAIR, and is meant to incentivise researchers to make their data FAIR. This tool can be used both as a teaching tool and as a resource for researchers and data stewards.	Since the creation of the tool, DANS has been hosting FAIR-Aware and will continue to do so after the completion of the FAIRsFAIR project. DANS continues to play a key role in the maintenance of the tool by conducting regular updates.

	F-UJI	KER	F-UJI is a practical tool developed by the project that uses FAIR data metrics to perform the assessments of research data objects.	F-UJI source code is available within GitHub for co-development and/or forking and re-use. PANGAEA has committed to the long-term hosting and updating of the F-UJI tool. This will include continuing to coordinate the Open Source development of F-UJI's program code via GitHub and contributing to Open Source community development efforts.
	FAIR-enabling repository finder	KER	A discovery service for FAIR-enabling repositories	Re3data and DataCite have been involved in the creation of this tool, and will continue to expand it after the end of the project.
	Reference implementation of FAIR Data Point	KER	Work done to expand on the requirements of developing a FAIR Data Point system, and to investigate its use in FAIR Data Stations	The code developed during the FAIRsFAIR project is stored both in the GO-FAIR and in the FAIRsFAIR repositories. The work package has already negotiated a long-term commitment for the continuous development of the FAIR Data Point from the GO-FAIR community.
	FAIRdata forum	KO	The FAIRdata Forum has been used as a training tool during the FAIRsFAIR project.	The forum will persist as an open but static resource after the end of the project. This static resource will be hosted by STFC.
	CoreTrustSeal + FAIR certification	KO	The CoreTrustSeal+FAIRenabling Capability Maturity Model emerged from open collaborative feedback and testing with the FAIRsFAIR repositories.	Version 1.0 of the CoreTrustSeal+FAIRenabling Capability Maturity Model can already be utilized by repositories. There are plans in place to conduct intermediate testing of the CoreTrustSeal+FAIRenabling Capability Maturity Model through a CTS sub-group. This will provide necessary FAIRsFAIR feedback to the CTS revisioning.
	European network of FAIR-enabling trusted digital repositories	KF	A number of repositories were involved in FAIRsFAIR work on certification and form the basis for a European network of FAIR-enabling trusted digital repositories. The outline for such a network was described in the Coordination Plan for a sustainable network of FAIR-enabling Trustworthy Digital Repositories.	The EOSC Association and the European Commission through the EOSC Partnership can play a critical role in incentivizing the network and encouraging its sustainability.
FAIR training	Training materials	KO	A searchable training library of materials integrated into the FAIRsFAIR website.	Training materials as key outputs of the project have been deposited in both GitHub and the FAIRsFAIR Zenodo community under CC-BY licenses. The

				training materials are accompanied by a CSV file that enables the FAIRsFAIR library to be imported into other training catalogues. This will enhance re-usability of these resources.
	Good practices in FAIR education	KO	A report that synthesises examples of successful integration of Research Data Management (RDM) and FAIR data-related skills in university curricula and training to provide an up-to-date perspective on how these skills are being implemented by higher education institutions.	The report has been published in the FAIRsFAIR Zenodo community as well as on the project website. Discussions are underway with EUA to publish output as OA publication and take ownership of curation, as well as hosting the report on its website.
	Data steward Schools	KO	CODATA-RDA Schools for Research Data Science and Data Stewardship have generated three key outputs, namely a network of trainers and alumni, open access training materials (slides, videos and training materials) available on Zenodo, and Virtual Learning Environment (VLE) versions of the ECR school and Instructor training.	Sustainability efforts for these two training events are in two key areas: hosting of the events after the end of the project, and maintenance of training materials. Discussions about the future of the school network are currently underway with key stakeholders, including CODATA and RDA. An advisory board has been appointed to guide these discussions. Key action still required is the development of a viable model for financial sustainability.
FAIRsFAIR project tools	Project deliverables	KO	Over 160 project outputs. These include deliverables and underlying data, milestone documents, intermediary results and intermediary data, code, reports and working documents.	Work Package and Task Leaders were responsible for depositing the outputs in Zenodo as they become available as part of the project's compliance with the ORDP (Open Research Data Pilot). The Zenodo deposits were ordered using a FAIRsFAIR community. This ensures that all the materials are linked and easily findable. The FAIRsFAIR community will not be added to after the end of the project, but could be linked to ongoing FAIR-related communities. All software outputs were deposited into GitHub. At the end of the project the selected assets were deposited in the CoreTrustSeal-certified trustworthy data repository EASY (DANS) for long-term preservation.
	Coordination and synchronization	KF	FAIRsFAIR has established several expert groups, including FAIR Experts & Ambassadors, FAIR Champions, HLAC, The Synchronisation Force core team that ran until the end of	It is possible that EOSC can capitalize on these groups by integrating the members into existing task forces or affiliated groups within the EOSC Association. The FAIRsFAIR Synchronisation Force report

			the project in Feb 2022.	and affiliated documentation is available on Zenodo under a CC-BY license. While the document is not intended to be a living document, it provides future projects with important information regarding lessons learned. The FAIRsFAIR Roadshows have been a successful initiative through which to share information about the project to researchers around Europe. At the end of the project a guidance document will be prepared that will serve as a "blueprint" for future events.
	FAIRsFAIR website	KF	The website hosts all project related information.	The website will be maintained online after the end of the project as a static resource for 5 years after the end of the project. Trust-IT Services will ensure access to information on the website. The website will be maintained with minimal technical effort, credentials to access and manage the platform could be given to other people indicated by the EC.

Table 1: summary of FAIRsFAIR project outputs and sustainability planning[53]

3. Uptake of the project deliverables by EOSC and future recommendations

The 2021 publication of the Recommendations for a FAIR EOSC White Paper of the FAIRsFAIR Synchronisation Force[54] provides a comprehensive overview of how the project has contributed to the EOSC ecosystem. The publication offers a number of recommendations to the EOSC Partnership and the EOSC Association Task Forces in three areas related to the Strategic Research and Innovation Agenda (SRIA)[55] of the EOSC. These are FAIR by design; sustainability of the components: the federated data layer; and a strategic and targeted approach to training. These recommendations are linked to eight specific actions and are detailed in figure 2 below.

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[53] Posters of project outputs used in January 27 (2022) sustainability meeting can be viewed at Bezuidenhout, Louise. (2022). Posters of FAIRsFAIR outputs detailing sustainability plans. Zenodo. https://doi.org/10.5281/zenodo.6204596.

[54] Dillo, Ingrid, Hodson, Simon, Pittonet Gaiarin, Sara, & Grootveld, Marjan. (2021). D5.7 Recommendations for a FAIR EOSC - White Paper FAIRsFAIR Synchronisation Force 2021 (Version 1.0 DRAFT). Zenodo. https://doi.org/10.5281/zenodo.5793105.

[55] European Commission (2022). Strategic Research and Innovation Agenda (SRIA) of the European Open Science Cloud (EOSC). Publications Office. https://www.eosc.eu/sria.

Figure 2: eight recommendations for a FAIR EOSC, mapped to SRIA priorities and EOSC Task Forces (taken from FAIR EOSC White Paper of the FAIRsFAIR Synchronisation Force)

It is recognized that addressing these recommendations will require involvement of other stakeholders, such as research infrastructures, research funders, policy makers and projects, at national and international, domain and cross-domain levels. Within this context, however, it is evident how the outputs discussed in this sustainability report can contribute to achieving these

recommendations. Indeed, EOSC will benefit from the practical tools, communities of practice and stakeholder connections created during the FAIRsFAIR project.

3.1 EOSC Task Forces

The FAIRsFAIR outputs are positioned to immediately contribute to the development of EOSC through their use in the newly formed EOSC Task Forces. These Task Forces fall under the EOSC Association Advisory Groups,[56] a structure to allow Association members and others to help steer the implementation of EOSC. The Advisory Groups provide an "umbrella" for a set of Task Forces that are highly related. The Task Forces address key areas of implementation and liaise with EOSC projects to offer feedback on developments, as well as identify strategic gaps and areas for investment to input to SRIA. The table summarizes the Task Forces currently in operation and demonstrates how the specific outputs described in this report can contribute to the work of the different groups.

Advisory group	Task Forces	Relevant FAIRsFAIR outputs
AG Implementation of EOSC	TF PID Policy and Implementation	Capability model for FAIR-enabling organizations (ACME-FAIR)
	TF Researcher Engagement and Adoption	Data steward schools FAIR-Aware
	TF Rules of Participation Compliance Monitoring	Capability model for FAIR-enabling organizations (ACME-FAIR) Framework for assessing FAIR-enabling services Policy description template of structured Open Science policy descriptions CoreTrustSeal + FAIR certification European network of trusted digital repositories FAIR competence framework F-UJI
AG Metadata and Data Quality	TF FAIR Metrics and Data Quality	Policy description template of structured Open Science policy descriptions
	TF Semantic Interoperability	Recommendations on FAIR semantics
AG Research Careers and Curricula	TF Data Stewardship Curricula and Career Paths	Data steward schools FAIR-Aware FAIR competence framework FAIR adoption handbook for universities

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[56] https://www.eosc.eu/advisory-groups (accessed 18 February 2022).

		Good practices in FAIR education Training materials
	TF Research Careers, Recognition, and Credit	FAIR competence framework FAIR implementation stories and guidance FAIR adoption handbook for universities Good practices in FAIR education
	TF Upskilling Countries to Engage in EOSC	CoreTrustSeal + FAIR certification European network of trusted digital repositories Capability model for FAIR-enabling organizations (ACME-FAIR) Framework for assessing FAIR-enabling services FAIR adoption handbook for universities Training materials
AG Sustaining EOSC	TF Defining Funding Models for EOSC	
	TF Long-Term Data Preservation	Reference implementation of FAIR data point CoreTrustSeal + FAIR certification European network of trusted digital repositories
AG Technical Challenges on EOSC	TF AAI Architecture	Policy description template of structured Open Science policy descriptions Capability model for FAIR-enabling organizations (ACME-FAIR)
	TF Infrastructure for Quality Research Software	Recommendations for FAIRness of research software Reference implementation of FAIR data point

Table 2: Potential contributions of FAIRsFAIR outputs to the work of the EOSC task forces

3.2 EOSC projects and related partners

As mentioned through this report, a flourishing EOSC will involve further collaboration between other EOSC-related projects. This will involve the uptake of the FAIRsFAIR outputs into their activities, as well as further linking the communities and stakeholders engaged throughout the project. As one example, the EOSC-Nordic project has already made use of both the FAIRAware and F-UJI tools, and the continued use of these tools in this project will enrich and expand the impact of these tools within the EOSC context and beyond.

In addition to the outputs of the FAIRsFAIR project, an additional impact of the FAIRsFAIR project is as a case study of continuous, detailed sustainability planning. The details provided in this report, together with the working group outputs, provide a clear roadmap to future projects for the valuable contributions made by the EOSC-funded projects to building a FAIR ecosystem. This

sustainability planning was already undertaken during the lifespan of the FAIRsFAIR project. In the previous years the FAIRsFAIR project team brought together other projects and key EOSC stakeholders to discuss sustainability in three FAIR Synchronisation Workforce meetings. These meetings, together with the sustainability workshop and this report, describe both processes which will help build a FAIR ecosystem for the European Open Science Cloud and encourage researchers to "participate in a culture of sharing the results of their research".[57]

The last of these workshops focused on recommendations 14 and 15 of the TFiR Report in particular. Discussions around recommendation 14, Investment in FAIR services, highlighted the need for strategic and coordinated funding. In particular, it identified a critical need for a coordinated approach to supporting core infrastructure and services that builds on existing investments where appropriate. In order to achieve this, there is a need for funders to directly fund FAIR activities and to develop services that serve communities now and in the future. Funding should be tied to certification schemes, sustainable business models and other community-vetted indicators that demonstrate viability. This links strongly with recommendation 15, providing sustainable funding, in order to strengthen the FAIR ecosystem.

3.3 International organizations and partnerships

As is evident from this FAIRsFAIR sustainability plan, volunteer networks, such as the RDA, continue to play a vital role in the FAIR ecosystem. This is not only through the potential for interest/working groups to take forward the outputs mentioned in this report, but also through the considerable sharing of expertise that these volunteer networks bring through their engagement in project/stakeholder meetings and related activities. Providing funding to support the FAIR-related activities of these volunteer networks is yet another way in which strategic funding can advance the FAIR ecosystem.

The implementation of EOSC involves a huge and expanding number of organisations, projects, and individuals. The FAIR principles are relevant, or even essential, both for this large, diverse group of organisations, projects, and individuals, but also on a global scale. Implementing the FAIR principles requires conscious efforts towards synchronising and aligning both information and developments throughout EOSC and beyond, and towards avoiding unnecessary duplication of work. The FAIR EOSC White Paper of the FAIRsFAIR Synchronisation Force outlines four key instruments that can support long-term FAIR planning (Figure 3). It is important to recognize that this paper is important

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[57] Pittonet Gaiarin, Sara, Davidson, Joy, Grootveld, Marjan & Proudman, Vanessa. (2021). FAIRsFAIR's contribution to EOSC: sustainable solutions for a FAIR Open Science ecosystem (1.0). Zenodo. https://doi.org/10.5281/zenodo.5543260.

not only for EOSC, but for the global communities that will connect to European research through EOSC.
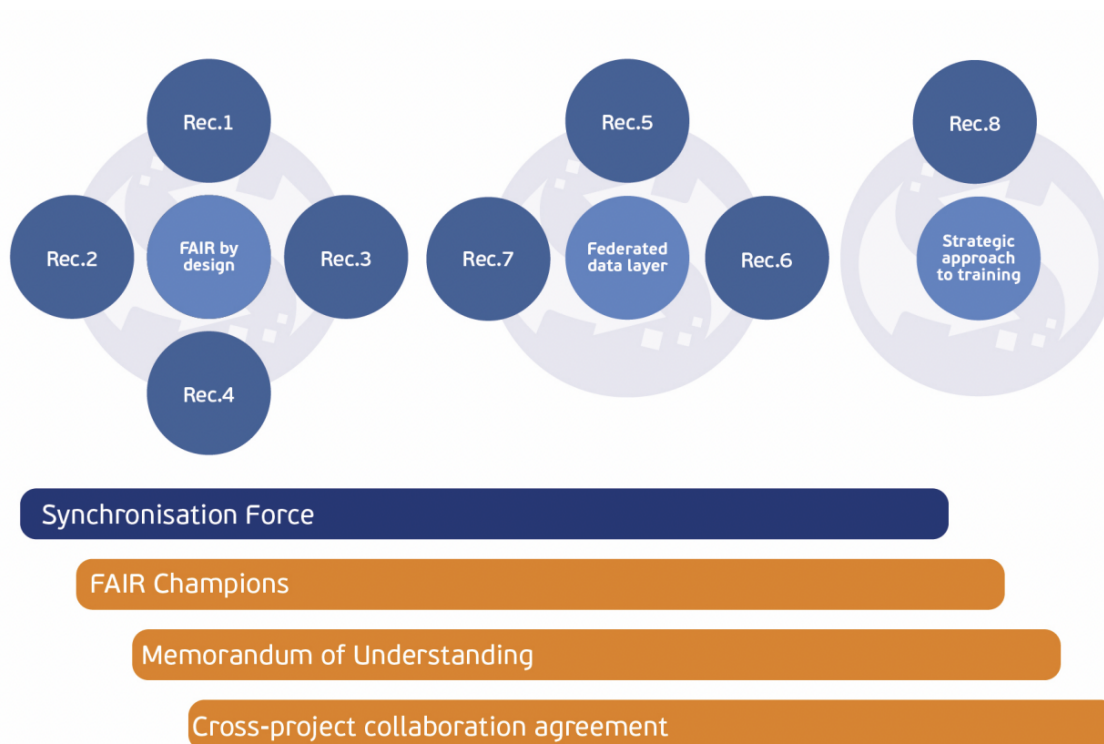

Figure 3: four instruments to align activities and implement recommendations for a FAIR EOSC (taken from FAIR EOSC White Paper of the FAIRsFAIR Synchronisation Force)

The White Paper concludes with some pointers for good practice that it is important to reiterate in this report. These pointers are salient not only for EOSC-related projects, but for any funded research activity. The pointers are:

Be pro-active: Based on our experience in FAIRsFAIR, we recommend organising collaboration across projects in the same funding call and/or with related remits.

Be on time and make it doable: The organisation of the collaboration mentioned above should be done before the projects start when there is still room to allocate capacity to the collaboration. Ideally the call for funding should require the allocation of resources for collaboration.

Be as lightweight as possible: It is important to strive for lightweight MoUs which also address operational support for the implementation of the collaboration identified in the agreements.

Sustain the success of the Synchronisation Force and FAIR Champions

Finally, the two instruments that were created in the FAIRsFAIR project itself to promote further synchronisation and alignment among projects and initiatives in the FAIR ecosystems, the Synchronisation Force and the FAIR Champions, should be maintained as they have proven to be very effective

Through these pointers, it is the ambition of the FAIRsFAIR project to provide an example of sustainable and FAIR planning to any future project, regardless of project location or subject.

5. Conclusion

The FAIRsFAIR project has demonstrated that many exciting opportunities exist to integrate FAIR widely into research practice. Through its project partners, stakeholder relationships and community engagement, the project has shown that it is now time to implement FAIR principles throughout research processes and bring about the associated benefits to research. Nonetheless, the project has also demonstrated that much remains to be done in order to achieve these ambitions - both within EOSC and beyond. By undertaking the sustainability activities planned during the project and described in this report, it is expected that the outputs of the FAIRsFAIR project will continue to advance the FAIR agenda in Europe and make a substantial contribution to the evolution of a more effective research ecosystem.

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