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EOSCpilot
The European Open Science Cloud for Research Pilot Project

D3.5: Open Science Policy Toolkit

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Abstract:

This report provides an overview of the results of the Policy Toolkit research for EOSCpilot. The toolkit offers a collection and comparison of tools which can be used to develop and implement Open Science policies in order to facilitate the EOSC as a federated system. The Open Science Policy Toolkit is primarily useful for research producing organisations, funders, (research) ministries, and research infrastructures. It is part of the EOSC's suite of Policy Supporting Services, thus complementing the Open Science Monitor (D3.2) and Open Science Policy Registry (D3.4).

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EXECUTIVE SUMMARY

This report introduces the proposal and scoping for the EOSCpilot Policy Toolkit. The Policy Toolkit is a collection of third-party tools which have been designed to facilitate the development and implementation of Open Science policies by three scientific and academic stakeholders: research producing organisations, funders and (research) ministries, as well as research infrastructures. Through the toolkit, these users should be able to identify resources which help them to formulate Open Science policies, facilitate their operationalization in line with the EOSC's policy requirements (as e.g. defined by the EOSC policy recommendations and Rules of Participation), and meet EOSC-specific use cases. The Policy Toolkit is part of WP3's suite of policy supporting services, complementing the Open Science Monitor (D3.2) and the upcoming Policy registry (D3.4)

Based on a comprehensive set of qualitative indicators, a comparative survey has been conducted, leading to the identification of 60 eligible Open Science policy tools. These have been classed into two broad use case categories: Tools which serve *policy development* (i.e. the scoping, conceptualisation, and formulation of policies) and *policy implementation* (i.e. steps to embed a policy in an organisational context in order to make it actionable). Additionally, based on an inductive content analysis, 13 different tool classes are identified. Grouping the tools by their relevant stakeholder categories finds substantive imbalances between the supply of tools for the different user groups: While there are 58 tools available in the toolkit for research producing organisations, only 31 are listed for funders and ministries. For research infrastructures only 20 tools are identified, most of which have some relevance for research infrastructures, but which were nonetheless not developed for them as primary users. Further development needs for future tools are identified, including:

- a need to develop tools for more RIs than just repositories;
- a need for implementation monitoring, impact measurement, and compliance support tools which are designed specifically for funders and RIs;
- a need to accelerate the development of FAIR implementation tools, particularly if FAIR is supposed to become a major focus and differentiator of the EOSC.

The EOSC portal is anticipated to launch by the end of 2018. Until then, as an interim solution, the Policy Toolkit will be made available for downloading and commenting via eoscpilot.eu.

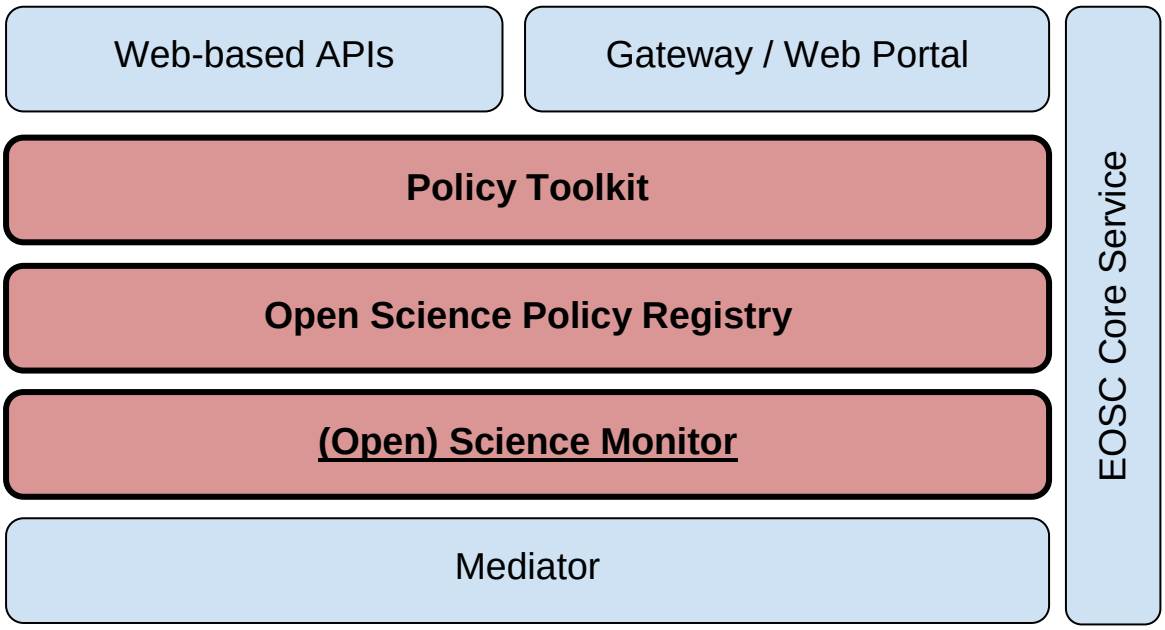
1. INTRODUCTION

This report introduces the proposal and scoping for the EOSCpilot's Policy Toolkit (D3.5). The paper presents the outcome of the activities of *WP3 - Policy* to assemble a collection of existing tools which are relevant to the development and implementation of Open Science policies. An Open Science policy is a set of rules and/or principles, usually formulated to advance the realisation of Open Science practices among a dedicated group of target stakeholders. An example for this could be the realisation of open workflows throughout the research life cycle. To achieve their objective, Open Science policies can cover either *individual (fragmented)* policy areas relating to Open Science[1] or connect multiple policy areas as part of a larger, *holistic* framework[2]. As Open Science gains popularity among policy makers, the latter appears to become increasingly the norm - and is arguably particularly relevant in the context of the EOSC. However, for this report, it is important to stress that we include both *holistic and fragmented* policy types in our definition.

The main scope of *WP3 - Policy* is to develop "*a uniform policy framework* governing the stakeholders and resources that comprise the EOSC". The Policy Supporting Services, which are designed and specified by T3.2 will facilitate the implementation and ongoing operation of this policy framework (see figure 1). In this context, the aim of the Policy Toolkit is to serve as a resource which helps relevant stakeholders to identify third party tools, that can help to develop and implement best practice Open Science policies. Other EOSC Policy Services to support this objective are:

- the Open Science Monitor (D3.2[3]), which is a framework to measure the openness and FAIRness of EOSC Open Science Resources,
- and the Policy Registry (D3.4), which will provide a framework to support machine-readability and actionability of policies, helping EOSC stakeholders and users comply with EOSC's Rules of Participation as well as to improve the general scalability of the EOSC's policy framework.

Figure 1: EOSC Policy Supporting Services (highlighted in red)



[1] This can e.g. be specific policies on open access to publications, research data management, or archiving/long-term preservation.
[2] An example for this are the recently updated recommendations on access to and preservation of scientific information: https://ec.europa.eu/digital-single-market/en/news/recommendation-access-and-preservation-scientific-information
[3] https://eoscpilot.eu/content/d32-eosc-open-science-monitor-specifications

To assemble the Policy Toolkit, a survey of the existing landscape of policy-supporting third-party tools was conducted. These were categorised and classed into tool categories to provide summary information to users about the functions of these tools and to retrieve an indicative view on the current supply of tools, including potential areas for development which might become relevant in future iterations of the EOSC. In the following sections, the report introduces a more detailed definition of the Toolkit and its relevance in the EOSC's context (section 1.1 and 1.2), the methodology and limitations of the Toolkit (section 2), main findings and a discussion of these (section 3 and 4), and conclusions (section 5).

1.1. Scope and definition of the Policy Toolkit

The Policy Toolkit is a collection of third-party tools[4] which have been designed to facilitate the development and implementation of Open Science policies by three scientific and academic stakeholders. These stakeholders have also been crucial for the reports on the Open Science Monitor[5], the Policy Landscaping Review[6], and the Draft Policy Recommendations[7] [8]:

1. **Research Producing Organisations** (RPOs): Organisations which perform research and produce research outputs, e.g. universities, other research and academic institutions, and research or academic libraries.
2. **Research Infrastructures** (RIs): Large physical installations or distributed facilities which include networked resources or skill / capacity building initiatives. These resources use advanced ICT, cloud, and big data technologies to underpin new, collaborative methods of research. Research infrastructures may be based at a single location, distributed across several sites and organisations, or provided via online platforms.
3. **Funders/ministries**: Ministries are policy makers for research policies, and often also fulfil a monitoring function for the implementation of such policies. Funders are organisations which provide financial resources e.g. to RPOs and RIs in order to conduct research. They can either be subsidiaries of higher-level government bodies (e.g. ministries) or act independently from government.

Depending on the type of their stakeholder organization end-users of the toolkit can have very different roles, such as library professionals, research managers, research officers, funding managers, public administrators or policy makers (tasked with science and research policies, e.g. to define funder policies or national research policies).

Through the toolkit, these users should be able to identify resources which help them to formulate Open Science policies, facilitate their operationalization in line with the EOSC's policy requirements (as e.g. defined by the EOSC policy recommendations and Rules of Participation), and meet EOSC-specific use cases. A central requirement for the Policy Toolkit has been that it should provide users with resources to address both general and specific policy issues. As an example, users should be able to find in the toolkit a selection of tools which address general Open Science policy issues, providing them with general guidance on how to develop a policy, and specific implementation challenges, such as the introduction of research data management or FAIR data workflows. As a result of this broad requirement, we have applied a very broad definition of "tools": Tools can be any publicly available object which can be used by relevant stakeholders

[4] The notion of third-party tools implies that the tools in the toolkit have been developed by third-party organisations or projects, not EOSCpilot or any other EOSC project. Please refer to section 2.1 for more information on the notion of different toolkit types.

[5] https://eoscpilot.eu/content/d32-eosc-open-science-monitor-specifications

[6] https://eoscpilot.eu/content/d31-policy-landscape-review

[7] Work in progress at the time of writing.

[8] The following definitions are also broadly in line with the definitions of RPOs, RIs, government bodies, and funding agencies used in the Draft Governance Framework (D2.2). The latter two have been classed as one stakeholder group in this report, but are separately defined in D2.2: https://eoscpilot.eu/sites/default/files/eoscpilot-d2.2.pdf

as an instrument to support strategic decision making and/or the implementation of Open Science policies.[9] In line with the proposed EOSC service Architecture, the Policy Toolkit will be a part of the Core Services Catalogue of the EOSC[10] (see figure 1 above). The Core Services suite will also contain the Open Science Monitor and the Policy Registry service. Together, these will constitute a set of supporting services to implement, monitor and validate policies within EOSC, and more generally Open Science scenarios. The Policy Toolkit's specific offer in this context is to provide a structured online resource which helps users to search and identify relevant, existing tools which facilitate the uptake of Open Science policies. To achieve this, the Policy Toolkit should eventually be made available on the EOSC Portal as a searchable database, with structured search functions that are based on the categorisations described in sections 2.2 and 3.2. In particular, the Policy Toolkit database should provide the following summary information:

- Short description: Basic information about the tool, its functionality, and use case.
- Development stage: Operational, pilot, or concept.
- Stakeholder group: Research producing organisations (RPOs), funders / ministries, and research infrastructures (RIs).

Due to the current delay in the release of the EOSC Portal, the Policy Toolkit will first be made available through the policy section of the EOSCpilot website[11] as a downloadable spreadsheet which contains all relevant information recorded as part of this research. Additionally, users will be able to access an online version of the spreadsheet, where they can also comment on contents and propose additions. Until its release through the EOSC Portal, this minimum viable product version of the Policy Toolkit will thus allow users to access information and engage with EOSCpilot's ongoing work in this domain. As required by the Description of Work, it is intended to publish the Toolkit on a dedicated section of the EOSC Portal upon its publication in Q4 2018.

1.2. Relevance for the EOSCpilot project and the EOSC in general

The EOSC Roadmap and EOSC Declaration[12] as well as the EOSC Staff working paper[13], lay out in detail the components for a federated EOSC. They propose a set of publicly funded services and resources to support the EOSC on the national, regional, and institutional level. Of the five types of services which are analysed in the staff working paper, two are highly relevant to the Policy Toolkit's mission: Access to relevant information (e.g. status of EOSC, list of infrastructures, policy-related information, compliance framework) and specific guidelines (e.g. how to make data FAIR, certify a repository or service, procure joint services). It is worth highlighting that including services in the Policy Toolkit, as is the case with all services currently being examined by the EOSCpilot and the EOSC-Hub projects, does not preclude any future decisions about their EOSC compliance. Whether a service is EOSC compliant or not will depend on whether it conforms with and adheres to the EOSC's Rules of Participation[14].

[9] Further information on the boundaries of this definition is supplied in section 2.1.

[10] https://docs.google.com/document/d/1ZeEo32_c6zWE-1r04VxJL9oBkKVcXBdRxlQp5Skj4-I/edit#heading=h.fu4p09rnsfnr p.37

[11] https://www.eoscpilot.eu/policy

[12] http://ec.europa.eu/research/openscience/index.cfm?pg=open-science-cloud

[13] https://ec.europa.eu/research/openscience/pdf/swd_2018_83_f1_staff_working_paper_en.pdf

[14] The EOSC Rules of Participation are in development at the time of writing this report. Therefore, no final statement or assessment can be made about the degree of compliance with these emerging rules. At this stage, it appears likely that a range of tools included in the Toolkit will eventually also become EOSC compliant as they are provided by organisations and/or projects that are either immediately involved in EOSCpilot as project partners or participate otherwise in projects which contribute to the EOSC implementation (e.g. EOSC-Hub, e-infracentral, OpenAIRE, etc). However, whether this projection holds true will only be revealed once the EOSC Rules of Participation are released for adoption by interested parties.

The main objective of EOSCpilot is to set requirements for the creation of the EOSC at a strategic and at operational level. In this context, the Policy Toolkit supports the identification of policy requirements and the mapping of existing tools to match these requirements. Therefore, the Policy Toolkit also relates to and complements the ongoing work on the EOSCpilot Policy Recommendations (WP3, T3.1), the Governance Framework (WP2) as well as the Rules of Participation (WP2, T2.5). The EOSCpilot Policy Recommendations are derived by in-depth examination of aspects which drive and constrain the adoption and implementation of EOSC policy areas, i.e. Open Science/ Open Scholarship, Procurement, Ethics and Data Protection. The Governance Framework proposes a governance model with strategic, executive and steering layers whereas the Rules of Participation define a compliance framework for potential EOSC service suppliers.

It is widely recognized that to develop and adopt Open Science policies in line with the EOSC's wider requirements, stakeholders need a coherent collection of services, actionable guidance, and other educational information. Likewise, tools and advice are needed for potential users to practice state of the art Open Science as advocated in the context of the EOSC. Furthermore, the wider policy environment is not static: complementary to EOSCpilot, new policy demands are expected to arise as a response to the EC's new Recommendations for access to and preservation of scientific information[15], which positions the EOSC at the epicenter of Open Science Infrastructures and research data management services. The implementation of the EOSC by stakeholders as well as the adoption of the EC's revised access and preservation recommendations by member states, will likely contribute to a growing demand for best practice guides on Open Science (both at organisational/institutional and national level). Therefore, the EOSC needs to identify ongoing best practice to find gaps and weaknesses in the current provision as well as opportunities to source data or other working practices from existing initiatives which can then inform EOSC-internal services. An example for this is the integration of some Policy Toolkit tools with the Open Science Monitor. Therefore, in addition to its role as a service for external EOSC users, the Policy Toolkit also adds value and helps to enhance other EOSC-internal services and activities.

[15] https://ec.europa.eu/digital-single-market/en/news/recommendation-access-and-preservation-scientific-information

2. METHODOLOGY

In this section, the case limitations and methodology for the Policy Toolkit research are explained. In addition, key performance indicators which were used to steer the research are presented.

2.1. Case boundaries

The transition to Open Science is riddled with complexity for many organisations, both on the strategic and operational level. As Open Science drives change on so many layers it affects a diverse range of practices such as open access to publications, research data management, organisational culture, intellectual property rights, and many more[16]. In the face of such complex movements, many organisations have started to look for resources and solutions which help them to navigate the required changes. This has led to a rising number of "toolkits", i.e. collections of tools or resources which help users to solve strategic or implementation issues relating to Open Science. Most of these toolkits follow slightly different design concepts and purposes, however three main archetypes can nevertheless be identified:

1. **Integrated toolkits**: This type of toolkit usually presents an integrated, customised set of tools, which have been designed and created specifically for the toolkit according to coherent design principles. An example for this are the toolkits for *Research Producing Organisations* and *Research Funders* developed by the PASTEUR4OA project[17]. These contain a selected set of pdf-formatted briefing papers, guidelines, and self-assessment questionnaires to help RPOs and Research Funders understand and make decisions regarding Open Science policy and implementation issues. The respective guides and other documents have been developed by the PASTEUR4OA project for a specific set of stakeholders (i.e. RPOs and Research Funders).
2. **Third-party toolkits**: The second, more frequent type of toolkit is based on a looser collection of third party resources, which have been selected and categorised by the toolkit provider. Examples for this practice are the resource collections of the FOSTER project[18], which categorises resources according to the FOSTER taxonomy[19], and the RRI project's RRI Toolkit[20], which provides a search engine for tools to support the adoption of responsible research and innovation practices. Both third-party toolkits contain mostly summaries and links to a variety of relevant external resources, covering for example other projects, presentations and slide decks, services, and conceptual papers. Other than in the case of the PASTEUR4OA toolkit, various included resources (particularly slide decks, blog posts or event reports) do not provide direct action guidance but have a more informative nature. Hence, due to the range of included items, third-party toolkits can also be seen as educational or informative resources, providing usually less tightly structured implementation guidance than integrated toolkits.
3. **Decision-support toolkits**: Decision-support toolkits are just emerging and can be seen as a (semi-) automatic iteration of integrated toolkits. They provide tools or services to directly support practitioners in decision- or policy-making. Other than integrated toolkits, decision-support toolkits actively guide users through a decision-support workflow, as proposed by the FORCE11 Decision Trees[21]. These decision trees model policy issues into a semi-automatic interview questionnaire workflow which is used to guide users through a decision-making process for different open science policy areas. Currently, the FORCE11 Decision Trees are an early stage development with prototype questionnaire workflows modeled only for open software, FAIR data, open access journals, and open grants[22]. However, the principle can be applied to any policy which can be modelled as a successive,

[16] https://link.springer.com/chapter/10.1007/978-3-319-00026-8_2
[17] http://www.pasteur4oa.eu/
[18] https://www.fosteropenscience.eu/resources
[19] https://www.fosteropenscience.eu/foster-taxonomy/open-science
[20] https://www.rri-tools.eu/search-engine
[21] https://www.force11.org/group/scholarly-commons-working-group/wp3decision-trees
[22] http://decision-trees.force11.org/models/

clear and discrete sequence of questions. This requirement makes decision trees and (semi-) automatic decision-support toolkits particularly suitable to facilitate decision-making and implementation in policy cases which focus on the implementation of eligibility or compliance rules (e.g. compliance with Open Access mandates, FAIR data requirements, and funding conditions).

Given the emerging nature of the EOSC as a pan-European framework for Open Science services, the primary purpose of the EOSCpilot Policy Toolkit is to provide an informative and educational resource for Open Science practitioners and stakeholders. Complementary to the EOSC's emerging policy recommendations[23] and the Open Science Monitor[24] framework, the purpose of the toolkit is furthermore to collect and present an international selection of best practice tools to support strategic decision-making and provide Open Science policy in line with the EOSC's requirements. With its selection of services, actionable guidance, and practice examples, the Policy Toolkit aims to facilitate the strategic transition of key stakeholders towards Open Science, thus helping to get EOSC-ready. By relying on third-party tools, the Toolkit also reflects existing best practices and emphasises the federated approach of the EOSC as a whole.

As already mentioned in section 1.1, given the broad scope of policy areas relevant to the EOSC, we have also applied a broad definition of "tools": Tools can be any publicly available object which can be used by relevant stakeholders as an instrument to support strategic decision making and/or the implementation of Open Science policies. Tools included in this toolkit are therefore not only operational services such as Jisc's SHERPA services[25] or other software products, but also workflow descriptions, data frameworks, methodological concepts, policy guides or use case descriptions. Relevant "tools" can also come in different maturity stages, including operational services, pilots (or proofs of concept), and even untested concepts. However, while working with an inclusive definition, the objective of the toolkit was to assemble a selection of *relevant, strategic, and usable* tools for practitioners and implementers of Open Science. This led to the formulation of three exclusion criteria, limiting the range of eligible tools:

1. **Relevance for Open Science**: Any included tools were required to have a clear, distinguishable connection either to Open Science in general or a specific aspect of it (e.g. FAIR data, data management, Open Access, article processing charges). Accordingly, candidate tools from related domains, e.g. library analytics, were excluded if their connection to Open Science was unclear or non-existent[26].
2. **Policy relevance**: Included tools were required to have relevance either for the formulation or implementation of Open Science *policies* by the stakeholders who are their intended users. This means, that the selected tools must in some form help their intended users either to make decisions about how to develop Open Science policies or how to implement these (e.g. by adopting formulating requirements for certain workflows). This can be with regards to the implementation of Open Science as a whole, individual aspects of it (e.g. Open Access), or domain-specific issues (e.g. research data management in a given discipline). Accordingly, tools which support the implementation of Open Science only in a narrow technical or operational sense, i.e. without discernible references to policy challenges, were excluded. In practice, this meant that repositories, such as Zenodo[27], were excluded from the Policy Toolkit. While they provide the means for the technical and operational implementation of Open Science policies, they usually do not support *policy* development or implementation as such.
3. **Direct utility ("actionability")**: Tools included in the toolkit must have some direct utility, i.e. they must be directly usable - or actionable - and create some direct added value for their uses. This means

[23] A first, draft version of the EOSC's policy recommendations (D3.3) are under review at the time of writing, building on the EOSC policy landscape review (https://eoscpilot.eu/content/d31-policy-landscape-review).
[24] https://eoscpilot.eu/content/d32-eosc-open-science-monitor-specifications
[25] https://www.jisc.ac.uk/sherpa
[26] As an example, we excluded the Lean Library services (https://www.leanlibrary.com/). While offering advanced library analytics and accessibility services for university libraries, the offer did not have a clear connection to (aspects of) Open Science.
[27] https://zenodo.org/

that *passive* outputs from other projects, such as slide decks, most webinar recordings, and blog posts on events, have been removed from the toolkit. Equally, the toolkit does not include general links to other projects, events or initiatives, unless these have produced outputs which can be directly used by others to develop or implement Open Science policies. Therefore, the included tools are not just clearly relevant to Open Science and the EOSC but can also be readily used by others to make forward-looking decisions and implement policy choices.

In summary, the EOSC Policy Toolkit consists of a limited number of best practice third-party tools to support users in establishing Open Science policies. To facilitate the uptake of such policies in practice, the Toolkit focusses on tools which are clearly relevant and useable by RPOs, funders / ministries, and RIs. With this, the Toolkit also helps to improve the Open Science capacities of users, thereby paving the way for the adoption of specific policies in the context of the EOSC.

2.2. Methodological design and implementation

The toolkit has been assembled based on a mixed methods approach to broaden the range of tools that were surveyed. This approach was instrumental to achieve two overarching objectives:

1. Ensuring a comprehensive survey to identify relevant tools, irrespective of their maturity, discipline or geographic origin.
2. Aligning the Toolkit with the EOSC's objectives, conceptual models, categories and other strategic choices applied in the course of related work (particularly WP3 - Policy, T3.1 and T3.2).

Work was formally launched in October 2017 with the creation of a collaborative spreadsheet to collect suggestions and pieces of related work. Given the diverse nature of tools to be surveyed and in order to provide a universally applicable set of comparative indicators, we decided to focus on a set of qualitative characteristics which describe the main features and functions of each tool. From a user perspective, the documentation of such functional aspects trumped the collection of technical details which, given the heterogeneity of included tools, would likely have been relatively generic. The categories of the toolkit were revised on a regular basis for their suitability and appropriateness, leading to the set of final indicators (Table 1):

Table 1: Toolkit survey framework

Indicator	Explanation	Rationale / relation to other EOSC work (if applicable)
Tool name	States the name of each tool (linked with tool URL in Annex A).	Basic information for maintenance of the toolkit.
Short description	Summary of the use case and main functions of each tool.	Provides basic information for Toolkit users to understand the use case and function of each tool and assess its utility.
Developed by	Provides names of the developing organisations and/or individuals.	Helps to indicate potential contact persons for Toolkit users.
Development stage	Indicates the maturity level of each tool, whether *operational* (i.e. fully developed service or other tool, which is maintained on a regular basis and for which the functionality	Provides an indication for Toolkit users on how mature a tool is and what is to be expected in terms of its level of

	has been fully tested); *pilot* (i.e. tools which have been pilot-tested for feasibility and utility, but are not yet at operational service status; can also include tools where maintenance status is unclear); and *concept* (i.e. tools which have been proposed as concepts, e.g. new data frameworks, but which have not yet been pilot tested).	functionality.
Country or regional area	Gives information on whether there are geographical limitations on where tools can be applied. Note that most tools have an international use case; where limitations exist, these emerge usually from context-specific design features (e.g. a tool only covering UK open access mandates, makes it mostly only useful for the UK) and not from technical access limitations (e.g. IP-based access restrictions).	Informs Toolkit users whether a tool is likely to be applicable and useful in their given region. Can also help to identify suitable candidates for regional replication (if the original tool is only usable for a specific location).
Element of Open Science	Summarises which element (or domain) of Open Science the tool is useful for, e.g. open access policies, research data, software, licensing, etc. (non-conclusive enumeration[28]).	Supports a quick understanding for which area of Open Science the tool is useful and whether it is thus relevant for a user.
Focus	Lists which challenge or problem the tool is focused on. Partly overlaps with "Element of Open Science" but provides a more detailed overview of the relevant areas covered.	Gives more detailed information of the issues and challenges a tool can help to address.
Scientific discipline	Indicates whether a tool is useful only to selected disciplines, or whether it can be used by multiple disciplines.	Helps to determine utility of tools in discipline-specific contexts.
Stakeholder users	Lists the main stakeholder groups for which a given tool is relevant, based on a categorisation used for the D3.1 Policy Landscaping[29] and D3.3 Draft Policy Recommendations: Research Producing Organisations (RPOs), Research Infrastructures (RIs), and funders / ministries.	Provides a connection to stakeholders as defined in the Open Science Monitor deliverable (D3.2), aligning terminology and underlying methodology. Categorisation is also useful for stakeholder

[28] Elements of Open Science have been tagged following an inductive, practice-led approach. This means that no specific classes of elements were predefined by theoretical or conceptual considerations. This led to a relatively long list of 44 elements of Open Science, which the surveyed tools covered. The classification can be used as a basis for a more refined tagging of tools to improve the discoverability of tools in the Policy Toolkit database. However, from an analytical perspective, we found that the classification had limited added value. Accordingly, we have not included it in the findings we present here. A full list of terms included in the "Elements of Open Science" is however provided in Annex A.2.

[29] https://eoscpilot.eu/content/d31-policy-landscape-review

	The minimum requirement for a tool to classify as "relevant" was that, based on an external assessment, at least some added value had to be discernible for the respective stakeholder group.	groups to identify tools which are of potential use for them.
Main intended user group	Gives a more end-user-centric assessment of the (intended) users of each tool: researchers, research managers, librarians, data stewards, repository managers, policy makers, funder representative, publisher representatives, other (*conclusive* enumeration).	Provides a more refined assessment of the end-users on whether a tool might be useful for them.
Relevant EOSC policy area respective to policy recommendations subject area	Provides an indication of the EOSC policy area(s) for which a tool is relevant: Open Science/ Open Scholarship, Procurement, Ethics, Data Protection.	Indicates alignment with EOSC Policy Recommendations (D3.1 and D3.3) and overarching framework of EOSC policy work.
Relevant Open Science Monitor Targets	Indicates the Open Science Monitor Target(s) for which a tool is relevant. Monitor targets are based on the Open Science Monitor framework as defined by D3.2[30].	Indicates alignment with the Open Science Monitor's monitoring framework and high-level goals. Also serves as the basis for a prioritisation of future integrations of external tools into the OSM framework.
Direct utility for Open Science Monitor	Provides a first indicative assessment whether a tool could be useful as a datasource for the Open Science Monitor (see section 3.3 for further explanatory notes).	Useful as a first scoping of additional tools which could be integrated in the Open Science Monitor framework (subject to availability of data, agreements with tool providers, etc.)
Use case category	Classifies tools into two major use case categories: Policy development (i.e. scoping, conceptualisation, and formulation of policies) and policy implementation (i.e. steps to embed a policy in an organisational context in order to turn it into practice). See further details in section 3.	Provides a high-level assessment for users, helping them to understand which main use case a given tool is useful for.
Type of tool	Provides a bottom-up (inductive) typology of 13 tool categories, indicating which main function or activity a tool supports. Typology is based on observations from surveyed tools,	Provides users with easily accessible detail on the primary functions or activities which a tool supports (e.g. compliance

[30] https://eoscpilot.eu/content/d32-eosc-open-science-monitor-specifications

	rather than pre-defined categories. See details of categorisation in section 3.	support, creation of metadata, or general guidance for policy development).
Relevant research output	Describes the research output which a tool is relevant for: articles (i.e. journal publications), data, software, services, workflows, other.	Provides insights on the types of research outputs for which policy development or implementation tools are available. Gives thus important insight on where support measures are currently focused.

To identify relevant tools and other input for our research, three main routes were pursued: First, some tools were sourced from deliverables which have either already been delivered or are currently in progress.[31] While it is noteworthy that only a limited number of tools were suitable to be also included in the Policy Toolkit, this helped us to ensure a general alignment with previous and other ongoing research.

Second, a phase of online-based desk research was conducted, seeking to identify tools via a variety of approaches. This included searching relevant tools via Google and Bing, using anonymous search and a variety of different search queries. Additionally, links to EU-funded Open Science and Open Access projects were identified through the EC's Cordis database[32]. Following a snowball sampling approach further resources were identified, e.g. by extracting information from websites, reports and deliverables. The desk-based research was the main focus of our work.

Third, we also requested expert input from within WP3 as well as from other EOSCpilot work packages. The involved partners in WP3 added several tools to our collection. Additionally, we presented a policy consultation survey at the collaborative WP5&6 meeting in Amsterdam in May 2018, which included several questions to collect further tools and retrieve information on their perceived utility from cross-workpackage collaborators.

In sum, the above methodology facilitated a wide-ranging collection of tools, particularly multi-disciplinary ones with an international applicability. The toolkit does not present a representative sample, but a selective snapshot of the current availability of tools in light of the Open Science policy needs emerging in the context of the EOSC. The lightweight approach taken to assemble the toolkit however also means that the research can be expanded continuously and iteratively.

2.3. Key performance indicators

To determine the scope of the research and in order to set effort targets, a limited set of key performance indicators was defined, as listed in Table 2. Given the restrictive case boundaries described in the previous section, a target of 50 cases for the toolkit was defined. Given the breadth of stakeholders involved in the EOSC, it was also seen as important that the selection of surveyed and included tools should not be skewed too heavily towards one stakeholder group. Acknowledging the fact that one tool can be useful or informative for several stakeholder groups, we established a target that each stakeholder group should at least have 20 tools available from the Toolkit. Following a similar rationale, we also decided to primarily focus on tools which can be used by multiple disciplines (i.e. instead of tools which can only be used by one discipline) and in various countries or regions (i.e. they should have an international usability). In both cases, circa two thirds

[31] This was particularly the case for D3.2 Open Science Monitor (submitted), the D3.1 Policy Landscape Review and the D3.3 draft policy recommendations (work in progress at the time of writing).
[32] https://cordis.europa.eu/projects/home_en.html

(i.e. 66% of tools) of the included tools should comply with these criteria. The extent to which these KPIs have been reached is reflected in the right column of Table 2.

Table 2: Toolkit Key Performance Indicators

KPI	**KPI target**	**Actual results**
Total number of tools	50+	60
Stakeholder groups to be covered: RPOS RIS Funders / ministries	 >20 RPO tools >20 RI tools >20 funder/ministry tools	 58 RPO tools 20 RI tools 31 funder/ ministry tools
Scientific discipline coverage	66% multi-disciplinary	95%
Intended user country or regional area	66% international	82%

3. THE POLICY TOOLKIT IN DETAIL

In the following section the constitution of the toolkit is described, covering the main results of the research. It starts with a general overview of the maturity and coverage of tools which were surveyed, before looking at how the tools serve different stakeholders as well as how they could serve the further development of the Open Science Monitor in the medium and long term.

3.1. Coverage and maturity of tools

One of the main rationales of the EOSC is to enhance European research, allowing it to reap economies of scale in the transition to Open Science better than the current European research environment. At the same time, the EOSC should not replace, but build on existing practices, communities, and services in specific disciplines or geographic regions. The EOSC's policy recommendations and services, including the Policy Toolkit, aim to support this ambition of supporting the *trans*- or *multi*-functions of European research: especially, multi-disciplinarity and trans-nationality. A first crucial test for the Policy Toolkit was thus to identify tools which can be used across various countries (or geographic regions) and multiple disciplines.

Of the 60 tools which were not excluded according to the exclusion criteria described in section 2.1, 49 have an international scope, i.e. they can be used in various geographic areas and are neither explicitly or implicitly restricted to one country (see Table 3). SPARC's HowOpenIsIt? Guides[33] are examples of Open Science tools which are designed for an international user community. In other cases, such as Jisc's SHERPA FACT, Romeo, and Juliet services, tools may have been created with a domestic - i.e. UK - user community in mind. However, they are nonetheless equally used by - and useful for - international audiences, thus qualifying them as international tools. Only in a limited number of 11 cases, the utility of tools was limited to certain geographic areas, such as in the case of the Dutch National Academic Research and Collaborations Information System, the Danish Open Access Indicator, as well as the University of California's Pathways to Open Access guide.[34]

Table 3: Country / regional coverage of tools

Geographic coverage	Number of tools
International	49
EU	1
US	1
Finland	2
Australia	2
UK	3
Denmark	1
Netherlands	1

[33] HowOpenIsIt? A Guide for Evaluating the Openness of Journals and HowOpenIsIt? Guide to Research Funder Policies

[34] Despite its limited, non-EU scope, the resource has been included in the Policy Toolkit as it provides an example for a well-structured implementation guidance for Open Access.

An overwhelming majority of 57 surveyed tools also had no discipline-specific usage limitations. This means they are *generic* Open Science policy tools which can be used by a variety of disciplines or communities. The three cases which have been developed with specific disciplines in mind are: the ADA-M Automatable Discovery and Access Matrix[35], a metadata framework developed primarily to support data sharing and access management in health and genomic research; the Parthenos Policy Wizard[36], a policy finder tool to identify FAIR data policies in archaeology, social science, history, and language studies; as well as the FAIR-TLC metrics[37], a conceptual proposal to expand the FAIR concept by other measurable components (i.e. traceability, licensure, and connectedness), which has been developed in the context of biomedical research.

In addition to the geographic and discipline coverage, it is also important to understand which types of research outputs the tools in the Policy Toolkit cover. One of the core assumptions of Open Science is that beyond the openness of publications – or *articles* – the openness of various other research outputs gains importance: As an example, good Open Science practice prescribes that researchers who conduct quantitative studies which are based on advanced data analytics should not only publish their journal articles in a way that complies with Open Access requirements. Additionally, and where appropriate, they should also make the underlying data accessible, publicly document software code which they may have written for their project, and also describe workflows which they used to produce their work. For the Policy Toolkit it is thus important to understand whether the current tool landscape provides tools which can help relevant stakeholders to formulate policies which ultimately support such practices. Additionally, it is crucial to investigate for which research outputs such policy tools exist.

Open Access to publications, often focused on journal publications, is the longest standing component of Open Science policies. This seems to be also reflected in the availability of policy tools which support this research output. As listed in Table 4, it is unsurprising that 26 policy tools focus on articles, often in the context of Open Access policies, such as in the case of the SHERPA services[38]. Through the increasing importance of research data management and the requirement to produce data management plans, data has become a growing concern for research practitioners and policy makers. The fact that 26 policy tools are centered around data use cases appears to reflect this current state. Typical examples for data policy tools are various services to identify or formulate data management policies or plans, such as EUDAT's B2SAFE Data Manager Tool[39] and the Parthenos Data Policy Wizard[40].

Strikingly, however, is that far fewer tools appear to be available to inform policy design for other research outputs. Only one tool, GitHub's Choose a Licence guide[41], is focused on the implementation of policies that ensure the accessibility and reusability of software. Three tools focus on workflows as elements of the scientific process which require designated policies to ensure their openness. These include the OpenUpHub's collaborative, community driven research platform[42], the FOSTER Open Science Resources[43] (which contains some materials on Open Science workflows), as well as the Rainbow of Open Science Practices[44], which provides a conceptual schema to map 17 Open Science practices throughout the research workflow. Resources which are relevant to service design are provided by three tools: The Framework for Open Science and Research[45], which presents advice by the Finnish Ministry of Education and Culture on how organisations can integrate different Open Science components into a full service environment; the

[35] https://github.com/ga4gh/ADA-M
[36] http://test.parthenos-project.eu/parthenos-wizard/
[37] https://zenodo.org/record/203295#.WwQeTS7wZhF
[38] https://www.jisc.ac.uk/sherpa
[39] https://eudat.eu/news/a-new-feature-for-b2safe-the-data-policy-manager-dpm-tool
[40] http://test.parthenos-project.eu/parthenos-wizard/
[41] https://choosealicense.com/
[42] https://www.openuphub.eu/
[43] https://www.fosteropenscience.eu/resources
[44] https://zenodo.org/record/1147025#.Wwfsfy7wbIU
[45] https://openscience.fi/framework-for-open-science

CoreTrustSeal[46] certification mechanism, which includes 16 requirements to ensure the service quality of repositories; and the Centre for Open Science's OSF Toolkit for Digital Scholarship Support[47], which provides guidance for institutions on how to develop open science services.

Table 4: Covered research outputs

Research output	Number of tools in Policy Toolkit which concern output type[48]
Articles	26
Data	26
Services	3
Workflows	3
Software	1
Other	7

The overview of the maturity stages (table 5) also shows that the vast majority of tools are *operational*. Naturally, due to the diverse formats of tools in the toolkit, the definition of *operational* is equally wide, ranging from fully operational *services* such as Jisc's SHERPA services[49] or the OpenDOAR[50] registry to handbook publications or frameworks - under the condition that these have been adopted by their respective audiences. This was for example the case with the Finnish Open Science and Research handbook[51] and framework[52]. Five surveyed tools were at the pilot stage. As in the case of the previously cited ADA-M framework[53], this means that the general feasibility of these tools has been shown, but further development and/or user testing is needed for them to become operational. In nine cases, we ranked tools as concepts, which are useful resources for the policy toolkit, particularly to frame emerging practices in Open Science. However, as it is the case for the FAIR-TLC metrics[54], these tools also require more development to allow pilot-testing of their practical feasibility.

Table 5: Maturity stage of surveyed tools

Tool maturity stage	Number of tools
Concept	9
Pilot	5
Operational	46

[46] https://www.coretrustseal.org/
[47] https://osf.io/ubzve/
[48] Please note that the total in this table is N=66, because some tools support multiple research outputs (e.g. data and articles).
[49] https://www.jisc.ac.uk/sherpa
[50] http://v2.opendoar.sherpa.ac.uk/view/repository_by_country/countries=5Fby=5Fregion.html
[51] https://openscience.fi/handbook
[52] https://openscience.fi/framework-for-open-science
[53] https://github.com/ga4gh/ADA-M
[54] https://zenodo.org/record/203295#.WwQeTS7wZhF

3.2. Tool classes and stakeholder groups

As mentioned in the introduction, the Policy Toolkit is designed to serve three separate stakeholder groups, which also formed the basis for EOSCpilot's policy landscaping[55] and policy recommendations reports[56] as well as the proposed Open Science Monitor[57]: Research Producing Organisations (RPOs), Research Infrastructures (RIs), and funders / ministries. Based on the research for the Open Science Monitor, our assumption is that users in these stakeholder categories will have two broad use cases in mind when using the Policy Toolkit, i.e. either to develop a policy ("policy development") or to implement a policy ("policy implementation").

Policy development involves activities which help stakeholders to improve their readiness for Open Science, e.g. by formulating new policies to prepare an organisation for Open Science or to guide specific aspects of Open Science such as the development of technical guidelines or principles of FAIR data management.[58] Instead, the *policy implementation* use case covers activities which support or lead to the adoption or execution of policies. In this case, policies can either be formulated by the implementing stakeholders themselves or externally. A common case of policy implementation occurs when organisations adopt guidelines, practices or workflows to ensure compliance with Open Access policies - which may have been defined by external funders or the adopting organisation itself. Other examples are the introduction of actions to implement FAIR data practices, monitoring the adoption of Open Science more generally, or measuring Open Science. In practice, the line between policy development and implementation is not always clear. However, for the indicative categorisation used here, the general rule is that policy development is concerned with the identification and formulation of guiding principles, whereas policy implementation turns these into action.

To capture their main functions from a user perspective, the tools were classified in the toolkit into 13 different categories. The main question for this classification was: what is the main function of the respective tool from the point of users? As already alluded to in Table 1, it is important to highlight that this is an inductive classification. Hence, rather than first formulating a set of theory-based tool categories, the tools were classified in concise terms based on observed similarities of the surveyed tools. The advantage of this bottom-up approach is that the resulting categories reflect the current state of the art better than through a theory-led approach - and thus provide a sharper reflection of the current policy tool landscape. A disadvantage is that the resulting spectrum of tool classes might be less balanced than a theory-led framework, which places equal weight on a pre-defined set of policy areas. However, given the emerging nature of the EOSC policy framework and with EOSC policy recommendations entering a consultation phase in Q3 2018, an inductive approach appeared as the more suitable approach. In particular, the resulting tool classes reflect the current state of the art in a manner, which does not preclude specific policy choices or models.

Before examining in greater detail how - and which of - these tools support RPOs, RIs, and funders or ministries, the constitution of the Toolkit is discussed. Table 6 summarises information on the different tool classes, their frequency in the toolkit, and whether the included tools support policy development or policy implementation - or both. Which use case a tool supports is specific to each tool. In principle, tool classes can therefore support both use cases, which some tool classes do, as Table 4 shows. In practice, however, various classes contain tools which support only implementation use cases, such as in the case of compliance support tools.

[55] D3.1 Policy Landscape Review: https://eoscpilot.eu/content/d31-policy-landscape-review

[56] D3.2 Draft Policy Recommendations (in review / work in progress at the time of writing).

[57] D3.2 EOSC Open Science Monitor specifications: https://eoscpilot.eu/content/d32-eosc-open-science-monitor-specifications

[58] The use case category "policy development" has been adopted from the OS Monitor target "Policy Readiness" and largely overlaps with this. However, for the purpose of the Policy Toolkit, the term "policy development" has been chosen as it presents a more user-centric description of the same concept.

Table 6: Types of policy tools

Tool type	Number of tools included in Toolkit[59]	Use case	
		Policy development	Policy implementation
Policy guidance	14	✓	
Implementation guidance	14		✓
Compliance support	10		✓
FAIR implementation	6	✓	✓
Policy survey	4		✓
Implementation monitor	3		✓
OA publication cost	2		✓
OA publication discovery	2		✓
Repository discovery	2	✓	✓
Technical guidelines	2	✓	✓
(Meta-)Data framework	1		✓
Impact measurement	1		✓
Quality assurance	1	✓	

Policy guidance and policy implementation:

Almost half of all tools included in the Policy Toolkit are tools which support users with broad guidance on either policy development ("**policy guidance**" tools) or policy implementation ("**implementation guidance**" tools). The dominance of these tools in the Toolkit follows not least from the broad definition of this class: both guidance tool classes congregate tools to support users with often relatively broad advice or otherwise informative materials on Open Science policy or aspects of it. In the case of *policy guidance* tools, guidance focusses more on high-level advice to support policy formulation, whereas *implementation guidance* tools provide advice to support the implementation or operationalization of policies. In a minority of cases, this guidance comes in unusual formats, such as a board game[60], a multi-functional tool to manage data policies[61],

[59] Note that the total count of this table is 62. This is because two tools in the Toolkit, the FOSTER Open Science Resources Toolkit and EUDAT's B2Safe Data Policy Manager tool, were classed as both policy guidance and implementation guidance tools. While it was possible to assign all other tools to only one category, this was not plausible for the two cited tools, which have a broader scope spanning policy development and implementation guidance.

[60] The Publishing Trap board game (classified as policy guidance): https://copyrightliteracy.org/resources/the-publishing-trap/

[61] B2SAFE - Data Manager Policy Tool (classified as both policy guidance and policy implementation): https://eudat.eu/news/a-new-feature-for-b2safe-the-data-policy-manager-dpm-tool

an interactive wizard to support those who work with research data[62], or a tool to identify suitable licences for software and other outputs[63]. In most cases, guidance is however delivered in the form of reports, papers, or other text-based web contents. The predominance of such text-centric formats to communicate advice and guidance in today's practice also contributes to the dominance of the policy and implementation guidance tools in the Policy Toolkit.

Compliance support:

Compliance support tools are the third-most frequent class with 10 tools in the toolkit. They have a more limited purpose than policy or implementation guidance tools, i.e.to help users *comply* with their own or third parties' policies. Compliance support tools are often designed to help users comply with open access mandates, reporting requirements, or data management policies. OpenAIRE's Repository Validator[64] service is the only tool which deviates from this pattern as it provides compliance support for OpenAIRE's technical repository guidelines[65]. The need, particularly of RPOs, to comply with a variety of funder-determined policies has obviously also created a clearly defined service need. As a result, Jisc alone has developed five compliance support services for open access, including the SHERPA services suite[66] and Monitor Local[67]. Similar to SHERPA Fact[68], Wiley's Author Compliance tool[69] helps authors to determine which of Wiley's journals allow them to comply with funder policies. While there is thus a certain business continuity for open access compliance support tools, compliance support tools for data management seem to emerge primarily from time limited projects and appear less mature than their Open-Access-centric counterparts. Arguably the most mature data management planning tool in the Toolkit is the Digital Curation Centre's DMP Online[70].

FAIR implementation:

A similarly well confined application area exists for FAIR implementation tools. FAIR implementation tools support users in developing or implementing FAIR data policies. Interestingly, the format of the six FAIR implementation tools in the toolkit is less service-heavy than for the compliance support tools. This might be due to the emerging nature of FAIR data policies, which means that on the one hand service needs are not yet as clearly defined on the user side as in the case of compliance support tools. On the other hand, the majority of potential tool providers are only starting to develop solutions – which is obviously difficult in an environment where both user needs and detailed policy requirements are not yet clearly defined. In this context, it is also not surprising that despite the prominence of FAIR data in many policy and practitioner discussions, we were only able to identify one classic service[71] to support FAIR implementation. The Data Fairport[72] suite is an interoperability platform that enables data owners to publish their (meta)data and allows data users to search for and access data (subject to licences). Data Fairport is based on four tool components: FAIRifier and Metadata Editor (to create FAIR data); FAIR Data Point (to publish data); FAIR Search Engine (to find data); and ORKA (to annotate data). The tool has been developed by the Dutch Techcentre for Life Sciences, one of the main proponents of the FAIR data movement. SmartAPI[73], developed

[62] Data Stewardship Wizard (classified as implementation guidance): https://dmp.fairdata.solutions/

[63] Choose a licence (classified as implementation guidance): https://choosealicense.com/

[64] https://www.openaire.eu/validator

[65] Nevertheless, OpenAIRE's Repository Validator clearly supports a compliance support function, which is why it qualifies as a compliance support tool. The nature of the rules requiring compliance is secondary in this context.

[66] https://www.jisc.ac.uk/sherpa

[67] https://monitor.jisc.ac.uk/local/

[68] http://sherpa.ac.uk/fact/

[69] https://authorservices.wiley.com/author-resources/Journal-Authors/licensing-open-access/open-access/author-compliance-tool.html

[70] https://dmponline.dcc.ac.uk/

[71] By *service* we mean an implemented system (technical or non-technical) which aims to support users by responding to a certain need.

[72] https://www.dtls.nl/fair-data/find-fair-data-tools/

[73] http://smart-api.info/

by the SmartAPI consortium, is another technical tool, though not a fully developed service. SmartAPI provides the documentation for an extension of the OpenAPI[74], which, if implemented, helps to increase the FAIRness of APIs.The remaining four tools provide report-based guidance which is informative for users to implement FAIR data.

Policy surveys:

Policy surveys collect, summarise, standardize, and present information on various aspects of Open Science policies, e.g. open access, FAIR data, or data management and sharing. For the toolkit, we identified four policy survey tools which provide information on how policies are implemented, thereby supporting users in the policy implementation process with a quicker overview of the current state of the art. The outputs of the four policy survey tools are classic aggregate statistics (ROARMAP[75]), a database (FAIRsharing[76]), or interactive tools which allow users to identify specific policies for specific use cases (Parthenos Policy Wizard[77] or Open Access Spectrum Evaluation Tool[78]). For the classification approach that was used here, the specific output format is however secondary. More important is their underlying function, which is to survey and provide information on policy implementation.

Implementation monitors:

Implementation monitors collect, summarise and present information on the implementation of Open Science and selected outputs. Implementation monitors thus have a similar, but more implementation-centric function than policy surveys. They effectively track the production of outputs which should follow from the organisational implementation of Open Science policies. The Policy Toolkit lists three different implementation monitors: The EC's Open Science Monitor[79] monitors trends and provides statistics on open access to publications, open research data, and collaborative research. The Danish Open Access Indicator[80] and the Dutch National Academic Research and Collaborations Information System[81] have a narrower scope, tracking Open Access publication activities.

The remaining tool classes list no more than two instances, but the highly specific and clearly defined functions of the tools meant that it appeared justifiable to list them as separate classes:

- **OA publication cost**: Open Access publication cost tools help users to assess the cost of Open Access publishing. Jisc's Monitor UK[82] is a benchmarking database for article processing charges, whereas APCDOI[83] is an Open Source Python program which identifies publication cost based on a combination of article DOIs, the Unpaywall API[84] and a JSON file with journal-specific APC data. This information can be useful to inform stakeholder strategies towards Open Access Publishing.
- **OA publication discovery tools**: Open Access publication discovery tools help users to discover Open Access versions of publications, thereby supporting the implementation of institutional Open Access policies which seek to promote the use of open over paywalled content. The Toolkit includes the

[74] https://github.com/OAI/OpenAPI-Specification
[75] https://roarmap.eprints.org/
[76] https://fairsharing.org/policies/
[77] http://test.parthenos-project.eu/parthenos-wizard/
[78] http://oaspectrum.org/
[79] https://ec.europa.eu/research/openscience/index.cfm?pg=home&section=monitor
[80] https://ufm.dk/en/research-and-innovation/cooperation-between-research-and-innovation/open-access/Publications/open-access-barometer
[81] https://www.narcis.nl/
[82] https://www.jisc.ac.uk/monitor-uk
[83] https://github.com/ryregier/APCDOI
[84] https://unpaywall.org/products/api

Open Access Button[85] and Kopernio[86], two services which help users to identify the Open Access versions of journal articles, thus facilitating the replacement of paywalled contents with Open Access publications.

- **Technical guidelines**: Technical guidelines provide documentation for users to implement technical systems that support general or specific Open Science policies. The Toolkit includes the operational OpenAIRE guidelines[87], which provide guidance on how to ensure technical compatibility of repository metadata with OpenAIRE's requirements, as well as a conceptual proposal[88] for how to translate Open Access policies into a CERIF-based data framework.
- **(Meta-)Data framework tool(s):** Metadata framework tools provide documentation and implementation guidance for (meta-)data frameworks in support of certain policy objectives. The toolkit lists the ADA-M Automatable Discovery and Access Matrix[89], a standardized framework to represent the conditions related to data discovery and access. The ADA-M Automatable Discovery and Access Matrix supports specifically data sharing and access management, core policy objectives for the EOSC.
- **Impact measurement tool(s):** Impact measurement tools provide users with instruments or information to measure the impact of research activities. The only tool of this class in the Toolkit is the Metrics Toolkit[90], which provides an overview and assists users in the selection of appropriate metrics to assess research impact claims, mostly relying on altmetrics.
- **Quality assurance tool(s):** Quality assurance tools provide users with instruments to ensure, e.g. via certification, the service quality of Open Science services. Quality assurance tools can thus be seen to support policy development by providing operative requirements – or indicators - for effective policies. The CoreTrustSeal[91] is the only tool of this class in the Toolkit. It offers data repositories a core level certification based on 16 requirements, to ensure that repositories provide a reliable, secure service for the availability and reuse of data.

The following sections explore how the different tool classes are provided to different stakeholder groups, separated by the use case categories "policy development" and "policy implementation". This provides insights into the provision of tools for RPOs, funders / ministries, and RIs.

3.2.1. Research Producing Organisations

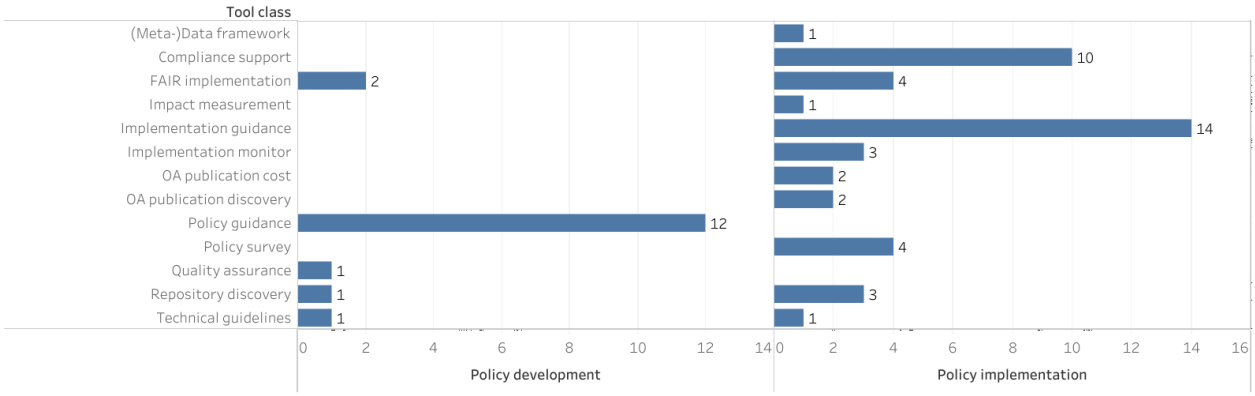
As displayed in Figure 2, 58 of the 60 tools included in the toolkit are relevant for and can be used by RPOs[92]. Accordingly, the selection of relevant tools for RPOs reflects the general distribution of tools in the toolkit and generally also covers all tool classes described in section 3.2. RPOs can often make strong usage of policy tools since they are both highly active in developing and implementing policies. Arguably, RPOs also cover a wide range of user groups with diverse and well-articulated needs for policy tools, including researchers, research administrators, librarians, institutional data stewards, repository managers, as well as institutional

[85] https://openaccessbutton.org/
[86] https://kopernio.com/
[87] https://guidelines.openaire.eu/en/latest/
[88] https://www.sciencedirect.com/science/article/pii/S1877050917303022
[89] https://github.com/ga4gh/ADA-M
[90] http://www.metrics-toolkit.org/
[91] https://www.coretrustseal.org/
[92] As was explained in section 2.2, the minimum requirement for a tool to classify as *relevant* was that it had to display some discernible added value for the respective stakeholder group. This means that it is not necessary that a tool has been developed with a focus on a specific user group – which would be difficult to identify for a number of cases in the Toolkit. Instead, the criterium is broader, asking generally whether a tool can be generally useful to support a stakeholder group in its policy development or implementation activities.

policy makers. Together, these factors make RPOs the most likely users of policy tools - and thus also the primary user group which tool developers target. Accordingly, the finding that almost all tools in the Policy Toolkit have some usage for RPOs should be expected.

Only two tools were not categorised as having RPOs among their user groups: SPARC's HowOpenIsIt? Guide to Research Funder Policies (which targets funders) and the Center for Open Science's Transparency and Openness Promotion Guidelines[93]. The latter are primarily targeted at publishers, a stakeholder group which is not included in the stakeholder categorisation. However, the Transparency and Openness Promotion Guidelines also have a lateral usage for research funders.

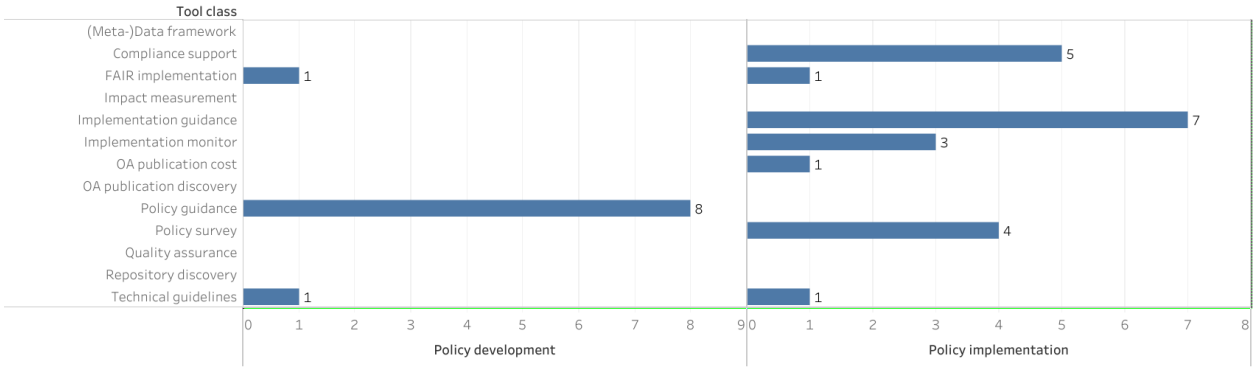
Figure 2: Open Science Policy Tools for RPOs



3.2.2. Funders and ministries

Thirty-one policy tools are also relevant for funders of research and ministries as high-level policy makers (see Figure 3). Just like in the case for RPOs, policy and implementation guidance resources are the most frequently available tool classes for these stakeholders. However, for each of the two tool classes, only about every second tool in the toolkit also had relevance for funders and/or ministries. This means that our assessment found that the excluded policy and implementation guidance tools had no clearly identifiable added value for funders and (national) ministries; e.g. because tools were only developed with a focus on RPOs. Despite the still relatively high number of *relevant* tools for funders/ministries, only a minority of tools have been developed with a specific focus on these stakeholders as their primary users. Funder-specific guidance tools, such as SPARC's "HowOpenIsIt? Guide to Research Funder Policies" or the "Open Science and Research Handbook" of the Finnish Ministry of Education and Culture are more the exception than the rule[94].

Figure 3: Open Science tools for funders / ministries



[93] https://cos.io/our-services/top-guidelines/

[94] Even if tools were not primarily developed for a specific stakeholder group, we decided to still list these as "relevant", as long as some added value for this group was discernible.

The same observation also applies to the five compliance support tools which were listed as relevant for funders, including Jisc's SHERPA FACT, Juliet, and REF as well as Jisc's Monitor Local and Wiley's Author Compliance Tool[95]. The primary function of these tools is to help users navigate the compatibility of funder and journal/publishers' policies. The resulting information has undoubted value for funders and ministries as well, e.g. by providing individual funders insights on the compatibility of their own policies with those of publishers or journals. Nevertheless, for these tools, this is only a secondary use. Hence, despite the general relevance of some compliance support tools in the toolkit, what appears to be missing is funder-specific compliance tools which could provide funders with directly relevant, targeted support on how to develop effective and interoperable policies[96].

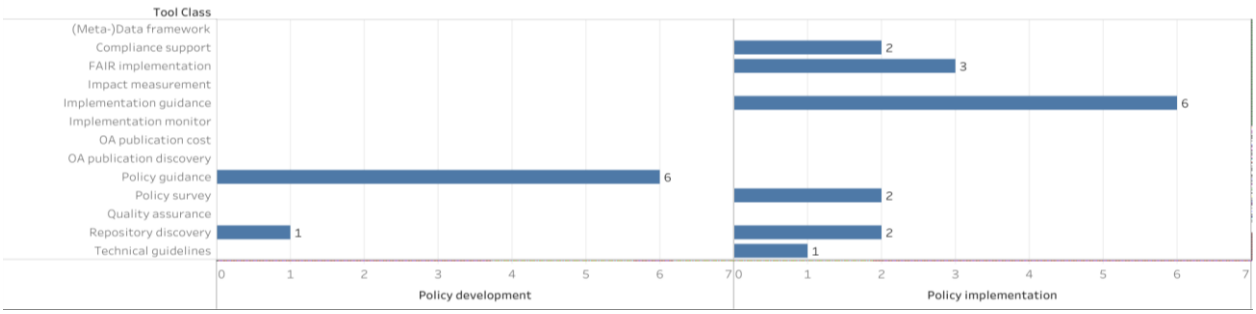
Similarly, four relevant policy survey tools which are generally relevant to funders were identified. The FAIRsharing Policy database, the Parthenos Policy Wizard, SPARC's Open Access Spectrum Evaluation Tool, and Roarmap can provide valuable information for policy makers on general policy implementation trends and compatibility issues. However, again, none of these tools has been designed with a funder-centric user scenario in mind. Hence, compared to the clear user orientation which some tools displayed with regards to RPOs, the policy surveys are no match for funders or ministries. The same pattern of secondary utility for funders also applies to the relevant FAIR implementation, technical guidelines, and OA publication cost tools.

A single deviation from this pattern are implementation monitors, the tool category with arguably the strongest alignment with funder or ministry needs. All three implementation monitors included in the toolkit are also highly relevant to funders. They track implementation practices around open science and thus provide crucial information which funders can use to assess e.g. whether their policy objectives are met in practice. In this context it is however also notable that in the course of this research no specific impact measurement tools for funders were identified

3.2.3. Research infrastructures

Based on the Toolkit desk research, RIs appeared to be the stakeholder group which are least targeted (see Figure 4). With 20 tools in the toolkit, the tool supply for RIs is substantially lower than for RPOs and funders / ministries. Furthermore, a closer look reveals that the majority of tools are only partly relevant to RIs and have been primarily developed for other user groups - just as in the case of many funder tools.

Figure 4: Open Science tools for RIs



While policy and implementation guidance tools constitute again the most frequent tool types available to RIs, only a minority of these resources have been designed with a specific focus on this stakeholder group.

[95] https://authorservices.wiley.com/author-resources/Journal-Authors/licensing-open-access/open-access/author-compliance-tool.html

[96] The notion of interoperable policies refers to the proliferation of Open Science-related policies by funders/ministries, which impose e.g. new compliance requirements on funding recipients. Ideally, these policies should not specify conflicting requirements and be compatible to reduce the "compliance onus" on funding recipients. Funder-specific compliance support tools could support funders in developing such policies.

Examples for this are the handbook and framework for Open Science by the Finnish Ministry of Education and Research[97], which take into consideration strategic issues for the evolution of research infrastructures in an increasingly international, Open-Science-driven research environment. Other resources providing policy or implementation guidance for data management, such as the B2SAFE Data Policy Manager tool[98], the LEARN toolkit for Research Data Management[99], or the Data Stewardship Wizard[100], can be used and are relevant to RI users as well, however they are not their intended primary user group. This observation also applies to the three relevant FAIR implementation tools[101] as well as two policy surveys[102].

While the previous tools have some utility for a variety of RIs, repositories are the only specific type of RI which is served by some tools, especially technical guidelines, as well as compliance support and repository discovery tools. These services include the OpenAIRE guidelines and validator tools, as well as OpenDOAR[103] and the re3data registry[104].

Furthermore, while it is correct that not all tool classes are highly relevant to RIs, the absence of RI-relevant tools is in some cases notable. Particularly in the context of the EOSC, RI-specific implementation monitors and impact measurement tools could provide valuable information e.g. on how RIs are implementing Open Science, the quality of their data, and impact on research practices. Furthermore, the development of (meta-) data frameworks and more specific FAIR implementation tools might help RIs to adopt Open Science practices more quickly.

3.3. Alignment with Open Science Monitor target

The Open Science Monitor is a service included in the EOSCpilot Policy Work Package (WP3) and is designed to serve as an instrument to monitor the implementation of Open Science policies. To develop a uniform monitoring framework, the specifications for the Open Science Monitor included an extensive scanning of the wider Open Science landscape. Because Open Science is a heterogeneous concept, often described in varying terms across different approaches, the landscaping exercise helped to identify a range of core Open Science elements and also facilitated a better understanding of the differences and connections between elements used in often only marginally different Open Science concepts. A scoping and mapping of these elements identified Openness and FAIRness of research artefacts as the main elements of the EOSC's monitor ecosystem. The Open Science Monitor report[105] proposes an extensive list of indicators ("monitoring targets"), metrics, as well as third-party services and tools which could supply relevant data.

A lateral purpose of the Policy Toolkit is to identify potential further data sources which could be useful for the EOSC's Open Science Monitor. Table 7 below represents the result of a mapping of Policy Toolkit tools and Open Science Monitor targets or subtargets (marked by a "/"). This provides an indication on how many tools in the Policy Toolkit relate to monitoring targets, also indicating whether these tools could be potentially usable as data sources by the Open Science Monitor. It is important to stress that, at this stage, we only conducted an indicative, hypothetical assessment of whether a tool could be useful. The main consideration to make this distinction was whether a given tool even produces data which could in theory feed into the metrics for a relevant monitoring target. As an example, various tools in the toolkit are reports or handbooks, i.e. resources that do not produce data – and which have been classed as "not useful" therefore. Instead,

[97] https://openscience.fi/handbook; https://openscience.fi/framework-for-open-science
[98] https://eudat.eu/news/a-new-feature-for-b2safe-the-data-policy-manager-dpm-tool
[99] http://learn-rdm.eu/wp-content/uploads/RDMToolkit.pdf
[100] https://dmp.fairdata.solutions/
[101] These include the Data Fairpoint service of the Dutch Techcentre for Life Sciences, the SmartAPI tool, and a conceptual proposal for a framework to measure the FAIRness of data (https://www.biorxiv.org/content/early/2017/12/01/225490).
[102] Including the FAIRsharing database and SPARC's Open Access Spectrum Evaluation Tool.
[103] http://v2.opendoar.sherpa.ac.uk/view/repository_by_country/countries=5Fby=5Fregion.html
[104] https://www.re3data.org/search
[105] https://eoscpilot.eu/content/d32-eosc-open-science-monitor-specifications

compliance support tools such as the SHERPA suite are services which produce data that could in principle also be used for the Open Science Monitor. Table 8 provides a full list of tools, which have been classed as useful to support different monitoring targets[106]. However, how these tools could contribute as data sources to the Open Science Monitor is subject to further investigations and specific arrangements (e.g. to agree the reuse of data) which go beyond the scope of this work.

Table 7: Relevance of Policy Toolkit tools for Open Science Monitor targets

Monitoring target	Number of relevant tools in toolkit	
	Useful for OSM	Not useful for OSM
Policy Compliance	19	9
Policy Adoption	5	5
Policy Readiness	4	7
Openness	1	2
Open Access	1	
Openness/ OA costs	3	2
Openness/ licenses		2
Trustworthiness/ Archiving	2	1
Trustworthiness/ Repository Certification	1	
FAIRness	3	5
Findability	2	1
Accessibility	1	2
Interoperability	2	1
Reusability	1	3
Research Impact	2	
Research Impact / Excellence	2	
Research Impact / Societal	1	
Skills / Training	1	3
Citizen Engagement	1	
Research Collaboration		3

[106] As can be seen in Table 7, one tool can support several monitoring targets. Accordingly, the count in Table 6 does not add up to the sum of tools in the toolkit (N=60), but produces a higher number.

Table 7 shows that tools in the toolkit could be useful to support a number of monitoring targets, particularly in the areas of policy compliance, policy adoption and policy readiness. The results of this bridging and mapping exercise between the Policy Toolkit and the Open Science Monitor represent a first step to further exploit the findings of the Policy Toolkit. In particular, they help to better reflect interconnections and complementarities and to make more apparent the way in which the findings could be directly or indirectly used by the Open Science Monitor's monitoring targets. It should however be stressed that this only presents an early stage assessment because any practical potential for the integration of data from the Toolkit's resources is subject to further, more detailed investigations.

Table 8 lists in detail the relevant tools which have been assessed as being potentially useful as data suppliers for the Open Science Monitor.

Table 8: List of relevant tools per monitoring category

Monitoring target	**Relevant tools in toolkit** **(lists only tools classified as useful in table X)**
Policy Compliance	SHERPA FACT, SHERPA RoMEO, SHERPA Juliet, SHERPA REF,OpenAIRE Repository Validator, FAIRsharing policies, Wiley Author Compliance Tool, PARTHENOS Policy Wizard, openDOAR, DMP OPIDoR, Monitor Local, Monitor UK, DMPonline, ROARMAP, FORCE11 Decision Trees, RDMO - Research Data Management Organiser, The Danish Open Access Indicator, NARCIS - National Academic Research and Collaborations Information System, re3data
Policy Adoption	SHERPA FACT, SHERPA RoMEO, SHERPA Juliet, FAIRsharing policies, B2SAFE-Data Policy Manager Tool
Policy Readiness	B2SAFE-Data Policy Manager Tool, FORCE11 Decision Trees, Toolkit on Public Engagement with Science, OpenAIRE Repository Validator
Openness	OS Monitor
Open Access	Open Access Spectrum Evaluation Tool
Openness/ OA costs	APCDOI, Monitor Local, Monitor UK
Openness/ licenses	
Trustworthiness/ Archiving	OpenAIRE Repository Validator, openDOAR
Trustworthiness/ Repository Certification	CoreTrustSeal
FAIRness	Data FAIRport, smartAPI, OS Monitor
Findability	re3data.org, OpenAIRE Guidelines, openDOAR
Accessibility	OpenAIRE Guidelines
Interoperability	OpenAIRE Guidelines, Open Access Spectrum Evaluation Tool
Reusability	OS Monitor
Research Impact	Metrics Toolkit, Toolkit on Public Engagement with Science
Research Impact / Excellence	Metrics Toolkit, SHERPA REF
Research Impact / Societal	Toolkit on Public Engagement with Science
Skills / Training	FOSTER Open Science Resources
Citizen Engagement	Toolkit on Public Engagement with Science

The individual Open Science Monitor targets and potentially supportive tools are as follows:

Policy Compliance, **Policy Adoption** and **Policy Readiness** are three core monitoring targets specified by the EOSCpilot OS Monitor. Given the scope of the Policy Toolkit, which is embedded in the Policy Work Package, the resources gathered for the Toolkit are strongly policy-related. This also means that they often facilitate the policy-related monitoring targets of the Open Science Monitor. Many tools and resources could be applied to multiple or even all three policy monitoring targets. This why the relevant tools for each monitoring target are explained in more detail below.

Policy Readiness concerns the preparatory stage of policy development, ensuring that all considerations from technical to strategic requirements have been examined, thus enabling effective policy development. Tools supporting Policy Readiness are: B2SAFE-Data Policy Manager Tool[107] developed for data policy management which data managers can use to assess the state of the art in policymaking before proceeding with further policy development; FORCE11 Decision Trees[108] have a broader scope as they are used with a view on identifying policy requirements in Open, FAIR and Citable contexts. They could therefore be used as checklists evaluating policy readiness according to specified requirements as expressed by the relevant user stakeholder. The Toolkit on Public Engagement with Science[109] could be useful in getting an overview of citizen science aspects of Open Science practices. The OpenAIRE Repository Validator[110] is relevant because it facilitates the development of interoperable metadata records, which is a FAIR component required in an increasing number of Open Science policies.

Policy Adoption is a monitoring target which sits between readiness and compliance. It reports on the adoption of different policies and revisions or evaluations of policies after the policy has been developed. The SHERPA suite of services, in particular SHERPA FACT[111], SHERPA RoMEO[112], SHERPA Juliet[113], are included in this category since all three services provide such insights with respect to the OA policies of funders and publishers. FAIRsharing policies [114] is another database with information about data preservation, management and sharing policies. The B2SAFE-Data Policy Manager Tool[115], mentioned previously could potentially support this monitoring target as well.

The monitoring target **Policy Compliance** measures activities to ensure compliance with various policies. Compliance may be targeting researchers to make them aware of journal policies in contrast to their research funders' policies and requirements but in the EOSC, it also aims to support compliance with the Rules of Participation, the minimum requirements responsible for stakeholders' compliance with the EOSC. SHERPA FACT, SHERPA RoMEO, SHERPA Juliet, SHERPA REF[116] have been providing policy compliance services for many years in order to facilitate publishing and archiving in OA environments. The Wiley Author Compliance Tool[117] serves the same purpose with the exception that it is provided by a publisher. FAIRsharing policies, formerly BioSharing, expanded its scope to include policy information from domains beyond Life Sciences. ROARMAP [118], although a derivative of a project which is no longer in operation, contains significant information and statistics on funders' policies.

As a service implementation, FORCE11 Decision Trees guide researchers to identify compliance requirements

[107] https://www.eudat.eu/news/a-new-feature-for-b2safe-the-data-policy-manager-dpm-tool
[108] https://www.force11.org/group/scholarly-commons-working-group/wp3decision-trees
[109] https://toolkit.pe2020.eu/
[110] https://www.openaire.eu/validator/welcome
[111] http://sherpa.ac.uk/fact/
[112] http://sherpa.ac.uk/romeo/index.php
[113] http://v2.sherpa.ac.uk/juliet/
[114] https://fairsharing.org/policies/
[115] https://www.eudat.eu/news/a-new-feature-for-b2safe-the-data-policy-manager-dpm-tool
[116] https://ref.sherpa.ac.uk/
[117] https://authorservices.wiley.com/author-resources/Journal-Authors/licensing-open-access/open-access/author-compliance-tool.html
[118] http://roarmap.eprints.org/

for research objects with Open, FAIR and Citable principles as expressed by declarations, reports and other documents throughout the years. The PARTHENOS Policy Wizard[119] follows the same service design but focuses only on the identification of FAIR data policies.

For issues regarding technical aspects such as long-term preservation, openDOAR[120] concerning institutional repositories and their policies registration as well as re3data for data repositories are services which could potentially support the monitoring of policy compliance. Similarly, the OpenAIRE Repository Validator could support the technical monitoring of policy implementation, helping information exchange and linkage between repositories with the primary goal of creating research entities of contextualised linked research information. Other monitoring mechanisms which have been put in place by EU member states to evaluate the state of OA practices and uptake in their regional and national areas are Monitor Local[121] (UK) and Monitor UK[122], the Danish Open Access Indicator[123], and NARCIS - National Academic Research and Collaborations Information System in the Netherlands[124]. Currently, statistics derived by these mechanisms mostly relate to Open Access to publications, thus facilitating the compliance monitoring of Open Access policies.

Tools assisting the process of Data Management Planning, which is at the core of most RDM policies, are the RDMO - Research Data Management Organiser[125], DMP OPIDoR[126], and DMPonline[127] (which is the widely used pioneer in this field). Particularly the data which these tools produce through their usual service function for users could support the monitoring of policy compliance.

FAIR is particularly relevant in FAIR and Open Access contexts and is often discussed as an interconnected, monolithic set of components. However, depending on the specific scope of each application case, it can also be that only some components of FAIR are relevant for an implementation.

Findability as an OS Monitor target covers the use of persistent identifiers, metadata and open directories. OpenDOAR, the registry of Open Access Repositories, as well as re3data, the equivalent registry for data repositories, support the latter because they enhance the visibility and findability of individual repositories. OpenAIRE Guidelines[128] through their metadata schema also support the findability of scientific information.

The monitoring target **accessibility** relates to the technical provisions, locus of deposit, and costs to make research outputs Open and FAIR. It also covers embargo periods and the types of resources which are made open and accessible (e.g. metadata or data). OpenAIRE Guidelines are listed here as a supportive tool because they also contain data that specify and increase the accessibility of repositories, their research outputs, and metadata records.

The monitoring target **interoperability** monitors the proliferation of standardised practices which promote machine readability, ensure completeness of metadata as well as suitable technical formatting of research artefacts to facilitate their exploitation. In this context, OpenAIRE Guidelines support the interoperability of institutional repositories through their metadata schema, which enables better and smoother information exchange and linkage between scientific information. The Open Access Spectrum Evaluation Tool[129], the second tool which could support the interoperability monitoring target, is the result of the implementation

[119] http://test.parthenos-project.eu/parthenos-wizard/
[120] http://v2.sherpa.ac.uk/opendoar/
[121] https://monitor.jisc.ac.uk/local/
[122] https://www.jisc.ac.uk/monitor-uk
[123] https://ufm.dk/en/research-and-innovation/cooperation-between-research-and-innovation/open-access/Publications/open-access-barometer
[124] https://www.narcis.nl/
[125] https://rdmorganiser.github.io/
[126] https://opidor-preprod.inist.fr/
[127] https://dmponline.dcc.ac.uk/
[128] https://guidelines.openaire.eu/en/latest/
[129] http://oaspectrum.org

of the "HowOpenIsIt? Guide for Evaluating the Openness of Journals[130]" which primarily seeks to formulate standardised levels of openness in OA journal policies. However, from an interoperability perspective, this policy standardization function of the "HowOpenIsIt? Guide" is also highly relevant and could therefore support this monitoring target.

Reusability is a monitoring target which aims to support the measurement of how reusable research outputs are. The relevant entities for this measurement are licences attributed to research artefacts and other provenance information. The European Commission's Open Science Monitor [131] currently focuses on openness in OA publications, policies, collaboration activities but also delivers data on the reuse of research data by considering variables such as the deposit locus of data, funder and journal policies, as well as researchers' attitudes towards a sharing culture. These considerations also make the Open Science Monitor relevant to support measurements of reusability.

In addition to the monitoring of individual components, FAIR can also be measured as a whole. In the OS Monitor, this is addressed by the **FAIRness** monitoring target. Data FAIRport[132] is a set of services that aim to facilitate the implementation of FAIR data. smartAPI[133] is another tool which can be used to build APIs with a higher degree of FAIRness. Given its scope, the OS Monitor is also relevant as a potential data source to measure FAIRness holistically.

According to the EOSCpilot OS Monitor, the **trustworthiness** Open Science Resources is another important monitoring target for the sustainable functioning of an Open Science ecosystem. Trustworthiness can be claimed either by the certification of the repository which is chosen for the deposition of research artefacts (i.e. **Trustworthiness/ Repository Certification** sub-target in the Open Science Monitor framework) or by the archiving policy and process followed by a repository (i.e. **Trustworthiness/ Archiving** sub-target in the Open Science Monitor framework). From a tools perspective, the former is supported by CoreTrustSeal[134], which could potentially provide data for this measurement. The OpenAIRE Repository Validator and openDOAR are tools which could provide supportive data for the Archiving dimension of Trustworthiness.

There are different types of costs reflecting the production and particularly publication of an OA work, reflected in the Open Science Monitor as **OA costs**. Some information on these costs is included in the HowOpenIsIt? Guide to Research Funder Policies[135] which focusses on the types of costs which are eligible and therefore likely to be reimbursed by funders. APCDOI[136], Monitor Local, Monitor UK are three services developed from the need to better understand and monitor OA costs.

An attempt was made during the composition of the monitoring targets of the EOSCpilot OS Monitor, to also include indicators which describe **research impact** on science and society. The Metrics Toolkit[137] provides a suite of metrics which can be used to assess research impact relying fundamentally on altmetrics and the Toolkit on Public Engagement with Science is yet another tool fulfilling the aforementioned needs also from the society's point of view. The Toolkit on Public Engagement with Science also allows to develop a better understanding of **citizen engagement** in research activities. In addition, measurements which can provide data for **research excellence** are likely to be concealed in tools that assess impact in the research area, as is the case with the Metrics Toolkit. SHERPA REF could also provide research excellence data for the UK, as it provides a service which assists researchers in achieving compliance with the REF requirements for Open Access to research in the UK.

A great enabler for Open Science is education, specifically when established following open principles. The

[130] https://sparcopen.org/our-work/howopenisit/
[131] https://ec.europa.eu/info/research-and-innovation/strategy/goals-research-and-innovation-policy/open-science/open-science-monitor_en
[132] https://www.dtls.nl/fair-data/find-fair-data-tools/
[133] http://smart-api.info/
[134] https://www.coretrustseal.org/
[135] http://www.orfg.org/resources/
[136] https://github.com/ryregier/APCDOI
[137] http://www.metrics-toolkit.org/

Open Science Monitor therefore also measures **Open Education**. The Monitor limited the range of this monitoring target to indicators exploring **skills** required for OS practitioners to measure **expertise** and **uptake** in training as well as the **Open Educational Resources** (OER) uptake. A very useful resource for OS practices in the context of this target are the FOSTER Open Science Resources[138], a collection of resources attempting to familiarise researchers with the new scholarly communication system and with new research workflows and practices.

[138] https://www.fosteropenscience.eu/resources

4. SUPPLY GAPS AND NEXT STEPS

The following section discusses the main findings and in particular deficit areas which can be identified based on the constitution of the Policy Toolkit as described in section 3. Furthermore, the section gives a summary of recommended further development as well as next steps.

4.1. Supply gaps

The Toolkit research has identified a wide variety of highly different tools, covering various areas relevant to Open Science. Notably, a relatively sound supply of tools seems to exist for tools which are relevant to RPOs. RPOs are arguably a wide and typical user group, in particular because they have emerged not just as creators of institutional Open Science policies, but even more so because they are most likely to be subject of such policies defined by funders. However, grouping the listed tools according to the EOSC's primary policy areas as defined by T3.1[139], reveals that almost all tools are relevant to Open Science/ Open Scholarship only. The remaining policy areas, i.e. procurement, ethics, and data protection, remain therefore largely unaddressed. This is even the case for RPOs, where almost all tools in the toolkit have some relevance. Only three tools in the toolkit, listed in Table 9, contain information or functions which are at least partly relevant to other policy areas. However, as the inductive classification of tools described in Section 3 found, none of the surveyed tools had such a strong focus on the stated policy areas, that it would have been justifiable to classify them as e.g. procurement tools.

Table 9: Tools with relevance beyond Open Science / Open Scholarship

Tool name	Primary policy areas	Secondary policy areas (minor relevance)
RECODE Policy recommendations	Open Science/ Open Scholarship, Ethics, Data Protection	Procurement
APCDOI	Open Science/ Open Scholarship	Procurement
LEARN Toolkit for Research Data Management	Open Science/ Open Scholarship	Procurement, Data Protection, Ethics

The absence of tools which cover a wider policy spectrum indicates areas which the EOSC could potentially support to develop in the medium-term. Given its wide remit to create a pan-European research environment and to promote data-driven European research, the EOSC would likely have a strong interest in a more holistic ecosystem of tools which can deliver specific support to users on ethics, procurement, and data protection issues. Drivers for this should not only be external factors, such as the recent introduction of the GDPR, but also the EOSC-inherent need for services which help users accommodate for example ethical challenges and procurement opportunities. It appears that the current tool supply in this area is insufficient, particularly if one requires ethics, data protection, or procurement tools which also take the specifics of Open Science into consideration.

The constitution of the toolkit also raises the impression of a general imbalance between the wide-ranging supply of tools for RPOs, a shorter supply of tools for funders / ministries, and a considerably lower supply for RIs. As it was noted in section 3.2, it appears that only a very limited number of tools is developed which

[139] In particular the policy recommendations reports D3.1 and D3.3.

target RIs or funders / ministries as their primary users. In the context of the EOSC, however, the ability of funders and RIs to adopt Open Science policies and practices is a particularly relevant lever in order to create a research ecosystem in which all stakeholders are driven by Open Science.

Utilising the facilities of RIs more effectively is a major motivator for the EOSC. As mentioned in the EOSC Roadmap Staff working paper[140], this is particularly the case with regards to the vision of connecting European RIs closely with the EOSC, as well as optimising their data production and reuse. In this context, the absence of any implementation monitoring or impact measurement tools specific to RIs is another potentially relevant supply gap. Raising implementation and impact measurement data could be a crucial first step to better coordinate the functions which various RIs play in the context of the European research system. As it has been noted previously, gathering data relevant to implementation and impact measurements is notoriously difficult for RIs, e.g. because they are not usually credited as sources for research outputs[141]. Further iterations of the EOSC's Policy Toolkit in the medium term should however seek to address this issue, because measurements in this area can be seen as the basis for any coordinated further activity. Additionally, given that repositories were the only RI-type for which specific tools were identified, it also appears that there is a severe lack for resources that can guide other RIs in their transition to Open Science. Therefore, a role for the EOSC could be to help define requirements and foster general conditions which support the development of RI-specific Policy Tools beyond repositories.

A similar case exists with regard to the lack of specific compliance support tools for funders. An important element of the EOSC is to work with funders on the gradual transition to policies which require FAIR data, the use of accredited repositories, and promote the adoption of open data policies by research institutions across the EU. However, already today RPOs - and to a certain degree funders - are struggling with a proliferation of varied, sometimes conflicting policy mandates. Therefore, addressing the interoperability challenges which might come with the increasing introduction of new policy mandates (e.g. requiring FAIR data) across different stakeholder groups is a superior challenge for the EOSC. Specifically designed compliance support tools for funders could potentially help to address this problem. In particular, these would need to provide more refined functions to support users in developing, formulating, and actively managing the compatibility requirements of policies.

Lastly, a similar challenge exists with regard to the provision of FAIR implementation tools. The promotion and increased production of FAIR data is an important focus of the EOSC in order to optimise the use of European research investments, avoid duplicate research, and accelerate learning cycles. Strikingly, however, the FAIR implementation tools were again particularly lagging for funders and RIs. Even for RPOs, few usable services, such as the Dutch Telecentre for Life Science's Data Fairport exist. This suggests that the implementation of FAIR data in practice is still in its infancy. Just as in the case of compliance support tools, implementation monitors, and impact measurements, the development of suitable tools to serve emerging user needs could greatly supplement the EOSC and, in particular, its suite of policy supporting services.

4.2. Proposed next steps

In the medium and long term, the Policy Toolkit should evolve together with the wider changes that will most likely occur in the EOSC ecosystem. In a widely spanned environment such as the EOSC, capturing best practices and trends in a timely manner is undoubtedly challenging and requires an ongoing effort. Especially in order to provide effective support in response to emerging policy developments, tool development trends should be closely monitored, communicated and updated. Therefore, first on the list of next steps is the Toolkit's enhancement with new achievements taking place during the duration of the EOSCpilot project. In alignment with the EOSC Policy Framework and the D3.3 policy recommendations (currently in draft form), updates and further additions to the Toolkit will be based on user feedback and ongoing expert consultations in close collaboration with T3.1 work. White papers that were produced as part of the D3.3 Draft Policy

[140] https://ec.europa.eu/research/openscience/pdf/swd_2018_83_f1_staff_working_paper_en.pdf

[141] http://training.parthenos-project.eu/sample-page/management-challenges/impact-management-perspective/assessing-impact/

Recommendations, will be included in the Toolkit once they are published. It is envisaged that the part of the Toolkit which is closely related to the OS Monitor supplying it with analytics, will be fed by the Monitor's dynamic mechanism to ensure that trends, new data sources for data collection and new indicators are captured in notifications coming from its frequent updates.

The Policy Toolkit will initially be made accessible via the EOSCpilot website. Initially denotes a delay in fulfilling the Description of Work, which specifies that the Tookit will "be accessible from the EOSC portal". Since the EOSCportal is currently in development with an expected release in Q4 2018, the most appropriate interim solution is to release the toolkit online and for commenting on the EOSCpilot website eoscpilot.eu. This means that users can start to utilise the resource immediately and will also be able to comment on and make proposals for additions to the toolkit. Together with Trust-IT, who manage eoscpilot.eu, it has been agreed to position the toolkit on the policy sub-page[142], which is a section dedicated to promote and disseminate WP3 Policy Task outcomes, news and achievements.

Finally, it is important to highlight that the inclusion of tools - particularly if they are *services* - does at this point not imply an assessment regarding their EOSC compliance. In the future, these tools might become compliant if they decide to follow the Rules of Participation; e.g. the OpenAIRE validator or SHERPA services could gain EOSC compliance if they describe their services and implemented terms of use according to and in response to the Rules of Participation. Therefore, a revision of the toolkit would be required in the medium-term, once the services have been properly identified and documented and their inclusion in the EOSC is ascertained. It is likely that this activity would have to take place following the completion of the EOSC-hub project.

[142] https://eoscpilot.eu/policy

5. CONCLUSIONS

EOSCpilot is the first in a series of projects to realise the EOSC, a trusted and federated research environment where data can flow freely between open infrastructures and their management. EOSCpilot is tasked to define a strategic and operational framework for the EOSC which can be implemented in a sustainable and resource efficient way. The federation of services by the EOSC is a core element of this vision. In this context, the Policy Toolkit provides a selection of third-party policy development and implementation resources which are highly relevant to the EOSC's emerging policy framework.

The 60 tools listed in the toolkit address the policy development and implementation needs of the three main stakeholder categories as defined by T3.1: RPOs, RIs, and funders as well as (research) ministries. The relevant tools have been assessed and classified into two broad use cases (*policy development* and *policy implementation*) and 13 functional tool classes. Based on this categorisation and the indicative alignment of surveyed tools with the Open Science Monitor's target areas, the Policy Toolkit supports the realisation of the EOSC Policy Framework. However, the Toolkit research also identified areas where supply gaps exist in relation to the EOSC's strategic objectives:

- a limited supply of policy tools for RIs, but also funders;
- a need to develop tools for more RIs than just repositories;
- a need for implementation monitoring, impact measurement, and compliance support tools which are designed specifically for funders and RIs;
- a need to accelerate the development of FAIR implementation tools, particularly if FAIR is supposed to become a major focus and differentiator of the EOSC.

The EOSC portal is anticipated to launch by the end of 2018, with its specific constitution and design still in progress at the moment. As a crucial resource for the practical implementation of the EOSC's policy framework, the Policy Toolkit is described by the EOSCpilot Description of Work as a resource which should be available via the EOSCportal. Until then, as an interim solution, the Policy Toolkit will be made available via eoscpilot.eu.

ANNEX A. POLICY TOOLKIT

A.1. Policy toolkit table (detailed)

This annex documents the detailed contents of the Policy Toolkit. Due to space constraints the full spreadsheet has been separated into two tables. The first table (marked with a red header) documents the following indicators:

- Tool name (linked with tool URL)
- Short description
- Developed by
- Country or regional area
- Element of Open Science
- Focus
- Scientific Discipline

The second table (marked with a blue header) documents the remaining indicators:

- Tool name (repeated from first table; linked with tool URL)
- Stakeholder users
- Main intended user group
- Relevant EOSC policy area
- Relevant Open Science Monitor Targets
- Direct utility for Open Science Monitor
- Use case category
- Type of tool
- Relevant research output

An online version of the Policy Toolkit is accessible and can be commented on here:

https://docs.google.com/spreadsheets/d/1gqhL3NqdQ2FD47N2e26ifviovK30ZROW5TG_SgtW9Eo/edit?usp=sharing

Tool name	Description	Developed by	Development stage	Country or regional area	Element of Open Science	Focus	Scientific discipline
A design framework and exemplar metrics for FAIRness.	This paper proposes a general framework and early stage indicators to measure the FAIRness of data.	Mark D. Wilkinson; Susanna-Assunta Sansone; Erik Schultes; Peter Doorn; Luiz Olavo Bonino da Silva Santos; Michel Dumontier	concept	international	research data; FAIR data	FAIR data	multi-disciplinary
ADA-M Automatable Discovery and Access Matrix	The Automatable Discovery and Access Matrix (ADA-M) provides a standardized way to unambiguously represent the conditions related to data discovery and access. By adopting ADA-M, data custodians can generally describe what their data are (the Header section), who can access them (the Permissions section), terms related to their use (the Terms section), and special conditions (the Meta-Conditions). By doing so, data custodians can participate in data sharing and collaboration by making meta information about their data computer-readable and hence directly available for digital communication, searching and automation activities.	GA4GH - Global Alliance for Genomics & Health IRDiRC - International Rare Disease Research Consortium	Pilot	international	OA policies; open research data; data sharing	policy standardisation; data sharing	Health and genomic data exchange
APCDOI	This is a python program where users can enter a list of DOIs in a csv file to find out what journal articles are Gold or Hybrid open access and how much the APC for each of these articles are. The program makes use of the Unpaywall API and a JSON file of Article Proccessing Charges (APCs).	Ryan Regier	operational	international	OA policies; licensing	open access; cost of publishing; article processing charges	multi-disciplinary
B2SAFE - Data Manager Policy Tool	The Data Policy Manager (DPM) is a tool that provides data policy management functionality. It can be used by: data managers to define data policies, store and share them with the data service providers, who will enforce them; service integrators to integrate a third-party service with the DPM relying on the XML DB API; B2SAFE service administrators to get an overview of the policies defined by a community data manager ,	EUDAT project	operational	international; EU	research data; research data management	policy development; policy compatibility	multi-disciplinary
Budapest Open Access Initiative	The Budapest Open Access Initiative (BOAI) is a declaration of principles on open access to research literature, first released on 14th February 2002. The declaration lists a series of high-level policy principles to implement Open	Open Society Foundation	operational	international	open access	open access; self-archiving	multi-disciplinary

Tool name	Description	Developed by	Development stage	Country or regional area	Element of Open Science	Focus	Scientific discipline
	Access. The declaration has been supplemented by a series of resources, including guides and handbooks, to facilitate the adoption of its principles: http://www.budapestopenaccessinitiative.org/resources						
CERIF description of Open Access policies	The paper describes a metadata model for a CERIF-based description of Open Access policies. The model can be used, e.g. by journals or funders, to express and represent key elements of Open Access policies with consistent language.	PASTEUR4OA project	concept	international	OA policies	OA policies; policy development; standardisation of policies	multi-disciplinary
Choose a licence	Choose a licence is a website, developed by GitHub, which helps users to select an appropriate licence for their project outputs. The service has been primarily designed for software projects, hence listing mostly open source software licences. However, for non-software projects, some selected licences are covered as well.	GitHub	operational	international	licencing; intellectual property rights	licencing; intellectual property rights	multi-disciplinary
CoreTrustSeal	The CoreTrustSeal offers data repositories a core level certification based on the DSA-WDS Core Trustworthy Data Repositories Requirements catalogue and procedures. Certification requires compliance with 16 requirements, which together aim to ensure that repositories provide a reliable, secure service which promotes the availability and reuse of data.	ICSU World Data System (WDS) / Data Seal of Approval (DSA)	operational	international	research data	research data management; trustworthiness; long term preservation	multi-disciplinary
Data Fairport	Dutch Techcentre for Life Sciences, DTLS' Data Fairport is an interoperability platform that allows data owners to publish their (meta)data and allows data users to search for and access data (subject to licenses). Data Fairport is based on four tools: FAIRifier and Metadata Editor (to create FAIR data); FAIR Data Point (to publish data); FAIR Search Engine (to find data); and ORKA (to annotate data).	DANS / SURFsara	operational	international	research data; data management; discoverability	FAIR data	multi-disciplinary
Data Stewardship Wizard	A wizard with questions based on the DS Knowledge Model covering all stages of the lifecycle that is intended for use by data stewards. Topics covered are: Design of experiment, Data Design and Planning, Data Capture/ Measurement, Data Processing and Curation, Data integration, Data interpretation, Information and insight.	Collaborative project run among others by DTL and ELIXIR nodes	concept	international	research data; data management	FAIR; data management plannig	multi-disciplinary

Tool name	Description	Developed by	Development stage	Country or regional area	Element of Open Science	Focus	Scientific discipline
DMP OPIDoR	DMP OPIDoR is a tool to help users write data management plans. The tool includes a number of templates that represent the requirements of different funders and institutions. To determine the appropriate template for display, users are asked three questions. DMP OPIDoR is based on the open source DMPRoadmap codebase, which is jointly developped by the Digital Curation Centre and the University of California Curation Center.	Digital Curation Centre (DCC); University of California Curation Center (UC3).	operational	international; France	research data; data management	research data management; policy development	multi-disciplinary
DMPOnline	DMPonline helps users to create, review, and share data management plans to meet various institutional and funder requirements. DMPOnline asks users three questions to select the appropriate DMP templates to display (e.g. the ESRC template when applying for an ESRC grant). Additional guidance, structured by research funders, universities and disciplines, is provided to help users determine specific data management questions.	Digital Curation Centre	operational	international	research data	research data management; data management plans	multi-disciplinary
FAIR Data Advanced Use Cases: from principles to practice in the Netherlands	This report presents use cases and expertise on the implementation of FAIR data policy in the Netherlands. The six use cases included in this report describe developments in FAIR data, and different approaches taken, within different scientific domains and insitutions. In particular, the report illustrates the move from principles to policy and the development of standards for creating, processing, saving, and using FAIR data.	SURFsara	operational	Netherlands; international	research data	FAIR data; data management; policy development	multi-disciplinary
FAIR-TLC: Metrics to Assess Value of Biomedical Digital Repositories: Response to RFI NOT-OD-16-133	The paper applies the FAIR principles to the evaluation of the value, utility, and impact of biomedical digital repositories. For each FAIR element, it provides detailed metrics which can be used to evaluate digital repositories. Additionally, three more elements with respective metrics are introduced to complement the FAIR framework: traceability, licensure, and connectedness.	Melissa Haendel (OHSU); Andrew Scru (Scripps Research Institute); Julie McMurry (OHSU)	concept	US	discoverability; data management; repository quality	FAIRness; repository management	biomedical science
FAIRsharing Policies	A catalogue of data preservation, management and sharing policies from international funding agencies, regulators and journals. Provides standardised high-level information on individual policies, e.g. applicable scientific domain, issuance date, issuing organisation, standards and databases, conditions of use, support/contact information.	University of Oxford e-Research Centre	operational	international	OA policies	comparison of policies; policy compatibility	multi-disciplinary

Tool name	Description	Developed by	Development stage	Country or regional area	Element of Open Science	Focus	Scientific discipline
FORCE11 Decision Trees	The FORCE11 Decision Trees are a technical decision-support framework which can be used to help users make decisions on how to comply with different Open Science principles and requirements. Decision trees model core aspects of a policy into a successive set of questions through which users can determine whether they - or how to - comply with a given policy. Decision trees effectively help to translate human readable policies into a workflow which is also machine actionable.	FORCE11	concept	international	open science policies	machine-actionability of policies	multi-disciplinary
FORCE11: Guiding principles for findable, accessible. interoperable and re-usable data publishing version B1.0	The guiding principles on FAIR data provide a general guide to FAIRness of data (i.e. not a "specification" with specific implementation choices). The Guiding Principles are meant to guide implementers of FAIR data environments in checking whether their particular implementation choices are indeed effective in achieving FAIRness goals.	FORCE11	operational	international	research data; FAIR data	FAIR data; research data management; policy development	multi-disciplinary
FOSTER Open Science Resources	The FOSTER Open Science Resources collection lists a variety of resources and information about Open Science structured by the FOSTER taxonomy. This includes tools which can be used to implement Open Science as well as training resources. Additionally, the collection also lists resources such as presentations and publications.	FOSTER project	operational	international; EU	OA policies; research data; data management; reproducibility of Open Science	open data; open access; reproducibility; policies	multi-disciplinary
Framework for Discipline-specific Research Data Management	The document provides a generic framework and guidance for the implementation discipline-specific research data management plans as well as domain data protocols. Short case studies explore how different research communities could approach their implementation.	Science Europe	concept	international	research data; FAIR data; data management; intellectual property rights	research data management; FAIR data; intellectual property rights	multi-disciplinary
HowOpenIsIt? A Guide for Evaluating the Openness of Journals	The HowOpenIsIt? Open Access Guide standardizes Open Access terminology. It provides a means to identify the core components of open access and how they are implemented in journal policies along the spectrum from "Closed Access" to "Open Access". The Guide consolidates the key elements of journal policies into a single framework to assess how open journals are in detail. The Open Access Spectrum Evaluation Tool (http://oaspectrum.org/) provides an implementation of the Open Access Guide.	SPARC	operational	international	open access policies; licensing	open access; policy standardisation; journals	multi-disciplinary

Tool name	Description	Developed by	Development stage	Country or regional area	Element of Open Science	Focus	Scientific discipline
HowOpenIsIt? Guide to Research Funder Policies	HowOpenIsIt? is a policy development guide to help funders establish criteria for the level of open access required for their policies and mandates. For example, should the policy require unrestricted reuse right? Should authors be allowed to repost any version of their articles in institutional and subject repositories? HowOpenIsIt? provides a mechanism to prioritise the key pillars of funders' open access policies.	ORFG - Open Research Funders Group	operational	international	OA policies	open access; policy development	multi-disciplinary
Kopernio	Kopernio is a browser plug-in to facilitate the discovery of and access of open access journal publications. The tool integrates with Google Scholar and PubMed. Note that Kopernio has recently been acquired by Clarivate Analytics.	Kopernio Limited	operational	international	open access	open access; identifying free journals	muti-disciplinary
LEARN Toolkit of Best Practice for Research Data Management	The LEARN Toolkit for Research Data Management provides a set of case studies on best practices, advocacy strategies (eg. to communicate issues to institutional leadership), policy development, and implementation issues. It also provides a model policy template for RDM.	LEARN project	pilot	international; EU	research data; data management; data management policies	FAIR data; research data management; policy development	multi-disciplinary
Metrics Toolkit	The Metrics Toolkit provides an overview and assists users in the selection of appropriate metrics to assess research impact claims. The toolkit lists metrics, mainly altmetrics, which can be used for a variety of disciplines and impact types.	Robin Champieux; Heather Coates; Stacy Konkiel	operational	international	research impact; evaluation	research impact; impact metrics	multi-disciplinary
Monitor Local	Monitor Local is a cloud based, customised solution for institutions to record data relating to the publication of Open Access outputs by their academics, including 'Gold' and 'Green' publication routes. The resulting data can be used in particular for reporting on Open Access costs and funder policy compliance. Monitor Local's integrations with other systems such as KB+ help to keep track of compliance issues, such as licence and funder policy.	Jisc	operational	UK	OA policies; OA funder policies	reporting; policy compliance	multi-disciplinary
Monitor UK	Monitor UK is a service to help UK institutions benchmark their spend on article processing charges at a national level. The information helps insitutional users to understand average article processing charge values across UK publishers and institutions. This information can be useful	Jisc	operational	UK	open access	open access; cost of publishing; article	multi-disciplinary

Tool name	Description	Developed by	Development stage	Country or regional area	Element of Open Science	Focus	Scientific discipline
	to institutions e.g. to optimise their own expenditure on article processing charges while ensuring compliance with funder's open access requirements.					processing charges	
NARCIS - National Academic Research and Collaborations Information System	NARCIS provides access to scientific information, including (open access) publications from the repositories of all Dutch universities, KNAW (Royal Academy of Arts and Sciences in the Netherlands), NWO (Netherlands Organisation for Scientific Research) and a number of research institutes. NARCIS provides furthermore datasets from some data archives as well as descriptions of research projects, researchers and research institutes. NARCIS monitors and publishes summary statistics on these publication activities.	Data Archiving and Networked Services (DANS)	operational	Netherlands	research practice; open access policies	open access practice	multi-disciplinary
Open Access Spectrum Evaluation Tool	The Open Access Spectrum Evaluation tool is an implementation of the HowOpenIsIt Open Access Guide for journals (https://sparcopen.org/our-work/howopenisit/). The tool scores journals' degrees of openness with regards to different policy aspects, automatic posting (ie. dissemination), and machine readaibility. The tool offers a quantifiable, transparent mechanism to analyze publications' policies.	SPARC	operational	international	OA policies	OA policies; machine readability of journal articles	multi-disciplinary
Open Access Toolkit	The Open Access Toolkit of the University of Western Australia provides comprehensive information and an institutional step-by-step guide to help researchers and research managers navigate the procedures and requirements for open access. This includes general information on open access and different funder mandates, as well as procedural guidance on publishing in open access journals, open data, and the institutional repository.	University of Western Australia	operational	Australia	open acess; research data	open access; open data; funder policies	multi-disciplinary
Open Peer Review protocol	The Open Peer Review protocol describes the general conditions and a workflow for the open peer review of published and unpublished articles in any article repository which supports open peer review.	OpenScholar.org.uk	concept	international	open peer review	peer review	multi-disciplinary
Open Science and Research Handbook	The Open Science and Research Handbook, published by the Finnish Ministry of Education and Culture, provides guidance for researchers, research organisations, decision-	Finnish Ministry of Education and Culture	operational	Finland	open culture; data management;	open science; implementation of open science	multi-disciplinary

Tool name	Description	Developed by	Development stage	Country or regional area	Element of Open Science	Focus	Scientific discipline
	makers, financiers, and the general public to adopt open science and research. The handbook provides specific strategic and implementation-oriented guidance for the different user communities on how to promote open science.				methods; services and infrastructure		
Open Science Monitor	The Open Access Monitor monitors trends and provides statistics on open access to publications, open research data, and collaborative research. It covers EU member states and selected associated countries, tracking trends across various disciplines. The Open Science Monitor aims to provide data and insight to understand the development of open science in Europe and gather the most relevant and timely indicators on the development of open science in Europe and other global partner countries.	European Commission	operational	EU; international	research practice; data management; open science policies	open science practice	multi-disciplinary
OpenAccessButton	OpenAccessButton is a search engine through which users can find the open access versions of journal articles. It sources data from the following resources: Unpaywall Data, Share, CORE, OpenAIRE, Dissem.in, Europe PMC, and BASE.	Joe McArthur; Marc McGillivray; Natalia Norori	operational	international	open access	open access; identifying free journals	muti-disciplinary
OpenAIRE Guidelines	The OpenAIRE Guidelines help repository managers expose publications, datasets and CRIS metadata via the OAI-PMH protocol in order to integrate with OpenAIRE infrastructure. Three guidelines exist for publication repositories, data archives and CRIS systems (based on CERIF-XML). The guidelines specifically provide guidance on how to specify access rights, funding information, and related publication and datasets.	OpenAIRE	operational	EU; international	OA policies; OA repositories	interoperability of repositories	muti-disciplinary
OpenAIRE Repository Validator	The OpenAIRE services helps repository managers to validate their repository/journal and register it into the OpenAIRE network. The tool works for publication repositories, journals, aggregators, as well as data archives/repositories.	OpenAIRE	operational	EU; international	OA policies; OA repositories	interoperability of repositories	muti-disciplinary
OpenDOAR	OpenDOAR is the quality-assured global directory of academic open access repositories. It enables the identification, browsing and search for repositories, based on a range of features, such as location, software or type of material held. It also enables repository administrators and	Jisc	operational	international	OA policies	policy development; policy standardisation; repository	multi-disciplinary

Tool name	Description	Developed by	Development stage	Country or regional area	Element of Open Science	Focus	Scientific discipline
	service providers to share best practice and improve the quality of the repository infrastructure. Furthermore, OpenDOAR's policy tool helps repository administrators to formulate and/or present their repository's policies based on current industry standards.						
OpenUpHub	OpenUp Hub is a collaborative community platform to capture, organize and categorize research outcomes, best practices, tools and guidelines. The platform lists materials to support the transition to open science, structured into three phases of the research cycle: review, dissemination, and assessment. It provides a toolbox of tailored-made solutions and trainings, an observatory that senses the community pulse, a blog and a Q&A forum to promote the two-way communication and a calendar to share information about events.	OpenUpHub project	operational	EU; international	research practice; open culture	open science practice; implementation of open science; dissemination	muti-disciplinary
OSF Toolkit for Digital Scholarship Support	The OSF Toolkit for Digital Scholarship Support is a collection of resources developed as part of the Center for Open Science's Open Science Framework. Librarians, archivists, and other information specialists can use the toolkit to retrieve information and guidance on how to implement Open Science services at their institutions/libraries. The toolkit covers resources for working with researchers; scripts and code; presentations, workshops and outreach materials; and success stories on partnering across research services.	Center for Open Science / George Washington University	operational	international; US	open access policies; research data	data management; open access; collaboration	multi-disciplinary
Parthenos Policy Wizard	The policy finder tool has been designed to support users in finding relevant FAIR data policies. The tool is primarily designed for research communities, digital repositories, and cultural heritage institutions in archaeology, history, language studies, and social sciences.	PARTHENOS project	operational	EU	research data; research data management	FAIR data	archaeology; social sciences; history; language studies
PASTEUR4OA	General toolkit for Research Funders and Research Producing Organisations grouping the materials considered essential to policy makers to allow them to understand the basic concepts around Open Access. Includes Model Policy Templates for each stakeholder category.	PASTEUR4OA project	Pilot	international; EU	OA policies	open access; policy development	muti-disciplinary

Tool name	Description	Developed by	Development stage	Country or regional area	Element of Open Science	Focus	Scientific discipline
Pathways to Open Access	The Pathways to Open Access report analyses various approaches to achieving open access (Green, Gold-APC, Gold-non-APC), and the actionable strategies that exist to implement each approach (e.g. library subvention funding). The document has been prepared by the University of California Libraries team and is intended to assist campus libraries and the California Digital Library with decision-making and strategies to achieve large-scale transition to OA.	University of California Libraries	operational	US	open access policies	open access	multi-disciplinary
Rainbow of Open Science Practices	The Rainbow of Open Science Practices is a presentation of 17 open science practices throughout the whole research workflow, focusing on the openness of open workflows. The overview also includes exemplary tools.	Jeroen Bosman; Bianca Kramer; Utrecht University Library	concept	international	research practice	open science; research practice; open science workflows	multi-disciplinary
RDA Practical Policy Working - Outcomes Policy Templates	A survey of policies to collect and categorize policies of data production systems. The working group also proposes policy templates to standardise policies, make them more interoperable, and machine-actionable. The latter is particularly important, e.g. to make roles of different users in data management systems machine-actionable, which enables automated data management.	Research Data Alliance RDA	Concept	international	OA policies; data management	comparison of policies; policy standardisation; machine-readable policies	multi-disciplinary
RDMO - Research Data Management Organiser	The Research Data Management Organiser (RDMO) is a tool to support the planning, implementation, and organization of research data management. The RDMO supports planning, by helping users to compile all relevant information for data management plans, as well as the ongoing data management throughout the full data life cycle.	Leibniz Institute for Astrophysics Potsdam; University of Applied Sciences Potsdam; Karlsruhe Institute of Technology	operational	Germany; international	research data	data management; data management plans	multi-disciplinary
re3data	re3data is a global registry of research data repositories from a diverse range of academic disciplines. It provides information on repositories for the permanent storage and access of data sets to researchers, funding bodies, publishers and scholarly institutions. The service is referenced by multiple publishers in their editorial policies as the best tool to identify the most appropriate data repository and recommended in the European Commission's Guidelines on Open Access to Scientific Publications and Research Data in Horizon 2020.	DataCite	operational	international	research data; data management	policy development; policy standardisation; repository	multi-disciplinary

Tool name	Description	Developed by	Development stage	Country or regional area	Element of Open Science	Focus	Scientific discipline
RECODE	Policy recommendations proposed by the RECODE project to improve open access to research data. Stakeholders targeted to implement recommendations are: funders; research institutions; data managers; publishers. Includes Model Policy Templates per stakeholder category.	RECODE project	Pilot	international; EU	OA policies; research data	open access; policy development; data management	multi-disciplinary
Research Data Management Toolkit	The Research Data Management Toolkit of the University of Western Australia provides an institutional step-by-step guide to help researchers and research managers navigate the procedures and requirements for research data management. This includes aspects of planning, documentation, intellectual property, storage/backup, sharing/reuse, retention/disposal, and support.	University of Western Australia	operational	Australia	research data; licensing	intellectual property rights; research data management	multi-disciplinary
Roarmap	The Registry of Open Access Repository Mandates and Policies (ROARMAP) is a searchable international registry charting the growth of open access mandates and policies adopted by universities, research institutions and research funders. It maps open access mandates and policies which require or request researchers to provide open access to their peer-reviewed research articles by depositing these in an open access repository.	University of Southampton School of Electronics and Computer Science	operational	international	OA policies	OA policies	multi-disciplinary
SHERPA FACT	SHERPA FACT checks if compliance with funder open access policies can be achieved with a particular journal. SHERPA FACT is an online resource that combines and interprets data from SHERPA RoMEO, SHERPA Juliet and other sources to provide clear guidance to researchers on whether a journal they wish to publish in complies with Research Councils UK (RCUK), Wellcome Trust and Charity Open Access Fund (COAF) open access policies, and offers advice on available options.	University of Nottingham / Jisc	operational	UK; international	OA policies; journal policies	OA compliance	muti-disciplinary
SHERPA Juliet v2	SHERPA Juliet enables researchers and librarians to see funders' conditions for open access publication. SHERPA Juliet is a searchable database and single focal point of up-to-date information concerning funders' policies and their requirements on open access, publication and data archiving. Replaced the original release of SHERPA Juliet in late 2017.	Jisc	operational	UK; international	OA funder policies	OA compliance	muti-disciplinary

Tool name	Description	Developed by	Development stage	Country or regional area	Element of Open Science	Focus	Scientific discipline
SHERPA REF [Beta]	The new SHERPA REF beta service helps authors and institutions decide whether a journal allows them to comply with the UK's Research Excellence Framework policy for Open Access. SHERPA REF considering the reformed REF post 2014. Jisc launched this service in beta in March 2016.	Jisc	operational	UK	OA policies	OA compliance	muti-disciplinary
SHERPA RoMEO	SHERPA RoMEO enables researchers and librarians to see publishers' conditions for open access archiving on a journal-by-journal basis. SHERPA RoMEO is an online resource that aggregates and analyses publisher open access policies from around the world and provides summaries of self-archiving permissions and conditions of rights given to authors on a journal-by-journal basis.	Jisc	operational	UK; international	OA depositing; journal policies	OA compliance	muti-disciplinary
SmartAPI	The smartAPI Specification (smartAPI) is a community-based extension of the OpenAPI specification, which aims to improve the FAIRness of APIs. It specifies an extended set of metadata elements and value sets to support this goal.The OpenAPI Specification (OAS) defines a standard, language-agnostic interface to RESTful APIs which allows both humans and computers to discover and understand the capabilities of the service without access to source code, documentation, or through network traffic inspection	SmartAPI consortium	operational	international	research data; FAIRness	FAIR data; data management	multi-disciplinary
The Danish Open Access Indicator	The Open Access indicator monitors how the Danish universities fulfill the targets of the National Strategy for Open Access. Results are displayed at the Danish National Research database: http://www.forskningsdatabasen.dk/en	The Ministry of Higher Education and Science	operational	Denmark	research practice; open access policies	open access practice	multi-disciplinary
The framework for the Open Science and Research	The report describes the framework for the Finnish Open Science and Research Initiative (ATT). The document describes the national principles of openness that govern the data and services used in science and research, the exchange of information, and the development of e-services in support of open science. The document is an example for a framework of open science, which breaks down policy components into more actionable areas which can be implemented by the respective stakeholders.	Finnish Ministry of Education and Culture	operational	Finland	open science policies	open science strategy	multi-disciplinary

Tool name	Description	Developed by	Development stage	Country or regional area	Element of Open Science	Focus	Scientific discipline
The Publishing Trap (boardgame)	The Publishing Trap is a board game from the UK Copyright Literacy team that allows participants to explore the impact of scholarly communications choices and discuss the role of open access in research. The game follows four academics who at each stage in their career, from PhD submission, through to Professorship, have to make choices about how to disseminate research outputs. Throughout the game, the characters experience and discuss the impact of their choices on their respective character's careers.	UK Copyright Literacy	operational	international	research practice	open science practice	multi-disciplinary
The realities of Research Data Management	Report series with case studies on how four different research universities in the US, UK, Netherlands, and Australia approach and implement Research Data Management.	OCLC Research	pilot	international	research data; research data management	research data management; data management plans	multi-disciplinary
Toolkit on Public Engagement with Science	The toolkit provides access to a variety of resources which help users to understand different aspects of public engagement. Tools are categorised in four domains: strategic framework (i.e. how is public engagement positioned in wider policy context?); methods and tools (i.e. how can public engagement be implemented?); institutional anchorage (i.e. how can organisations embed public engagement practices in the long run?); societal anchorage (how can public engagement be embedded in society as a whole?).	PE2020 project	operational	international; EU	public engagement; accessibility of research	openness of research	multi-disciplinary
Transparency and Openness Promotion Guidelines	The Transparency and Openness Promotion Guidelines aim to promote the adoption of journal policies furthering transparency, open sharing, and reproducibility. The guidelines include eight modular policy standards, covering e.g. data transparency, analytical methods transparency, and the encouragement of replication studies. Journals select which of the eight transparency standards they wish to adopt for their journal, and select a level of implementation for each standard.	Center for Open Science / George Washington University	operational	international	open access policies	open access; OA policies; policy development	multi-disciplinary
Wiley Author Compliance Tool	The Wiley Author Compliance Tool is designed to help authors, research managers, and librarians assess which Wiley journals comply with the Open Access policies of different funders and/or institutions.	Wiley	operational	international	OA policies	open access; policy compliance;	multi-disciplinary

Tool name	Description	Developed by	Development stage	Country or regional area	Element of Open Science	Focus	Scientific discipline
						policy compatibility	

Tool name	Stakeholder users	Main intended user group	Relevant EOSC policy area	Relevant Open Science Monitor Targets	Direct utility for Open Science Monitor	Use case category	Type of tool	Relevant research output
A design framework and exemplar metrics for FAIRness.	RPOs; funders ministries; RIs	data stewards; funder representatives; research managers	Open Science/ Open Scholarship	FAIRness (Policy Compliance)	No	Policy implementation	FAIR implementation	data
ADA-M Automatable Discovery and Access Matrix	RPOs	researchers	Open Science/ Open Scholarship	Findability; Accessibility	No	Policy implementation	(Meta-)Data framework	data
APCDOI	RPOs; funders / ministries	researchers; research managers; librarians; funder representatives; data stewards	Open Science/ Open Scholarship (Procurement)	Openness/ OA costs	Yes	Policy implementation	OA publication cost	articles
B2SAFE - Data Manager Policy Tool	RPOs; RIs	research managers; policy makers; repository managers; data stewards	Open Science/ Open Scholarship	Policy Readiness; Policy Adoption	Yes	Policy development	Policy guidance; Implementation guidance	data
Budapest Open Access Initiative	RPOs; RIs; funders / ministries	researchers; research managers; repository managers; policy makers; funder representative; private/commercial funders; funding officers; publisher representatives	Open Science/ Open Scholarship	Skills/Training	No	Policy development	Policy guidance	articles
CERIF description of Open Access policies	RPOs; funders / ministries	funder representatives; research managers; policy makers; content provider representatives	Open Science/ Open Scholarship	Policy Compliance	No	Policy development	Technical guidelines	articles
Choose a licence	RPOs; funders / ministries	research managers; researchers; policy makers	Open Science/ Open Scholarship	Openness; Reusability	No	Policy implementation	Implementation guidance	software
CoreTrustSeal	RPOs	data stewards; repository managers	Open Science/ Open Scholarship	Trustworthiness/Repository Certification	Yes	Policy development	Quality assurance	services
Data Fairport	RPOs; RIs	data stewards; researchers; research managers	Open Science/ Open Scholarship	FAIRness	Yes	Policy implementation	FAIR implementation	data

Data Stewardship Wizard	RPOs; RIs	researchers; data stewards	Open Science/ Open Scholarship		No	Policy implementation	Implementation guidance	data
DMP OPIDoR	RPOs; RIs	research managers; repository managers; policy makers	Open Science/ Open Scholarship	Policy Compliance	Yes	Policy implementation	Compliance support	data
DMPOnline	RPOs	researchers; research managers; policy makers	Open Science/ Open Scholarship	Policy Compliance	Yes	Policy implementation	Compliance support	data
FAIR Data Advanced Use Cases: from principles to practice in the Netherlands	RPOs	research managers; policy makers; repository managers	Open Science/ Open Scholarship	Policy Readiness; Policy Adoption	No	Policy development	FAIR implementation	data
FAIR-TLC: Metrics to Assess Value of Biomedical Digital Repositories: Response to RFI NOT-OD-16-133	RPOs; funders / ministries	repository managers; researchers; research managers	Open Science/ Open Scholarship	FAIRness	No	Policy implementation	FAIR implementation	data
FAIRsharing Policies	RPOs; RIs; funders / ministries	research managers; researchers; funders	Open Science/ Open Scholarship	Policy Adoption; Policy Compliance	Yes	Policy implementation	Policy survey	data
FORCE11 Decision Trees	RPOs; funders / ministries	research managers; data stewards; policy makers	Open Science/ Open Scholarship	Policy Compliance (Policy Readiness)	Yes	Policy implementation	Implementation guidance	other
FORCE11: Guiding principles for findable, accessible. interoperable and re-usable data publishing version B1.0	RPOs; funders / ministries	data stewards; policy makers; funder representatives; research managers	Open Science/ Open Scholarship	FAIRness; Policy Compliance	No	Policy development	FAIR implementation	data
FOSTER Open Science Resources	RPOs; RIs; funders / ministries	research managers; librarians; data stewards; repository managers; policy makers; funder representatives; researchers; others	Open Science/ Open Scholarship	Skills/Training	Yes	Policy implementation; policy development	Implementation guidance; policy guidance	articles; data; workflows
Framework for Discipline-specific Research Data Management	RPOs; RIs; funders / ministries	data stewards; research managers; research community representatives; funder representatives	Open Science/ Open Scholarship	FAIRness	No	Policy Implementation	Implementation guidance	data
HowOpenIsIt? A Guide for Evaluating the Openness of Journals	RPOs	research managers; researchers; funders; policy makers	Open Science/ Open Scholarship	Openness/ OA costs; Openness/ licenses; Trustworthiness/ Archiving; Interoperability	No	Policy development	Policy guidance	articles

HowOpenIsIt? Guide to Research Funder Policies	funders / ministries	funders	Open Science/ Open Scholarship	Openness/ OA costs; Openness/ licenses; Accessibility; Reusability	No	Policy development	Policy guidance	articles
Kopernio	RPOs	researchers			Yes	Policy implementation	OA publication discovery	articles
LEARN Toolkit of Best Practice for Research Data Management	RPOs; RIs; funders / ministries	research managers; repository managers; policy makers; funder representatives	Open Science/ Open Scholarship (Procurement, Data Protection, Ethics)	Policy Adoption; Policy Compliance	No	Policy development	Policy guidance	data
Metrics Toolkit	RPOs	researchers; research managers; publisher representatives	Open Science/ Open Scholarship	Research Impact (Research Impact / Excellence)	Yes	Policy implementation	Impact measurement	other
Monitor Local	RPOs; funders / ministries	research managers; repository managers;	Open Science/ Open Scholarship	Openness/ OA costs; Policy Compliance	Yes	Policy implementation	Compliance support	articles
Monitor UK	RPOs	repository managers; librarians; research managers; policy makers	Open Science/ Open Scholarship	Openness/ OA costs; Policy Compliance	Yes	Policy implementation	OA publication cost	articles
NARCIS - National Academic Research and Collaborations Information System	RPOs; funders / ministries	funder representatives; librarians	Open Science/ Open Scholarship	Policy Compliance	Yes	Policy implementation	Implementation monitor	articles; data
Open Access Spectrum Evaluation Tool	RPOs; RIs; funders / ministries	researchers; librarians; policy makers; funder representatives	Open Science/ Open Scholarship	Open Access; Interoperability	Yes	Policy implementation	Policy survey	articles
Open Access Toolkit	RPOs	researchers; research managers; repository managers	Open Science/ Open Scholarship	Policy Compliance	No	Policy implementation	Implementation guidance	articles
Open Peer Review protocol	RPOs	repository managers; researchers; research managers	Open Science/ Open Scholarship	Open Collaboration	No	Policy implementation	Implementation guidance	articles
Open Science and Research Handbook	RPOs; RIs; funders / ministries	research managers; researchers; policy makers; funder representatives; data stewards	Open Science/ Open Scholarship	Skills/Training	No	Policy implementation	Implementation guidance	other

Open Science Monitor	RPOs; funders / ministries	policy makers; funder representatives	Open Science/ Open Scholarship	Openness; Reusability (FAIRness)	Yes	Policy implementation	Implementation monitor	data; articles
OpenAccessButton	RPOs	researchers			Yes	Policy implementation	OA publication discovery	articles
OpenAIRE Guidelines	RPOs; funders / ministries; RIs	repository managers; librarians; research managers	Open Science/ Open Scholarship	Findability; Accessibility; Interoperability	Yes	Policy implementation	Technical guidelines	articles; data
OpenAIRE Repository Validator	RPOs; RIs	repository managers; librarians; research managers	Open Science/ Open Scholarship	Trustworthiness/ Archiving; Policy Compliance (Policy Readiness)	Yes	Policy implementation	Compliance support	articles; data
OpenDOAR	RPOs; RIs	repository managers; policy makers	Open Science/ Open Scholarship	Findability; Trustworthiness/ Archiving; Policy Compliance	Yes	Policy implementation; policy development	Repository discovery	articles
OpenUpHub	RPOs; RIs; funders / ministries	researchers; research managers; librarians; data stewards; repository managers; policy makers; funder representative; publisher representatives	Open Science/ Open Scholarship	Policy Readiness	No	Policy implementation	Implementation guidance	workflows
OSF Toolkit for Digital Scholarship Support	RPOs	librarians; data stewards; repository managers; research support staff	Open Science/ Open Scholarship	Open Collaboration	No	Policy implementation	Implementation guidance	services
Parthenos Policy Wizard	RPOs; funders / ministries	research communities; repository managers; librarians; cultural heritage institutions	Open Science/ Open Scholarship	Policy Compliance	Yes	Policy implementation	Policy survey	data
PASTEUR4OA	RPOs; funders / ministries	research managers; policy makers	Open Science/ Open Scholarship	Policy Adoption; Policy Readiness (Policy Compliance)	No	Policy development	Policy guidance	articles
Pathways to Open Access	RPOs	policy makers; librarians			No	Policy implementation	Implementation guidance	other
Rainbow of Open Science Practices	RPOs	researchers; research managers	Open Science/ Open Scholarship	Open Collaboration	No	Policy development	Policy guidance	workflows

RDA Practical Policy Working - Outcomes Policy Templates	RPOs	research managers; researchers	Open Science/ Open Scholarship	Policy Compliance; Policy Adoption; Policy Readiness	No	Policy development	Policy guidance	data
RDMO - Research Data Management Organiser	RPOs	researchers; research managers; data stewards	Open Science/ Open Scholarship	Policy Compliance	Yes	Policy implementation	Compliance support	data
re3data	RPOs; RIs	repository managers; policy makers	Open Science/ Open Scholarship	Policy Compliance; Findability	Yes	Policy implementation	Repository discovery	data
RECODE	RPOs; RIs; funders / ministries	research managers; funders; policy makers; researchers	Open Science/ Open Scholarship, Ethics, Data Protection (Procurement)	Policy Adoption; Policy Readiness (Policy Compliance)	No	Policy development	Policy guidance	data
Research Data Management Toolkit	RPOs	researchers; research managers; repository managers	Open Science/ Open Scholarship	Openness; Reusability	No	Policy implementation	Implementation guidance	data
Roarmap	RPOs; funders / ministries	policy makers; funder representatives; repository managers	Open Science/ Open Scholarship	Policy Compliance	Yes	Policy implementation	Policy survey	articles
SHERPA FACT	RPOs; funders / ministries	research managers; researchers; librarians	Open Science/ Open Scholarship	Policy Compliance (Policy Adoption)	Yes	Policy implementation	Compliance support	articles
SHERPA Juliet v2	RPOs; funders / ministries	research managers; researchers; librarians	Open Science/ Open Scholarship	Policy Compliance (Policy Adoption)	Yes	Policy implementation	Compliance support	articles
SHERPA REF [Beta]	RPOs; funders / ministries	research managers; researchers; librarians	Open Science/ Open Scholarship	Policy Compliance (Research Impact / Excellence)	Yes	Policy implementation	Compliance support	articles
SHERPA RoMEO	RPOs	research managers; researchers; repository managers; librarians	Open Science/ Open Scholarship	Policy Compliance (Policy Adoption)	Yes	Policy implementation	Compliance support	articles
SmartAPI	RPOs; RIs	data stewards; researchers; repository managers	Open Science/ Open Scholarship	FAIRness	Yes	Policy Implementation	FAIR implementation	data
The Danish Open Access Indicator	RPOs; funders / ministries	funder representatives; librarians	Open Science/ Open Scholarship	Policy Compliance	Yes	Policy implementation	Implementation monitor	articles

The framework for the Open Science and Research	RPOs; RIs; funders / ministries	research managers; researchers; policy makers; funder representatives	Open Science/ Open Scholarship	Policy Readiness (Policy Compliance)	No	Policy development	Policy guidance	services
The Publishing Trap (boardgame)	RPOs	researchers; research managers	Open Science/ Open Scholarship	Skills/Training	No	Policy development	Policy guidance	other
The realities of Research Data Management	RPOs	research managers; repository managers; institutional IT departments	Open Science/ Open Scholarship	FAIRness	No	Policy development	Policy guidance	data
Toolkit on Public Engagement with Science	RPOs; funders / ministries	policy makers; funder representatives	Open Science/ Open Scholarship	Societal Impact; Research Impact; Citizen Engagement (Policy Readiness)	Yes	Policy implementation	Implementation guidance	other
Transparency and Openness Promotion Guidelines	funders / ministries	publisher representatives; funder representatives	Open Science/ Open Scholarship	Policy Readiness	No	Policy development	Policy guidance	other
Wiley Author Compliance Tool	RPOs; funders / ministries	researchers; research managers; librarians; funders	Open Science/ Open Scholarship	Policy Compliance	Yes	Policy implementation	Compliance support	articles

A.2. Toolkit elements of Open Science

The following table lists the terms with which the tools were classified to indicate the elements of Open Science that they cover. These terms can be used as tags to support filtering functions for the Policy Toolkit. One tool can be tagged multiple times.

article processing charges
collaboration
comparison of policies
cost of publishing
data management
data sharing
dissemination
FAIR
FAIR data
Funder policies
impact metrics
implementation of open science
intellectual property rights
interoperability of repositories
journals
licencing
long term preservation
machine readability of journal articles
machine-actionability of policies
machine-readable policies
OA compliance
OA policies
open access
open data
open science
open science practice
open science strategy
open science workflows
openness of research

peer review
policies
policy compatibility
policy compliance
policy development
policy standardisation
reporting
repository management
reproducibility
research data management
research impact
research practice
self-archiving
standardisation of policies
trustworthiness

ANNEX B. GLOSSARY

APCs - Article Processing Charges

EC - European Commission

EU – European Union

EOSC - European Open Science Cloud

OA - Open Access

OS - Open Science

RI - Research Infrastructure

RRI - Responsible Research and Innovation

RPO - Research Producing Organisation