Persistent Identifiers & US Government Policies

Sara Bowman, Crossref
Amanda French, ROR
Brian Minihan, ORCID
Carly Robinson, US DOE, OSTI

June 26 2023
JCDL Conference, Santa Fe, New Mexico

Agenda

Introduction Brian Minihan, ORCID
Review of the White House Initiatives Carly Robinson, DOE Office of Scientific and Technical Information
Technical Discussion

- **Introduction to Crossref** Sara Bowman, Crossref
- **Introduction to ORCID** Brian Minihan, ORCID
- **Introduction to ROR** Amanda French, ROR

Questions, Answers & Interaction

Workshop outcomes

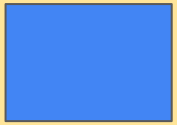
Articulate what a PID is
Familiarity of the new Federal Policies'

- Intention
- Guidelines for use of PIDs

Familiarity with how the different PIDs operate and how this relates to research policies

Articulate how PIDs might benefit librarians (repository managers), developers, funders + policy makers and publishers.

Q&A feedback and interaction



Review of the white house initiatives (Carly)

https://tinyurl.com/2z6un37x

Intro to Crossref (Sara)

https://tinyurl.com/38ypwkrh

Intro to ORCID (Brian)

https://tinyurl.com/32whcu7u

Intro to ROR (Amanda)

https://tinyurl.com/2xee3yx9

What is a Persistent Identifier?

Basic definition

Persistent identifiers (PIDs) are long-lasting references to digital objects of various types

US Government Definition

A digital identifier that is globally unique, persistent, machine resolvable and processable, and has an associated metadata schema.

https://www.whitehouse.gov/wp-content/uploads/2022/08/08-2022-OSTP-Public-Access-Memo.pdf

What is a Persistent Identifier?

“..because a PID may be connected to a set of metadata describing an object rather than to the object itself. They allow different platforms to exchange information consistently and unambiguously..”

https://library.cern/submit-and-publish/persistent-identifiers/what-are-pids CERN Library (European Council for Nuclear Research)

Common Persistent Identifiers

DOIs Digital objects (publications, datasets, etc)

ORCID IDs individuals

ROR IDs organizations

Persistent Identifiers you may not be aware of

RAID (Research Activity ID) projects

IGSN (Int’l Generic Sample Number) physical objects

What are the benefits of a Persistent Identifier?

Link rot or content drift is particularly damaging in the context of academic research. A 404 error is always annoying, but if the goal is findability, accessibility, interoperability and reusable, then a PID is good bet.

What are the benefits of a Persistent Identifier?

The PIDs we will talk about today were specifically created to address the issues of sustainability while pointing to an object uniquely.

They are structures to prevent the loss of research through opacity

Why would you use a Persistent Identifier?

PIDs are “standards”

They should include

- Provenance
- Policies & guarantees
- Metadata
- Machine Readability

Clark, Jonathan (2017): Overview of PID Systems for THOR Webinar. figshare. Journal contribution. https://doi.org/10.6084/m9.figshare.5016803.v1

Why would you use a Persistent Identifier?

“Since the construction of a PID follows a predictable format, PIDs are machine readable, that is to say a PID can be used to connect information without human intervention”

Umeå Universitet
https://www.umu.se/en/library/research-data/specialised-topics/metadata/pid-research-data/

Why would you use a Persistent Identifier?

Incentives to invest in identifiers: A cost-benefit analysis of persistent identifiers in Australian research systems
Josh Brown, Phill Jones, Alice Meadows, Fiona Murphy
https://doi.org/10.5281/zenodo.7100578

How five PIDs (and their metadata!) could save your country millions!
Australia Data Research Commons, et al.
https://youtu.be/YVvjeWJyzcU

Increasingly present in national research policies of numerous countries

The recognition that the trust infrastructure included in persistent identifiers assists in compliance and integrity

as well as reducing the associated cost of research administration

means that PIDs are increasingly present in national research policies and strategic planning of numerous countries

Further reading & resources

- NSPM-33 Memo
  - https://trumpwhitehouse.archives.gov/presidential-actions/presidential-memorandum-united-states-government-supported-research-development-national-security-policy/
- NSPM-33 Implementation Guidance
  - https://www.whitehouse.gov/wp-content/uploads/2022/01/010422-NSPM-33-Implementation-Guidance.pdf
- OSTP Public Access Memo
  - https://www.whitehouse.gov/wp-content/uploads/2022/01/010422-NSPM-33-Implementation-Guidance.pdf

Further reading & resources

- RDA PID Interest Group - https://www.rd-alliance.org/groups/pid-interest-group.html
- RDA National PIDs Strategy Group - https://www.rd-alliance.org/groups/national-pid-strategies-wg
- Crossref: Guide on meeting policies using existing open infrastructure
  - https://www.crossref.org/blog/how-funding-agencies-can-meet-ostp-and-open-science-guidance-using-existing-open-infrastructure/
- ORCID Guide to supporting research institutions navigating Public Access and Research Security Policies
  - https://www.crossref.org/blog/how-funding-agencies-can-meet-ostp-and-open-science-guidance-using-existing-open-infrastructure/
- Lyrasis: NSPM-33 Guide
  - https://orcidus.lyrasis.org/nspm-33-guide/

US Government PID Policies: NSPM-33 and OSTI Public Access Memo

JCDL Workshop:

Persistent Identifiers & US Federal Agency Policies

June 26, 2023

Carly Robinson, PhD

US Department of Energy

Office of Scientific and Technical Information

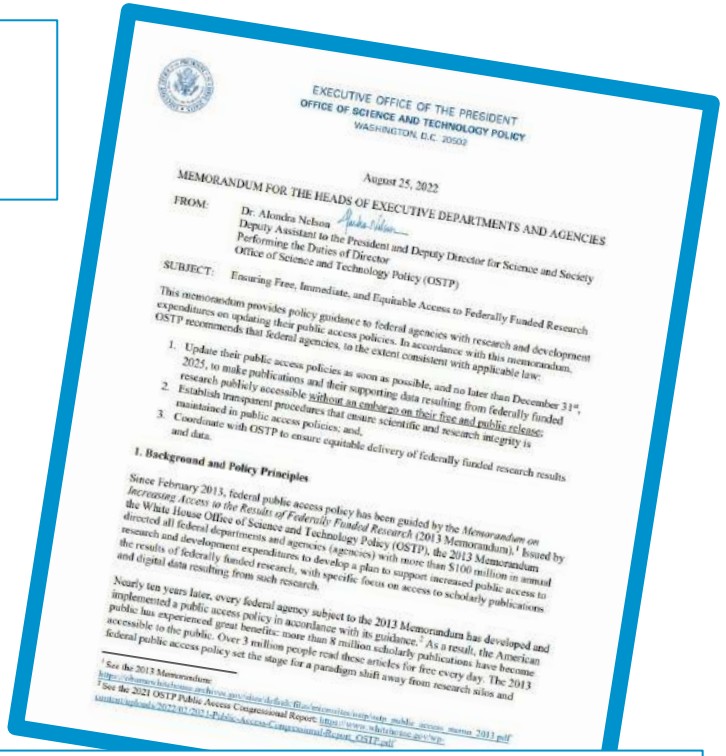
US Government PID-Related Policies

Supported Research and Development National Security Policy
(NSPM-33)


PRESIDENTIAL MEMORANDA

Presidential Memorandum on United States Government-Supported Research and Development National Security Policy

NATIONAL SECURITY & DEFENSE | Issued on: January 14, 2021


EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20502

August 25, 2022

MEMORANDUM FOR THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

FROM: Dr. Alondra Nelson
Deputy Assistant to the President and Deputy Director for Science and Society
Performing the Duties of Director
Office of Science and Technology Policy (OSTP)

SUBJECT: Ensuring Free, Immediate, and Equitable Access to Federally Funded Research

This memorandum provides policy guidance to federal agencies with research and development expenditures on updating their public access policies. In accordance with this memorandum, OSTP recommends that federal agencies, to the extent consistent with applicable law:

1. Update their public access policies as soon as possible, and no later than December 31st, 2025, to make publications and their supporting data resulting from federally funded research publicly accessible without an embargo on their free and public release;
2. Establish transparent procedures that ensure scientific and research integrity is maintained in public access policies; and,
3. Coordinate with OSTP to ensure equitable delivery of federally funded research results and data.

1. Background and Policy Principles

Since February 2013, federal public access policy has been guided by the *Memorandum on Increasing Access to the Results of Federally Funded Research* (2013 Memorandum),[1] issued by the White House Office of Science and Technology Policy (OSTP), the 2013 Memorandum directed all federal departments and agencies (agencies) with more than $100 million in annual research and development expenditures to develop a plan to support increased public access to the results of federally funded research, with specific focus on access to scholarly publications and digital data resulting from such research.

Nearly ten years later, every federal agency subject to the 2013 Memorandum has developed and implemented a public access policy in accordance with its guidance.[2] As a result, the American public has experienced great benefits: more than 8 million scholarly publications have become accessible to the public. Over 3 million people read these articles for free every day. The 2013 federal public access policy set the stage for a paradigm shift away from research silos and

[1] See the 2013 Memorandum:
[2] See the 2023 OSTP Public Access Congressional Report:

Ensuring Free, Immediate, and Equitable Access to Federally Funded Research
(OSTP Public Access Memo)

PID vs DPI

Digital Persistent Identifier (PID)

- Has been used as the acronym for persistent identifiers (e.g. digital persistent identifiers) by the community/SMEs for over 20 years
- Used by all the PID service organizations
- Used for the NSTC SOS PID Subgroup

Digital Persistent Identifier (DPI)

- Used in NSPM-33
- PID community/SMEs not involved in development of memo language
- NSPM-33 Implementation Guidance updated DPI definition to:
  "Digital persistent identifier (DPI or digital PID)…"

NSPM-33 – January 14, 2021

Memo directs action to strengthen protections of United States Government-supported Research and Development (R&D) against foreign government interference and exploitation.


PRESIDENTIAL MEMORANDA

Presidential Memorandum on United States Government-Supported Research and Development National Security Policy

NATIONAL SECURITY & DEFENSE | Issued on: January 14, 2021

- *(v) Consistent with applicable Federal laws and statutory authorities, within 1 year of the date of this memorandum, funding agencies shall establish policies regarding requirements for individual researchers supported by or working on any Federal research grant to be registered with a service that provides a digital persistent identifier for that individual.*

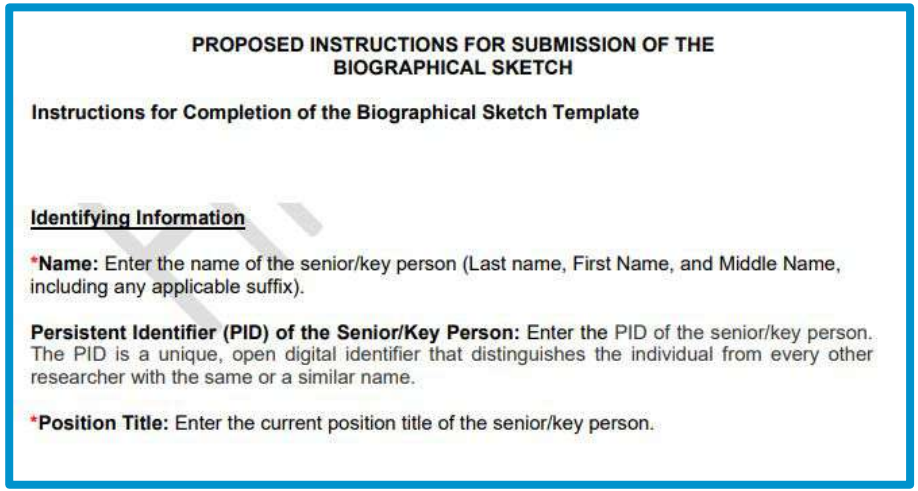
- *(vi) Agencies shall standardize disclosure processes, definitions, and forms across funding agencies to the extent practicable… Where appropriate and consistent with applicable Federal laws and regulation, agencies should standardize forms for initial disclosures as well as annual updates, integrating digital persistent identifiers wherever appropriate and practicable, and should provide clear instructions to accompany these forms and to minimize any associated administrative burden.*

https://trumpwhitehouse.archives.gov/presidential-actions/presidential-memorandum-united-states-government-supported-research-development-national-security-policy/

NSPM-33 Implementation – Disclosure Standardization

Government-wide effort to standardize disclosure forms:

- Biographical Sketch
- Current and Pending Support



PROPOSED INSTRUCTIONS FOR SUBMISSION OF THE BIOGRAPHICAL SKETCH

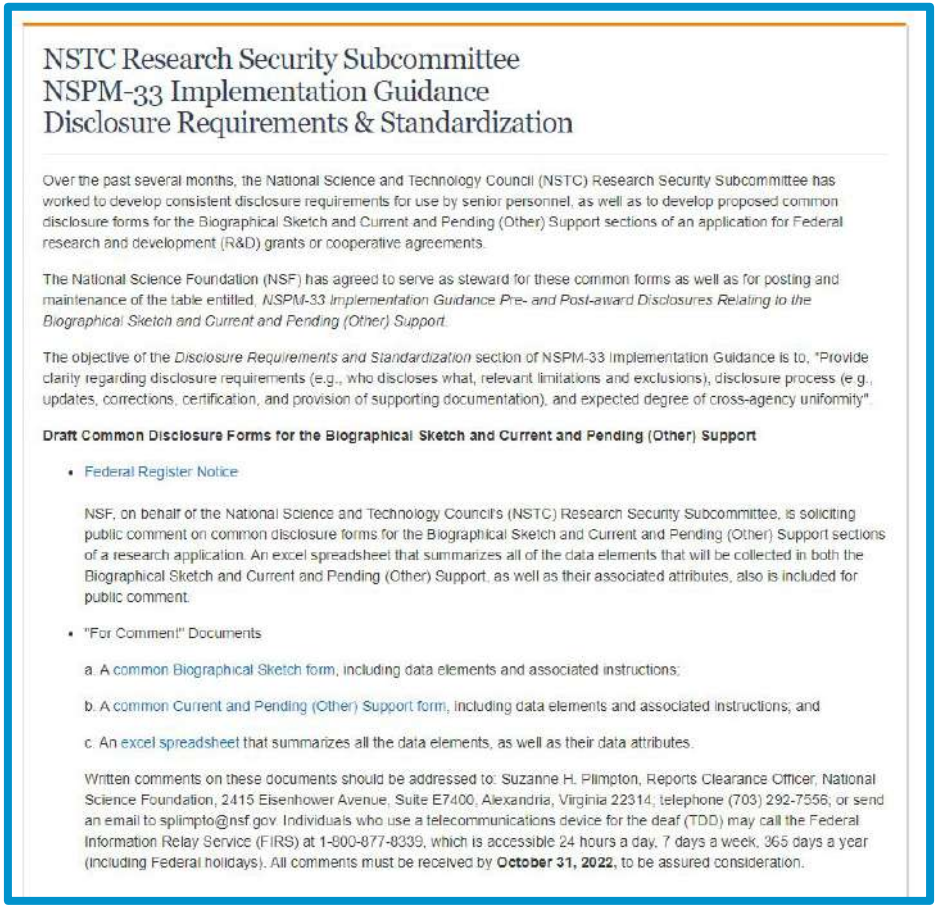
Instructions for Completion of the Biographical Sketch Template

Identifying Information

***Name:** Enter the name of the senior/key person (Last name, First Name, and Middle Name, including any applicable suffix).

Persistent Identifier (PID) of the Senior/Key Person: Enter the PID of the senior/key person. The PID is a unique, open digital identifier that distinguishes the individual from every other researcher with the same or a similar name.

***Position Title:** Enter the current position title of the senior/key person.



NSTC Research Security Subcommittee
NSPM-33 Implementation Guidance
Disclosure Requirements & Standardization

Over the past several months, the National Science and Technology Council (NSTC) Research Security Subcommittee has worked to develop consistent disclosure requirements for use by senior personnel, as well as to develop proposed common disclosure forms for the Biographical Sketch and Current and Pending (Other) Support sections of an application for Federal research and development (R&D) grants or cooperative agreements.

The National Science Foundation (NSF) has agreed to serve as steward for these common forms as well as for posting and maintenance of the table entitled, *NSPM-33 Implementation Guidance Pre- and Post-award Disclosures Relating to the Biographical Sketch and Current and Pending (Other) Support*.

The objective of the *Disclosure Requirements and Standardization* section of NSPM-33 Implementation Guidance is to, "Provide clarity regarding disclosure requirements (e.g., who discloses what, relevant limitations and exclusions), disclosure process (e.g., updates, corrections, certification, and provision of supporting documentation), and expected degree of cross-agency uniformity"

Draft Common Disclosure Forms for the Biographical Sketch and Current and Pending (Other) Support

- Federal Register Notice

  NSF, on behalf of the National Science and Technology Council's (NSTC) Research Security Subcommittee, is soliciting public comment on common disclosure forms for the Biographical Sketch and Current and Pending (Other) Support sections of a research application. An excel spreadsheet that summarizes all of the data elements that will be collected in both the Biographical Sketch and Current and Pending (Other) Support, as well as their associated attributes, also is included for public comment.

- "For Comment" Documents

  a. A common Biographical Sketch form, including data elements and associated instructions;

  b. A common Current and Pending (Other) Support form, including data elements and associated instructions; and

  c. An excel spreadsheet that summarizes all the data elements, as well as their data attributes.

  Written comments on these documents should be addressed to: Suzanne H. Plimpton, Reports Clearance Officer, National Science Foundation, 2415 Eisenhower Avenue, Suite E7400, Alexandria, Virginia 22314; telephone (703) 292-7556; or send an email to splimpto@nsf.gov. Individuals who use a telecommunications device for the deaf (TDD) may call the Federal Information Relay Service (FIRS) at 1-800-877-8339, which is accessible 24 hours a day, 7 days a week, 365 days a year (including Federal holidays). All comments must be received by **October 31, 2022**, to be assured consideration.

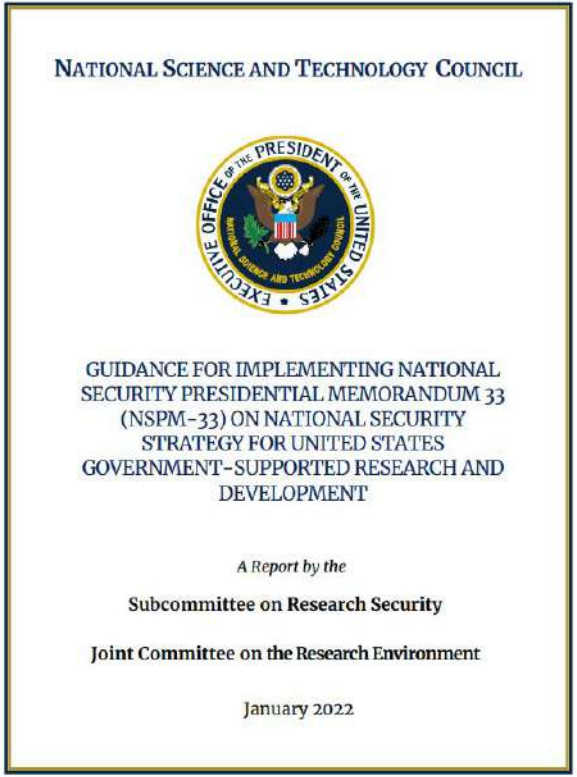
https://www.nsf.gov/bfa/dias/policy/nstc_disclosure.jsp

NSPM-33 – Implementation Guidance – January 2022

Objective: Describe how research agencies will incorporate digital persistent identifiers (DPIs) – also known as Persistent Identifiers (PIDs) – into disclosure processes to bolster research security and integrity while reducing administrative burden.

Guidance: Research agencies should work to implement DPIs into their electronic systems and processes as quickly as is feasible with appropriate protections for personally identifiable information. Until that time, completion of required disclosures using previous systems and processes may still be required. When available, the DPI option will facilitate population of this information into the requisite format.

Note: The DPI section pertains to individuals applying for grants or cooperative agreements. As indicated in point 3 of this section, agencies should consider providing a DPI option for other types of R&D award applicants.



NATIONAL SCIENCE AND TECHNOLOGY COUNCIL

GUIDANCE FOR IMPLEMENTING NATIONAL SECURITY PRESIDENTIAL MEMORANDUM 33 (NSPM-33) ON NATIONAL SECURITY STRATEGY FOR UNITED STATES GOVERNMENT-SUPPORTED RESEARCH AND DEVELOPMENT

A Report by the

Subcommittee on Research Security

Joint Committee on the Research Environment

January 2022

https://www.whitehouse.gov/wp-content/uploads/2022/01/010422-NSPM-33-Implementation-Guidance.pdf

NSPM-33 – Implementation Guidance: PID Definition

"A digital identifier that is globally unique, persistent, machine resolvable and processable, and has an associated metadata schema. Consistent with NSPM-33, digital persistent identifiers for individuals are used to disambiguate and identify an individual person."

- Globally unique: the identifier is universally/globally recognized and attached to a defined resource. It is not just internal or organizationally recognized.
- Persistent: the identifier needs to be maintained even if the object it is attached to goes away or becomes unavailable.
- Machine resolvable: the identifier is a URL that resolves to a (landing) page that provides information about the object it is identifying.
- Machine processable: the identifier is such that a machine can read it and process information about it.
- Associated metadata schema: the identifier has a metadata schema that is defined and associated with the identifier. The schema would often be defined by the PID provider. The schema is used to provide information about the object the identifier to which it is defined.

NSPM-33 – Implementation Guidance

1. Incorporation of DPIs into grant and cooperative agreement application and disclosure processes

Research agencies should allow submission of required disclosure information via a DPI service, consistent with the Paperwork Reduction Act and the Privacy Act of 1974, as applicable. Basic process steps should include the following:

- Researcher maintains information required under cross-agency disclosure requirements on an individual "profile" or "record" maintained by a DPI service and associated with a DPI.
- During the grant application process, the individual provides their DPI and, via the DPI service, authenticates their DPI and authorizes the research agency to access the required information. This replaces any need for the researcher to manually enter the required disclosure information.
- As part of the grant application process, the researcher certifies to the research agency that the information disclosed through the service is current, complete, and accurate.
- In cases where there remain variations between research agencies' application processes (i.e., timing of certain disclosure, use of different collection forms), the impact of these differences on the applicant will be minimized. The DPI profile or record will contain the needed disclosure information and can be accessed by the research agency at the appropriate time, once the researcher has provided authorization.
- In cases where a research agency requires an additional disclosure that exceeds the standardized requirements, researchers may also be able to maintain the additional disclosure information on the DPI service, and similarly provide it to the research agency, as an alternative to providing such information separately to the requesting research agency.
- When annual or other updates are required, the researcher may simply ensure that the profile/record information is current, provide an updated authentication if needed for the research agency to access the updated information, and provide an updated certification regarding the completeness and accuracy of the information.

NSPM-33 – Implementation Guidance

2. Requiring DPIs versus providing as an option for disclosures

All research agencies should provide the option of using a DPI service for disclosure, but also may retain the option for a grant or cooperative agreement application to be processed without the use of such a service. The DPI option should provide the lowest administrative burden for researchers, research organizations, and research agencies. Some research agencies currently require use of DPIs under some circumstances, and more may choose to do so.

3. Categories of individuals provided a DPI option for disclosures

Research agencies should provide the DPI option for all individuals seeking or receiving Federal R&D grant and cooperative agreement funding. Research agencies also should consider providing a DPI option for extramural researchers funded through non-grant mechanisms (e.g., contracts), and for intramural researchers.

4. Use of available DPI services

To the greatest extent possible, research agencies should leverage DPI services provided by private entities, including, where possible, services already widely used by researchers. Research agencies should coordinate to establish DPI service requirements and may allow research organizations and/or researchers to utilize any service that meets those requirements. Research agencies should increase consistency and further reduce administrative burden by ensuring that one or more common DPI service is available for use across agencies. If multiple DPI services are used, agencies should develop processes to integrate information from DPI services to assess completeness and consistency. Use of multiple DPI services may increase administrative complexity and cost, potentially impacting data quality.

NSPM-33 – Implementation Guidance

5. Common/core standards that a DPI service should meet to be included as an option for disclosure in Federal grant and cooperative agreement application processes

- Provided by an open, non-proprietary, researcher-driven platform, interoperable with the ISO 27729 certified global standard number service for identifying contributors to creative works including researchers, inventors, and authors.
- Disambiguates one researcher from another, distinguishing individual researchers from others with the same or similar name and allowing Federal research agencies to uniquely identify researchers included in government systems. The DPI service should ensure disambiguation by allowing the researcher to include all associated name variations and additional information that can ensure unique identification.
- Enables a researcher to create a single record that represents their curriculum vitae with relevant information (employment, education, funding, research outputs, etc.) to share with funders, publishers, researchers, and other organizations.
- Prevents unintentional creation of duplicate DPI records for the same researcher. In cases of unintentional duplicate DPIs, the service should allow for the identification and consolidation of records into a single DPI record for the researcher.
- Allows collection of disclosure information in a DPI record, reduces administrative burden by entering information once, and allows researcher information to be transmitted to research agencies and grant recipient organizations, as appropriate and as authorized.
- Provides an ability to exchange and make use of information from multiple systems.
- Supports connection between DPI-associated information about the researcher over time and is inclusive of researcher name changes or different name formats.
- Allows research agencies to read and write validated information associated with the DPI.
- Supports secure integration with standard authentication services – Security Assertion Markup Language (SAML) and Open Authentication (OAuth).
- Provided at no cost to the researcher.
- Allows the researcher to control access to the information, with the privacy level set by the individual researcher, specifically identifying the entities allowed to access the information.

NSPM-33 – Implementation Guidance

6. Ensuring interoperability across multiple options for DPI service

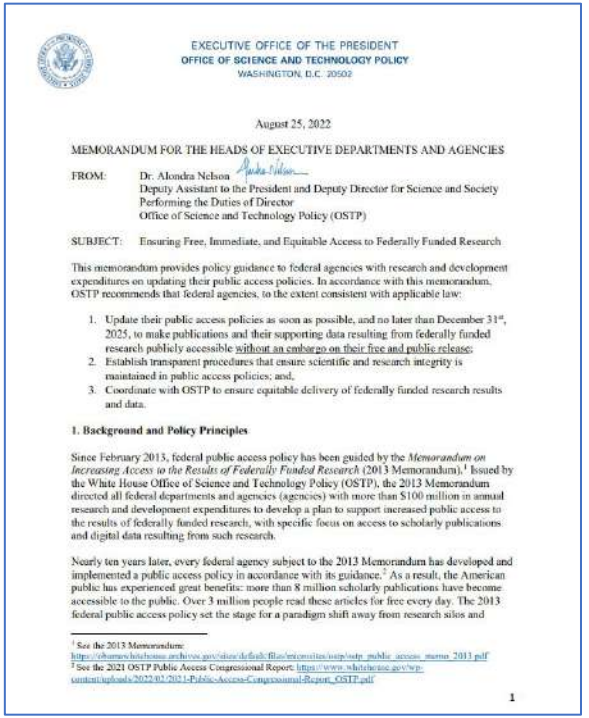
DPIs that meet the common/core standards will allow for interoperability. To ensure that research agencies can support multiple interoperable DPI options, DPI services should be open, non-proprietary, and provide the ability to exchange information. If using multiple DPI services, agencies should develop processes to integrate information access services to ensure complete and accurate reporting of disclosure information provided via DPI services.

7. Potential for public disclosure of information provided to research agencies via a DPI service

Research agencies should not require that individuals provide any public disclosure through the DPI service. Researchers may choose to make information publicly available through their DPI profile or record. Agencies may choose to include DPIs in public records in support of open science activities and/or requirements.

OSTP Public Access Memo – August 25, 2022

- Memo provides policy guidance to federal agencies with research and development expenditures on updating their public access policies.
- Builds off 2013 OSTP Memo – *Increasing Access to the Results of Federally Funded Scientific Research* (focused on making journal articles and data publicly accessible).
- Required agencies to develop new public access plan and provide to OSTP for review by February 23, 2023.
- Section 4: Ensuring Scientific and Research Integrity in Agency Public Access Policies (PIDs and metadata)
  - The public should be able to identify which federal agencies support given investments in science, the scientists who conduct that research, and the extent to which peer-review was conducted.
  - Do this through use of PIDs and making metadata and research results publicly available.
  - Same PID definition as NSPM-33 Implementation Guidance – "*A digital identifier that is globally unique, persistent, machine resolvable and processable, and has an associated metadata schema*."



EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20502

August 25, 2022

MEMORANDUM FOR THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

FROM: Dr. Alondra Nelson
Deputy Assistant to the President and Deputy Director for Science and Society
Performing the Duties of Director
Office of Science and Technology Policy (OSTP)

SUBJECT: Ensuring Free, Immediate, and Equitable Access to Federally Funded Research

This memorandum provides policy guidance to federal agencies with research and development expenditures on updating their public access policies. In accordance with this memorandum, OSTP recommends that federal agencies, to the extent consistent with applicable law:

1. Update their public access policies as soon as possible, and no later than December 31st, 2025, to make publications and their supporting data resulting from federally funded research publicly accessible without an embargo on their free and public release;
2. Establish transparent procedures that ensure scientific and research integrity is maintained in public access policies; and,
3. Coordinate with OSTP to ensure equitable delivery of federally funded research results and data.

1. Background and Policy Principles

Since February 2013, federal public access policy has been guided by the *Memorandum on Increasing Access to the Results of Federally Funded Research* (2013 Memorandum).[1] Issued by the White House Office of Science and Technology Policy (OSTP), the 2013 Memorandum directed all federal departments and agencies (agencies) with more than $100 million in annual research and development expenditures to develop a plan to support increased public access to the results of federally funded research, with specific focus on access to scholarly publications and digital data resulting from such research.

Nearly ten years later, every federal agency subject to the 2013 Memorandum has developed and implemented a public access policy in accordance with its guidance.[2] As a result, the American public has experienced great benefits: more than 8 million scholarly publications have become accessible to the public. Over 3 million people read these articles for free every day. The 2013 federal public access policy set the stage for a paradigm shift away from research silos and

[1] See the 2013 Memorandum: https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/ostp_public_access_memo_2013.pdf
[2] See the 2021 OSTP Public Access Congressional Report: https://www.whitehouse.gov/wp-content/uploads/2022/02/2021-Public-Access-Congressional-Report_OSTP.pdf

1

https://www.whitehouse.gov/wp-content/uploads/2022/08/08-2022-OSTP-Public-Access-Memo.pdf

OSTP Public Access Memo PID Language

Federal agencies should, consistent with applicable law:

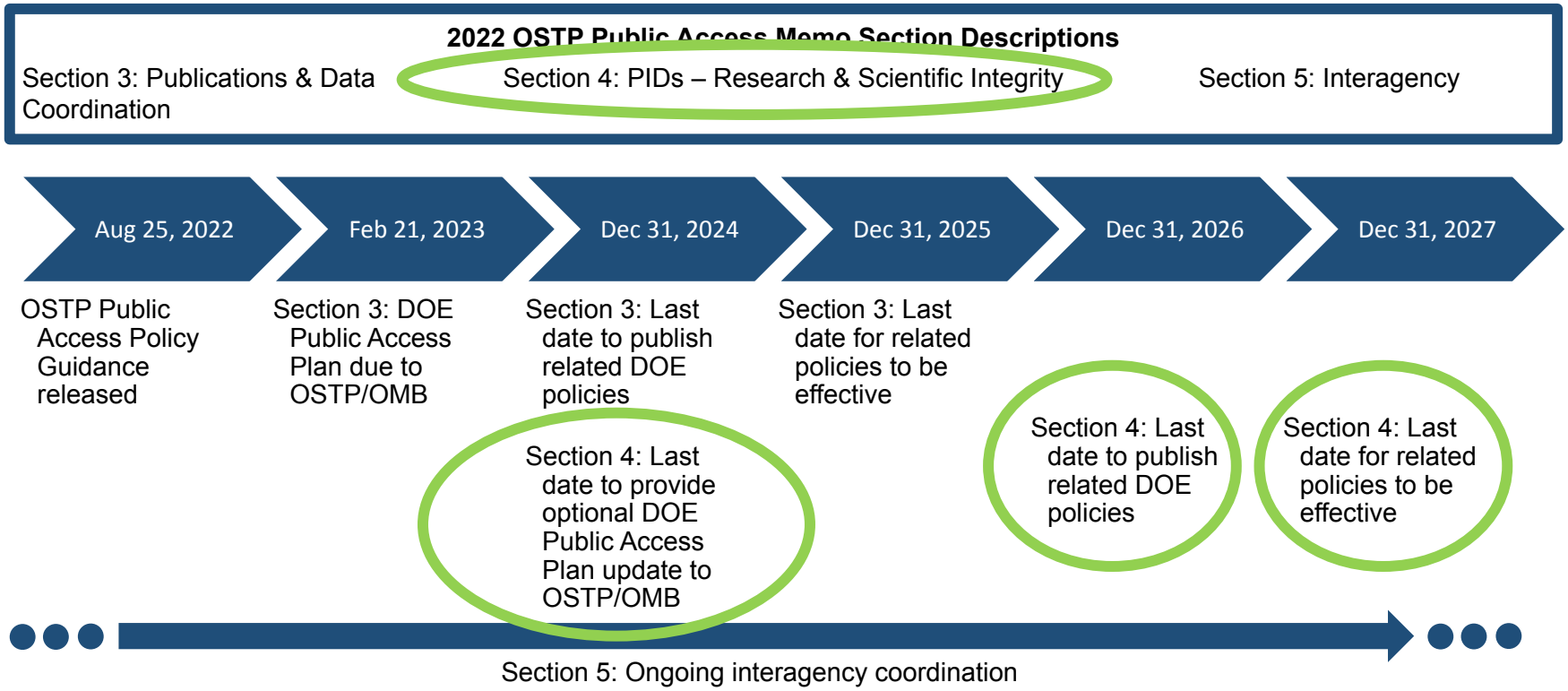
4a) Collect and make publicly available appropriate metadata associated with scholarly publications and data resulting from federally funded research, to the extent possible at the time of deposit in a public access repository. Such metadata should include at minimum:

- *i) all author and co-author names, affiliations, and sources of funding, referencing digital persistent identifiers, as appropriate;*
- *ii) the date of publication; and,*
- *iii) a unique digital persistent identifier for the research output;*

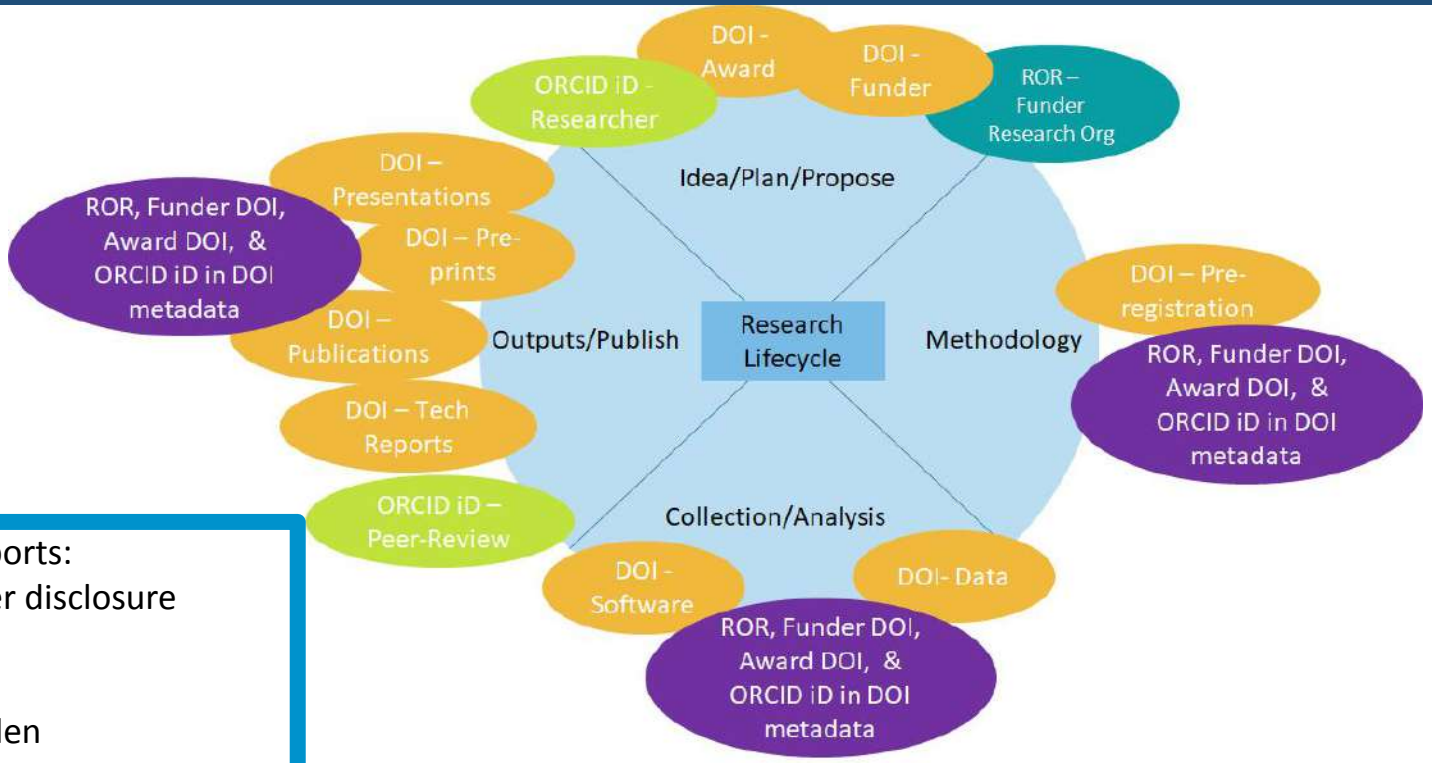
4b) Instruct federally funded researchers to obtain a digital persistent identifier that meets the common/core standards of a digital persistent identifier service defined in the NSPM-33 Implementation Guidance, include it in published research outputs when available, and provide federal agencies with the metadata associated with all published research outputs they produce, consistent with the law, privacy, and security considerations.

4c) Assign unique digital persistent identifiers to all scientific research and development awards and intramural research protocols that have appropriate metadata linking the funding agency and their awardees through their digital persistent identifiers.

OSTP Public Access Implementation Timeline



PID Implementation

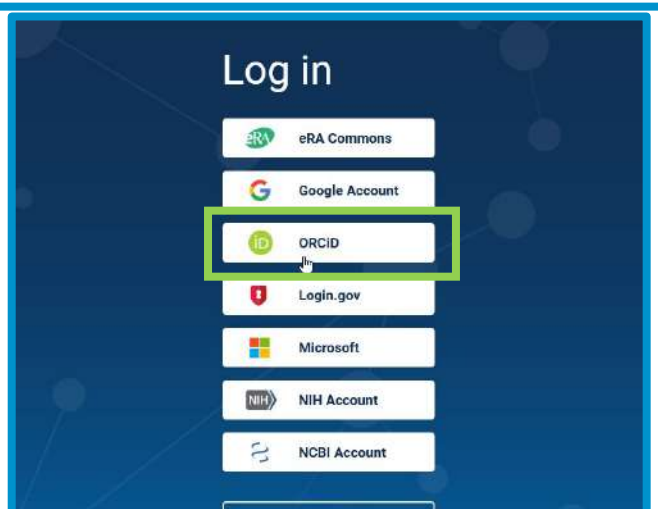


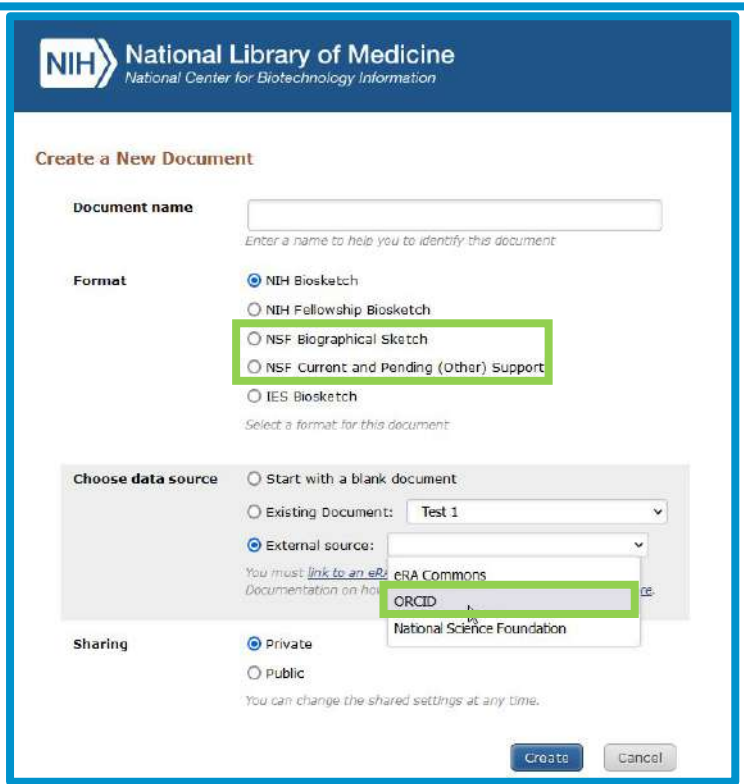
USG PID implementation supports:

- Research integrity & proper disclosure
- Disambiguation
- Giving proper credit
- Easing administration burden
- Help with reporting
- Enabling broader discovery and making connections
- Understanding impact

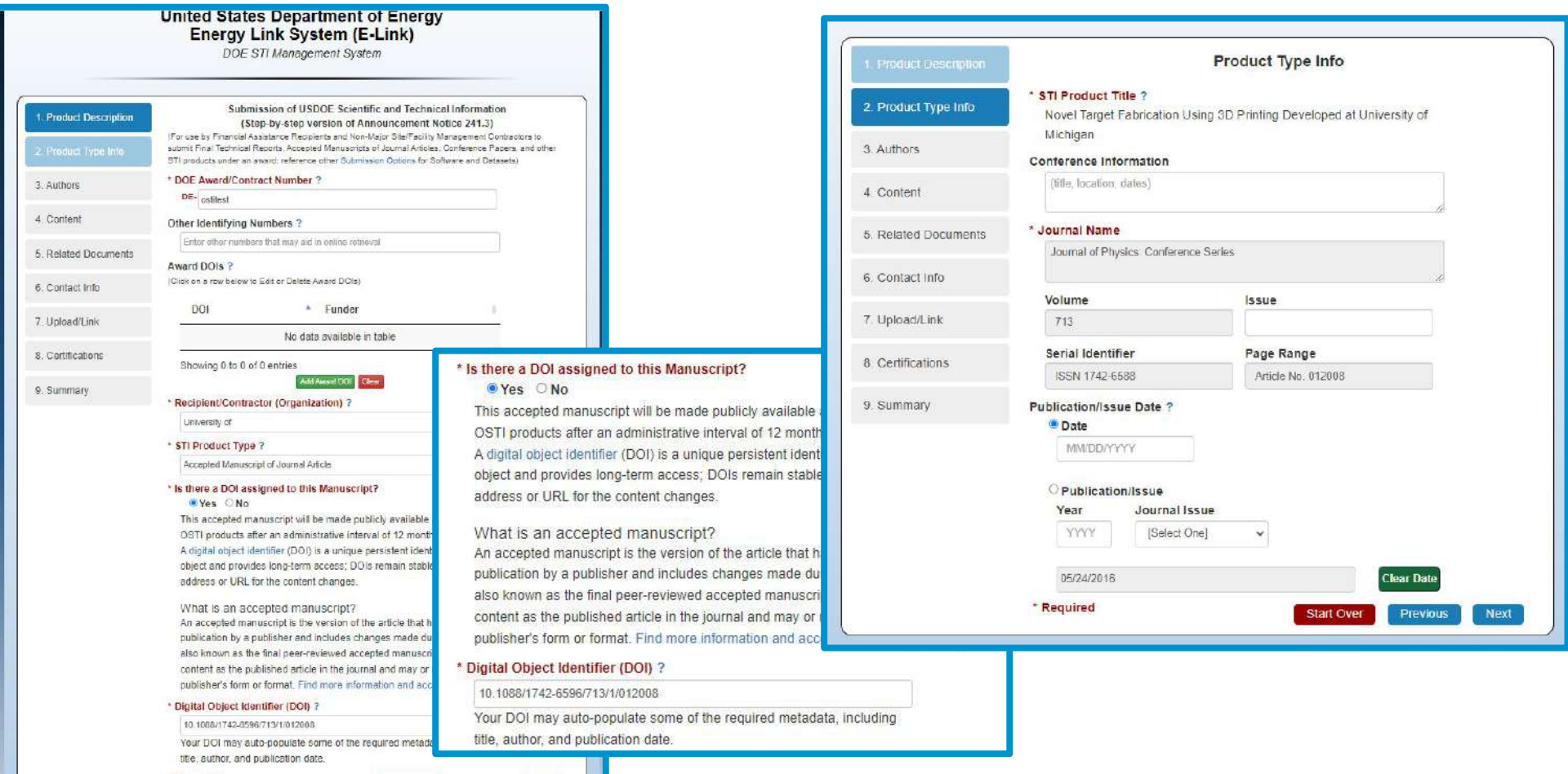
Using PIDs for Research Integrity & Proper Disclosure

DOE Office of Science "requires the use of the format approved by the National Science Foundation (NSF), which may be generated by the Science Experts Network Curriculum Vitae (SciENcv), a cooperative venture maintained at https://www.ncbi.nlm.nih.gov/sciencv/..."



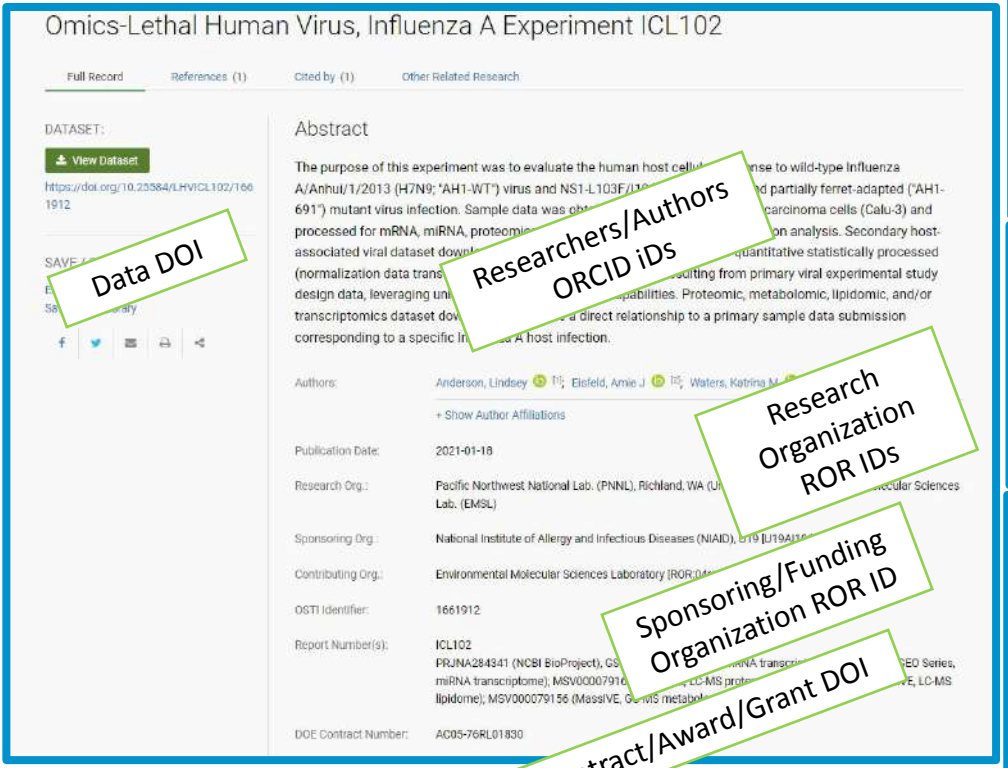


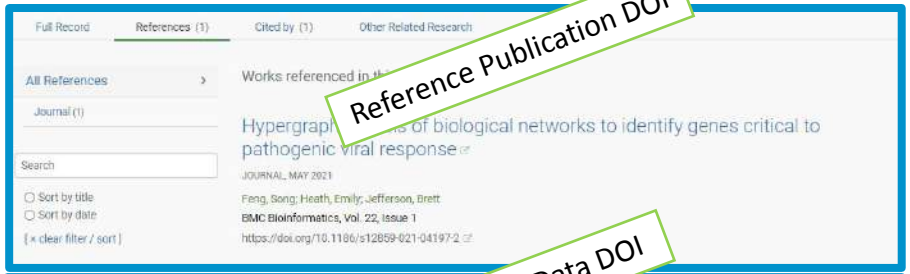
Using PIDs for Reporting and Easing Burden

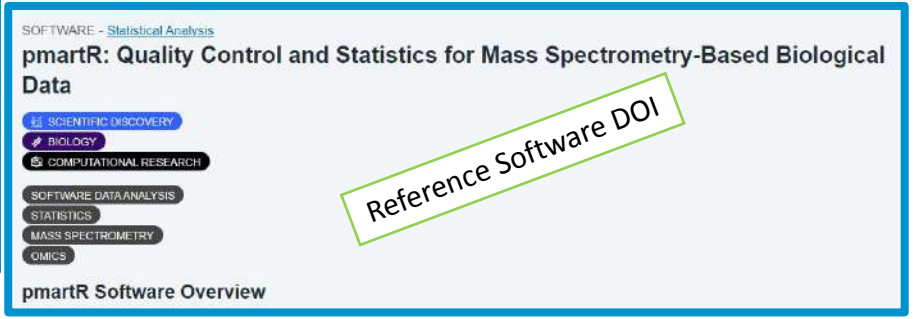


Using PIDs to Broaden Discovery and Make Connections

Data Record







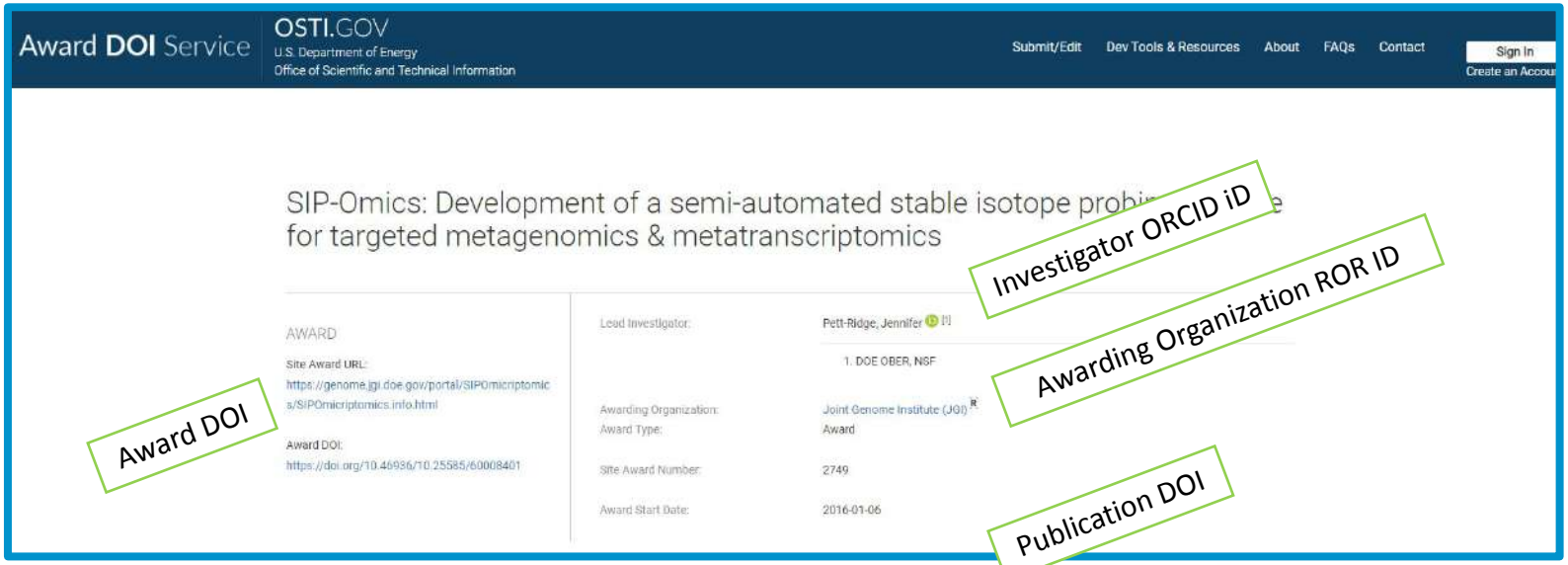
https://www.osti.gov/biblio/1661912

https://data.pnnl.gov/group/nodes/software/33341

Using PIDs to Broaden Discovery and Make Connections

Award Record

https://doi.org/10.46936/10.25585/60008401



Research | Open Access | Published: 25 November 2022

HT-SIP: a semi-automated stable isotope probing pipeline identifies cross-kingdom interactions in the hyphosphere of arbuscular mycorrhizal fungi

Erin E. Nuccio, Steven J. Blazewicz, Marissa Lafler, Ashley N. Campbell, Anne Kakouridis, Jeffrey A. Kimbrel, Jessica Wollard, Dariia Vyshenska, Robert Riley, Andy Tomatsu, Rachel Hestrin, Rex R. Malmstrom, Mary Firestone & Jennifer Pett-Ridge

Microbiome 10, Article number: 199 (2022) | Cite this article
3152 Accesses | 1 Citations | 105 Altmetric | Metrics

https://doi.org/10.1186/s40168-022-01391-z

Acknowledgements

We thank Steve Kubala for assistance programming the robotic methods, Craig See for assistance with manual refractometry, G. Mike Allen for SIP technical assistance, Edith Lai for laboratory assistance, and the JGI IMG and metagenomics teams for assistance with data processing (Neha Varghese, Alicia Clum, Marcel Huntemann, Tatiparthi Reddy, Supratim Mukherjee). Work at Lawrence Livermore National Laboratory was conducted under the auspices of the U.S. DOE under Contract DE-AC52-07NA27344. The work conducted by the U.S. Department of Energy Joint Genome Institute (https://ror.org/04xm1d337), a DOE Office of Science User Facility, is supported by the Office of Science of the U.S. Department of Energy operated under Contract No. DE-AC02-05CH11231.

Funding

Development of the HT-SIP pipeline was sponsored by the Joint Genome Institute through an Emerging Technologies Opportunities Program award (DOI: 10.46936/10.25585/60008401) to JP, SB, EN, and AC. Experimental validation of the LLNL HT-SIP pipeline was supported by the U.S. Department of Energy Office of Science, Office of Biological and Environmental Research (BER) Genomic Science Program (GSP) "Microbes Persist" Scientific Focus Area award SWC1632 to JP. Metagenomics sequencing and hyphosphere-SIP analysis was supported by DOE BER Early Career award SCW1711 to EN. The $^{13}CO_2$ plant-AMF experiment was supported by DOE BER GSP awards DE-SC0016247 and DE-SC0020163.

Using PIDs to Understand Impact

Impact of Persistent Identifiers

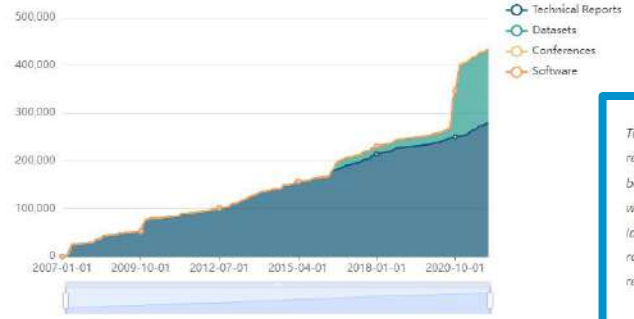
The persistent identification of digital entities (e.g., research outputs, people, funders, awards, etc.) can increase discoverability of research, alleviating data validation issues, and reducing researcher burden.

By increasing discoverability of research-related objects, user communities can track their research over time and develop programmatic methods for finding, reproducing, and reusing research. PIDs are an essential component to developing mechanisms for human-machine interoperability, which helps promote improved citation and reference tracking.

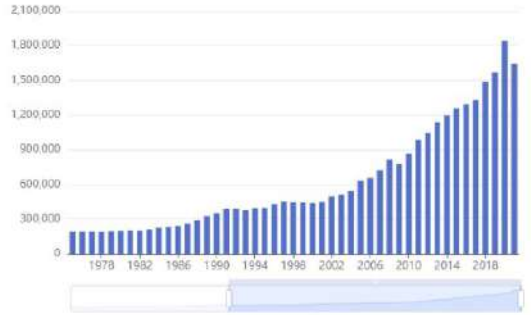
PIDs are not just for journal articles and datasets. DOE OSTI collects DOIs for many different research product types (e.g. conference papers, conference proceedings, journal articles, etc.). And OSTI's DOI Services provide DOI assignment and registration for technical reports, conference posters and presentations, data, and software.

Since 2007, more than 400k DOIs have been registered by OSTI on behalf of the DOE community for texts, data, and software. More than 1.6M of the records in OSTI.GOV can be referenced with a DOI.

Total DOI Registration by Type



Citations of OSTI Records in Scientific / Scholarly Publications



Citations by Field (All Years)

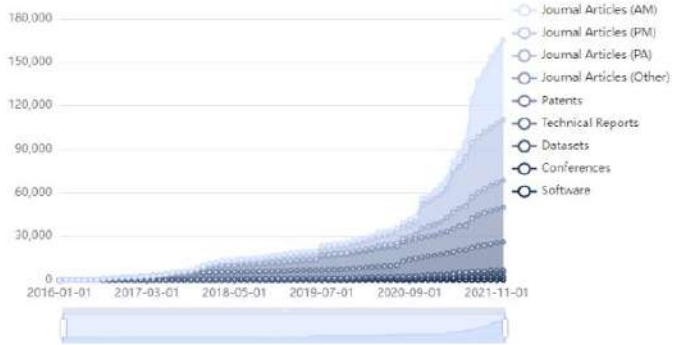
30,805,905 citations

Interact with the bar chart by hovering on or clicking on a year. To see the total number of citations for a given year, hover over the year. Clicking on a specific year will refresh the tree map of citations by field, showing the top seven (7) fields by citation volume for that year.

Interact with the tree map by hovering over a topic to see the number of citations by field; clicking on a field will drill into subfields, hovering over a subfield will display the

To date, more than 260k records in OSTI.GOV have been submitted or curated with related identifiers that identify specific types of relationships with other research products.

R&D Results with Related Identifiers by Type



https://www.osti.gov/pids/using-pids/impact

Thank you!

Intermission

10 mins

Next up: Technical Discussion

Crossref

Open infrastructure and identifiers to support policy

@CrossrefOrg

Agenda

- About us
- How open infrastructure supports federal policies
- Retrieving metadata from open APIs
- Summary

Our mission

Crossref makes research outputs easy to find, cite, link, assess, and reuse.

We’re a not-for-profit membership organization that exists to make scholarly communications better.

About Crossref

- A small team of 45, with staff based in Europe, the US, Indonesia, Nigeria and Kenya
- 17,000+ member and affiliated organisations across 146 countries
- Not just a DOI registration agency - we offer a wide range of services to ensure that scholarly research metadata is registered, linked and distributed
- We provide metadata and services to make research outputs easy to find, cite, link, assess and reuse
- We have a metadata store of >142 million scholarly content items
- **We preserve the metadata we receive and make it available via our open APIs and Search with ~600 million queries each month**

Universities, research institutes and publishers are our largest group of members

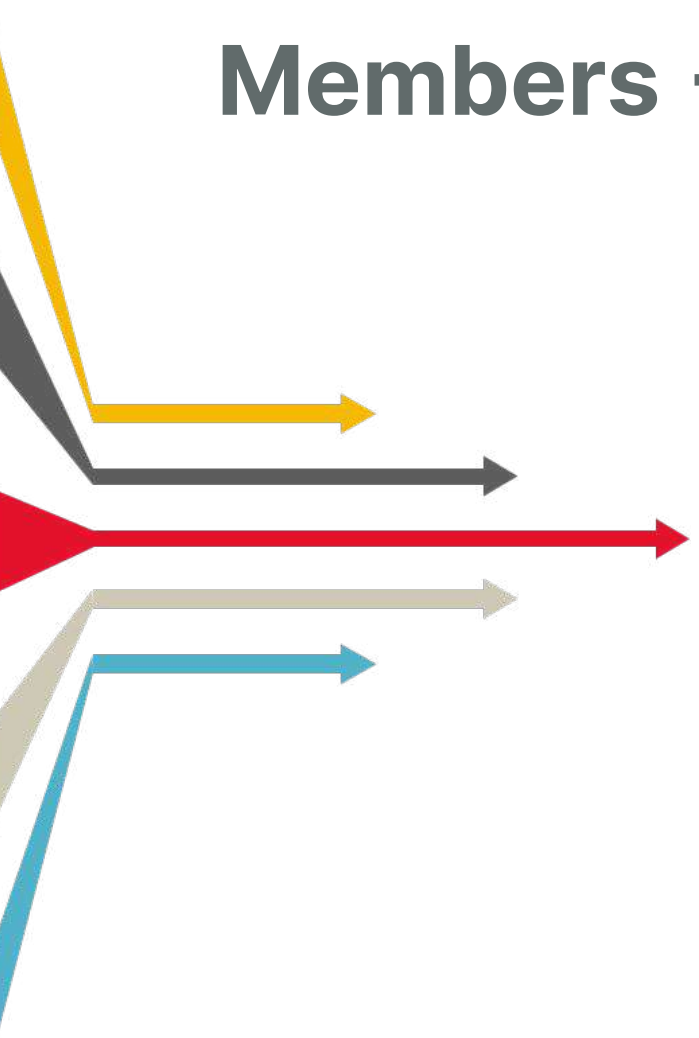
Funders can join and register grants

Everyone benefits from quality metadata and good quality research

- Archives & repositories
- Research councils
- Data centres
- Professional networks
- Patent offices
- Indexing services
- Publishing vendors

- Peer review systems
- Reference manager systems
- Lab & diagnostics suppliers
- Info management systems
- Educational tools
- Literature discovery services
- Registration Agencies

Members → Crossref



Basic metadata: titles; author names; ISSNs/ISBNs, abstracts, references

Funding information: Funder identifiers, award numbers

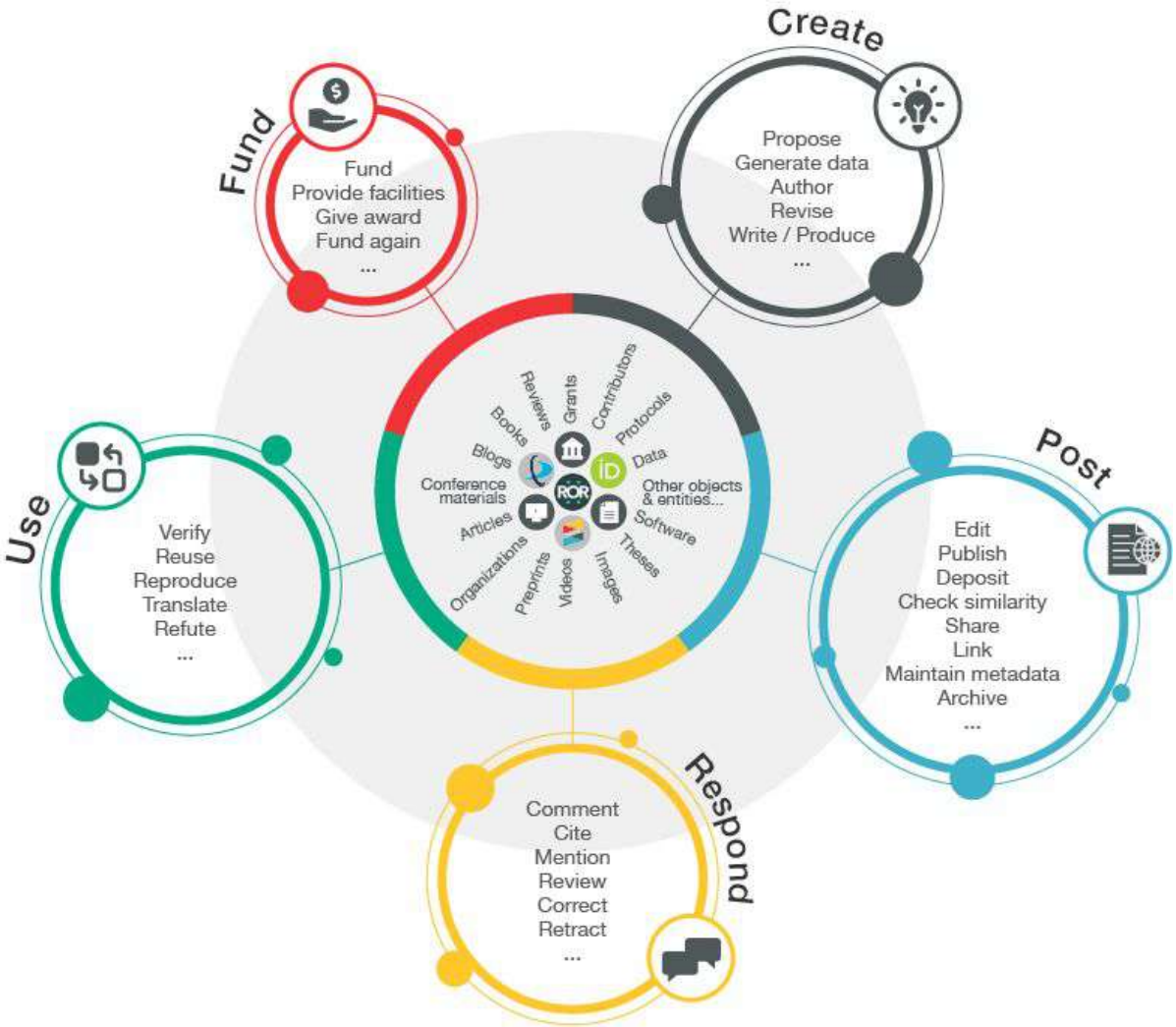
License information: License URLs

Full-text URLs: e.g. for text-mining and Similarity Check

Crossmark: updates, retractions, corrections ORCID iDs

Recently: Peer Review reports, relations, links to related data, Grant identifiers, ROR identifiers

Research Nexus vision



POSI and why it matters to us and our community

Principles of Open Scholarly Infrastructure

A set of concrete commitments that an organization can make to build trust about its accountability, funding, and protection of community interests

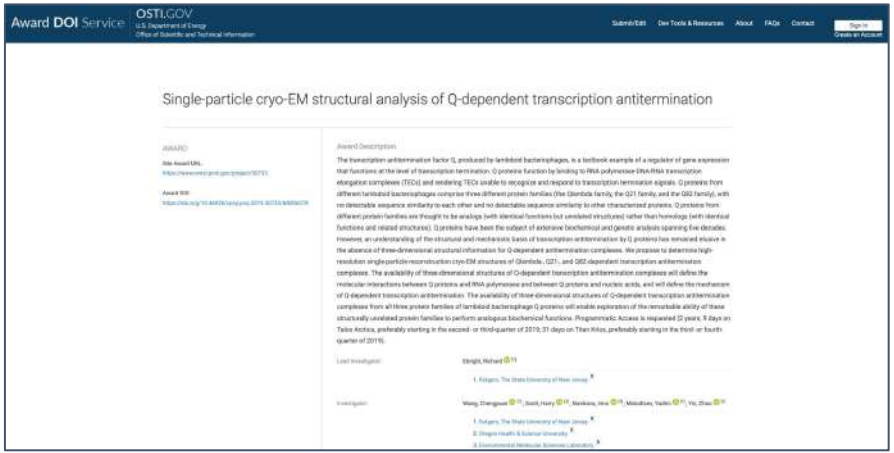
Open infrastructure already exists to support funder goals; it just needs more adoption

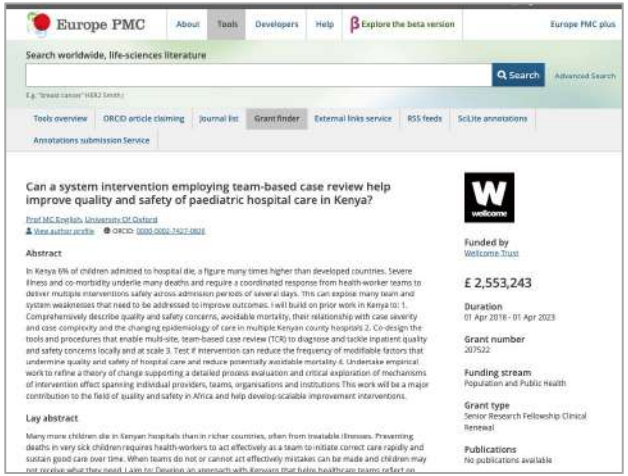
Ensuring free, immediate, and equitable access to metadata that captures the scholarly record is an essential part of meeting the aims of the memo but also supporting Open Science globally.

Open infrastructure already exists, but it’s unevenly implemented

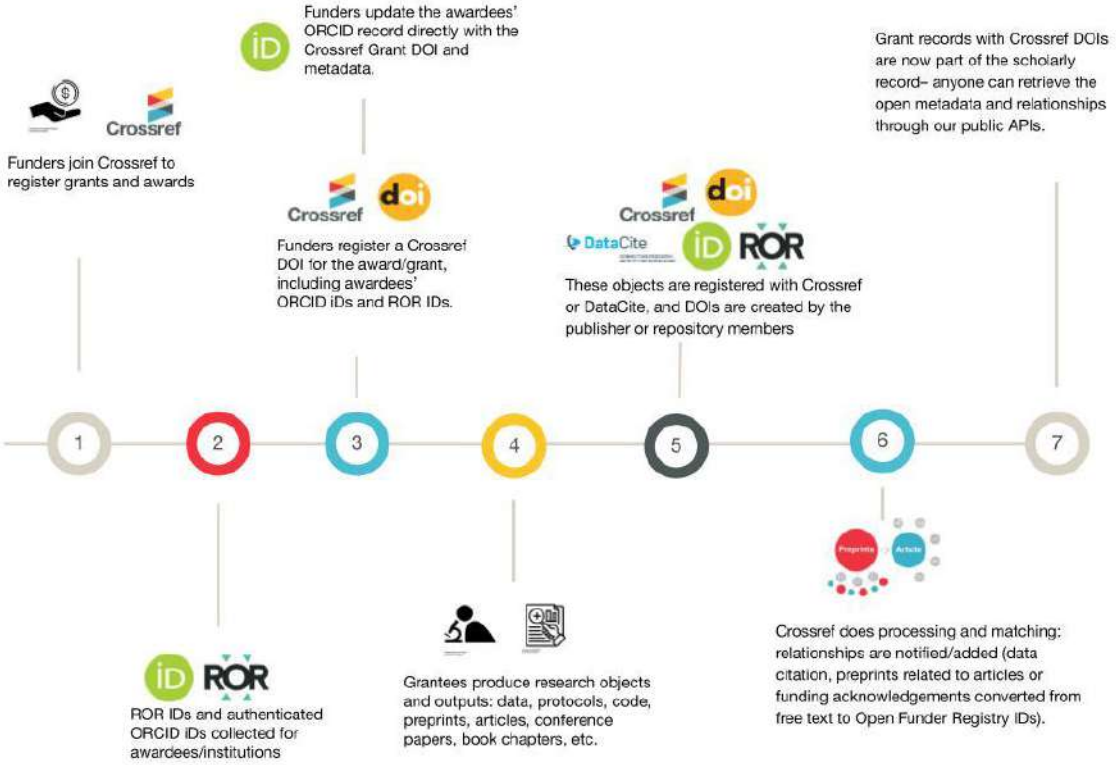
Some US federal agencies registering grant DOIs

Increased collaboration and effort are key to making this all work





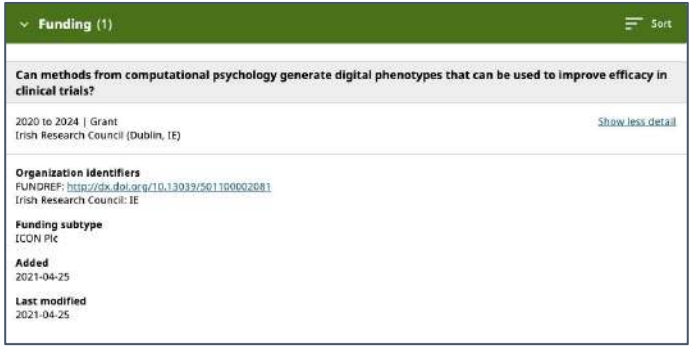
How do funders + publishers work w/this infrastructure

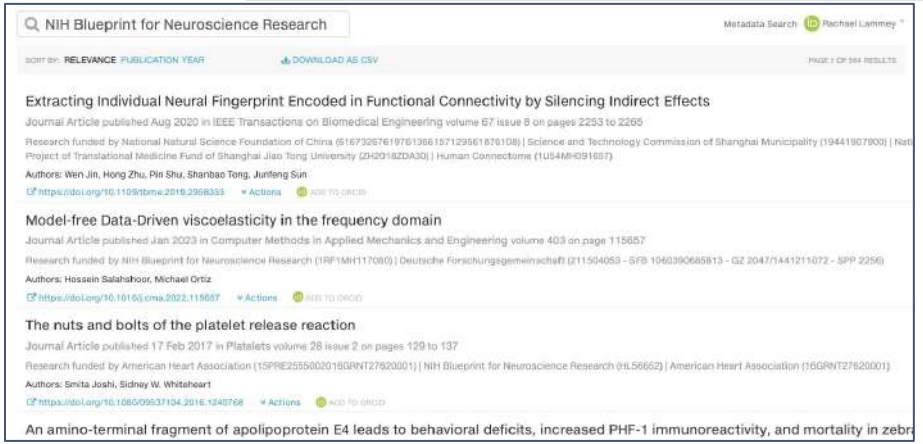


icons:
funding by Aneeque Ahmed from Noun Project
Microscope by Luis Prado from Noun Project
scrutinizing data by WiStudio from Noun Project

Using the metadata from Crossref/DataCite/ORCID/ROR

- Funding agencies can monitor compliance with their policies
- Publishers can identify the funder and meet their requirements
- Funding agencies can assess and report on the reach and return of their funding programs
- The provenance and integrity of the scholarly record is preserved and discoverable, benefitting all stakeholders.





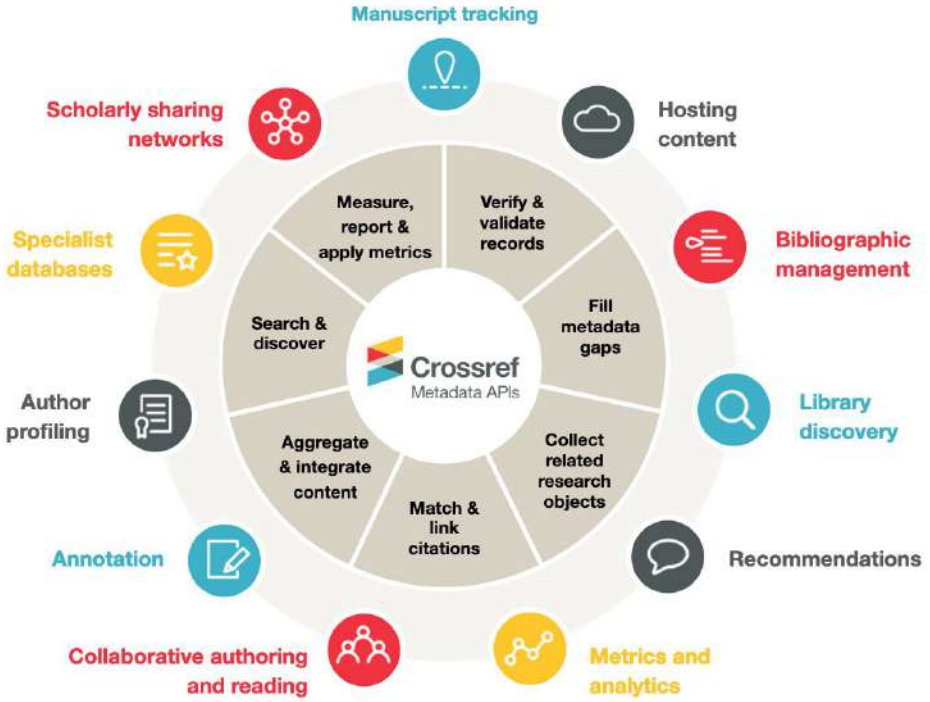
Using the metadata from Crossref

Interfaces for people

- https://search.crossref.org/

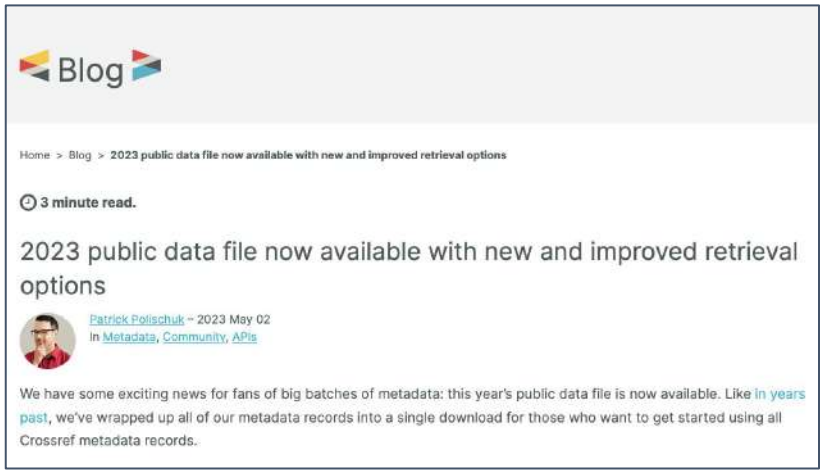
APIs for machines

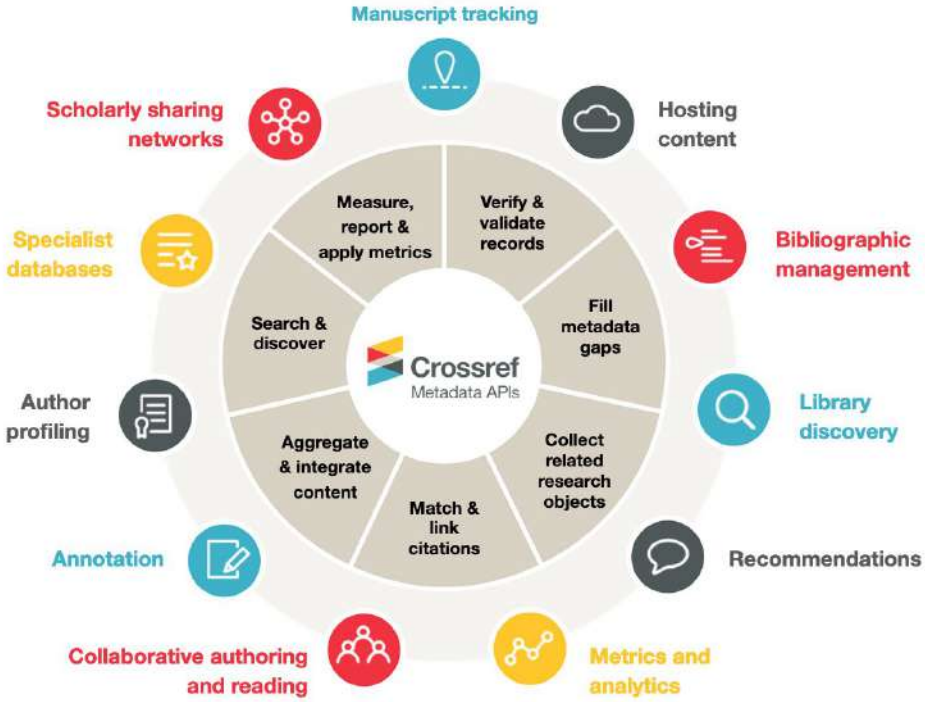
- REST API https://api.crossref.org
- XML API
- OpenURL



Crossref REST API and data file

- https://api.crossref.org
- Public, open, free!
- Public (anonymous), Polite (self-identification), Plus (paid) options





https://crossref.org/blog/2023-public-data-file-now-available-with-new-and-improved-retrieval-options/

In Summary

- Metadata and services make research outputs easy to find, cite, link, assess, and reuse.
- Crossref DOIs are citation identifiers: grants, preprints, articles, chapters, proceedings, standards, reports, protocols, dissertations, reviews, comments.
- Open data and APIs to retrieve metadata from >145 million records.
- “We envision a rich and reusable open network of relationships connecting research organizations, people, things, and actions; a scholarly record that the global community can build on forever, for the benefit of society.”

In Summary

- Open infrastructure to support funder goals already exists, it just needs more adoption
- Collaboration is key to making this work
- Open APIs and Open Metadata are foundational to making more connections between research objects

Thank-you

Email sbowman@crossref.org/ rlammey@crossref.org

Crossref

@CrossrefOrg

Introduction to ORCID: PIDs & US Gov't Policies Workshop

ACM/IEEE Joint Conference on Digital Libraries

Santa Fe, New Mexico

26 June 2023

Brian Minihan, ORCID Engagement

https://orcid.org/0000-0001-8412-717X

Technical Discussion

- ORCID: the organization that supports Persistent Identifiers for people
- The ORCID Record, the ORCID Registry of researchers
- Only ORCID record holders, and explicitly trusted individuals and organizations can add, edit or delete information. period.
- Technical walkthrough of the Member API
- Ways in which technical aspects relate to policies

ORCID provides three main services

1. The ORCID iD: a unique, persistent identifier free of charge to researchers

2. An ORCID record/profile connected to the ORCID iD, that can include employment, education, funding, peer review, research output and other metadata

3. A set of Application Programming Interfaces (APIs), as well as the services and support of communities of practice that enable interoperability between an ORCID record and member organizations

ORCID is a non-profit organization

- ORCID is a 501 c 3 non-profit registered in the United States
- It has a governance structure, with an elected Board
- an associated metadata schema that was developed by CASRAI
- ORCID works closely with other PID organizations (Datacite, Crossref, ROR)
- In 2022 ORCID, in agreement with initial lenders, started a global participation progam to extend membership growth beyond middle-high income countries, using ORCID's start-up loans from 2012

ORCID works best when used at pain points in the research cycle

a manuscript is submitted using an authenticated ORCID iD by the author.

publishers send manuscript metadata (including funding info) to Crossref

Crossref and Datacite create DOIs

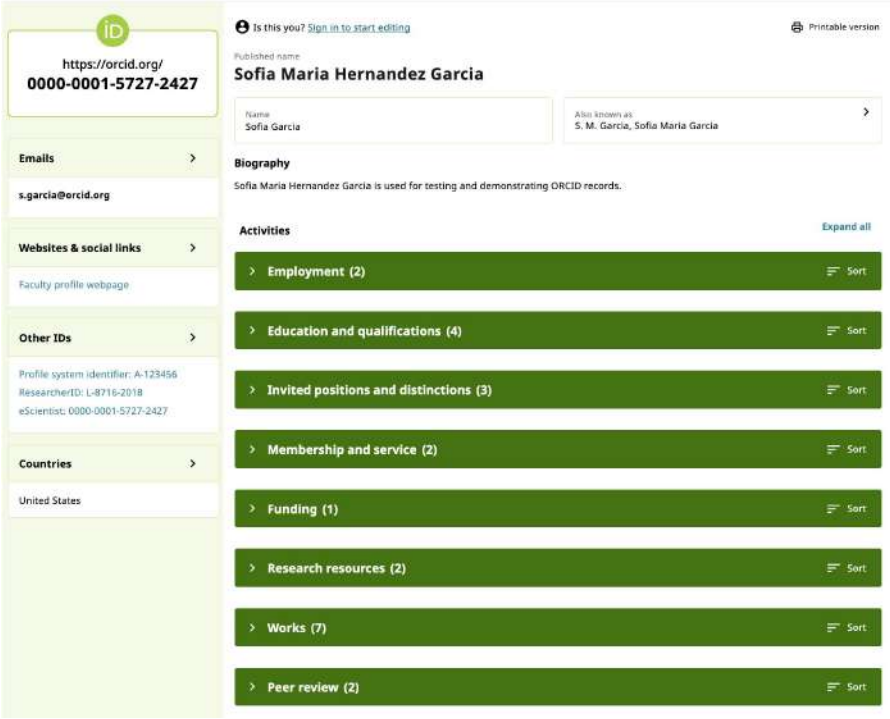
DOIs are added to ORCID records

Universities read author’s works data and add affiliations using RORs

Information on ORCID records

Researchers can add:

- Affiliations
- Professional activities
- Funding information
- Publications
- Other outputs
- Website URLs

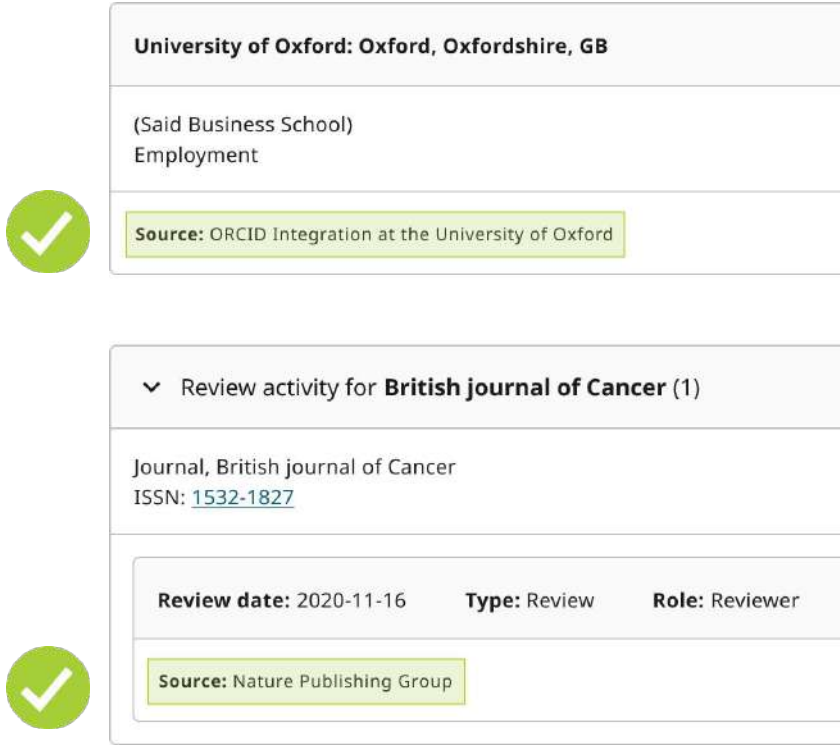


ORCID member organisations add validated information

When an ORCID member updates an ORCID record, the source of that update is captured for re-use:

- Research organisations add affiliations
- Publishers add outputs and reviews
- Funders add funding items

These provide **'trust markers'** that can be used to help in decision making.



The ORCID Member API

Oauth 2.0, RESTful

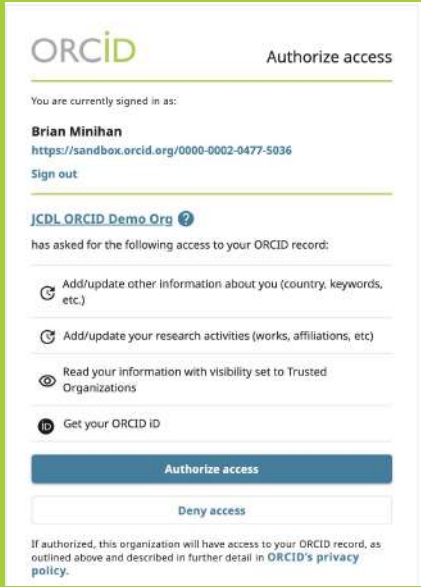
- all access to ORCID requires an access token
- and subsequently use that access token to obtain a token for API permissions
    - GET /read-limited
    - POST /activities/update
    - PUT /activities/update
- Using json or xml templates to add, update info in ORCID

3-legged OAuth authorization URL

https://sandbox.orcid.org/oauth/authorize?client_id=APP-674MCQQR985VZZQ2&response_type=code&scope=/read-limited%20/activities/update%20/person/update&redirect_uri=https://developers.google.com/oauthplayground

- host → https://sandbox.orcid.org/oauth/authorize = *endpoint*
- client_id → APP-674MCQQR985VZZQ2
- response_type → code
- scope → /read-limited & /activities/update & /person/update
- redirect_uri → https://developers.google.com/oauthplayground (the client application's landing page)

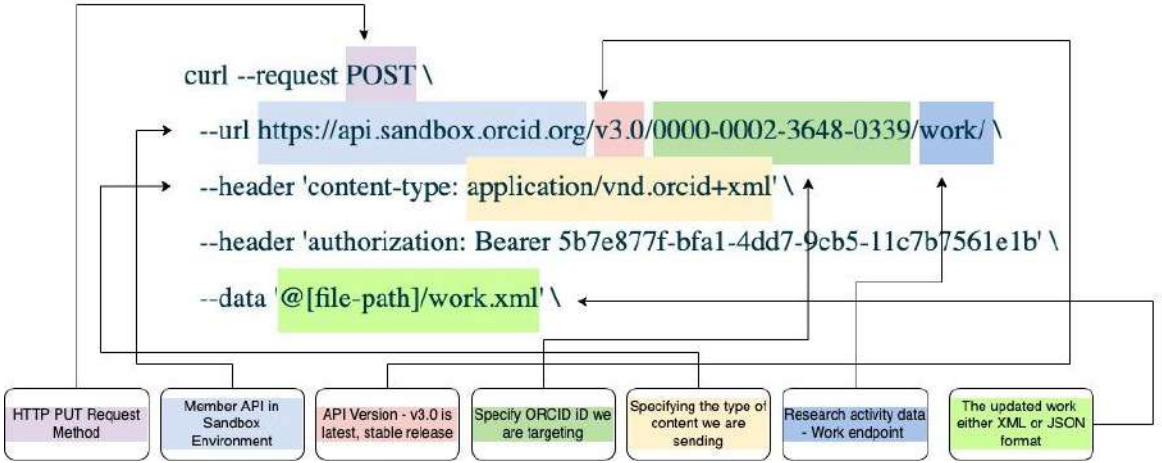
3-legged Oauth authorization URL produces this



POST: Adding items

Items (works, employment, funding, peer review etc) can be added to an ORCID record using the ORCID member API.

- First obtain permission from the researcher using OAuth and format the item metadata using the ORCID message schema.
- Make an API request using HTTP POST, specifying the relevant endpoint.
- The API will return a 201 message to indicate that the item posted correctly, along with the item's **put code**.



Posted content looks like this

University of California Davis: Davis, CA, US

2018-07-09 to present | ASSOCIATE DEAN (COLLEGE OF ENGINEERING)
Employment

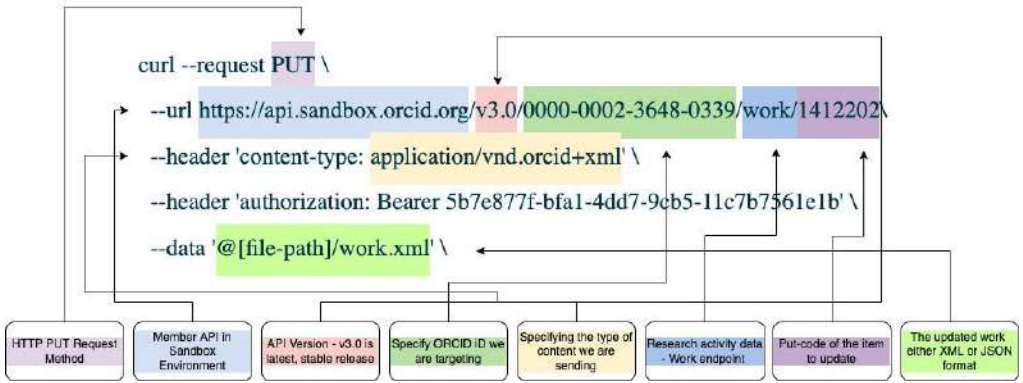
Show more detail

Source: University of California, Davis

PUT: updating items

ORCID members can update information they've previously added to an ORCID record. Only one item can be updated at a time, and it can only be updated using the client credentials that created it in the first place.

- Make sure you store the put code and access token when creating items.
- **Format the updated item in ORCID message schema** with the changed information and include the stored **put code**.
- The API will return a 200 OK message to indicate that the item updated correctly.



Use of identifiers (organizations) and PUT codes ensure that data added to ORCID is from a tracible source

```
<?xml version="1.0" encoding="UTF-8"?>
<funding:funding
    xmlns:common="http://www.orcid.org/ns/common" xmlns:funding="http://www.orcid.org/ns/funding"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.orcid.org/ns/funding /funding-2.0.xsd ">
    <funding:type>grant</funding:type>
    <funding:organization-defined-type>Principal Investigator</funding:organization-defined-type>
    <funding:title>
        <common:title>Moe Szicslak Annual Grant of Isotopic Studies in Cartoons</common:title>
        <common:translated-title language-code="en">Translated title</common:translated-title>
    </funding:title>
    <funding:short-description>Building on Dept. Chair Homer Simpson's work in epistimology this will result in more papers raising Springfield State's
funding:short-description>
    <funding:amount currency-code="HKD">17000</funding:amount>
    <funding:url>https://alt-url.org</funding:url>
    <common:start-date>
        <common:year>1997</common:year>
        <common:month>02</common:month>
        <common:day>14</common:day>
    </common:start-date>
    <common:end-date>
        <common:year>2020</common:year>
        <common:month>02</common:month>
        <common:day>02</common:day>
    </common:end-date>
    <common:external-ids>
        <common:external-id>
            <common:external-id-type>grant_number</common:external-id-type>
            <common:external-id-value>1234</common:external-id-value>
            <common:external-id-url>http://tempuri.org/12345</common:external-id-url>
            <common:external-id-relationship>self</common:external-id-relationship>
        </common:external-id>
    </common:external-ids>
    <funding:organization>
        <common:name>Wellcome Trust</common:name>
        <common:address>
            <common:city>London</common:city>
            <common:country>GB</common:country>
        </common:address>
        <common:disambiguated-organization>
            <common:disambiguated-organization-identifier>http://dx.doi.org/10.13039/100004440</common:disambiguated-organization-identifier>
            <common:disambiguation-source>FUNDREF</common:disambiguation-source>
        </common:disambiguated-organization>
</funding:funding>
```

https://github.com/ORCID/orcid-model/tree/master/src/main/resources/record_3.0

National Strategies are asking for help in ensuring Compliance and Integrity

Traceability of sources of information: organizations, works, grants, supporting data

Balance between access and security, machines (API) and human researchers (permission)

And interoperability between systems

Is also how ORCID works to reduce administrative burden for individual researchers

b.minihan@orcid.org

Many thanks!

ROR and U.S. Federal Agency Policies

JCDL 2023 workshop

June 26, 2023

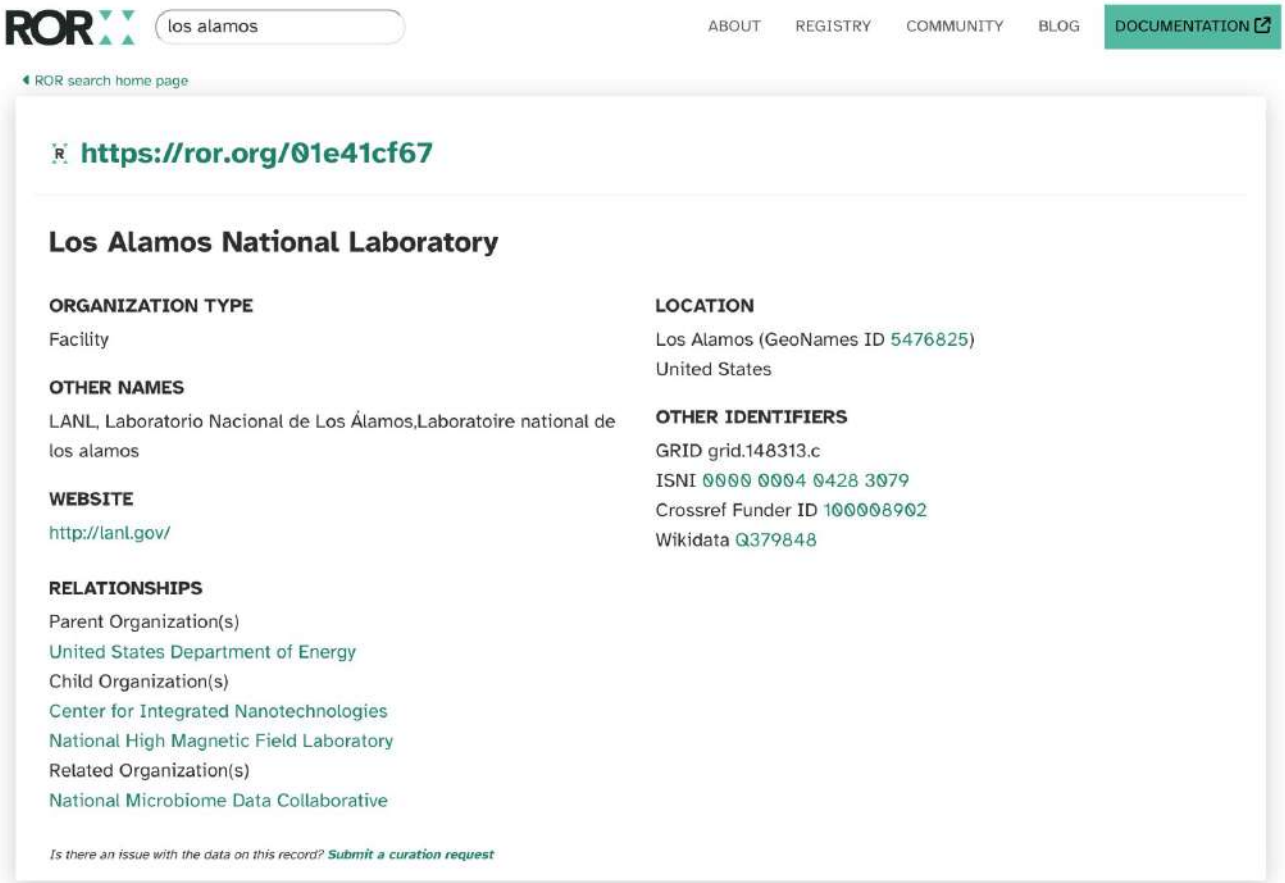
Dr. Amanda French

What is ROR?

What is ROR?

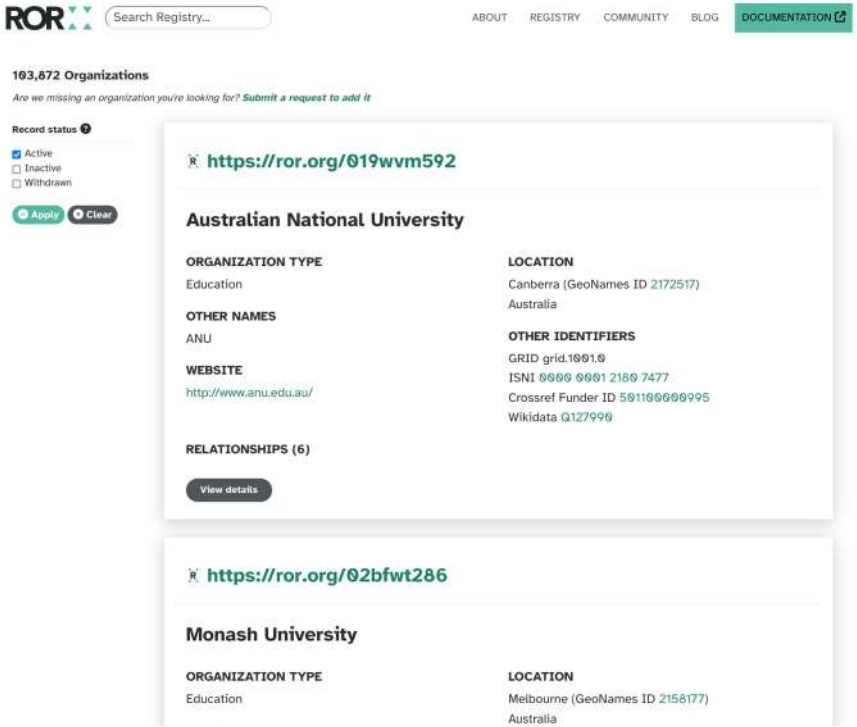
The Research Organization Registry (ROR) is a global, community-led registry of open persistent identifiers for research organizations.

(ROR is pronounced "roar" like a lion's roar. )



https://ror.org/01e41cf67 - ROR record for Los Alamos National Laboratory

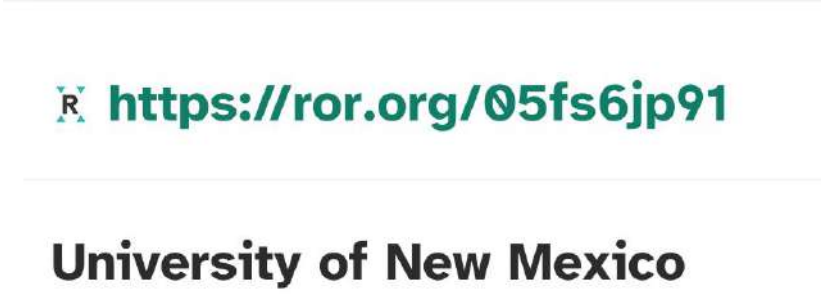
What is a "registry"?



ROR is a **registry**, meaning that it is fundamentally a list. There are currently over 100,000 research organizations listed in the registry.

https://ror.org/search

What is a "persistent identifier"?



ROR is not just a list of names, however: it is a list of alphanumeric **identifiers** that can help systems disambiguate research organizations. These identifiers will **persist** over time, unlike an ordinary URL, which may cease to resolve to a working web page.

ORCID for researchers

DOI for research outputs

ROR for research organizations

What does "open" mean?

CC0 1.0 Universal (CC0 1.0)
Public Domain Dedication

This is a human-readable summary of the Legal Code (read the full text). Disclaimer

No Copyright

The person who associated a work with this deed has **dedicated** the work to the public domain by waiving all of his or her rights to the work worldwide under copyright law, including all related and neighboring rights, to the extent allowed by law.

You can copy, modify, distribute and perform the work, even for commercial purposes, all without asking permission. See **Other Information** below.

Free Cultural APPROVED FOR Works

Every identifier in the ROR registry is part of an **open** record released into the public domain under a CC-0 Public Domain dedication. The ROR API and the ROR dataset of 100,000+ organizations with IDs and metadata are entirely free to use with no cost or restrictions.

What is a "research organization"?

- ROR defines “research organization” as any high-level organization that conducts, produces, manages, or touches research.

- ROR identifies organizations that have a formal relationship – an "affiliation" – with researchers, including but not limited to **employers, educators, funders, publishers,** and **scholarly societies**.

- ROR currently lists well over 100,000 research organizations from around the world.

Scope and criteria for inclusion in ROR: https://ror.org/registry/#scope-and-criteria-for-inclusion

What is a "research organization"?

Common organization types that are in scope for ROR

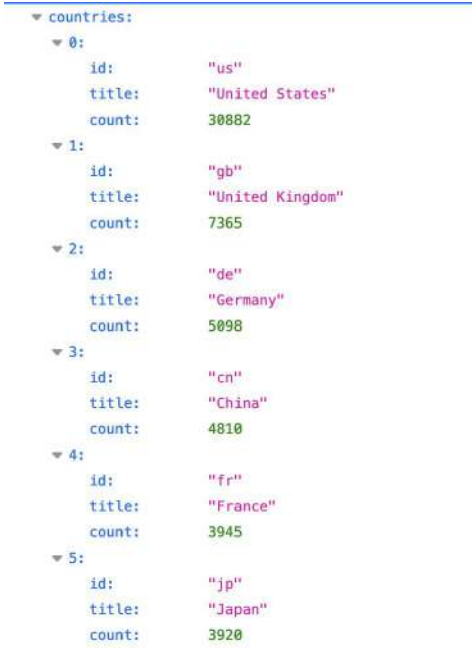
- Universities and colleges
- Companies that are involved in research
- Private foundations
- Government agencies
- Hospitals and healthcare centers
- Laboratories
- Nonprofits
- Research institutes and facilities
- Scholarly societies

Common research entities that are out of scope for ROR

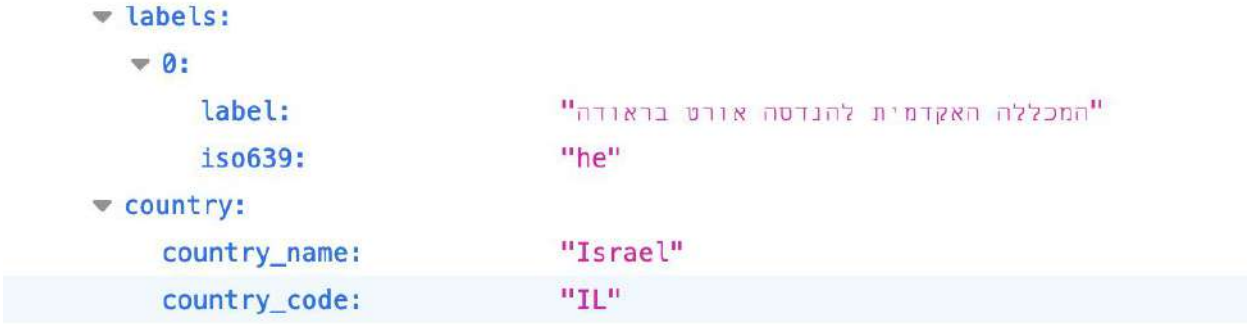
- Departments and wholly dependent subdivisions within organizations
- Companies that are not involved in research
- Single-person consultancies
- Pre-collegiate schools
- Journals
- Projects (see RAiD!)

Is my organization in scope for ROR? https://ror.org/about/faqs/#is-my-organization-in-scope-for-ror

What does "global" mean?



- ROR contains records for 229 countries
- All ROR records are multilingual and support non-Latin character sets



What does "community-led" mean?

- ROR was developed over three years of workshops from 2016-2019 and working groups in which 17 organizations outlined requirements for an open organization identifier.
- ROR is operated as a collaborative initiative by **California Digital Library, Crossref, and DataCite** as part of each organization's ongoing operational budget. **ROR does not depend on grants or on fees** for its sustainability, and it cannot be transferred to a commercial entity.
- All major changes to ROR's schema, technology, and governance are submitted for community comment and review.

See https://ror.org/about for more information.

What does "community-led" mean?

- ROR is a **curated** registry, meaning that anyone can request a change to a ROR record or the addition of a new ROR record and all such requests then go through a review process.
- ROR is not a membership organization and charges no fees, so it is not necessary to “join” ROR in order to add a record or request changes to a record.
- Simple change requests are approved or denied by the ROR Metadata Curation Lead. More difficult requests are sent to the international volunteer ROR Curation Advisory Board.

See https://ror.org/registry for more information.

What does "community-led" mean?

- ROR is a collaborative, open infrastructure initiative and service.
- ROR itself is not an independent organization or legal entity.
- ROR is committed to following the Principles of Open Scholarly Infrastructure (POSI).
- ROR cannot be governed by, purchased by, controlled by or sold to a commercial entity.
- The ROR governing organizations agree to not transfer control of any aspect of ROR or the ROR system to a commercial entity.

What tools does ROR offer?

- The ROR REST API - https://api.ror.org/organizations
- The ROR browser search interface - https://ror.org/search
- The ROR dataset - https://doi.org/10.5281/zenodo.6347574
- The ROR OpenRefine Reconciler - https://ror.readme.io/docs/openrefine-reconciler
- ROR scripts for searching and matching - https://github.com/ror-community/ror-utilities

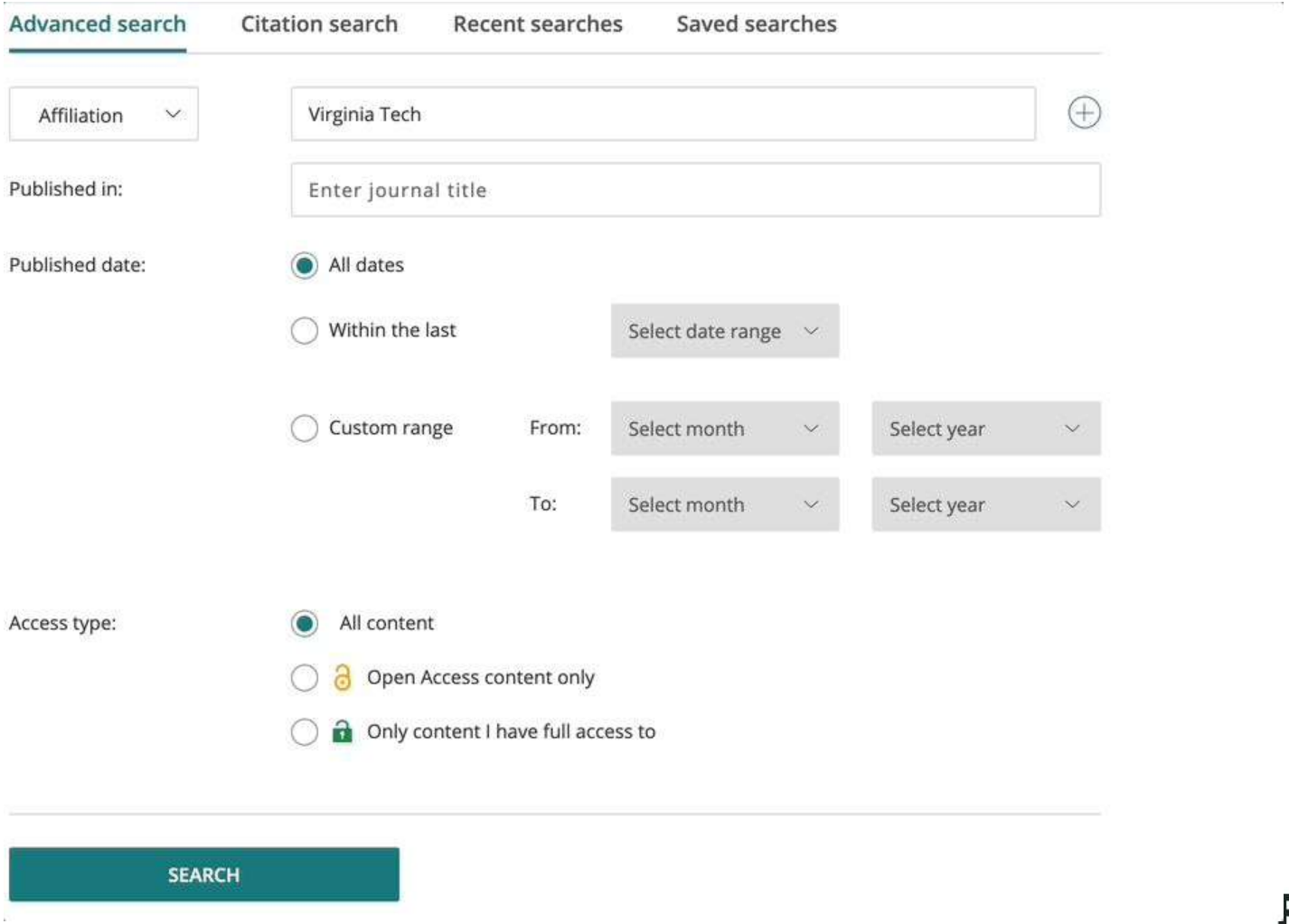
See all ROR technical documentation at https://ror.readme.io

Why ROR?

ROR makes information about research organizations cleaner and easier to exchange among information systems so that research outputs can be reliably associated with organizations.

What problems does ROR solve?

- Many different variants of organization names in user-entered, free text data make internal reporting difficult and produce inconsistent search results
- Research institutions have a hard time tracking the output of their researchers
- Funders have a hard time tracking research outputs they have funded


Advanced search
Citation search
Recent searches
Saved searches
Affiliation
Virginia Tech
Published in:
Enter journal title
Published date:
All dates
Within the last
Select date range
Custom range
From:
Select month
Select year
To:
Select month
Select year
Access type:
All content
Open Access content only
Only content I have full access to
SEARCH

ROR Typeahead Demos

This example queries the ROR API as the user types and generates suggestions based on the query results. The URL for this query is:

```
https://api.ror.org/organizations?query=
```

This is example uses Twitter typeahead.js and jQuery, however, it can be created using a variety of typeahead plugins, including those for specific JS frameworks.

Basic institution name typeahead

Institution name

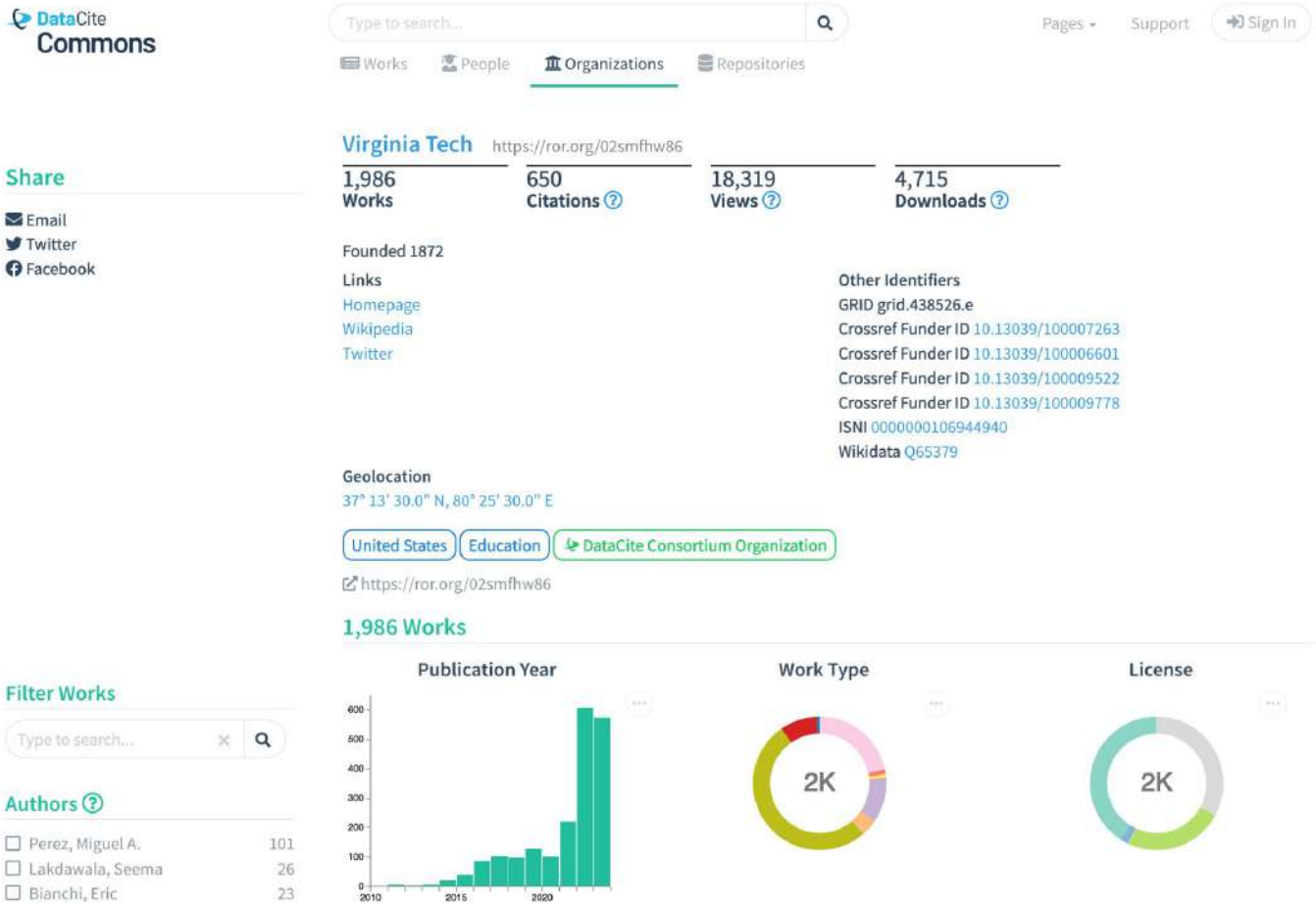
Begin typing to activate a suggestion list. Please choose an institution from the list, if available. If your institution is not listed, continue typing to enter its name manually.

Data returned from ROR API

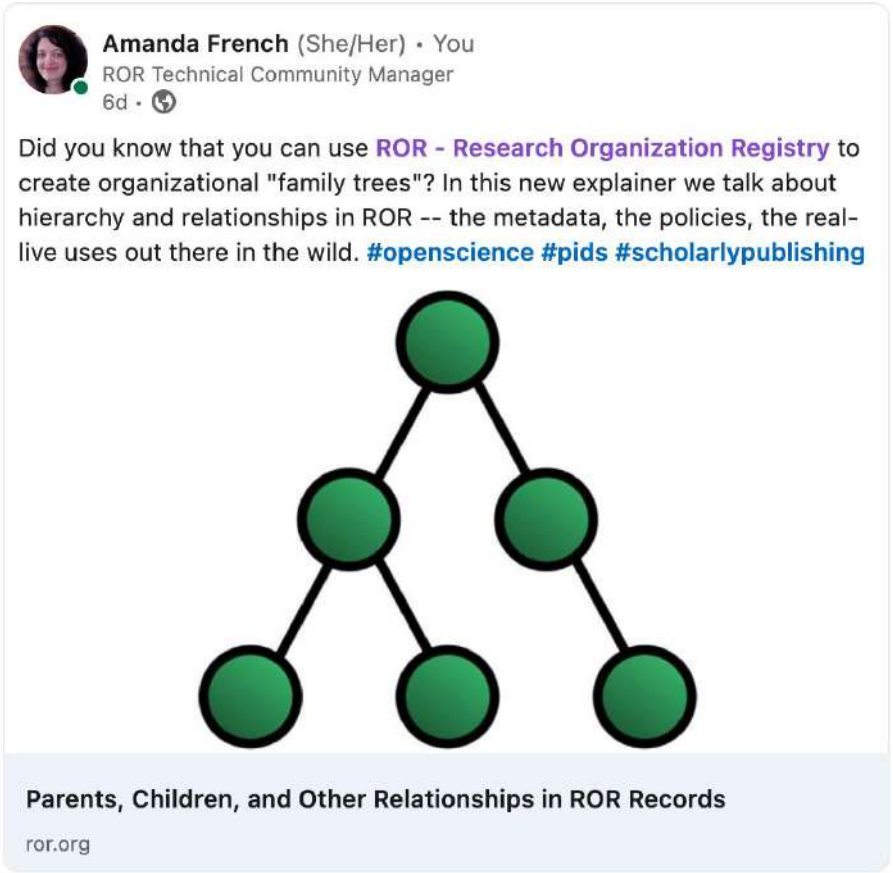
Including department-level information

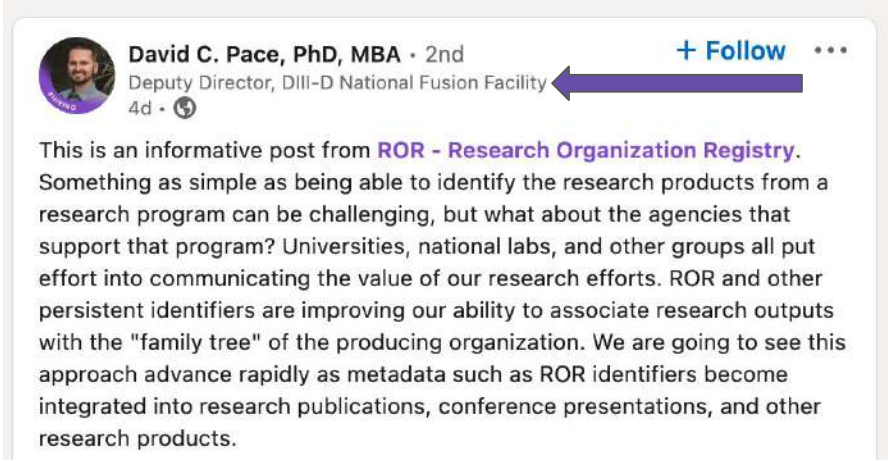
Use ROR to capture the the "top level" organization (ex: University of Wisconsin-Madison). If you also need to capture department,

Visit https://ror-community.github.io/ror-typeahead-demos to try this demo yourself



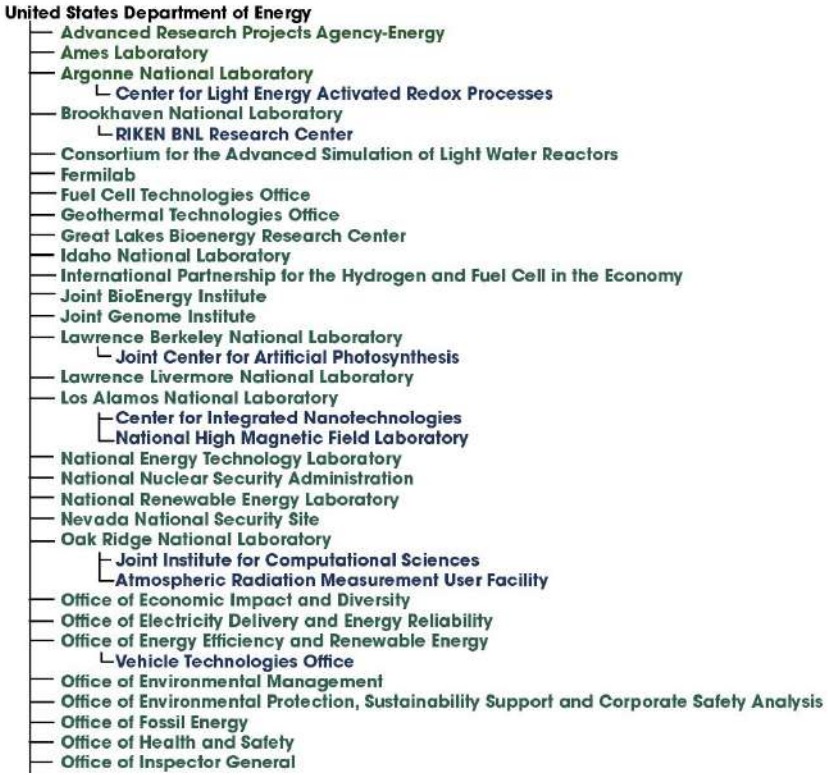
DataCite Commons at https://commons.datacite.org





ROR Core Team, "Parents, Children, and Other Relationships in ROR Records," ROR Blog, February 27, 2023: https://ror.org/blog/2023-02-27-parents-children-and-other-relationships-in-ror/

Amanda French LinkedIn post | David C. Pace LinkedIn post



Visual representation of ROR relationships for the US Department of Energy - https://ror.org/01bj3aw27

Amanda French

Were you the primary advocate of implementing ROR at your organization?

Tom Morrell

I would say yes, but we had lots of other librarians who were also very excited and interested in this. Because it's going to be helpful not only for discoverability by making our metadata better, but it'll also be really helpful for reporting. One of the types of reports that we have to do often is compliance reports for funders, and we track who's collaborating with who. At the moment those are challenging to put together, because you need to know everybody's affiliation, and trying to match up what a given affiliation is when you have random strings that are coming in from publications is really challenging. So we have librarians who are very excited about the possibility of actually having identifiers for these affiliations. That makes a lot of the reporting stuff a lot easier.

Amanda French, Case Study: ROR in Caltech Repositories, ROR blog, February 23, 2023

ROR and other organizational identifiers

ROR is different from other organizational identifiers such as **GRID**, **ISNI**, **Wikidata**, **Funder IDs**, and **Ringgold** in a few key ways:

- ROR is completely open (CC0 data, open API) and noncommercial
- ROR is focused on identifying scholarly affiliations
- ROR is designed to be supported in core scholarly infrastructure (e.g., Crossref, DataCite, ORCID)
- ROR is developed as a community initiative
- ROR has a transparent curation process
- ROR's modern REST API and JSON data makes it easy to implement

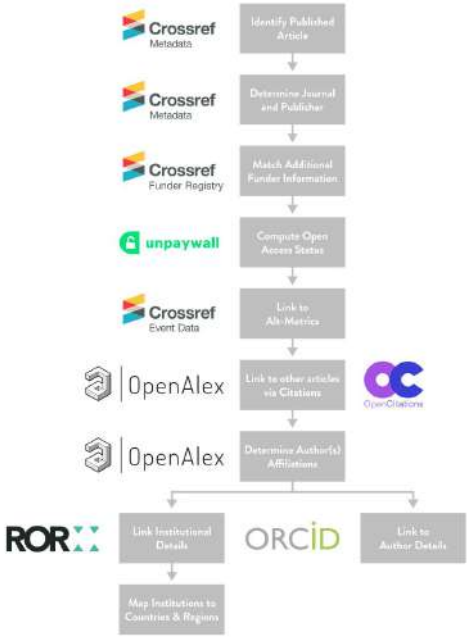
ROR and Public Access Monitoring

ROR

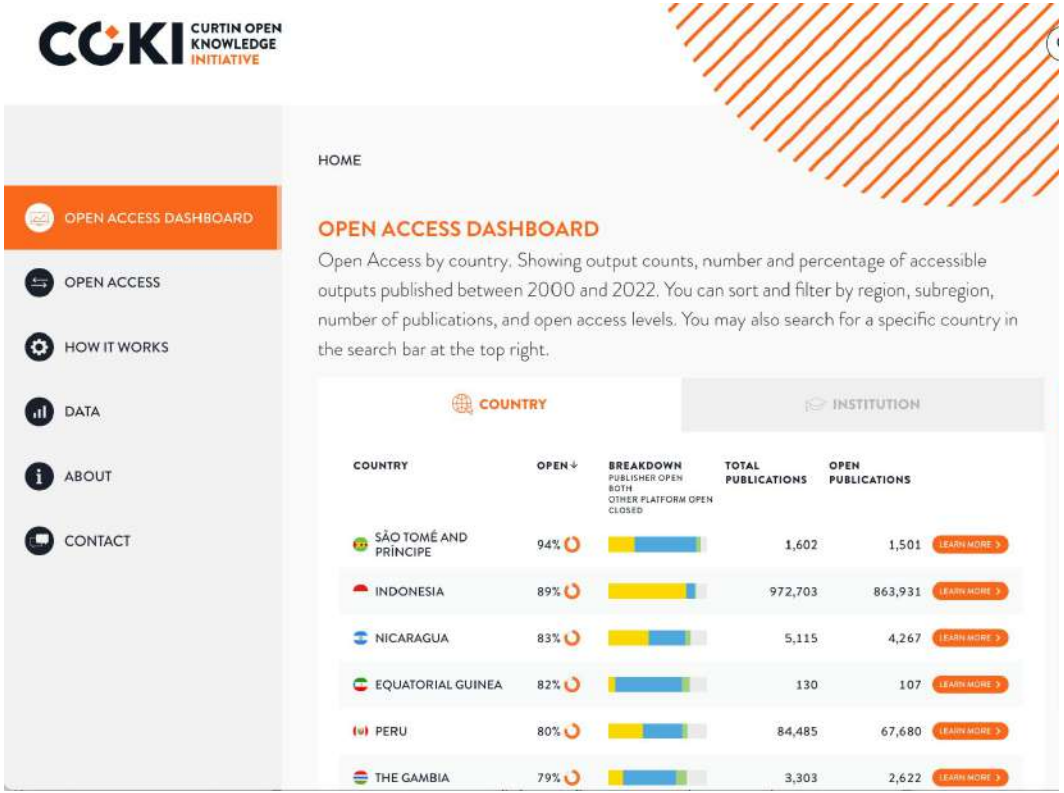
"Federal agencies should report to OSTP, when requested, on the status of their public access plans and policy implementation, including the number of all scholarly publications funded by the federal agencies and any other relevant statistics collected by the agency."

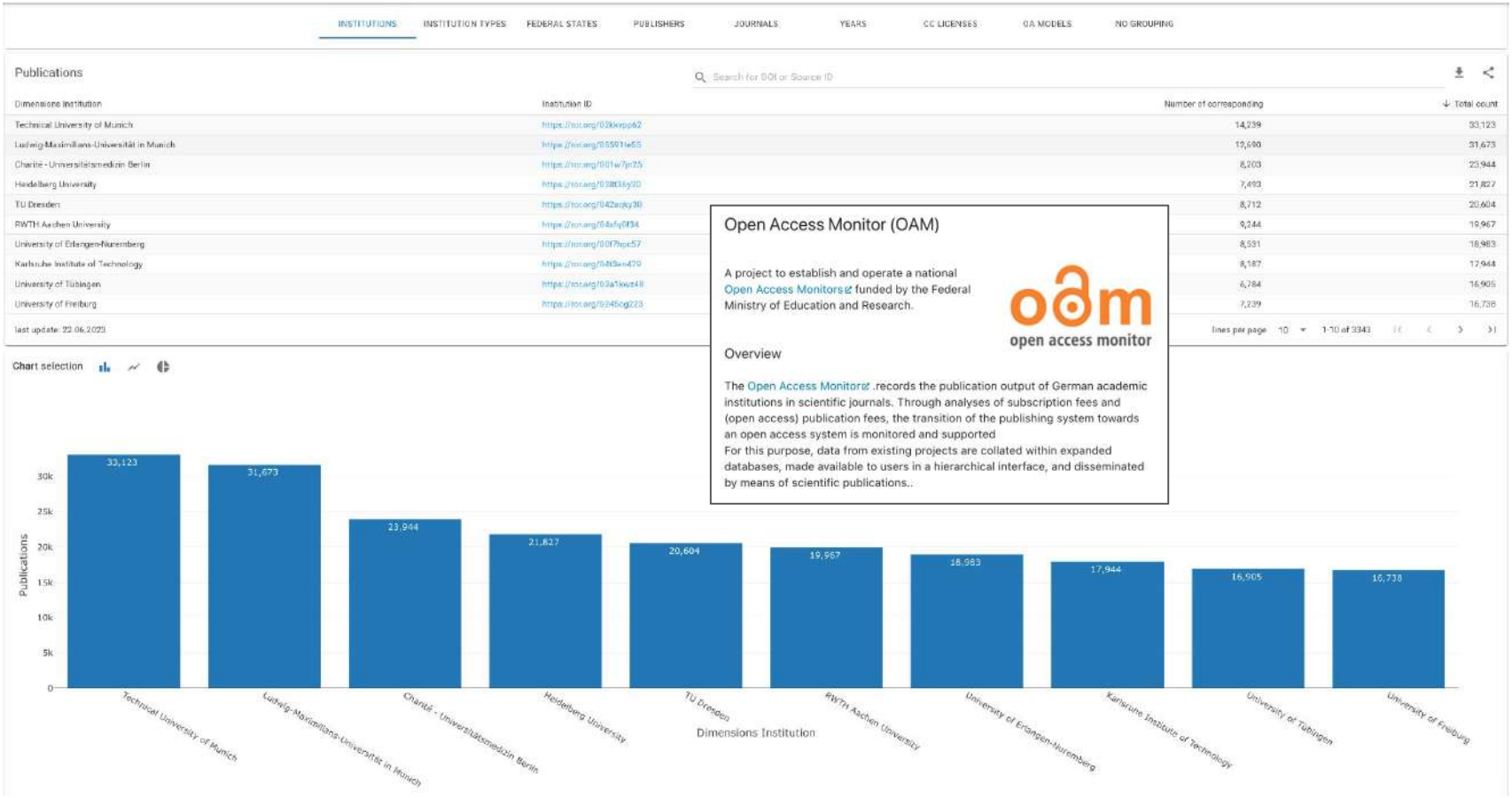
Figure 1. COKI dataset analysis pipeline.

The table of publications is created by joining records from the research publication datasets on Digital Object Identifiers (DOIs); unique digital identifiers given to the majority of publications. Figure 2 illustrates how each dataset contributes to the publications table during the joining process, using the example of a single publication. Unique publications are discovered with Crossref Metadata, from which the publication's DOI, Journal, Publisher, Funder identifiers and citation counts are derived. The publication's Open Access status is computed using Unpaywall. The authors of the paper and their institutional affiliations are derived from OpenAlex. ROR is used to enrich the institutional affiliation records with institution details and map institutions to countries and regions. The COKI Open Access Dataset uses the ROR assignment of country codes to institutions.



COKI Open Access Dashboard - https://open.coki.ac



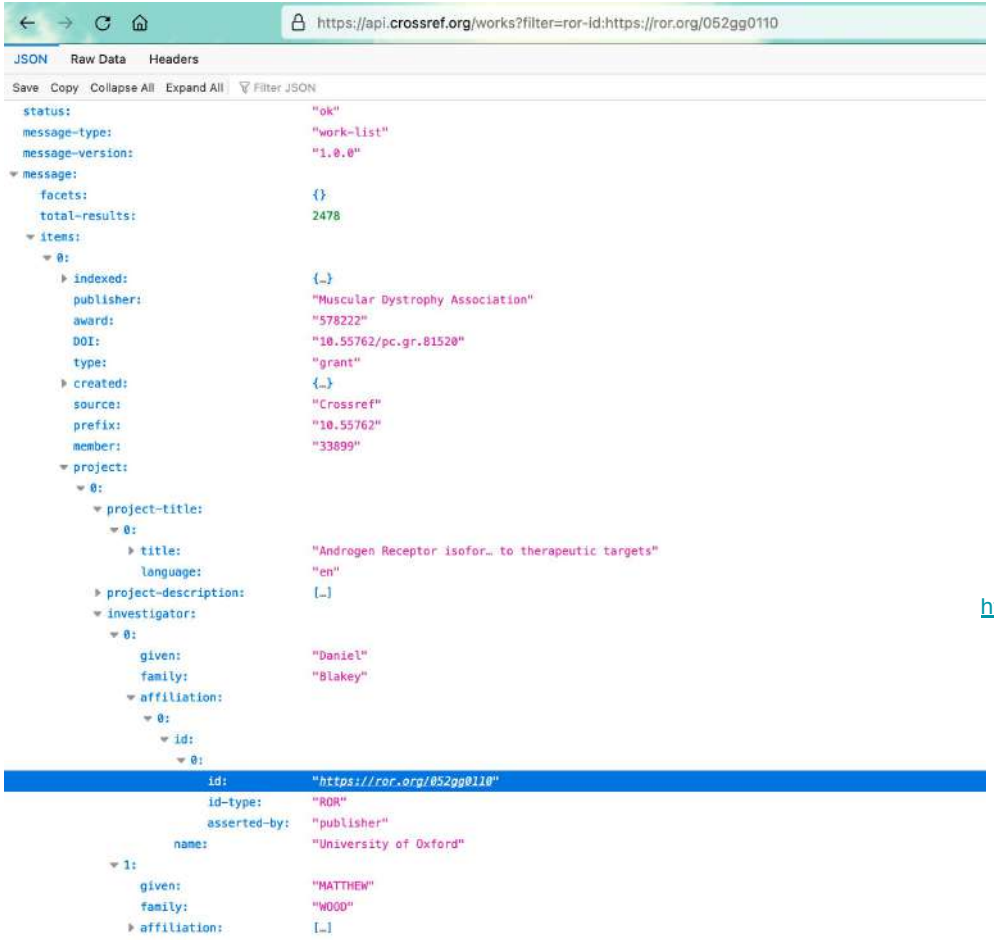


German Open Access Monitor - https://open-access-monitor.de/

ROR and Research Integrity

ROR

"Federal agencies should take steps to ensure that public access policies support scientific and research integrity by transparently communicating to the public critical information, including that which is related to the authorship, funding, ***affiliations***, and development status of federally funded research. The public should be able to identify which federal agencies support given investments in science, the scientists who conduct that research, and the extent to which peer-review was conducted."



Finding works whose authors are affiliated with the University or Oxford in the Crossref API

https://api.crossref.org/works?filter=ror-id:https://ror.org/052gg0110

ROR and International Collaboration

ROR

DRYAD

Explore data | Search

Who we are | What we do | Join us | Help | Login

Search...

Search

Start Over | Institution › North Carolina State University ✖ | Institution › Chinese Academy of Sciences ✖

Limit your search

‹ Previous | 1 - 10 of 12 | Next ›

- Subject keyword ›
- Geographical Location ›
- Journal ›
- Institution ⌄

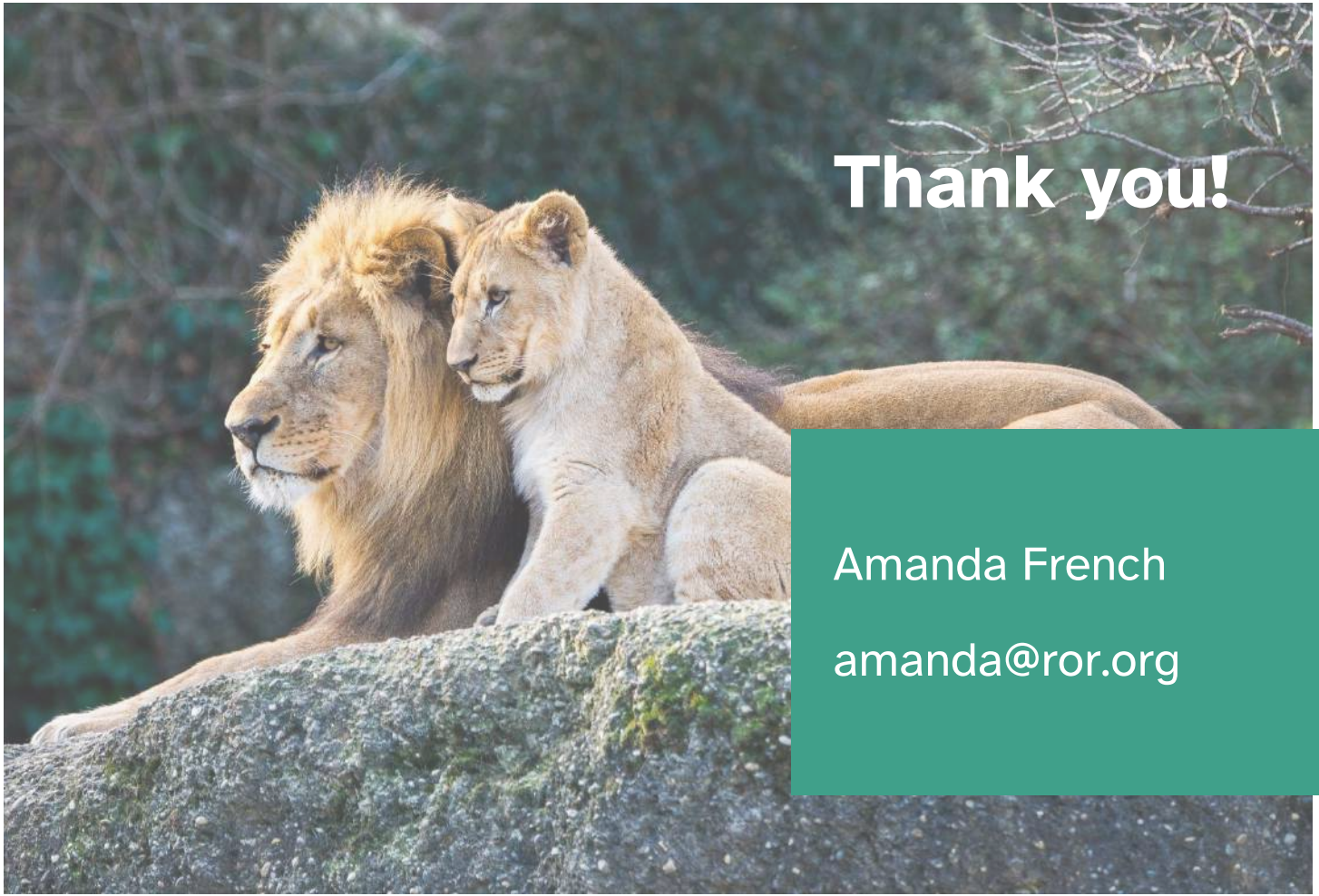
Chinese Academy of Sciences ✖	12
North Carolina State University ✖	12
China Three Gorges University	2
Nanjing Agricultural University	2
Zhejiang University	2
Alabama State University	1
Arizona State University	1
Beijing Forestry University	1

more »

1. Data for: Predation risk and the evolution of a vertebrate stress response: parallel evolution of stress reactivity and sexual dimorphism
2. Data from: Effects of plant functional group loss on soil biota and net ecosystem exchange: a plant removal experiment in the Mongolian grassland
3. Data from: Genetic structure and post-glacial expansion of Cornus florida L. (Cornaceae): integrative evidence from phylogeography, population demographic history, and species distribution modeling
4. Data from: Livestock grazing regulates ecosystem multifunctionality in semi-arid grassland
5. Data from: Natural selection and repeated patterns of molecular evolution following allopatric divergence
6. Data from: Reconciling multiple impacts of nitrogen enrichment on soil carbon: plant, microbial, and geochemical controls
7. Data from: Soil acidification exerts a greater control on soil respiration than soil nitrogen availability in grasslands subjected to long-term nitrogen enrichment


```
"creator": [
  {
    "@type": "Person",
    "name": "Ashley Call",
    "givenName": "Ashley",
    "familyName": "Call",
    "affiliation": {
      "@type": "Organization",
      "sameAs": "https://ror.org/04tj63d06",
      "name": "North Carolina State University"
    }
  },
  {
    "@type": "Person",
    "name": "Yan - Xia Sun",
    "givenName": "Yan - Xia",
    "familyName": "Sun",
    "affiliation": {
      "@type": "Organization",
      "sameAs": "https://ror.org/04tj63d06",
      "name": "North Carolina State University"
    }
  },
  {
    "@type": "Person",
    "name": "Yan Yu",
    "givenName": "Yan",
    "familyName": "Yu",
    "affiliation": {
      "@type": "Organization",
      "sameAs": "https://ror.org/04tj63d06",
      "name": "North Carolina State University"
    }
  },
  {
    "@type": "Person",
    "name": "Peter B. Pearman",
    "givenName": "Peter B.",
    "familyName": "Pearman",
    "affiliation": {
      "@type": "Organization",
      "sameAs": "https://ror.org/000xsnr85",
      "name": "University of the Basque Country"
    }
  },
  {
    "@type": "Person",
    "name": "David T. Thomas",
    "givenName": "David T.",
    "familyName": "Thomas",
    "affiliation": {
      "@type": "Organization",
      "sameAs": "https://ror.org/00h8xmr33",
      "name": "Science Learning Resources (United States)"
    }
  },
```


ROR



Amanda French

amanda@ror.org

Intermission

15 mins

Next up: Q&A Discussion