



Persistent identifiers in research infrastructure policy

The need for a holistic approach

A Crossref Position Paper | July 2026

Estimated reading time: 16 minutes



Executive summary

Persistent identifiers (PIDs) have become central to national and international open research strategies, but identifiers alone—however well-designed—cannot deliver the connected, open record that researchers, institutions, funders, publishers, and policymakers depend on. Effective research infrastructure rests on three interdependent elements: open, persistent identifiers; rich, open, and linked metadata; and the sustainable governance and operation of the organisations involved. All three are needed when designing a successful PID strategy.

Crossref therefore urges policymakers and others who are developing and implementing national PID strategies and open science policies to evaluate infrastructure holistically, looking beyond identifiers to the metadata, services, interoperability, and long-term sustainability that provide the real-world value sought.



Who this paper is for

Policy strategists

Understand how infrastructure choices shape the long-term success of a research strategy.

The macro view: why identifiers, metadata, and governance need to be evaluated together.

Decision-makers

Know what to require before a decision is made.

Criteria for evaluating PID infrastructure as a whole, including interoperability, sustainability, and governance.

Practitioners

Learn what good implementation looks like before you commit.

Practical requirements for the metadata and services that make an identifier system useful in daily operation.

Cite as: Crossref (2026). Persistent identifiers in research infrastructure policy: the need for a holistic approach. Crossref Position Paper. <https://doi.org/10.13003/q4vu-l2mw>

Licensed under a Creative Commons Attribution 4.0 International License (CC BY 4.0): <https://creativecommons.org/licenses/by/4.0/>



Key positions

PIDs are a means to an end.

The value of an identifier system lies in the richness of its associated metadata, the scalability of the services it enables, and the needs it meets for the communities it serves.

PIDs can be complementary rather than competitive.

Research uses many identifier types; they coexist productively, each serving the community and use case for which they were designed.

Not all DOIs are equivalent.

Different DOI Registration Agencies offer fundamentally different services, metadata, and governance. Concrete requirements and expected outcomes for each entity being identified—not just identifier type—are therefore essential in any policy or implementation.

Interoperability is critical.

Implementing identifier systems without evaluating their interoperability undermines the goal of a connected research record. National strategies must ensure that proposed PID infrastructure connects to the broader global research ecosystem.

Sustainability and governance matter as much as technical standards.

It is important that community governance and demonstrated financial resilience are taken into account in any assessment of infrastructure organisations.

Open infrastructure—not PID adoption alone—is the foundation of a connected, open research record.

Strategies should measure success based on the openness, connectivity, and reach of the surrounding infrastructure and its services.



01

Introduction

The scholarly research community has invested significantly in persistent identifier (PID) initiatives—from international registries to national strategies and dedicated events such as PIDapalooza and PIDfest. These efforts have contributed to the development of essential infrastructure such as the [Research Organization Registry \(ROR\)](#) and the expansion of [ORCID](#) adoption, and they have stimulated important governance and adoption discussions.

As the global research community continues to build on this foundation, the open metadata, relationships, and services that identifiers enable are what make research information useful, discoverable, and trustworthy.

This paper sets out Crossref's position on the role of PIDs in research infrastructure (with a focus on digital object identifiers, or DOIs), explaining what genuine persistence requires, and offering practical recommendations and examples for policymakers working on national and international open research strategies.



02

What is a PID, and what isn't it?

A persistent identifier is a long-lasting reference to a digital or physical object. Identifiers serve as stable labels, but their value depends entirely on what surrounds them. So the critical question for any PID strategy is not “which identifiers will we use?” but “what problems are we solving, and is our proposed infrastructure—identifiers and their associated metadata, technology, governance, and services—fit for that purpose?”

Consider a familiar analogy: when you return from a supermarket, you don't announce, “I've brought home 12 barcodes.” A barcode is a transactional tool; what matters is the product itself and what you can do with it. A PID without any associated metadata, services, and governance is similarly limited: it tells you something exists, but not what it is, how it relates to other things, or whether it will remain findable in 10 years.

Research uses many identifier types—ISSNs, ISBNs, ARKs, DOIs, ORCIDs, RORs, accession numbers, PMIDs, and more—each of which can serve different purposes at different levels of granularity. Crossref (and other) DOIs, ARKs, Handles, and other systems for identifying digital objects coexist productively, each serving the community and use case for which it was designed.

An ISBN, for example, identifies a format edition of a book; it is not a persistent locator link. A Crossref DOI, by contrast, functions simultaneously as an identifier, a persistent link, and as one element of rich, standardised metadata—recording who funded a work, who contributed to it, when it was published, whether it has been corrected or retracted, and how it relates to other objects, such as through citation.

Persistence is complex

Persistence is not simply a property of being digital. True persistence requires active governance, long-term financial commitment, and organisational stewardship. An identifier service whose maintaining organisation fails, or whose governance collapses, is not persistent in any meaningful sense. Sustainability and governance are core requirements rather than secondary considerations.

In practice, this means the organisations that register identifiers must take on formal stewardship responsibilities—something Crossref formalises through its [Member Obligations](#) and supporting operations such as quality checks and membership revocation processes for misleading metadata or organisations' misrepresentation.



03

DOIs: PIDs for 'things'

Persistent identifiers are available for a wide range of entities. These can broadly be broken into PIDs for people (e.g. ORCID iDs), PIDs for places (e.g. ROR identifiers), and PIDs for things (e.g. Crossref DOIs).

DOIs (Digital Object Identifiers) are used to identify any object—physical, digital, or abstract; matter, material, content, or activities. In the research space, this includes everything from theses, posters, journal articles and book chapters to geological samples, grants and awards, datasets, and much more.

A DOI is a unique string composed of a prefix and a suffix separated by a forward slash. It resolves via the DOI Foundation's global resolver at doi.org (a proxy of the underlying Handle System), and is displayed as a full hypertext link beginning <https://doi.org/>. The DOI system was standardised through the International Organization for Standardization, as [ISO 26324, Digital Object Identifier System](#). In recent years, several fake DOI organisations have started to appear, making it vital for policymakers and others to specify the use of DOIs registered via the DOI Foundation's Registration Agencies (RAs).



04

Crossref DOIs: a distinct implementation

Crossref is one of the 12 DOI Foundation (DOIF) Registration Agencies (RAs). This distinction matters more than is often recognised: the DOI is a general-purpose identifier and resolution system, not a scholarly infrastructure per se. What makes Crossref DOIs valuable is not just the DOI format and system itself, but Crossref's specific implementation of it.

Crossref's own system is more than just a tool; it is a mesh of technology, community infrastructure, and governance that facilitates the capture, maintenance, and enrichment of digital object records. Crossref's wide-reaching global membership—including universities, labs, libraries, publishers, funders, and government bodies—has registered hundreds of millions of metadata records. All of them resolve through doi.org, a globally distributed network, managed and governed by the non-profit DOIF, that processes billions of resolutions per month. But resolution—the term for a link that redirects and works—is only the starting point. The Crossref system additionally enables:

- **Rich, open metadata:** authorship, funding, institutional affiliation, licensing, version history, review information, corrections, and retractions.
- **Relationship metadata:** connections between contributors, funders, affiliations, works, and multiple research outputs, including billions of matched citations and other connections.
- **Services:** [reference linking](#) and wider [metadata matching and enrichment](#), [Cited-by](#) for citation counts, [Similarity Check](#) for text originality screening, the [Grant Linking System \(GLS\)](#) and proposal management system integrations, open [Retraction Watch](#) data, [Crossmark](#) status and integrity alerts for readers, the [Research Organization Registry \(ROR\)](#), [Open Funder Registry \(OFR\)](#), and [ORCID Auto-update](#).
- **Open APIs:** queried billions of times monthly, with unrestricted access to all machine-readable metadata; integrated into and relied on by many thousands of downstream tools and services across the research community and beyond.
- **Scale and reach:** hundreds of millions of Crossref DOI records that see billions of resolutions per month, accounting for the vast majority of all global DOI usage.

Crossref members do not simply register identifiers; they also actively maintain their DOIs, taking on a social contract of long-term stewardship through their Member Obligations. Members can update metadata, issue corrections and retractions through Crossmark, and enrich records over time. In fact, close to 70% of records registered over the past decade have been updated at least once. This stewardship is what makes Crossref DOIs genuinely useful and persistent. It differs from a discovery service that scrapes and indexes its own data, since Crossref membership formalises an organisation's responsibility for, and commitment to, the stewardship of the record.

Crossref further facilitates metadata completeness and quality and supports equitable participation in the infrastructure for its diverse membership by providing helper tools, plugins (e.g. for [Open Journal Systems](#)), enrichment processes at scale, and actionable dashboards such as [Participation Reports](#).



05

The DOI landscape: fragmentation and policy implications

“DOI metadata” or “PID metadata” is not a single, coherent term or body of information. DOIs are not homogeneous, and the DOIF does not provide centralised metadata or services beyond its resolution service.

For example, a record registered with one RA cannot be found through another’s search systems. There is no centralised DOI metadata repository or API, and the DOI system does not prevent the same article or object from being registered for a DOI by more than one RA. While the full identifier strings are unique across all DOIs, the objects being identified can be duplicated. Likewise, an organisation using another RA cannot use Crossref-specific services to, for example, match preprints with article versions, link references, communicate post-publication updates with Crossmark, or (in some cases) push works to contributors’ ORCID records. However, several scholarly DOI RAs—including [JaLC](#), [Chinese DOI](#), [mEDRA](#), and the [Publications Office of the European Union](#)—participate in Crossref’s [Sponsors program](#), sharing metadata through Crossref to access its global matching and linking system. Some RAs have also collaborated to support [content negotiation](#), which is the only RA-agnostic route for retrieving DOI-related metadata.

RAs collaborate in many ways, but national strategies and other policies that mandate DOI adoption are stronger when they recognise the differences between RA systems and services, and specify the needs, requirements, and expected benefits and outcomes of implementation. Metadata also gains value at scale; national strategies that connect to established global infrastructures, rather than building parallel systems, maximise community investment and contribute to a more complete and shared open research record.

Crossref therefore recommends that policies specify the required metadata and services, as well as the identifier type (e.g. Crossref DOIs, mEDRA DOIs, DataCite DOIs, JaLC DOIs, etc), since the services, governance, and interoperability associated with each agency differ substantially. This holistic approach will help decision-makers choose the right RA through its associated services, leading to the outcomes policymakers intend, and benefiting their public institutions and other implementers.



06

Beyond identification: metadata, services, and the Research Nexus

Crossref's strategic vision is described as the [Research Nexus](#): a rich, reusable, open network connecting research organisations, people, outputs, and actions. Identifiers are essential nodes in this network, but it is the metadata and relationships between them that create value—PIDs enable inquiry; metadata enables understanding.

Open, relational metadata, like that which Crossref holds and makes freely available, delivers value to funders, institutions, policymakers, and researchers, and supports a wide range of policy-relevant goals:

- **Research assessment and evaluation:** enabling funders, institutions, and national bodies to trace funding to outputs, map collaboration networks, and assess the reach and impact of their research investments.
- **Open research:** linking preprints to published versions, tracking both pre- and post-publication peer review and comments, retractions and corrections, and supporting reproducibility.
- **Discovery:** enabling researchers, policymakers, and the public to find, access, and contextualise research outputs.
- **Research integrity:** Crossmark notices for corrections and retractions travel with a Crossref DOI, reaching readers wherever the link appears. Retraction Watch data, now open and free, similarly augments the record. Provenance metadata denotes who funded the research and at what levels.

Crossref has built services on top of this metadata layer to meet evolving community needs, exposing relationship data that would be invisible if identifiers alone were tracked.

The Grant Linking System (GLS) is a particularly strong example of this. By registering Grant DOIs with Crossref, funders and research councils create a verifiable, machine-readable record connecting their investments to the outputs they enable—across institutions, disciplines, and borders. The result is an openly queryable funding graph that supports evaluation, accountability, and discovery at an international scale. No other system operates at this combination of breadth and depth, and national bodies developing research information strategies and implementations can benefit from—and contribute to—it by participating directly, thereby demonstrating their own responsibility and stewardship.



07

Governance and sustainability: the trust layer

The [Principles for Open Scholarly Infrastructure \(POSI\)](#), first drafted in 2015, provide one framework for evaluating the trustworthiness of scholarly infrastructure organisations. POSI comprises 20 principles covering governance, sustainability, and insurance, and has been adopted by nearly 30 infrastructure organisations, including Crossref.

For policymakers, POSI provides a practical evaluation tool. When assessing whether to mandate or fund PID infrastructure, the following questions matter as much as technical capability:

- Is the organisation involved community-governed, with transparent and accountable processes? Are elections representative, equitable, and contested (i.e. they offer more candidates than available seats) to ensure a real choice?
- Does it demonstrate financial resilience or show a credible path to long-term financial sustainability (e.g. not relying on project-based grant funding for core work)?
- Is its metadata open and accessible, with clear policies for service continuity, disaster recovery, or failovers?
- Has it made—and can it demonstrate—binding commitments to the communities it serves? Does it back other open infrastructures, recognise volunteer labour, and support global accessibility?

An infrastructure organisation that cannot reliably answer these questions poses a potential risk to a strategy that depends on it. Crossref therefore regards POSI (or equivalent frameworks) as a prerequisite for infrastructure endorsement, not an optional quality signal.

Financial sustainability is a difficult task for open community infrastructures and is often a work in progress. Through decades of steady growth and careful management, Crossref has achieved financial health, including maintaining an operating reserve equal to one year's expenses. This strong financial resilience is the result of a mixed-model membership- and activity-based structure; it doesn't rely on grant funding, which can be withdrawn at short notice and is often tied to discrete projects, thereby increasing the risk of failing to cover core costs.

Crossref's fees are tiered, and the organisation is not reliant on its largest members: over one-third of revenue comes from organisations in the smallest membership tier, reflecting the broad distribution of its membership. Fees are reviewed regularly through a Membership & Fees Committee and the [RCFS \(Resourcing Crossref for Future Sustainability\) project](#), which has steadily reduced or eliminated fees to keep the infrastructure accessible and equitable. Surpluses are reinvested in community work, and

Crossref has a history of co-developing, funding, and incubating emerging PID services, as well as supporting other open infrastructure initiatives as they work toward sustainability.

Crossref's governance reflects its global reach. Incorporated as a 501(c)(6) in New York, with a related international non-profit association (AISBL) in formation in Belgium, Crossref is extending its legal and data structures to ensure an even more resilient future for its system and community so that no single country's regulatory or political environment becomes a point of failure for the scholarly record.

Concerns about digital sovereignty are legitimate, and national strategies rightly weigh control against connection. But sovereignty is safeguarded by design, not just by trust: Crossref is governed by its members in 167 countries, not by any one government, commercial interest, or region; its metadata is openly licensed and available in bulk; and its commitments under POSI extend to open code and the continuity of the record. Participation never becomes lock-in, because national institutions are not customers of this infrastructure—they are members and governors of it; they remain the authoritative source of their own metadata, able to update and correct the record at any time; and their investment strengthens the shared record rather than fragmenting it.



08

Recommendations for policymakers and implementers

Crossref is committed to supporting the efforts of those developing and advancing national and international PID strategies and open science policies. Based on its own experience and that of its members, it offers five recommendations:

1 Frame the goal. Focus strategies on open research infrastructure and open metadata: what problems are identifier systems solving, and is the surrounding infrastructure fit for that purpose?

2 Be specific. Set out the technical, operational, and governance requirements, so that implementation—including the choice of DOI Registration Agency—is evidence-based and delivers the intended outcomes.

3 Require more than PID registration. Selected identifier systems should include open, machine-readable metadata, connect across the research landscape, and be maintained over time to provide confidence in each record's reach and persistence.

4 Evaluate sustainability and governance. Use POSI and other best-practice frameworks to assess community governance, financial resilience, and commitment to long-term data availability.

5 Build on existing open infrastructure. Where robust, community-governed infrastructure already exists, a shared solution maximises reach and community investment; if local systems are required, factor in the cost of integration and the years needed for wide adoption.



09

PID policies in practice

To illustrate the recommendations in action, this section includes examples of good practice in policy development and decision-making from the broader research community, all of which demonstrate the holistic considerations in infrastructure evaluation that Crossref recommends.

United Kingdom

The technical requirements for [UKRI's OA policy](#) show how a funder can clearly define the technical and metadata requirements necessary for policy compliance without prescribing which PID must be used. The policy sets out a number of metadata requirements—from licensing information to contributors and funding metadata—that research outputs need to meet. How those requirements are met is outside the scope of the policy, making it a good example of where the needs and outcomes are the drivers of which technical solution to implement.

Portugal

[FCCN|FCT](#)'s adoption of a variety of PIDs to build the Portuguese research information ecosystem is a compelling example of best practice. In addition to using ORCIDs, ISNI, and DOIs, they joined Crossref to register and share their funding information and use Crossref DOIs to identify their grants. Their strategy was not an isolated technical decision, but a deliberate next step in a journey towards a truly interconnected research ecosystem, guided by clear requirements. These included seamless integration with their infrastructure, a metadata schema capable of describing their awards with sufficient richness, and the ability to systematically and scalably connect funding to research outputs for impact tracking and policy compliance monitoring.

Canada

[CRKN](#) and the [Digital Research Alliance of Canada](#) commissioned a structured approach to guide decisions on PID and metadata services, demonstrating their understanding of the trust layer for open research information. The [matrix](#) they adopted considers several criteria, including governance, interoperability, and community-led initiatives to support a holistic decision-making process. The PID landscape evolves quickly, so any such matrix is a snapshot in time; the durable value lies in the criteria and the decision-making process, which can be reapplied as the landscape changes.

South Africa

The Department of Science, Technology and Innovation of South Africa published [The South African Open Science Policy](#) in March 2026. It is a landmark document for many reasons, including mandating open access to all publicly funded research. Importantly, from an infrastructure perspective, the policy emphasises data and metadata openness, interoperability, sustainability, and global connectivity as critical qualities of infrastructure for open science in the region. It's not prescriptive about systems; instead, it designates agencies to detail implementation and monitoring plans in light of this overarching policy.



10

Conclusion

Persistent identifiers are an essential component of open infrastructure for the modern research record. Their value is determined by the metadata they are part of, the services built around them, the governance that steers them, and the community that sustains them over time. A PID strategy that focuses on these deeper requirements will help to establish a connected, open, and trustworthy research record.

Crossref is committed to supporting the development of open, sustainable, and genuinely useful research infrastructure in order to achieve its vision of a Research Nexus—a rich, open, connected network that the global research community can build on for society's benefit. Crossref welcomes dialogue with policymakers, funders, national bodies, and others who are developing support for and use of open research infrastructure.



References

- 2025 Membership Terms. Crossref. <https://www.crossref.org/membership/terms/member-terms-2025>. Accessed July 6, 2026
- Canada's Persistent Identifiers Strategy. Canadian Research Knowledge Network, Digital Research Alliance of Canada. 2026. <https://doi.org/10.5281/zenodo.19206681>
- Canadian Research Knowledge Network (CRKN). <https://www.crkn-rcdr.ca/en>. Copyright 2013–2026
- Chinese DOI. <http://www.chinadoi.cn/>. Accessed July 6, 2026
- Cited-by. Crossref. <https://www.crossref.org/services/cited-by/>. Accessed July 6, 2026
- Digital Research Alliance of Canada. <https://www.alliancecan.ca/en>. Copyright 2025
- Documentation: Content negotiation. Crossref. <https://www.crossref.org/documentation/retrieve-metadata/content-negotiation/>. Accessed July 6, 2026
- Documentation: Crossmark. Crossref. <https://www.crossref.org/documentation/crossmark/>. Accessed July 6, 2026
- Documentation: Participation Reports. Crossref. <https://www.crossref.org/documentation/reports/participation-reports/>. Accessed July 6, 2026
- Documentation: The Research Nexus. Crossref. <https://www.crossref.org/documentation/research-nexus/>. Accessed July 6, 2026
- DOI Foundation. <https://www.doi.org>. Copyright 2026
- Foundation for National Scientific Computing (FCCN). <https://www.fccn.pt/en/>. Copyright 2026
- Grant Linking System (GLS). Crossref. <https://www.crossref.org/services/grant-linking-system/>. Accessed July 6, 2026
- ISO 26324:2025 Information and documentation — Digital object identifier system. International Organization for Standardization. <https://www.iso.org/standard/88862.html>. Accessed July 10, 2026
- Japan Link Center. <https://japanlinkcenter.org/top/english.html>. Accessed July 6, 2026
- mEDRA. <https://www.medra.org/>. Accessed July 6, 2026
- Metadata matching. Crossref. <https://www.crossref.org/community/special-programs/metadata-matching/>. Accessed July 6, 2026
- Open Journal Systems. PKP/SFU. <https://pkp.sfu.ca/software/ojs/>. Accessed July 6, 2026
- Open Researcher and Contributor ID (ORCID). <https://orcid.org>. Accessed July 6, 2026
- ORCID auto-update. Crossref. <https://www.crossref.org/community/orcid/>. Accessed July 6, 2026
- Publications Office of the European Union. <https://op.europa.eu>. Accessed July 6, 2026
- RCFS (Resourcing Crossref for Future Sustainability). Crossref. <https://www.crossref.org/community/special-programs/resourcing-crossref/>. Accessed July 6, 2026
- Research Organization Registry (ROR). Crossref. <https://www.crossref.org/services/ror/>. Accessed July 6, 2026
- Research Organization Registry (ROR). <https://ror.org>. Accessed July 6, 2026
- Retraction Watch. Crossref acquires Retraction Watch data and opens it for the scientific community. <https://doi.org/10.13003/c23rw1d9>. Accessed July 12, 2026

Similarity Check. Crossref. <https://www.crossref.org/services/similarity-check/>. Accessed July 6, 2026

South African Open Science Policy. <https://assaopenscience.co.za/wp-content/uploads/2026/03/Final-South-African-Open-Science-Policy-2026.pdf>. Accessed July 6, 2026

Sponsors program. Crossref. <https://www.crossref.org/community/sponsors/>. Accessed July 6, 2026

Support for Reference Linking. Crossref. <https://www.crossref.org/services/reference-linking/>. Accessed July 6, 2026

The Foundation for Science and Technology (FCT). <https://www.fct.pt/en/>. Accessed July 6, 2026

The Principles of Open Scholarly Infrastructure. <https://doi.org/10.14454/G8WV-VM65>. Copyright 2026

UK Research and Innovation open access policy. UK Research and Innovation. <https://www.ukri.org/publications/ukri-open-access-policy/uk-research-and-innovation-open-access-policy/>. Copyright 2026



About Crossref

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

We're a not-for-profit membership organisation that exists to make scholarly communications better, running open infrastructure to link research objects, entities, and actions—creating a lasting and reusable scholarly record that underpins open science.

Together with our more than 25,000 members in 167 countries, we drive metadata exchange and support 2.1 billion monthly API queries, facilitating global research communication, for the benefit of society.

Find out more at crossref.org.

