

Carnets botaniques

The architecture of digital scholarly publishing: persistent identifiers, metadata, dissemination platforms, open access, and the FAIR principles. The case of *Carnets botaniques*

ISSN 2727-6287 - LSID 20027545-1

Indexing: Mir@bel and Sherpa Romeo

Article No. 324 – 29 October 2026

DOI: <https://doi.org/10.34971/3S52-SWQ9>



Pierre Coulot

9 avenue des Cévennes, Vérargues, F-34400 Entre-Vignes ;
p.coulot@etik.com, <https://orcid.org/0000-0003-0149-8114>

Titre

L'architecture de l'édition scientifique numérique : identifiants pérennes, métadonnées, plateformes de diffusion, libre accès et principes FAIR. L'exemple de *Carnets botaniques*

Abstract

Digital scholarly publishing is most often perceived as a spider's web full of incomprehensible acronyms, with links that are difficult to grasp. Yet persistent identifiers, registration agencies, metadata, dissemination platforms and re-use licences are all clearly defined and complementary concepts. This article provides a historical and technical overview of these concepts, to highlight their functions and how they interrelate. Particular attention is paid to the DOI, the Handle system, and the Crossref and DataCite agencies. It distinguishes between the roles of identifiers such as DOI, ORCID, ROR and ISSN; discovery services such as OpenAlex, Google Scholar and ResearchGate; open access policies; and Creative Commons licences. The FAIR principles, which provide a general framework for all these concepts, are outlined. The experience of *Carnets botaniques*, for which 314 historical DOIs were transferred from DataCite to Crossref without modification, illustrates the possibilities and requirements of sustainable editorial management. Finally, a summary diagram presents the main stakeholders and their relationships.



Résumé

L'édition scientifique numérique est le plus souvent vécue comme une toile d'araignée pleine d'acronymes incompréhensibles et dont les liens sont difficiles à appréhender. Les identifiants pérennes, agences d'enregistrement, métadonnées, plateformes de diffusion, licences de réutilisation, sont pourtant autant de concepts parfaitement définis et complémentaires. Cet article en propose une synthèse historique et technique, pour rappeler leurs fonctions et de leurs articulations. Une attention particulière est portée au DOI, au système Handle et aux agences Crossref et DataCite. Il distingue les rôles des identifiants comme DOI, ORCID, ROR et ISSN, des services de découverte comme OpenAlex, Google Scholar et ResearchGate, des politiques de libre accès et des licences Creative Commons. Les principes FAIR, qui offrent un cadre général à tous ces concepts, sont rappelés. L'expérience de *Carnets botaniques*, dont 314 DOI historiques ont été transférés de DataCite à Crossref sans modification, illustre les possibilités et les exigences d'une gestion éditoriale durable. Enfin, une figure de synthèse présente les principaux acteurs et leurs relations.

1. Introduction: understanding the architecture of digital scholarly publishing

Document identification has always sought to resolve a fundamental difficulty: identifying a publication unambiguously, regardless of its medium, where it is held, or how it is disseminated.

In the print world, standardized numbers for serial publications and books helped stabilize bibliographic exchange. With the development of digital publishing, this issue took on a new dimension: a document's online address is not necessarily its identity. A page may be moved when a website is redesigned, a domain name may change, and a platform may disappear, whereas bibliographic references must remain intelligible and usable for several decades (Paskin, 2002; Klein *et al.*, 2014).

This distinction between identity and location is essential to the continuity of scholarly communication. It determines whether sources can be retrieved, published results verified, relationships between works traced, and older publications consulted. In particular, the studies by Klein *et al.* (2014) and Jones *et al.* (2016) highlighted a phenomenon known as "reference rot", which combines the disappearance of links with changes to the content to which they point. Persistent identifiers, foremost among them the DOI (Digital Object Identifier), help reduce this instability, although they alone guarantee neither document accessibility nor preservation.

The long-term availability of scholarly information actually depends on a set of complementary mechanisms. Alongside publication identifiers (DOIs) are identifiers for authors (ORCID), institutions (ROR), and journals, as well as registration agencies, metadata transmitted through XML files, dissemination platforms, open-access policies, reuse licences, and digital-preservation mechanisms. Each has its own role, but their interaction determines whether publications can be found, cited, linked to other works, and reused. The FAIR principles (Findable, Accessible, Interoperable, Reusable) provide a framework for analysing these different dimensions.

This article provides a historical, technical, and functional overview of this ecosystem, intended in particular for those responsible for independent scholarly journals. It examines how DOIs and the Handle System work, the role of the Crossref and DataCite agencies, the structuring of metadata and its relationship with discovery services, and the legal and technical conditions governing access to and reuse of publications. The experience of *Carnets botaniques*, the journal of the Société botanique d'Occitanie, serves as a common thread throughout the analysis. The unchanged re-registration with Crossref of its 314 historical DOIs, which were initially managed by DataCite, provides a concrete illustration of the challenges involved in sustainable editorial management.



2. Definition, structure, and resolution of DOIs

2.1. History

The history of the DOI did not begin with today's journal platforms. It forms part of the discussions that have taken place since the 1990s on how to represent digital objects and identify them independently of their location. The foundational work was published by Kahn and Wilensky and revisited in their 2006 publication, which describes objects equipped with identifiers that can be managed within a complex digital architecture.

These discussions accompanied the development of the Handle System, on which the resolution mechanism used by DOIs relies. It provides the technical infrastructure underpinning the DOI in particular, and can also manage other persistent identifiers. These identifiers are resolved through specialized services: doi.org for DOIs and, for example, hdl.handle.net for generic Handle identifiers. In summary:

- **the Handle System** is a distributed infrastructure for managing and resolving persistent identifiers, designed to separate the name of a digital object from its location on a server. A handle is a string registered in this system; DOIs are a standardized application of it, governed by the DOI Foundation;
- **the DOI** resolver is an online service, available at <https://doi.org>, that retrieves the current location of a resource from its DOI. It uses the Handle System to associate the DOI with a URL and automatically redirects the user to that address, in a manner entirely transparent to them.

The International DOI Foundation was established in 1997 to create a system shared by all stakeholders. In the context of electronic scholarly publishing, the aim was to provide an identifier that did not depend on the syntax of publishers' URLs. Crossref was therefore the first cooperative organization for scholarly publishers, established in 2000 with a focus on scholarly-article references. DataCite was launched in 2009 with a slightly different scope, aimed at promoting the identification of research data and other scholarly objects. Finally, ISO 26324, published in 2012 and revised in 2022, formalized the framework of the DOI system (Paskin, 2002; DOI Foundation, s.d.-a).

These various initiatives established the present architecture; they were not a succession of technologies replacing one another:

- the Handle System provides a technical infrastructure;
- the DOI adds a normative framework, assignment rules, and institutional responsibilities;
- registration agencies offer metadata schemas and services tailored to their communities.

2.2. The DOI: an identifier, not a storage address

A DOI consists of two parts separated by a forward slash: in the example 10.34971/XWV8-PH95, the string "10.34971" is the DOI prefix and "XWV8-PH95" is its suffix. The prefix identifies an allocation space managed within the DOI system, generally that of the journal. It describes neither the scientific discipline nor necessarily the publisher's current identity. The suffix is chosen according to the rules of the registration organization and the depositing entity.

Its form should not be interpreted as a universal bibliographic code: some suffixes are opaque and others incorporate editorial elements, but the stability of the identifier matters more than its readability (DOI Foundation, s.d.-a).

When a reader enters "<https://doi.org/10.34971/XWV8-PH95>", their web browser contacts a resolution service, or resolver. The resolver uses the information associated with the DOI to redirect the browser to a destination URL. This operation is invisible to the reader and normally leads to a descriptive page for the article, which may not provide its full text, depending on the publisher's policy. It may contain an abstract, the list of authors, or citation information only.

The document is therefore not stored on doi.org. The destination URL and the bibliographic metadata are two related but distinct sets of information. This distinction is essential for understanding maintenance. If a journal changes domain or reorganizes its pages, it must update the destinations of the relevant DOIs. New identifiers do not need to be created. Conversely, assigning a new DOI every time a page is moved would contradict the very principle of persistence. Readers and bibliographic systems must be able to use the same identifying string over time.





2.3. DOI persistence depends on active maintenance

As discussed above, DOI continuity is central to the system. Three levels can be distinguished: 1) identifier persistence means that the DOI string remains associated with the same intellectual resource; 2) resolution continuity means that the service points to a valid destination; and 3) document preservation requires the content itself to be preserved and accessible under satisfactory conditions. The three objectives reinforce one another, but none alone guarantees DOI persistence (Klein *et al.*, 2014; Jones *et al.*, 2016).

The stability of the landing page therefore deserves particular attention from the publisher. Redirection to a journal's home page, a 404 error, or an isolated file lacking bibliographic context only partially fulfils the promise of persistent identification.

Good editorial practice therefore consists in maintaining a dedicated page for each article, displaying the DOI and essential metadata on it, and preserving access to published versions as far as possible. Long-term digital preservation, which may be entrusted to specialized archiving services (see Section 11.4), is a complementary responsibility. All these concepts are summarized in Figure 1.

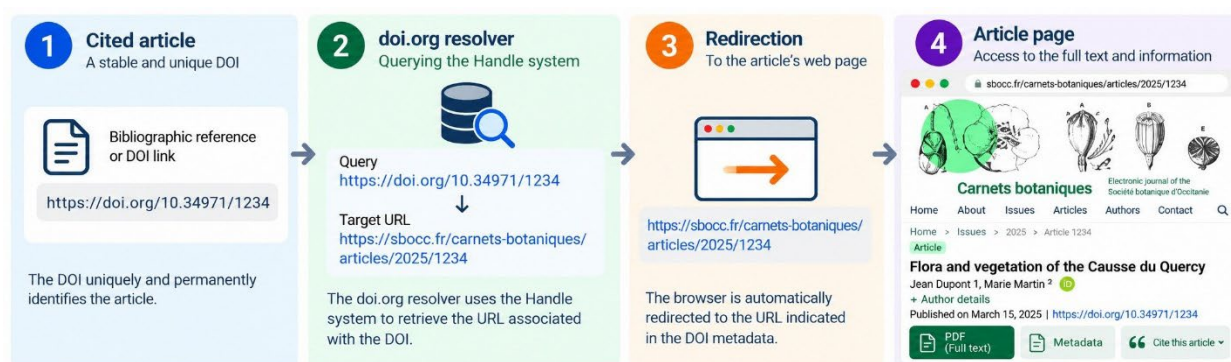


Figure 1. Resolving a DOI: from the identifier to the article page, the example of *Carnets botaniques*. P. Coulot, CC-BY-NC-ND.

3. Governance of the DOI system and diversity of registration agencies

The institutional architecture is sometimes misunderstood because users generally see only a link beginning with doi.org. The DOI Foundation provides the system's governance and standardization framework. Registration agencies such as Crossref and DataCite operate services for assigning and maintaining identifiers and disseminating metadata under policies applicable to their communities.

Members or depositors supply agencies with information about the objects they publish and must keep it up to date (DOI Foundation, s.d.-c; Hendricks *et al.*, 2020).

This division of roles explains why a DOI does not belong to a publishing platform. A publisher may decide to change host or technical service provider, or even registration agency, while retaining the DOI associated with each article. Its obligations do not disappear, however: an entity must remain responsible for the registration, metadata, and destination of the DOI. The governance of persistence thus relies on human and organizational commitments, not simply on a property of the computer protocol.

Identifiers other than DOIs are also involved in this ecosystem. The two most important are ORCID, which identifies researchers, and ROR, for organizations and institutions. DOIs can also be assigned to datasets, software, and other scholarly objects. Explicit relationships among these identifiers form a distributed knowledge infrastructure, sometimes described as a "persistent identifier graph" or "PID Graph" (Meadows *et al.*, 2019; Cousijn *et al.*, 2021).

3.1. A federation of agencies

The DOI system is based on a federation of Registration Agencies (RAs), whose common governance framework is administered by the DOI Foundation. Each agency allocates prefixes, registers identifiers, and

enables the metadata required for their resolution to be declared and updated. Agencies may, however, adopt different business models, descriptive schemas, and specialized services (DOI Foundation, s.d.-c).

Membership in this federation therefore does not imply a single bibliographic database. DOI resolution should not be confused with the ability to consult its metadata through an agency. A DOI registered with DataCite can be resolved by doi.org without appearing as a native record in Crossref's bibliographic API. Conversely, the identifier itself does not necessarily reveal the agency currently responsible for its registration. This distinction is critical when a corpus is transferred from one agency to another (see Section 6).

3.2. Diverse fields and communities

Crossref and DataCite are the two most visible agencies in academia. However, the official agency list shows that DOIs exist in a wide range of sectors: multilingual publishing, national research resources, documents from European institutions, audiovisual works, construction products, and talent identification. The DOI is therefore a cross-disciplinary technical framework, not a format reserved for scholarly articles (DOI Foundation, s.d.-b). Table 1 illustrates this diversity; the DOI Foundation's up-to-date official directory should be consulted to identify the agencies recognized at any given date.

Table 1. Overview of DOI registration agencies and their fields of activity (as at 13 October 2026).

P. Coulot, CC-BY-NC-ND.

Agency	Main domain	Related resources	Specific features
Crossref	International scholarly communication	Articles, books, book chapters, conference proceedings, preprints and other research outputs	Bibliographic metadata, cited references and links between publications
DataCite	Research data and results	Datasets, software, reports and other research outputs	Resource description, relationships between objects and metadata interoperability
mEDRA	European and multilingual digital publishing	Journals and other digital editorial content	Persistent identification, management of relationships between content and editorial services
Japan Link Center (JaLC)	Japanese research and scholarly publishing	Articles, data and other scholarly outputs	National coordination and cooperation with Crossref and DataCite
Korean DOI Center (KISTI)	Korean research and technical publishing	Articles, conference proceedings, reports, patents and data	Identification and promotion of Korean research outputs
Airiti DOI	Scholarly publishing in Taiwan and the Sinophone region	Scholarly publications in Chinese and English	Registration of DOIs, metadata discovery and bibliographic links
Chinese DOI (ISTIC/Wanfang)	Chinese research and scholarly publishing	Journals, books, theses, conference proceedings, preprints and data	Registration and resolution services for the Chinese scholarly community
China National Knowledge Infrastructure (CNKI)	Documentary resources and scholarly content	Journals, theses, conference proceedings, reference works and other resources	Integration of DOIs in a large-scale documentary environment
Entertainment Identifier Registry (EIDR)	Audiovisual industry	Films, series, broadcasts, audiovisual content and distribution services	Identification of works, versions and audiovisual services
BSI Identify	Construction products industry	Construction products and related information	Persistent identification of products, in particular using UPIN identifiers
Publications Office of the European Union	European institutional publications	Official publications, articles, data and grants	Assignment of DOIs to resources produced by the institutions of the European Union
HAND	Media and sports industries	People, fictional characters and virtual entities	Persistent identification of people and characters involved in media

3.3. Chronological overview

Work on the persistent identification of digital objects predates the announcement of the DOI in 1997. Crossref was launched in 2000, notably to facilitate links between publications, while DataCite emerged in 2009 in the context of research-data citation and recognition. The adoption and subsequent revision of ISO 26324 placed the system within an international standardization framework. Figure 2 presents these milestones.

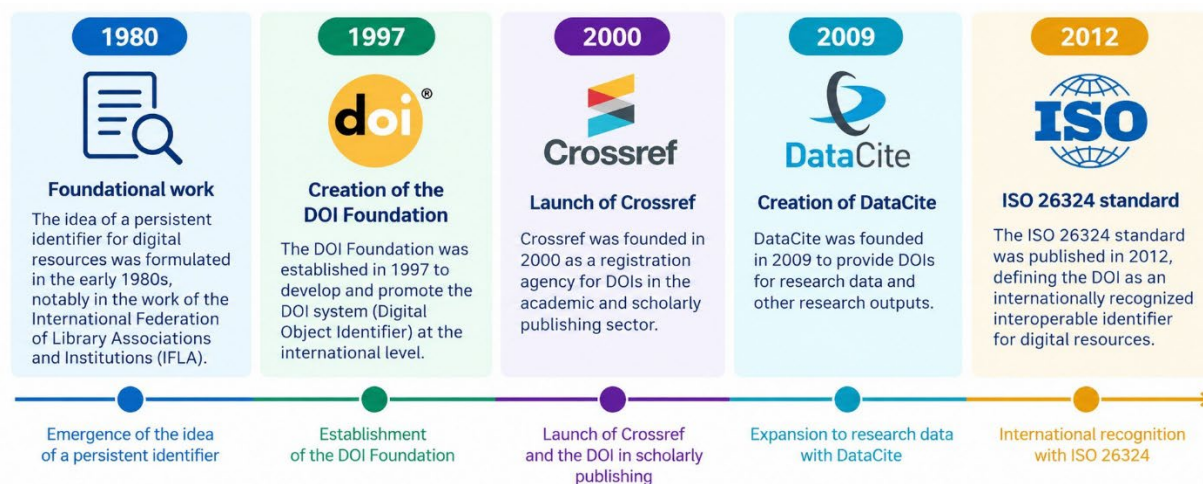


Figure 2. Major milestones in the history of the DOI. P. Coulot, CC-BY-NC-ND.

3.4. How should a scholarly journal choose its registration agency?

Although economic criteria may play a part, since agencies do not charge the same fees for their services, the choice of where to deposit DOIs should primarily address the publisher's documentary and technical needs. For an independent scholarly journal, the main criteria are the nature of the publications to be identified, the metadata accepted and therefore shared, the ease of depositing and updating records, the management of bibliographic references, and, secondarily, the arrangements for technical and administrative support.

The functions of the various parties should also be distinguished. The registration agency manages DOIs within the international system, whereas the publishing platform hosts and disseminates publications. A technical service provider may prepare or transmit metadata on the publisher's behalf without itself being a registration agency. Similarly, search engines and bibliographic databases use identifiers and records without necessarily participating in their assignment.

It is important to recognize that agencies have different historical orientations and services, while offering comparable DOI quality and persistence. Crossref and DataCite, which are especially relevant to publications and scholarly data, are examined in Section 5.

4. Metadata: from identification to interoperability

The presence of a DOI in an article is only the visible part of a broader documentary system. At registration, the publisher deposits an XML file containing a set of structured metadata prepared according to specifications supplied by the selected agency (for example, Crossref version 5.5.0 at the time of writing). These metadata enable third-party services to discover, cite, link, and analyse the publication. They are used by catalogues, search engines, bibliographic tools, and other services. The system's collective value therefore depends as much on record quality as on identifier stability (Hendricks *et al.*, 2020; Cousijn *et al.*, 2021).

The technical validity of a deposit must be distinguished from the documentary quality of its content. An XML file may comply with the specifications and thus be accepted without error while omitting useful information or containing inaccurate values. Structural validation checks formatting rules, but must be supplemented by editorial verification of the accuracy of names, titles, dates, relationships, and references. Comparisons of bibliographic databases show that metadata completeness varies considerably among platforms and fields examined (Delgado-Quirós & Ortega, 2024).

4.1. A priority: describing publications correctly

The visibility and sharing of a publication deposited with an agency unquestionably depend on the quality of the information submitted through the XML file. A compliant file may contain only the mandatory fields.

Ideally, the information should not be limited to identification (DOI, title, authors, journal, ISSN, publication date), location (landing-page URL), and editorial structure (volume, issue, pages, or article number); where the schema permits, it should also include additional information such as affiliations, funding, licences, abstracts, or relationships with other objects.

From a technical standpoint, exchange formats require particular discipline. An XML deposit contains elements organized according to a grammar established by each agency: tag order, attributes, reserved characters, and permitted values can determine whether the file is accepted. An unescaped ampersand, which is then read as part of the code, an inconsistent date, or an improperly closed tag may be enough to block a deposit.

The Crossref and DataCite schemas are not identical; a transfer therefore requires a different XML file to be created, rather than simply copying a file (Crossref, 2026; DataCite Metadata Working Group, 2026).

Checking author names is another challenge. Typographic variants, initials, and homonyms can complicate the attribution of works. Linking names to personal identifiers, such as ORCID iDs for researchers, facilitates matching. The same applies to institutional affiliations and relationships among articles, datasets, or successive versions. However, it is better to leave an optional field empty than to assign uncertain information to it.

4.2. Bibliographic references and open citations

A list of bibliographic references deposited with Crossref can be used to establish links between citing and cited publications. Matching services seek to identify the documents mentioned from their bibliographic information and, where possible, associate a DOI with them. A reference may sometimes be registered correctly without a DOI match being established.

Open citations are bibliographic relationships between publications that are made freely available as structured, reusable data. Their availability facilitates navigation through scholarly corpora, bibliographic analysis, and the development of discovery tools (Shotton, 2013). Their automated use nevertheless depends on reference quality: incorrect DOIs, incomplete information, or ambiguous bibliographic data may lead to missing or erroneous matches (Cioffi *et al.*, 2022).

This distinction is particularly important for botanical journals, whose bibliographies frequently include older publications, regional floras, monographs, or non-digitized documents, most of which have no DOI. The absence of an automatic match is therefore not in itself evidence of a bibliographic error. The priority remains to preserve accurate, intelligible references, whether or not they are linked to a DOI.

The *Biodiversity Heritage Library (BHL)* plays a special role in this context. This international digital library provides access to a vast corpus of historical biodiversity literature, including works on botany, taxonomy, and systematics. It offers stable links to documents and their pages, as well as metadata that other information systems can use. It also actively contributes to the retrospective assignment of DOIs to some older publications, helping to integrate them into contemporary networks of bibliographic references and citations (Biodiversity Heritage Library, s.d.).

In all cases, it is strongly recommended that bibliographic references be included in the XML metadata files deposited with DOI registration agencies whenever their deposit schemas allow it, whether or not those references are automatically associated with a DOI.

4.3. The FAIR principles: definition and scope

The FAIR principles (Findable, Accessible, Interoperable, Reusable) were proposed by Wilkinson *et al.* in 2016. Their aim was to establish common objectives for the various digital tools used in scientific research. Compliance is intended to enable both humans and computer systems to find, access, interrelate, and reuse digital scholarly resources (Dacos, 2019). Initially developed for research-data management, they also apply to scholarly publications and their metadata.

These principles are based on four complementary requirements:

- the findability of resources (**F**);
- their accessibility under clearly defined conditions (**A**);
- their interoperability with other information systems (**I**);
- and the conditions enabling their reuse (**R**).

In detail, they comprise fifteen sub-principles (Figure 3), which specify, among other matters, the role of DOIs, the impact of rich metadata, the use of standardized protocols, the description of rights, and documentation of resource provenance.

Compliance with the FAIR principles does not mean that a resource will necessarily be validated, particularly when it is deposited with a digital agency. Likewise, a resource subject to access restrictions may satisfy certain FAIR requirements without being open access. Conversely, making a document available free of charge guarantees neither its interoperability nor its reusability.

In general, the application of these principles must take the object concerned into account: the full text of an article, its associated data, and its bibliographic record may have different levels of compliance.



Figure 3. The FAIR principles: the fifteen sub-principles. P. Coulot, CC-BY-NC-ND.

4.4. The main identifiers available for implementing the FAIR principles

Implementing the FAIR principles in digital scholarly publishing relies on the interaction of several mechanisms. Persistent identifiers play a crucial role, but do not satisfy all the principles on their own. They must be associated with sufficiently rich metadata, explicit access arrangements, and documentation that makes it possible to understand, link, and reuse resources.

The **DOI** is clearly central to the findability of publications, assigning them a unique and persistent identifier that can be incorporated into metadata and used in different information systems. **ORCID** and **ROR** identifiers complement it by facilitating the identification of researchers and their affiliated organizations, respectively. When this information is correctly entered in structured fields, it can establish relationships among publications, authors, institutions, and research data. This approach is consistent with work on persistent-identifier graphs, or **PID Graphs** (Cousijn *et al.*, 2021).



The **ISSN** (International Standard Serial Number) is a standardized international identifier for serial publications, including scholarly journals, newspapers, bulletins, and editorial series. Governed by ISO 3297:2022, it consists of eight characters in two groups of four separated by a hyphen. The final character is a check digit. Unlike an article DOI, an ISSN identifies a serial publication as a whole, in relation to its title and publication medium (Bibliothèque nationale de France, s.d.).

A journal published in several media, especially print and electronic formats, generally has a separate ISSN for each medium; these are linked by a linking ISSN (ISSN-L).

The system is governed by the ISSN Network, coordinated by the ISSN International Centre in Paris. It administers the international register and coordinates the national centres responsible for assigning identifiers. In France, this task is entrusted to ISSN France at the Bibliothèque nationale de France (BnF).

Assignment of an ISSN to a journal is not mandatory and therefore constitutes neither authorization to publish nor certification of its scientific quality (Centre international de l'ISSN, s.d.). Nevertheless, the ISSN is essential metadata in DOI deposits, notably because it links identified articles to the journal that publishes them. Thus, for *Carnets botaniques* (ISSN 2727-6287), the ISSN identifies the journal, while the DOIs registered with Crossref identify its individual articles. These identifiers are complementary within the organization of scholarly information.

Application programming interfaces (APIs) facilitate the automated exchange and use of information, provided that the information is accurate, sufficiently complete, and expressed according to shared conventions.

Creative Commons licences help clarify reuse rights, without by themselves guaranteeing the documentary quality, provenance, or interoperability of resources. Finally, repositories and archiving systems can strengthen the accessibility and preservation of publications, subject to their respective policies.

As explained above, no single mechanism can satisfy all the FAIR principles. Their implementation results from the complementarity of identifiers, metadata, access protocols, licences, and preservation mechanisms. Table 2 presents the main contributions of these mechanisms and the limitations that should be recognized.

Table 2. Contributions and limitations of the main digital scholarly publishing mechanisms in relation to the FAIR principles. P. Coulot, [CC-BY-NC-ND](#).

System	Main contribution	Limitation to keep in mind
  DOI / Crossref	F : identification; searchable metadata	Does not guarantee open access or preservation
  ORCID / ROR	I : standardized links between people, institutions and works	Identifiers to be entered and verified
 APIs and metadata schemas	A I : standardized and automated exchange	Variable quality and completeness
 Creative Commons	R : explicit reuse rights	Does not ensure provenance or interoperability
 Repositories and archiving	A R : access, preservation and documentation	Different policies and guarantees depending on the platforms





5. DataCite and Crossref: roles and complementarities

Crossref and DataCite are the two main registration agencies within the DOI system. Their historical approaches to organizing and using metadata are not identical. Crossref has focused on identifying scholarly publications and bibliographic relationships among articles, establishing links between citing and cited articles. DataCite initially developed the widespread identification and citation of research data before extending its services to a range of other research outputs. Both approaches thus help build a network of interconnected scholarly information, but use different documentary models and services.

The resource categories handled by the two agencies may nevertheless overlap, and the services they offer continue to evolve (Hendricks *et al.*, 2020; DataCite Metadata Working Group, 2026).

This complementarity may lead the same institution or scientific community to use several registration channels: journal articles may be identified by DOIs registered with Crossref, while their associated datasets may fall under DataCite. Table 3 summarizes the main differences between Crossref and DataCite, their fields of application, and their shared responsibilities.

Table 3. Comparison of the DataCite and Crossref DOI registration agencies: fields of application, metadata, communities, and responsibilities. P. Coulot, CC-BY-NC-ND.

Question	 DataCite	 Crossref
 Historical background	Research data and other research outputs (datasets, software, workflows, methods, etc.).	Scholarly publications (articles, books, book chapters, conference proceedings, preprints) and bibliographic links.
 Types of resources typically identified	Datasets, collections, software, management plans, protocols, research resources.	Journal articles, books, book chapters, conference proceedings, preprints, and cited reference records.
 Metadata schema	DataCite metadata schema (based on Dublin Core, with specific fields).	Crossref deposit schema (based on JATS subsets and other dedicated formats, with specific fields).
 Specific information	Resource type, disciplines, version, relationships (e.g. IsDerivedFrom, IsPartOf), associated identifiers (ORCID, ROR, etc.).	Detailed bibliographic metadata, references to cited works, associated identifiers (ORCID, ROR, etc.).
 Community	Large research community, research infrastructures, data repositories, publishers.	Scholarly publishers, learned societies, publishing platforms, indexing services.
 Disciplinary coverage	All disciplines, with a strong presence in life sciences, Earth sciences and research data.	All disciplines, with broad coverage in scholarly and academic publishing.
 Shared responsibility	Long-term maintenance of identifiers and metadata, through a network of member organizations.	Long-term maintenance of identifiers and metadata, through a network of member organizations.

6. Migrating DOIs without changing the identifiers

Migration between registration agencies is unusual for a small journal, but follows a simple logic: preserving the identity of objects while transferring responsibility for managing them. It does not involve republishing the articles, assigning them new identifiers, or changing their scientific publication dates. Crossref and DataCite documentation provides mechanisms for transferring a prefix between agencies, subject to the necessary procedures and agreements (Crossref, 2022; DataCite, 2026). The migration comprises four complementary phases:

1. an administrative phase (agreements and association of the prefix);
2. a documentary phase (inventory, conversion, and record checking);
3. a technical phase (deposit and analysis of diagnostics);
4. a public-verification phase (DOI resolution and consultation of records).

6.1. Prefix transfer and re-registration of records

Transferring a prefix does not make complete records immediately available through the new agency. The journal must inventory the relevant DOIs, prepare the metadata in the required format according to the

specifications, and make the deposits under the agreed procedure. Retaining the DOI string is the operation's defining constraint.

Metadata conversion requires correspondences between fields to be addressed. The same bibliographic concept may be represented by different elements in different schemas; some fields may be mandatory in one and optional in the other. Cited references, when available, require additional attention. Checks must cover, in particular, DOI uniqueness, correct association of titles and authors, dates, URLs, and the absence of missing records.

6.2. Preparation, checks, and risks

A cautious method begins by compiling an inventory of historical records and DOIs. A correspondence table is then created between each article, its identifier, its URL, and its deposit status.

After the test XML file has been generated, an internal compliance check precedes an initial trial on a small number of DOIs; for non-specialists, this check can readily be performed with the aid of AI. The test result is examined before the complete batch is produced. This approach reduces the risk of discovering, after a bulk deposit, an error repeated across all records.

Once the test XML file is submitted, the agency automatically returns a diagnostic from its file-testing tool (the "Crossref XML spacer" in the case of Crossref). It must be read carefully. A success message indicates that the record has been accepted; it does not necessarily mean that all bibliographic references have been matched, that every optional field is populated, or that the landing pages are accessible. Likewise, a documentary warning is not always equivalent to rejection. Validation failures, warnings, citation-matching information, and checks performed through public interfaces must be distinguished.

Finally, migration does not end when the last file is submitted. It is advisable to retain processing reports, test a representative sample of old and recent DOIs, verify that the records are present in the new agency's services, and document the deposit procedure for future articles.

7. Case study: migration of the DOIs of *Carnets botaniques*

Carnets botaniques, the journal published by the Société botanique d'Occitanie (SBOcc), provides an instructive case because the DOI migration involved an entire retrospective corpus, without renumbering articles or changing identifiers. The historical prefix 10.34971 was retained. The objective was to bring the future management of the journal's DOIs into the Crossref environment while maintaining the continuity of references already present in publications, catalogues, and bibliographies.

7.1. Context and objectives

The journal's historical corpus comprised 314 articles published between 2020 and 2026. The records had initially been registered in the DataCite ecosystem with support from Inist-CNRS. The primary objective was to retain all existing DOIs, so as not to disrupt citations already in circulation. A second objective was to transfer the bibliographic metadata to the format required by Crossref, notably enriching it with the cited references.

The scope of the operation was clearly defined: the 314 historical articles were treated as a corpus to be re-registered, while new articles could follow the Crossref procedure directly. A distinction between retrospective and current data was also necessary for administrative and financial monitoring. Of the 314 historical articles, 171 records were from 2020-2023 and 143 from 2024-2026.

7.2. Preparation and deposits

Technical preparation was undertaken by the webmaster of the Société botanique d'Occitanie. It required the creation of an XML file compliant with the Crossref 5.5.0 deposit schema, the recovery of article metadata, and the inclusion of their bibliographic references. Bringing the file into compliance after resolving anomalies detected by internal checks was a major part of the preparation phase. In practical terms, because the journal lacked sufficient in-house computing expertise, these checks were carried out with the aid of AI.

Once the structure of the test file had been validated, a first article, No. 313, was re-registered separately with Crossref without changing its DOI (10.34971/XWV8-PH95). After this step was validated by the Crossref spacer, the remaining 313 historical articles were deposited as a batch. The complete XML file,



approximately 3.57 MB in size, also contained 9,671 bibliographic references. The batch identifier was sbocc-historical-313-20261009 and the Crossref submission number was 1771950540. Crossref's processing report confirmed acceptance of all 313 records in the main batch, without warnings or failures. This result demonstrates the successful deposit of the metadata, but does not certify that every bibliographic reference was matched.

Crossref support promptly confirmed the operational completion of the procedure to re-register the 314 historical DOIs of *Carnets botaniques*. It also announced that a credit of USD 168.65 would be applied to the invoice for the migration fees, corresponding to 143 registrations billed at USD 1 and 171 registrations billed at USD 0.15. This credit offset the cost of re-registration. Crossref further confirmed that the Société botanique d'Occitanie could now use its DOI prefix 10.34971 to register new articles or older articles without a DOI. This confirmation marked the operational completion of the migration (Table 4).

Table 4. Quantitative summary of the migration of the 314 historical DOIs of *Carnets botaniques* from DataCite to Crossref. P. Coulot, CC-BY-NC-ND.

Indicator	Result
 Historical articles concerned (total number of DOIs to be migrated)	314
 First article deposited separately (as a test)	1 (article no. 313) DOI retained: 10.34971/XWV8-PH95
 Articles included in the main batch (after the test)	313
 Bibliographic references submitted in the batch	9 671
 XML deposit file (Crossref schema 5.5.0)	Approximately 3.57 MB
 Batch identifier	sbocc-historical-313-20261009
 Crossref submission ID	1771950540
 Notices accepted in the main deposit (Crossref processing report)	313 / 313 (100 %) (no errors)
 Warnings reported (for the main deposit)	0
 Errors reported (for the main deposit)	0
 Amount charged by Crossref (registration fees, Q4 2026)	168.65 USD (143 × 1 USD + 171 × 0.15 USD)
 Prefix retained and reusable (for new articles)	10.34971 Yes, confirmed by Crossref

7.3. Verification and significance of the result

The journal then spot-checked the presence of articles in Crossref and the retention of their DOIs; approximately twenty articles were checked in total. This confirmed that the historical identifiers had been retained. The technical success of the re-registration is therefore supported by two complementary elements: Crossref's deposit-acceptance report and the Société botanique d'Occitanie's checks of publicly accessible records.

Coordination between the two registration agencies was also monitored with Inist-CNRS through the PID OPIDoR service. The service quickly informed SBOcc that DataCite International had received confirmation from Crossref and was to carry out the necessary operations concerning the former registered DOIs. This information confirms the agencies' excellent coordination.

The result has practical implications for other journals: it shows that a historical corpus can change registration agency without losing its identifiers, provided that the metadata are prepared, the relevant contacts are coordinated, and the migration is checked.

8. From DOIs to scholarly visibility platforms: researcher networks, indexing, and metadata reuse

8.1. Different functions behind an apparent similarity

Registering a DOI does more than provide a stable link to an article. It also creates an anchor for the circulation of bibliographic data between separate infrastructures. Organizations that register DOIs must therefore be distinguished from services that use them to find, display, link, or share publications. This distinction clarifies Crossref's role in the contemporary documentary architecture (Hendricks *et al.*, 2020; Meadows *et al.*, 2019).

- *ResearchGate* and *Academia.edu* are researcher-profile networks or platforms: they allow users to showcase works, compile a publication list, and, under certain conditions, share files.
- *Google Scholar* and *Semantic Scholar* are scholarly discovery and indexing services.
- *OpenAlex* builds an open graph of works, authors, institutions, and bibliographic relationships.
- *HAL* and *Zenodo* are repository and dissemination infrastructures.
- *Zotero* is reference-management software.
- The *Biodiversity Heritage Library (BHL)* is a heritage digital library specializing in biodiversity literature, combining digitization, access to historical publications, document identification, and discovery services.

These services are not interchangeable, and none should be confused with Crossref or a DOI registration agency. Table 5 presents their principal functions, without excluding the possibility that each service offers other tools. The presence of a publication on a platform, its discoverability in a search engine, the availability of its full text, and the quality of its record are four distinct properties.

Table 5. Main platforms for the dissemination, discovery, and bibliographic management of scholarly publications: functions and relationships with DOI identifiers. P. Coulot, [CC-BY-NC-ND](#).

Examples	Catégorie	Main use	Possible relationship to the DOI
 ResearchGate  Academia.edu	 Scholarly networks	Profiles, dissemination, exchanges, possible file sharing.	 DOI as an identification key; origin of records varies.
 Google Scholar  Semantic Scholar	 Discovery engines	Identification, linking of versions and citations.	 Multifaceted indexing; Crossref ingestion not assumed to be systematic.
 OpenAlex	 Open bibliographic database	Linked data on works, authors, institutions and citations.	 Reuse and linking of metadata, including DOIs.
 HAL  Zenodo	 Archives and repositories	Deposit, access and preservation according to their own policies.	 DOI possible as an identifier for a resource or link to a publication.
 Zotero	 Reference management	Collection, organization and citation.	 Import records via DOI and other sources.
 BHL Biodiversity Heritage Library (BHL)	 Digital library for heritage collections	Access to historical literature on biodiversity (books, journals and archives), digitization and discovery services.	 Retrospective DOIs for certain documents; stable links to collections and pages.

8.2. Crossref's role in the circulation of records

As noted above, the publisher sends Crossref a structured set of metadata associated with the DOI: title, authors, source, dates, links, and, where available, abstracts, additional identifiers, and cited references. Crossref makes this information available through search services and, above all, its REST API. Third



parties can then consult or enrich it, or compare it with other datasets. Deposited metadata do not, however, ensure immediate indexing or uniform coverage by all services (Hendricks *et al.*, 2020; Crossref, 2020). The time taken by each party to retrieve these data naturally varies, but in practice we found it to be very short, on the order of a few days (for example, between Crossref and ResearchGate).

A simplified chain is: publication by the journal → metadata deposit with Crossref → exposure of those metadata through the REST API → possible reuse by third-party services → discovery by the reader. In reality, there are many pathways: harvesting of the journal website, metadata embedded in HTML pages, institutional feeds, author input, and aggregated databases also play a part. It would therefore be inaccurate to portray ResearchGate or Google Scholar as simple Crossref interfaces.

8.3. ResearchGate: visibility, identification, and documentary ambiguities

ResearchGate is particularly instructive because it combines researcher profiles, bibliographic records, and possible text sharing. A correctly registered DOI can help resolve ambiguity about a publication, retrieve it, and link it to its version of record. However, the existence of a Crossref DOI guarantees neither the creation of a ResearchGate record nor the accuracy of an existing one. The platform's precise collection and updating mechanisms should not be inferred solely from the existence of a Crossref API.

A published article, its accepted manuscript, a preprint, and an associated dataset must also be distinguished. Different versions of the same work may legitimately have different DOIs, provided that their nature and relationships are correctly documented. Conversely, uncoordinated deposits may generate duplicate records or misleading links. The existence of several DOIs associated with the same work is therefore not necessarily an error: they must be interpreted in light of the version identified, the provenance of the registration, and the relationships declared among the objects (NISO, 2026).

8.4. DOIs, access to full text, and dissemination rights

The presence of a record in a scholarly network does not mean that the full text is freely available. Likewise, a resolved DOI may lead to an information page, an open resource, or content subject to access conditions. File-deposit arrangements on third-party platforms must be assessed in light of the rights of the author and publisher and the applicable licences. A DOI is an instrument for identification and linking, not a dissemination licence or a guarantee of archiving.

8.5. Practical consequences for *Carnets botaniques*

The migration of the 314 historical DOIs of *Carnets botaniques* to Crossref now enables its records to be exposed in an environment widely used by bibliographic services. The 9,671 references transmitted with the historical batch also constitute a database that may improve documentary relationships between the journal's articles and the references they cite.

In parallel with this migration, *Carnets botaniques* now has a dedicated page on ResearchGate (<https://www.researchgate.net/journal/Carnets-botaniques-2727-6287>). It identifies the journal and its editor-in-chief, whose role has now been confirmed by the platform. This page gives *Carnets botaniques* an additional point of visibility within the scientific community. This was not the case when DataCite was the registration agency.

It would nevertheless be premature to conclude that the visibility of articles on ResearchGate, Google Scholar, or OpenAlex will automatically increase: any such effect must be documented empirically, platform by platform. As an example, however, the journal's ResearchGate page shows in real time the number of researchers who have consulted at least one journal article during the current year; regular monitoring of this figure will provide a rapid indication of any increase in the visibility of *Carnets botaniques* resulting from the migration.

To go further, a reproducible protocol could select a sample of articles from several years, record for each its DOI, its presence, and the quality of its record on Crossref, OpenAlex, Google Scholar, and ResearchGate, and then repeat the observation after a defined period.

9. DOIs, copyright, open access, and reuse licences

9.1. Clearly distinguishing these concepts

Identifying a scholarly publication says nothing about how it can be accessed or the rights attached to its reuse. Those matters depend on the journal's own choices. The DOI determines neither the conditions under which the publication can be consulted nor the permitted uses of its content. Likewise, making an article available free of charge does not automatically mean that it can be freely reproduced, adapted, or redistributed.

A distinction must therefore be made between the dissemination and funding models associated with "open access" and the licences governing the reuse of publications. For example, the "Diamond Open Access" model applies to a publication available free of charge to readers and with no publication fees for authors. A CC BY-NC-SA licence, meanwhile, defines the legal conditions for reusing the content, irrespective of its funding model.

This section describes the principal routes to open access (9.2), Creative Commons licences (9.3), and methods for declaring licence information in Crossref metadata (9.4).

9.2. The main routes to scholarly open access

As noted above, open access means making scholarly publications available online without a financial barrier for the reader. Several routes are traditionally distinguished (Table 6):

- the **Gold route** is publication made directly accessible on the journal website, with or without Article Processing Charges (APCs) payable by authors;
- the **Green route** is based on depositing an authorized version of the article in an open institutional or disciplinary repository, possibly after an embargo period;
- the **Diamond model**, sometimes called Platinum, refers to open-access journals that charge neither readers nor authors, generally but not always supported by public institutions or learned societies.

These categories are not mutually exclusive: a Diamond journal also follows the Gold route in the sense that it is disseminated immediately by the publisher. These dissemination arrangements say nothing about reuse licences; restrictions imposed by some licences may limit compliance with the most demanding definitions of open access.

Carnets botaniques therefore follows the Diamond Open Access model, with no publication fees for authors and free access for readers. Articles are distributed under a CC BY-NC-SA 4.0 licence, which permits non-commercial reuse subject to attribution and the sharing of adaptations under the same terms (see Section 9.3).

Table 6. The main routes to scholarly open access: dissemination arrangements, publication fees, and characteristics. P. Coulot, [CC-BY-NC-ND](#).

Route	Principle	Fees for authors	Characteristics
Gold Open Access	Publication immediately accessible on the journal's website.	Possible (APC), but not systematic.	Free access to the published version of the article.
Green Open Access	Deposit of an authorised version of the article in an institutional or subject-based open repository.	Generally no fee for the deposit.	Possible embargo and restrictions depending on the publisher's policy.
Diamond Open Access	Publication immediately accessible on the journal's website.	None.	No fees for readers or authors; funding provided by institutions, learned societies or public funds.
Hybrid Open Access	Open access publication of individual articles in a subscription-based journal.	Generally APCs.	Coexistence of open access articles and subscription-based articles.

9.3. Creative Commons licences: a range of permissions

Creative Commons (CC) licences are international standards through which a rights holder may grant certain permissions to the public in advance, subject to defined conditions. They do not replace copyright,



but rely on it. They were introduced in 2001 under the impetus of Lawrence Lessig, a professor of law at Stanford University (Lessig, 2004).

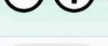
In practical terms, a journal publisher independently selects the licence appropriate to its dissemination policy and states it on its publications, without any further procedure.

A CC licence combines several conditions: BY requires attribution; SA requires adaptations to be shared under the same or a compatible licence; NC limits commercial uses; and ND prohibits the public sharing of adaptations, while allowing them to be made privately, subject to the licence's other conditions.

These combinations produce six main licences (Table 7). CC0 follows a different logic: it is intended to waive rights to the extent permitted by law and, failing that, to grant very broad permissions (Creative Commons, s.d.).

Compatibility with demanding definitions of open access should not be inferred from the CC acronym alone: the NC and ND clauses restrict certain uses. For research articles, CC BY is often preferred when the objective is to allow broad reuse with attribution; the specific choice nevertheless depends on editorial policy and the rights actually held by the authors or publisher (BOAI, 2002; Creative Commons, s.d.).

Table 7. Comparison of the six Creative Commons licences and the CC0 instrument: reuse possibilities and main restrictions. P. Coulot, [CC-BY-NC-ND](#).

License	Permitted reuse	Key restriction
 CC BY	Sharing and adaptation, including commercial use	 Attribution
 CC BY-SA	Sharing and adaptation, including commercial use	 Attribution; share alike
 CC BY-ND	Sharing, including commercial use	 Attribution; no sharing of adaptations
 CC BY-NC	Sharing and adaptation for non-commercial use only	 Attribution; non-commercial use
 CC BY-NC-SA	Sharing and adaptation for non-commercial use only	 Attribution; non-commercial use and share alike
 CC BY-NC-ND	Non-commercial sharing with no adaptation	 Attribution; non-commercial use and no derivatives
 CC0	As free to reuse as possible	 Waiver of rights within the limits of applicable law

9.4. Licence information in Crossref metadata

Crossref allows licence information to be declared using access and licence metadata, including `license_ref` elements containing the URL of the applicable terms. The declaration does not in itself constitute legal validation of the licence. Services that reuse the metadata can use this information to indicate rights and access conditions, although it is not necessarily taken up automatically (Crossref, 2024).

For an independent journal, good practice is to display the licence explicitly and consistently on each article page and, if possible, in the PDF, and then to include an accurate licence URL in the deposited metadata. As noted above, the licence must not be inferred from the fact that the site is free to access. In the case of *Carnets botaniques*, the rights policy actually applicable to the articles was established before this information was entered in Crossref.

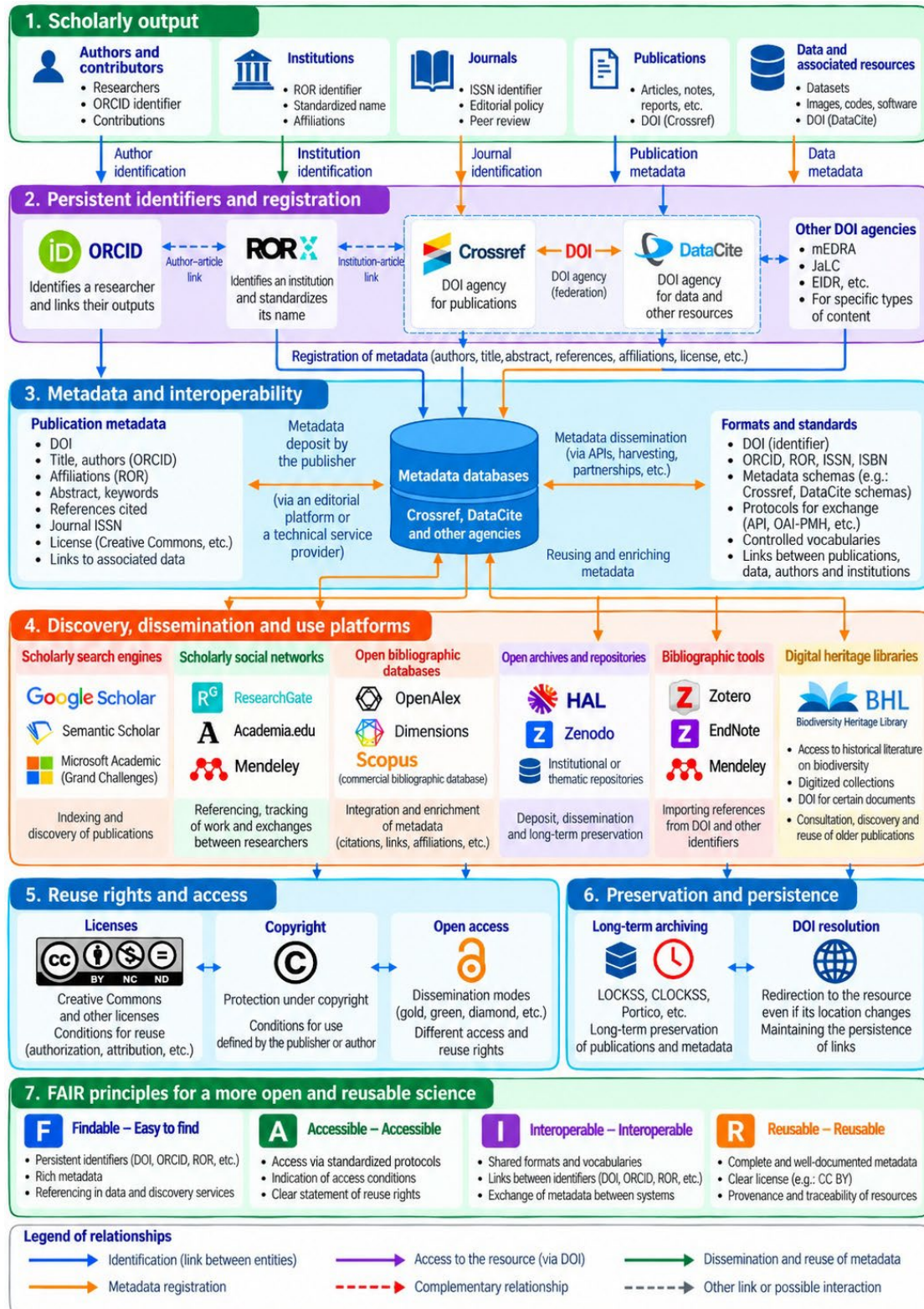


Figure 4. The architecture of digital scholarly publishing: stakeholders, persistent identifiers, metadata, discovery and dissemination platforms, reuse rights, resource preservation, and the FAIR principles.
P. Coulot, CC-BY-NC-ND.



10. The documentary architecture: an overview

Figure 4 brings together on a single page the stakeholders discussed in this article: identifiers for people (ORCID), organizations (ROR), journals (ISSN), and scholarly objects (DOI); agencies that register DOIs; platforms that make works visible; and legal entities governing their reuse. It also presents the main routes to open access: Gold, Green, and Diamond.

The flows represented by arrows are not mandatory transfers: Google Scholar, ResearchGate, OpenAlex, and Zotero have different collection mechanisms and may combine several sources. Crossref does not "publish" articles on their behalf, and Creative Commons does not "issue" DOIs. Reading the architecture in layers helps clarify the contribution of each mechanism without confusing their respective functions.

11. Practical recommendations for independent journals

The experience of *Carnets botaniques* enables us to offer several recommendations for independent scholarly journals operated by small organizations without substantial administrative structures. Integrating the architecture of digital publishing is generally experienced as a complex obstacle course, marked by concepts and acronyms that are not always self-explanatory. Only rigour and a progressive methodology allow these operations to be carried out with confidence. These recommendations concern both newly established journals and those seeking to modernize an existing infrastructure or change DOI registration agency.

11.1. Establishing a digital publishing infrastructure

Creating a digital scholarly journal begins with publishing files on a website, but does not end there. It also involves defining an editorial identity, establishing clear publication procedures, and maintaining an infrastructure that enables articles to be identified, cited, and consulted over the long term.

A chronological approach can be followed, from defining the editorial project through to maintaining publications. In sequence, it includes obtaining an ISSN; choosing a DOI registration agency and structuring metadata according to its specifications; defining the legal conditions of dissemination by selecting licences; and, where appropriate, implementing mechanisms that support content preservation. Table 8 sets out the main stages in this process.

Although presented here in a particular order, these stages do not constitute a rigid sequence of operations. Except for obtaining the ISSN, which appears to be priority No. 1, some phases can be conducted simultaneously, for example choosing an agency, compiling the XML file, and selecting CC licences. Their implementation will naturally depend on the publishing organization's human, technical, and financial resources. A journal may also rely on sponsor organizations, known as Sponsoring Organizations or Crossref Sponsors, to register its DOIs. The largest in France include OpenEdition and Métopes, although there are many others. Major organizations worldwide include PKP, which develops Open Journal Systems (OJS), SciELO (Scientific Electronic Library Online), and Lyris. Depending on their status, they offer free or paid services.

Particular attention must be paid to metadata quality from the first publications onward. The DOI, author identification through ORCID, organization identification through ROR where an identifier exists, inclusion of the ISSN, structured bibliographic references, and explicit indication of reuse licences all facilitate record interoperability and their use by documentary services.

11.2. Preparing and securing a DOI transfer between registration agencies

Transferring DOIs between registration agencies is a relatively exceptional operation. It must be prepared rigorously to ensure that historical identifiers are retained. The experience of *Carnets botaniques* shows that such a migration can be carried out without changing existing DOIs.

For the practical implementation of this operation, see Section 7.

**Table 8.** Recommended process for integrating an independent scholarly journal into the digital publishing architecture. P. Coulot, CC-BY-NC-ND.

Step	Recommended action	Relevant organization or tool
1. Editorial identity	Define the journal title, subject scope, publisher, editorial board, peer-review procedures and editorial policy.	Publishing association Editorial board
2. Publication website	Create a stable website with a persistent address, a dedicated page for each article and access to the full text.	Journal website CMS or publishing platform
3. Journal identification (ISSN)	Request an ISSN (and, if applicable, an ISSN-L) and display it on the website and in the publications.	ISSN Centre France (BnF) ISSN Network
4. DOI registration	Choose a registration agency and define the membership arrangements, either directly or via a sponsoring organization.	 (or sponsoring organization)
5. Metadata	Structure the records: titles, authors (with ORCID), affiliations (with ROR), ISSN, abstracts, references, dates and licenses, using a standardized schema.	 Crossref or DataCite schemas
6. Deposit and resolution	Register the DOIs, check the deposit reports and verify that the identifiers resolve to the article pages.	 Resolve at https://doi.org/
7. Rights and open access	Define the authors' rights, specify the conditions for dissemination and adopt an appropriate reuse license.	Creative Commons Journal editorial policy
8. Visibility and discovery	Facilitate indexing and explore possibilities for referencing in services adapted to the discipline.	 Other services depending on the discipline
9. Preservation	Plan regular backups, maintain the files and, if possible, set up a long-term archiving solution.	Publisher's infrastructure Archiving services (e.g.: LOCKSS, Portico, etc.)
10. Monitoring and maintenance	Regularly check the DOIs, the accuracy of the metadata, links to the articles, licenses and presence in discovery services.	 Monitoring and tracking tools

11.3. Ensuring the visibility and long-term availability of publications

Assigning DOIs alone guarantees neither the visibility nor the preservation of publications. A journal must ensure the stability of landing pages, update its metadata, and periodically verify the presence and accuracy of its records in the principal discovery services. Explicitly defining reuse licences also contributes to interoperability and the application of the FAIR principles.

Long-term content availability also requires regular backups and, where possible, appropriate archiving systems. These operations must form part of a sustainable document-maintenance policy proportionate to the publishing organization's resources.

11.4. Website hosting security and long-term preservation of publications

The long-term preservation of scholarly publications is a major concern. Nothing would be more damaging to a journal than to establish all the procedures described above only to lose its visibility because its data were not preserved for technical reasons. Articles must remain physically preserved, intact, and accessible over time. Four levels of protection should be distinguished:

- the security of the IT hosting environment;
- data backup and restoration;
- continuity of dissemination;
- long-term digital archiving.

a) The first requirement concerns the **reliability of the infrastructure** hosting the journal website. Using a specialist provider such as OVHcloud, as *Carnets botaniques* does, or an institutional infrastructure with appropriate safeguards can limit certain risks: hardware failures, service interruptions, and cyberattacks. Although this is not an absolute guarantee against such problems, declining to use these structures and choosing to host the website independently would expose the journal to major and irreversible risks.

b) **Regular backups** are also essential. Ideally, they should include article PDFs, illustrations, databases, metadata, editorial files, and the components required to rebuild the website. Several copies should be kept,





at least one of them on a medium separate from the main server. Restoration tests must also be conducted. The respective roles of the host, webmaster, and publisher must be precisely defined in a procedure.

c) **Website availability** is another major objective. Temporary interruptions are acceptable, but several rare events must be anticipated: the permanent closure of the journal, the cessation of the publisher's activities, and infrastructure obsolescence. They must not result in the journal becoming permanently unavailable.

d) **Long-term preservation** is not an obligation, but provides important security, especially as data volumes grow. It requires systems specifically designed to preserve scholarly resources over several decades. Four deserve particular attention:

- **The LOCKSS** (Lots of Copies Keep Stuff Safe) Program, created by Stanford University, is an organization of several institutions that maintain multiple copies of the same digital content. Periodic comparison of these copies makes it possible to detect and correct certain file alterations (LOCKSS Program, s.d.).

- **CLOCKSS** (Controlled LOCKSS) uses LOCKSS technology but extends it internationally across libraries and scholarly publishers. Content is preserved within this extensive network and is not publicly accessible. Its aims include guaranteeing access to scholarly resources even when their publisher is no longer able to disseminate them (CLOCKSS, s.d.).

- **Portico** is a digital-preservation service developed by ITHAKA, the non-profit organization that also manages the JSTOR digital library. It provides shared infrastructure for preserving electronic publications and monitors their integrity and long-term technical viability (Portico, s.d.).

- **The PKP Preservation Network** (PKP PN), developed by the Public Knowledge Project, is another option, particularly well suited to small independent scholarly journals. Based on LOCKSS technology, the network provides distributed preservation of content published using the open-source Open Journal Systems software (see Section 11.1). Its chief advantage is that the service is free for journals using OJS. It is therefore a particularly attractive solution for journals with limited financial resources (Public Knowledge Project, s.d.).

The main characteristics of these systems are compared in Table 9.

Table 9. Comparison of the main digital-preservation systems for scholarly publications. P. Coulot, [CC-BY-NC-ND](#).

Criterion	LOCKSS	CLOCKSS	Portico	PKP Preservation Network
Nature of the service	Open-source technology and distributed preservation networks	International cooperative archive based on the LOCKSS technology	Shared digital preservation service	Preservation network for journals using OJS (based on LOCKSS)
Organization	Program developed by Stanford Libraries; networks managed by their members	Independent non-profit organization governed by libraries and publishers	Service operated by ITHAKA, a US-based non-profit organization	Developed by the Public Knowledge Project (PKP)
Technical principle	Multiple copies, regular comparison and file repair	Distributed copies with integrity checks (LOCKSS technology)	Controlled preservation of files and long-term format management	Distributed preservation of OJS content (LOCKSS technology)
Types of content	Journals, books, conference proceedings, websites and other digital resources	Journals, books, conference proceedings and other scholarly publications	Journals, books, conference proceedings and other scholarly publications	Journals published with OJS (articles, issues, metadata, files)
Access to content	According to the rules of the participating network (notably local access in case of unavailability)	Closed archive, public release after a triggering event	Closed archive, access according to the agreements and triggering events	Closed archive, public release according to the conditions of the PKP PN network
Participation model	Participation in a network or deployment of a LOCKSS infrastructure	Preservation agreement with CLOCKSS (publishers or libraries)	Preservation agreement with Portico (publishers or libraries)	Registration for journals using OJS (according to eligibility criteria)
Format management and longevity	Preservation of original files; repair from redundant copies	Integrity checks and format migration when necessary	Integrity checks, format normalization and migration	Preservation of OJS files, management of updates and formats
Main strengths	Decentralization, institutional control of copies, open-source technology	Cooperative preservation and public access to triggered content	Specialized preservation service and document management	Free service for eligible journals (using OJS)
Key limitations	Requires institutional participation; access rules vary between networks and do not cover all publications	Fee-based service; archiving subject to a triggering event; does not replace the routine management of the journal website	Fee-based service; access conditions defined contractually; does not replace the routine management of the journal website	Restricted to journals using OJS; subject to eligibility criteria; does not cover content outside OJS

12. Conclusion

The architecture of digital scholarly publishing is based on the interaction of mechanisms with distinct functions:

- persistent identifiers make it possible to recognize objects, people, and organizations;
- registration agencies maintain DOI records;
- structured metadata support discovery and exchange;
- platforms make works findable or accessible according to their own rules;
- licences specify the conditions for reuse;
- finally, archiving strategies address preservation.

The FAIR principles provide a cross-cutting analytical framework, but no single tool is sufficient to satisfy them.

For independent journals, the challenge is not limited to owning a prefix. It consists in establishing a sustainable chain of responsibilities, from describing articles through maintaining links and preserving content. The migration of *Carnets botaniques* illustrates the possibility of fully preserving historical identifiers while changing their registration framework. It also reminds us that a successful operation depends on precise documentary and technical work that is often largely invisible to the end reader.

Statement on the use of artificial intelligence

The figures and tables presented in this article were produced with the assistance of ChatGPT (OpenAI), under the supervision of the author, who defined their content and retains full scientific responsibility for them.

References and web resources

- Bibliothèque nationale de France (BnF), s.d. Qu'est-ce que l'ISSN ? <https://www.bnf.fr/fr/quest-ce-que-lissn> [14/10/2026].
- Biodiversity Heritage Library (BHL), s.d. About the Biodiversity Heritage Library. <https://about.biodiversitylibrary.org/> [14/10/2026].
- BOAI (Budapest Open Access Initiative), 2002. Read the Budapest Open Access Initiative, <https://www.budapestopenaccessinitiative.org/read/> [14/10/2026].
- Centre international de l'ISSN, s.d. Le réseau ISSN, <https://www.issn.org/the-centre-and-the-network/our-organization/le-reseau-issn-en/?lang=en>.
- Cioffi A., Coppini S., Massari A., Moretti A., Peroni S., Santini C. & Asadi N.-S., 2022. Identifying and correcting invalid citations due to DOI errors in Crossref data. *Scientometrics* 127 : 3593-3612, <https://doi.org/10.1007/s11192-022-04367-w>.
- CLOCKSS, s.d. How CLOCKSS Works. CLOCKSS Archive. <https://clockss.org/about/how-clockss-works/> [21/10/2026].
- Cousijn H., Braukmann R., Fenner M., Ferguson C., van Horik R., Lammey R., Meadows A. & Lambert S., 2021. Connected research: the potential of the PID Graph. *Patterns* 2 (1): 100180, <https://doi.org/10.1016/j.patter.2020.100180>.
- Creative Commons, s.d. About CC Licenses, <https://creativecommons.org/share-your-work/cclicenses/> [10/10/2026].
- Crossref, 2020. REST API. Documentation officielle, <https://www.crossref.org/documentation/retrieve-metadata/rest-api/> [10/10/2026].
- Crossref, 2022. Transferring prefixes between different Registration Agencies, documentation technique, <https://www.crossref.org/documentation/register-maintain-records/creating-and-managing-dois/prefix-transfers-other-ra/> [10/10/2026].
- Crossref, 2024. License information, documentation technique relative aux licences et aux indicateurs d'accès (Access Indicators), <https://www.crossref.org/documentation/schema-library/markup-guide-metadata-segments/license-information/> [13/10/2026].
- Crossref, 2026. Metadata deposit schema 5.5.0, documentation technique. <https://www.crossref.org/documentation/schema-library/metadata-deposit-schema-5-5-0/> [10/10/2026].



- Dacos M., 2019. Des nains sur les épaules de géants : ouvrir la science en France. *Revue Politique et Parlementaire*. (hal-02366604).
- DataCite Metadata Working Group, 2026. DataCite Metadata Schema, version 4.7, <https://schema.datacite.org/https://schema.datacite.org/> [10/10/2026].
- DataCite, 2026. Prefix Transfers and Aliasing, documentation technique, <https://support.datacite.org/docs/prefix-transfers-and-aliasing> [10/10/2026].
- Delgado-Quirós L. & Ortega J.L., 2024. Completeness degree of publication metadata in eight free-access scholarly databases. *Quantitative Science Studies* 5 (1) : 31-49, https://doi.org/10.1162/qss_a_00286.
- DOI Foundation, s.d.-a. DOI Handbook, <https://www.doi.org/doi-handbook/html/> [10/10/2026].
- DOI Foundation, s.d.-b. Existing Registration Agencies, <https://www.doi.org/the-community/existing-registration-agencies/> [10/10/2026].
- DOI Foundation, s.d.-c. What Are Registration Agencies? <https://www.doi.org/the-community/what-are-registration-agencies/> [10/10/2026].
- GO FAIR Foundation, s.d. The FAIR guiding principles, <https://www.go-fair.org/fair-principles/> [10/10/2026].
- Hendricks G., Tkaczyk D., Lin J. & Feeney P., 2020. Crossref: the sustainable source of community-owned scholarly metadata. *Quantitative Science Studies* 1 (1) : 414-427, https://doi.org/10.1162/qss_a_00022.
- International Organization for Standardization (ISO), 2022. Information et documentation. Numéro international normalisé des publications en série (ISSN). Norme ISO 3297:2022, <https://www.iso.org/fr/standard/84536.html>.
- Jones S.M., Van de Sompel H., Shankar H., Klein M., Tobin R. & Grover C., 2016. Scholarly context adrift: three out of four URI references lead to changed content. *PLOS ONE* 11 (12) : e0167475, <https://doi.org/10.1371/journal.pone.0167475>.
- Kahn R. & Wilensky R., 2006. A framework for distributed digital object services. *International Journal on Digital Libraries* 6 : 115-123, <https://doi.org/10.1007/s00799-005-0128-x>.
- Klein M., Van de Sompel H., Sanderson R., Shankar H., Balakireva L., Zhou K. & Tobin R., 2014. Scholarly context not found: one in five articles suffers from reference rot. *PLOS ONE* 9 (12) : e115253, <https://doi.org/10.1371/journal.pone.0115253>.
- Lessig L., 2004. *The Creative Commons*. *Montana Law Review* 65 (1) : 1-15.
- LOCKSS Program, s.d. What is LOCKSS? Stanford University Libraries, Stanford. <https://www.lockss.org/about/what-lockss> [21/10/2026].
- McMurry J., Juty N., Blomberg N., Burdett T., Conlin T., Conte N., Courtot M., Deck J., Dumontier M., Fellows D., Gonzalez-Beltran A., Gormanns P., Grethe J., Hastings J., Hériché J.-K., Hermjakob H., Ison J., Jimenez R., Jupp S., Kunze J., Laibe C., Le Novère N., Malone J., Martin M.-J., McEntyre J., Morris C., Muilu J., Müller W., Rocca-Serra P., Sansone S.-A., Sariyar M., Snoep J., Soiland-Reyes S., Stanford N., Swainston N., Washington N., Williams A., Wimalaratne S., Winfree L., Wolstencroft K., Goble C., Mungall C., Haendel M. & Parkinson H., 2017. Identifiers for the 21st century: how to design, provision, and reuse persistent identifiers to maximize utility and impact of life science data. *PLOS Biology* 15 (6) : e2001414, <https://doi.org/10.1371/journal.pbio.2001414>.
- Meadows A., Haak L.L. & Brown J., 2019. Persistent identifiers: the building blocks of the research information infrastructure. *Insights* 32 : 9, <https://doi.org/10.1629/uksg.457>.
- National Information Standards Organization (NISO), 2026. Journal Article Versions (JAV). NISO Recommended Practice RP-8-2026, <https://doi.org/10.3789/niso-rp-8-2026>.
- OpenAlex, s.d. OpenAlex Help Center, <https://docs.openalex.org/> [13/10/2026].
- ORCID, s.d. À propos d'ORCID, <https://info.orcid.org/what-is-orcid/> [13/10/2026].
- Paskin N., 2002. Digital object identifiers. *Information Services & Use* 22 (2-3) : 97-112, <https://doi.org/10.3233/ISU-2002-222-309>.
- Portico, s.d. – Our Work. Portico, ITHAKA. <https://www.portico.org/our-work/> [21/10/2026].
- Public Knowledge Project, s.d. – PKP Preservation Network. Public Knowledge Project. <https://pkp.sfu.ca/pkp-pn/> [28/10/2026].
- Research Organization Registry (ROR), s.d. About ROR, <https://ror.org/about/> [13/10/2026].
- ResearchGate, s.d. Help Center, <https://help.researchgate.net/> [13/10/2026].
- Shotton D., 2013. Publishing: Open citations. *Nature* 502 : 295-297, <https://doi.org/10.1038/502295a>.
- Shotton D., Portwin K., Klyne G. & Miles A., 2009. Adventures in semantic publishing: exemplar semantic enhancements of a research article. *PLOS Computational Biology* 5 (4) : e1000361, <https://doi.org/10.1371/journal.pcbi.1000361>.



Wilkinson M.D., Dumontier M., Aalbersberg I.J., Appleton G., Axton M., Baak A., Blomberg N., Boiten J.-W., Bonino da Silva Santos L., Bourne P.E., Bouwman J., Brookes A.J., Clark T., Crosas M., Dillo I., Dumon O., Edmunds S., Evelo C.T., Finkers R., Gonzalez-Beltran A., Gray A.J.G., Groth P., Goble C., Grethe J.S., Heringa J., 't Hoen P.A.C., Hooft R., Kuhn T., Kok R., Kok J., Lusher S.J., Martone M.E., Mons A., Packer A.L., Persson B., Rocca-Serra P., Roos M., van Schaik R., Sansone S.-A., Schultes E., Sengstag T., Slater T., Strawn G., Swertz M.A., Thompson M., van der Lei J., van Mulligen E., Velterop J., Waagmeester A., Wittenburg P., Wolstencroft K., Zhao J. & Mons B., 2016. The FAIR Guiding Principles for scientific data management and stewardship. *Scientific Data* 3 : 160018, <https://doi.org/10.1038/sdata.2016.18>.

Acknowledgements – I thank Grégory Ravaz, webmaster of the Société botanique d'Occitanie, for preparing and validating the XML files and for his decisive role in re-registering the historical DOIs of *Carnets botaniques*. I also thank the Crossref teams, particularly Collin Knopp-Schwyn and Lara Mattos, and the Inist-CNRS teams, especially Julie Solviche, for their support.

