

# Recommendations for improving aspects of institutional publishing platforms



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## D6.3 – Recommendations for improving aspects of institutional publishing platforms

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This report focuses on OpenAIRE's technical workflows for the development of an integrated scholarly communication framework, and presents the results of a survey launched with an aim to collect information on the current standards of institutional publishing platforms and stand-alone scientific journals. It also suggests a minimum set of common functionalities for electronic publishing platforms that will enhance interoperability across the different elements of Open Science.



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## Acronyms

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APC	Article Processing Charges
API	Application Programming Interface
CAP	(OpenAIRE) Content Acquisition Policy
COAR	Confederation of Open Access Repositories
CRIS	Current Research Information Systems
DOAJ	Directory of Open Access Journals
GUI	Graphic User Interface
ISG	(OpenAIRE) Information Space Graph
JATS	Journal Article Tagging Suite
NOAD	National Open Access Desk(s)
OAI- PMH	Open Archives Initiative – Protocol for Metadata Harvesting
OJS	Open Journal Systems
OS	Open Science
PID	Persistent Identifier(s)

# Publishable Summary

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The document focuses on the standards for electronic publishing platforms, and emphasizes their importance in the context of Open Science as the emerging paradigm of scholarly communication. Based on a survey conducted from November 2018 until January 2019 and addressed to hosting infrastructures and operators of institutional publishing platforms and stand-alone journals, the document also identifies important technical aspects in electronic publishing, and provides basic recommendations toward the specification of common interoperability standards and their future implementation across institutional scientific publishing initiatives.

## 1 | INTRODUCTION

Open Science recently emerged as the prevailing scholarly communication paradigm, which reflects the ongoing transitions on how research is performed, researchers collaborate, knowledge is shared and science is organized. Both in its conceptual and practical dimension, Open Science has strong foundations on principles proclaiming openness and reuse of research results. Thus, it entails a wide spectrum of benefits for the research community, research performing organizations, and other stakeholders involved in scholarly communication, as it fosters innovation and enables wider dissemination of knowledge. Moreover, it promotes collaborative efforts that result in a significant increase of the efficiency of research and scientific integrity and effectively addresses the challenges related to data accessibility and interoperability.

As publishing remains the norm in the scholarly communication lifecycle, open access to publications and research data constitutes a key element of Open Science. Yet, the constantly evolving research and dissemination practices result in higher user expectations and infrastructure providers face significant challenges, which are further reproduced by the fragmentation that permeates the Open Access publishing landscape.

In this context, interoperability across publishing platforms, repositories, aggregators, and other digital infrastructures becomes crucial. Its importance has been widely acknowledged, to the extent that the deployment of tools and procedures dedicated to content and metadata identification, authentication, enrichment and discovery is considered essential for the sustainability of publishing initiatives. Thus, an increasing number of international consortia (e.g. NISO, PKP, JATS4R) have been actively engaged in initiatives for the implementation of common operational principles across e-infrastructures and, more importantly, the introduction of quality standards for metadata and digital content.



## 2 | OPENAIRE IN THE OPEN SCIENCE LANDSCAPE

OpenAIRE, the participative Open Scholarly Communication Infrastructure for Research in Europe, promotes innovative ways to explore, communicate and monitor research results. It deploys a technical infrastructure and workflows for an integrated scholarly communication framework and provides a pan-european human network of Open Science experts that offers training and support enabling researchers, content providers, funders and research-performing organizations to adopt Open Science principles.<sup>1</sup>

### 2.1 OpenAIRE services

OpenAIRE has designed a spectrum of services focusing on diverse aspects of Open Science, which address the needs of stakeholders and communities involved in scholarly communication:

#### Content Provider Dashboard

The Content Provider Dashboard<sup>2</sup> is a dedicated portal that provides access to the following tools

- OpenAIRE Validator and Registration: validates and assesses the implementation of OpenAIRE metadata standards and guidelines using OAI-PMH as a transfer protocol and enables the registration of content providers into the OpenAIRE infrastructure
- OpenAIRE Broker: allows repositories, publishers or aggregators to add, correct and enrich their local metadata by receiving notifications for information that is not available in the original collection of the provider (e.g. links to Open Access versions, links to projects, links to datasets and missing publication dates)
- OpenAIRE Usage Statistics: contributes in the evaluation of usage activity on research results and in Open Access content providers. The service collects and analyzes usage data and metrics, such as number of downloads and metadata views of publications.

#### Policy alignment

Based on the belief that infrastructure and policies are two mutually reinforcing elements, OpenAIRE Advance has set up a dedicated task force on Open Science policies. The goal of the task force is to support the development and alignment of OS policies in Europe, with NOADs constituting a core part of this effort through the organisation of awareness-raising and training activities and the active support of national stakeholders. A core element of the task has been the design of resources tailored to the needs of different stakeholders and at different levels of familiarity with the concept of OS/OA and OS/OA policies. To achieve this, the first phase of the Task Force focused on identifying these needs through the use of a variety of activities and tools.

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<sup>1</sup> Schirrwagen, J., Manghi, P., Manola, N., Bolikowski, L., Rettberg, N., & Schmidt, B. (2013). Data Curation in the OpenAIRE Scholarly Communication Infrastructure. *Information Standards Quarterly*, 25(3), 13-19. doi:10.3789/isqv25no3.2013.03

<sup>2</sup> <https://provide.openaire.eu/>

A key output of this effort has been the development of an Open Science Toolkit comprising Templates for Research Performing and Research Funding Organisations and Factsheets.

## Open Science Training

To promote the cultural change for the transition to Open Science, OpenAIRE Advance is committed to train researchers, content providers, and policy makers to acquire the skills and competencies for the practice of Open Science. OpenAIRE has reached a broad and diverse user base through a special train-the-trainer programme via its National Open Access Desks and through other activities such as workshops, webinars, and conferences.

Regarding Open Science policies, a Task Force has supported NOADs and stakeholders interested in the adoption of OS policies through the OS Toolkit and the organisation of dedicated webinars.

## 2.2 OpenAIRE aggregation workflows

Metadata and the corresponding (open access) fulltext of publications are collected from different sources, such as repositories, open access journals, Current Research Information Systems (CRIS), data archives, aggregators and/or entity registries. To ensure compliance with the OpenAIRE standards, support is provided to infrastructure managers for proper collection, validation, and transformation of metadata records according to the OpenAIRE data model. The aggregated data, once indexed, becomes publicly available via the Information Space Graph (ISG), which describes the relationships between research literature, datasets and software as well as authors, funders, grants and associated beneficiaries.

OpenAIRE applies specific workflows for the semantic interlinking of research data, publications and their metadata as well as the de-duplication of digital objects.

### 2.2.1 Metadata aggregation

OpenAIRE implements three complementary metadata aggregation processes:

- Aggregation from data sources that comply with the OpenAIRE content acquisition policy: information packages are collected in XML format from an OAI-PMH endpoint. Content validation may also be enabled to assess the compatibility of collected metadata records; then, the records are transformed and indexed according to the OpenAIRE data model and become accessible via the OpenAIRE ISG.
- Aggregation of information packages from entity registries: information packages are collected in machine-readable format (e.g. XML, JSON, CSV) using one of the supported exchange protocols (OAI-PMH, SFTP, FTP(S), HTTP, REST). Packages are then transformed and indexed according to the OpenAIRE data model and eventually become accessible via the OpenAIRE ISG.

## 2.2.2 Full – text aggregation

Full-text aggregation refers to the collection of files described by metadata records, and text extraction in formats readable by mining algorithms. The main challenge to be addressed relates to maintaining the association between each file and the corresponding metadata record. The full-text collection system is designed to be extensible with new plugins, capable to manage specific html page structures or to be configured to recognize specific URL patterns; in addition, the workflow has been designed to automatically extract structured metadata from PDF files. The extracted full texts are then stored in dedicated caches that are accessible by the OpenAIRE Information Inference System.

## 2.3 The OpenAIRE Guidelines

The OpenAIRE Guidelines<sup>3</sup> refer to the implementation of local data management policies complying with the OpenAIRE Content Acquisition Policy (CAP),<sup>4</sup> which defines the conditions for the inclusion in OpenAIRE of metadata collected from content providers. The latest Guidelines for institutional and thematic repository managers (v. 4.0)<sup>5</sup> were released in November 2018, and provide an overview of how to configure and use the OAI-PMH protocol for metadata harvesting, in order to expose open access and non-open access publications together with funding information.

The current version of the Guidelines have been enriched with descriptions of the application profile and schema, which are based on Dublin Core and DataCite, including a new OAI-metadata prefix. The Guidelines also describe in detail the individual metadata fields (how these are named and mapped to an element, their level of cardinality and properties).

Moreover, the Guidelines document identifier schemes for authors, organizations, funders and scholarly resources, and introduce controlled vocabularies maintained by the Confederation of Open Access Repositories (COAR) that enable the identification of resource attributes in terms of their type, accessibility and versioning. By implementing the Guidelines, repository managers will enable authors who deposit publications in the respective repository to fulfill the EC Open Access requirements (and, eventually, the requirements of other (national or international) funders with whom OpenAIRE cooperates) and to incorporate their publications into the OpenAIRE infrastructure.

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<sup>3</sup> <https://guidelines.openaire.eu/en/latest/>

<sup>4</sup> <https://doi.org/10.5281/zenodo.1446408>

<sup>5</sup> <https://doi.org/10.5281/zenodo.1299203>

## 3 | PUBLISHING PLATFORMS – INTEROPERABILITY STANDARDS

### 3.1 Open Journal Systems (OJS)

Open Journal Systems (OJS) is the most widely used online publication management system. It is based on an open source platform developed by the Public Knowledge Project (PKP), and supported by a global community of developers. Its architecture is plugin-oriented and allows integration of new features, tools and functionalities that enhance the platform's interoperability with other systems (aggregators and harvesters, repositories, etc.). The main interoperability features of OJS relate to the support of the OAI-PMH protocol and export of XML-based metadata files.

OJS provides plugins allowing data import and/or export in editable and machine-readable formats. The generated XML files for data export may contain metadata for individual items or collections of articles and/or issues. In the most recent versions of the software, users with administrative rights may proceed in data extraction and/or injection via the Graphic User Interface (GUI). The following plugins have been developed to generate files compatible with the different formats requested by journal indexing services:

- PubMed XML Export Plugin: Exports article metadata in PubMed XML format for indexing in MEDLINE
- DataCite Export/Registration Plugin: Exports and/or registers metadata of publication components (issue, article) and files (galley and supplementary files) in DataCite format
- CrossRef XML Export Plugin: exports automatically or manually article metadata in CrossRef XML, for CrossRef registration
- mEDRA export/registration plugin: exports issue, article and galley metadata in Onix for DOI (O4DOI) format, for DOI registration with mEDRA
- Export DOAJ Export Plugin: exports issue and article metadata to DOAJ either manually or automatically (using the DOAJ API)

OJS integrates components that allow flexible description of objects and handling of metadata schemata and data exchange processes with external infrastructures. An automatically extracted API documentation defines modules, packages and classes corresponding to data element structures such as databases, entities and their relationships. Data is comprehensible and machine-readable, thus allowing third party systems to understand semantic representations and their corresponding metadata schemata, and apply proper queries.

OJS also supports the OAI protocol. It can harvest metadata in a variety of schemata (including unqualified Dublin Core, the PKP Dublin Core extension, the Metadata Object Description Schema [MODS], and MARCXML). Additional schemata are also supported by dedicated plugins.

**OpenAIRE plugin:** initially developed for OJS versions 2.4.x, the OpenAIRE plugin modified OJS's OAI-PMH interface according to the OpenAIRE interoperability guidelines, and added an extra metadata element for authors to submit their funded project details. Upon integration in the latest OJS version, the plugin has been further extended to support the JATS (Journal Article Tagging

Suite) standard as additional metadata format in OAI-PMH, as well as the implementation of controlled vocabularies related to COAR's access rights and resource types. The upgraded OJS-OpenAIRE JATS plugin can also be used to integrate with any source of funding information.<sup>6</sup>

## 3.2 DSpace

DSpace is an open source software supported by a community of developers, under the supervision of the non-profit organisation DuraSpace. It is extensively used in repositories and also serves as a content management system in various publishing infrastructures.

DSpace has built-in support of the OAI-PMH protocol for metadata harvesting, and responds to OAI-PMH and selective harvesting requests. It also provides a REST API module and a programmatic interface to DSpace communities, collections, items, and bitstreams. The latest version of the DSpace REST API allows user authorisation to access restricted content as well as create, edit and delete actions for the DSpace objects. It also supports remote deposit of items into the repository, via the SWORD (Simple Web-service Offering Repository Deposit) protocol.

By default, DSpace supports the following metadata formats for harvesting: OAI Dublin Core, Qualified Dublin Core, MODS, ORE, METS, RDF, Marc, ETDMS (Electronic Thesis and Dissertation Metadata Standard) and OpenAIRE. The DSpace OAI implementation is based on XSL Transformations and may extend these schemata, or support new ones. In addition, it has the capacity to filter or modify generated metadata records.

DSpace supports the following file types: bibtext, CSV, TSV, RIS, EndNote and the following online services: arXiv, CrossRef, PubMed, CiNii and the mapping to the repository's schema can be achieved via configuration files.

## 3.3 Technical implementations under the FP7 alternative Funding Mechanism for APC-free Open Access journals and platforms

The Alternative Funding Mechanism for APC-free Open Access journals and platforms was launched under the EC FP7 Post-Grant Open Access Pilot in OpenAIRE2020, with an aim to enhance the technical capacities of individual electronic publishing installations. 11 proposals have been funded with a total allocated budget of €200,000. The proposed implementations focused on metadata integration in publication workflows and procedures, and upgraded the installations' level of interoperability with the OpenAIRE infrastructure. The improvements were mainly applied to OJS-based platforms, along the following lines:

**OJS upgrade:** migration into OJS or upgrades in existing installations using OJS versions 2.x or 3.x. The upgrades related to the development of plugins that improved the platform's functionalities,

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<sup>6</sup> Cf. "Open Journal Systems (OJS) sets new standards to achieve OpenAIRE compliance with JATS". Available at <https://www.openaire.eu/blogs/open-journal-systems-ojs-sets-new-standards-to-achive-openaire-compliance-with-jats>

as well as to enhanced quality and enrichment of metadata (e.g. ORCID integration, addition of funder information - described in detail below).

**Production of XML files:** implementation of technical procedures and workflows to support production of XML files for published articles and encourage the adoption of XML as a standard publication format. The suggested improvements referred to the production of tools allowing authors and/or editors to generate xml files during the submission/editorial process.

**ORCID integration:** collection, indexing and display of author information in an automated manner. The work undertaken relates to the development of authentication mechanisms that enable the association of ORCIDs with new and existing author profiles. Author ORCIDs may now be delivered as metadata elements to third parties, and be displayed as linkable information in the platforms' public interface.

**Funder information:** introduction of funder and project information as standard metadata components and improvement of the relevant procedures, by a) examining and allowing retrieval of funder IDs b) enabling authors to submit funding information c) including funder information as available metadata retrospectively.

**Article-level information transfer to DOAJ:** creation of exportable metadata information in schemata suitable with the DOAJ and other databases and delivery of article metadata via the DOAJ API

Other proposed implementations referred to the integration of altmetrics and DOIs into several installations, the incorporation of anti-plagiarism software and the provision of statistical data.

The technical improvements undertaken within the Alternative Funding framework introduced new features and enhanced functionalities in major OA publishing platforms and journals, thus contributing towards increased integration of metadata with OpenAIRE and other harvesters.

## 4 | THE OPENAIRE SURVEY FOR JOURNAL PUBLISHING PLATFORMS AND STAND-ALONE JOURNALS

In the context of OpenAIRE's focus on interoperability, a survey was launched from November 2018 until January 2019 with an aim to collect information on the current operational and technical standards of institutional publishing platforms and stand-alone scientific journals<sup>7</sup>. The survey questionnaire comprised sections related to journal quality criteria and publication workflows, metadata standards, and platform interoperability. A special section was dedicated to respondents' assessment of the OpenAIRE services, and platform/journal level of integration with the OpenAIRE infrastructure. The total number of responses corresponds to more than 1500 journals hosted in 21 institutional platforms, while 17 responses from stand-alone journals have also been received.

The main findings of the survey are presented below:

### **Platform/Journal operational aspects**

The vast majority of platforms and stand-alone journals receive institutional support, both in terms of funding and effort commitment. Alternative funding sources include community support, grants/endowments and –to a lesser extent- article processing charges (APCs). It appears that platform/journal affiliation to public institutions (research centres, universities) determines their operational model, which strongly relies on researchers' contribution and involvement in various editorial and management processes. Moreover, it reflects the institutions' diverse research activities (there is a balancing trend between different disciplines in terms of subject coverage), as well as their commitment towards the implementation of open access-oriented publishing initiatives (extensive use of CC licenses has been reported).

Responses suggest wide adoption of acknowledged quality standards. Both platform-based and stand-alone journals apply combined publishing policies (peer review, ethics policy, editorial and scientific committees) and are registered in international indexes and databases. In the case of publishing platforms, a range of additional services for authors and/or hosted journals complement the standard editorial processes: these include usage statistics, export of references, training (workshops) for publishers, design of custom user interfaces, plagiarism checks, DOI assignment, advanced search options. Stand-alone journals generate and provide usage statistics.

In most cases, content is available in at least two languages (English and local language). The main publication format is text (pdf, html, xml). In descending order, images (JPEG, TIFF, PNG), multimedia (AVI, MP4, MPG) and data (TXT, CSV, XLS) files are also available.

### **Interoperability and Metadata Standards**

OJS is the most widely used publishing platform. Use of DSpace, Drupal, Wordpress and custom solutions has also been reported. Responses reflect discrepancies in terms of applied technical solutions and interoperability standards. Participants have also acknowledged the importance of standardized processes and enhanced technical functionalities. In several instances, publishing

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<sup>7</sup> <https://www.openaire.eu/blogs/openaire-survey-for-online-journals-and-publishing-platforms>

platforms have been upgraded with additional functionalities and services that improve their interoperability with external infrastructures (e.g. ORCID plugin, JATS plugin). DOI assignment is common practice.

Divergence is observed in terms of applied documentation standards and workflows for the provision of structured metadata for harvesting. In most cases, metadata are generated at article level, with use of controlled vocabularies and thesauri being reported in few cases only. Content-descriptive metadata is available for harvesting in varying degrees of detail. A number of institutional publishing platforms apply uniform metadata quality policies. Most platforms provide metadata through OAI-PMH (use of API has only been indicated once), by using schemata such as OAI\_DC, MARC XML, MODS, the OpenAIRE metadata schema, Datacite, etc. Content licensing and project/article funding information are not always provided in machine-readable format.

The majority of platforms and stand-alone journals apply digital archiving policies, using services such as LOCKSS, Archive.org, PKP's private LOCKSS network, Zenodo and/or institutional preservation infrastructures.

### **OpenAIRE**

Only a limited number of platforms and journals have registered and provide content to OpenAIRE. Responses also suggest a relatively low level of awareness regarding OpenAIRE's services, which have been identified as follows:

- Harvesting and aggregation
- Validation
- Content discovery/visibility
- Usage and access statistics
- Linking with funding and project information
- Deduplication

Overall, OpenAIRE is positively evaluated. Respondents expressed interest in registering or further integrating their platforms, yet it seems that further guidance would be needed on the particular steps to be taken towards increased interoperability with the OpenAIRE infrastructure.



## 5 | RECOMMENDATIONS FOR IMPROVING ASPECTS OF INSTITUTIONAL PUBLISHING PLATFORMS

The current diversity of workflows, operational models and technical standards in electronic publishing shapes a fragmented landscape and highlights the importance of standards that will enable the integration of electronic publishing infrastructures and stand-alone journals into the Open Science ecosystem. To this end, the implementation of a minimum set of common functionalities for electronic publishing platforms becomes a necessity for the achievement of interoperability.

In technical terms, interoperability is supported by the introduction of globally applied communication protocols and procedures that enable data transfer across systems. Most publishing platforms (such as OJS) support proper documentation of digital resources and data disposal to third-party applications. Interoperability also refers to the capacity of communicating systems to process and interpret data. Semantic interoperability strongly relies on the implementation, on behalf of platform managers and journal editorial teams, of processes and workflows that allow uninterrupted provision of content and related metadata in a structured format.

The following list of recommendations refers to technical standards and operational principles that will increase platform interoperability with OpenAIRE:

### **Metadata quality standards, semantic interoperability**

- Use of appropriate knowledge representation languages, and established ontologies (e.g. the Dublin Core ontology) for the documentation of digital resources
- Use of persistent identifiers (PIDs) to facilitate meta-services based on proper element interlinking.
- Metadata value encoding based on established standards (e.g. ISO 639-2 for language, ISO 8601 for dates)
- Use of controlled vocabularies, thesauri and registries (contextual data) for subjects, item types, persons, organizations, places and other metadata elements. Links/references to descriptive labels and PIDs used for metadata description
- Use of common (and appropriate for each information type) metadata schemes to provide identifiable metadata
- If possible, content publication in linked data format, and application of an RDF-based data model to represent metadata
- Links to external resources (e.g. publications, datasets or other primary material in digital format) referred to in published content
- Copyright status and applied licenses delivered in machine-readable format (inclusion of Creative Commons licenses via RDF is recommended)

### Interoperability at system level

- Capacity to provide data to third party applications, through APIs (Application Programming Interfaces) that allow content reuse in real time. Use of standards such as OpenSearch, Search/Retrieve via URL (SRU), Search/Retrieve via Web Service (SRW) and Z39.50
- Implementation of functionalities that allow harvesting (e.g. the OAI-PMH protocol or the ResourceSync protocol).
- Use of open file formats for web dissemination of digital resources, such as: PDF/A (searchable), EPUB v.3, XML and Open Office/ODT

### Long-term preservation

- Long-term commitment to resolving digital resources and apply content preservation and archiving policies
- Provision for at least one remote copy of digital objects and relevant metadata entries, as well as automated processes for remote backup of digital content

The implementation of common standards is the most important step towards full interoperability across the elements of Open Science. The recommendations for institutional publishing platforms address a spectrum of operational and technical aspects that will enable a wider adoption of tools and procedures to ensure content findability, accessibility and interoperability.

## 6 | REFERENCES

- [1] Becker, Amelie, Loeden, Aenne, Manghi, Paolo, Principe, Pedro, & Schirrwagen, Jochen. (2018). OpenAIRE Content Acquisition Policies (Version 1.0). Zenodo. Doi: 10.5281/zenodo.1446408
- [2] Nygård, A.J., Mruck, K. (2019). Open Journal Systems (OJS) sets new standards to achieve OpenAIRE compliance with JATS. Blog post. Available at: <https://www.openaire.eu/blogs/open-journal-systems-ojs-sets-new-standards-to-achive-openaire-compliance-with-jats> (last accessed August 2, 2019)
- [3] Schirrwagen, J., Manghi, P., Manola, N., Bolikowski, L., Rettberg, N., & Schmidt, B. (2013). Data Curation in the OpenAIRE Scholarly Communication Infrastructure. *Information Standards Quarterly*, 25(3), 13-19. doi:10.3789/isqv25no3.2013.03Reference 1
- [4] Schirrwagen, Jochen, & Baglioni, Miriam. (2018). OpenAIRE Guidelines for institutional and thematic repository managers 4.0 (Version 4.0.0). Zenodo. Doi: 10.5281/zenodo.1299203
- [5] Manghi, Paolo, Bardi, Alessia, Atzori, Claudio, Baglioni, Miriam, Manola, Natalia, Schirrwagen, Jochen, & Principe, Pedro. (2019, April 17). The OpenAIRE Research Graph Data Model (Version 1.3). Zenodo. <http://doi.org/10.5281/zenodo.2643199>