

JINR Open Access Repository based on the JOIN² Platform

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Abstract. In recent years, Open Scientific Infrastructures have become an important tool for providing researchers and society with scientific information. Research institutes and universities worldwide actively plan and implement archives of their scientific output. Likewise, the JINR Document Server (JDS — jds.jinr.ru) stores JINR information resources and provides effective access to them. JDS contains numerous materials that reflect and facilitate research activities. Technically, JDS is based on the Invenio software platform developed by CERN. To further improve the services, JDS is now adapting JOIN² workflows. JOIN², also based on Invenio, allows users, authors, librarians, managers, etc. to view the results of scientific work in a useful, friendly form and provides rich functionalities in the simplest way. The JOIN² workflow covers several verification layers of user data to minimize errors and thus provides checked and reliable information to end users. JDS features records with media files (video lectures, seminars, tutorials), and data import using DOI, ISBN, IDs from arXiv, WoS, Medline, PubMed, INSPIRE. Private collections with working group identification enable the integration into the research workflow. A common collection of Authority Records, i.e. grants, experiments, institutions, institutes, people, periodicals and their link with bibliographic records, establishes a high level of consistency and data quality.

Keywords: Open Access (OA), Institutional Repository, CRIS & OAR, JOIN², Invenio, Authority Records, JINR Document Server (JDS)

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1 Introduction

Currently, the concept of a corporate information system (CIS), i.e. a scalable platform designed for integrated and automatic reporting of all types of the organization's activities [1], is being discussed at JINR. As seen from the CIS pyramid in Fig. 1, such systems aggregate data from various systems.

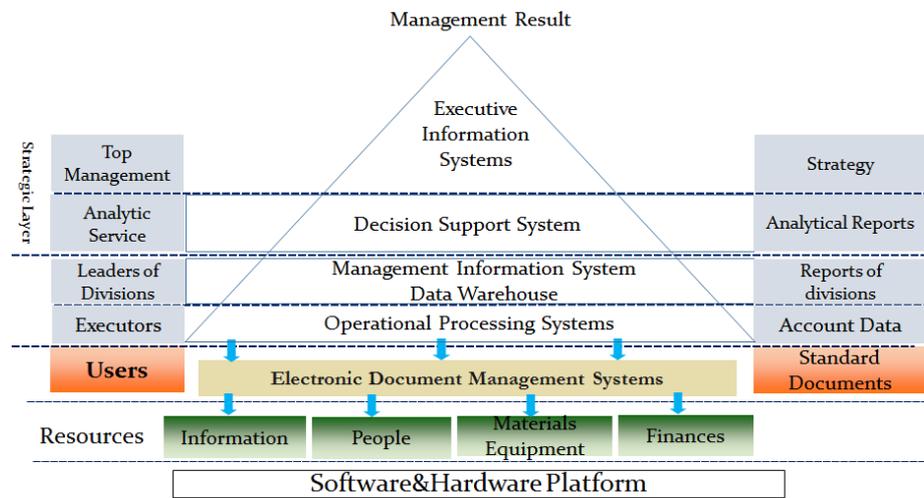


Fig. 1. Structure of the CIS pyramid.

A large number of these systems already exist and specialize in different areas such as accounting, taxation, financial, personnel, materials, equipment and project management, business analytics, etc. At JINR these are:

- 1C: Enterprise Resource Planning platform;
- JINR video portal;
- JINR Document Server, i.e. an Open Access (OA) repository of articles, preprints and other documents reflecting and contributing to research activities underway at JINR;
- platform for organizing and supporting scientific events;
- personnel information system (PIN);
- monitoring and accounting systems;
- tool for planning activities for the NICA experiment;
- project management system;
- information system of technical support, i.e. Help Desk;
- and many others.

For a CIS to work effectively, a high degree of automation is required in all areas of the organization to ensure timely and accurate data delivery. Consequently, another challenge arises as standards and interfaces to handle it have yet to be defined.

For a scientific organization like JINR, one highly important component that lists the intellectual output is still missing. This component comprises Current Research Information Systems (CRIS) with an integrated Open Access Repository (OAR). The CRIS & OAR component is located between the operational and strategic levels of the pyramid.

CRIS & OAR have both common features and peculiarities. Common features encompass bibliographic information, affiliation and project information. At the same time, CRIS is characterized as an administrative, integrated, person-oriented, analytical system. CRIS manages financial, personnel and research information. This class of systems is designed to register Research and Development (R&D) activities and store metadata about projects, people, the organizational structure, R&D results, scientific events, facilities and equipment. On the other hand, OAR is an open access file-oriented system that distributes data using the Open Access Initiative Protocol for Metadata Harvesting (OAI-PMH). The purpose of OAR is to acquire and store metadata of the results of scientific activities, to provide information services to both collaborators and the management. Open Repositories enable the distribution of digital resources, taking into account access levels. In addition to the metadata, the repository provides access to the actual results and plays a significant role in scientific communication by raising awareness and visibility.

From the Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities [2], Open Access (OA) denotes:

- Method of scientific communication through the realization of authors' rights to present their research results to the public.
- Free, operational and stable access to full-text scientific research materials for every Internet user in real time.

For a relevant, concise introduction to OpenAccess see [3].

The following benefits of OAR can be distinguished:

- for authors
 - dissemination and communication of their ideas to the scientific community;
 - increasing their visibility;
- for scientific and educational organizations
 - presentation of their scientific products;
 - enhancing their prestige in the scientific world;
- for users
 - effective access to primary sources;
 - high-quality supply of information needs;
- For society:
 - return of investment in research;
 - free access to information.

It is usually facilitated by an Institutional Repository (IR), i.e. a system for accumulation and long-term storage of information that provides reliable access to digital objects being the result of the intellectual activity of a scientific or educational institution. IRs

play an essential role in the implementation of the Open Access principles to scientific research results [2, 4, 5]. Repositories can provide access to research results from around the world, as well as enable every scientist and institution to participate in a global research network [6].

The JINR Document Server (JDS — jds.jinr.ru) [7] is an information system representing an Open Access institutional repository (OAR) of articles, preprints and other materials that reflect and facilitate research activities at JINR. JDS is based on the Invenio software platform developed at CERN (formerly known as CDS ware and CDS Invenio). Invenio represents an all-inclusive application framework, which allows running a fully functional digital library server [8]. The first version of JDS was deployed in 2009. The goals of JDS are to store JINR scientific information resources and provide effective access to them. The web interface of the repository is shown in Fig. 2.

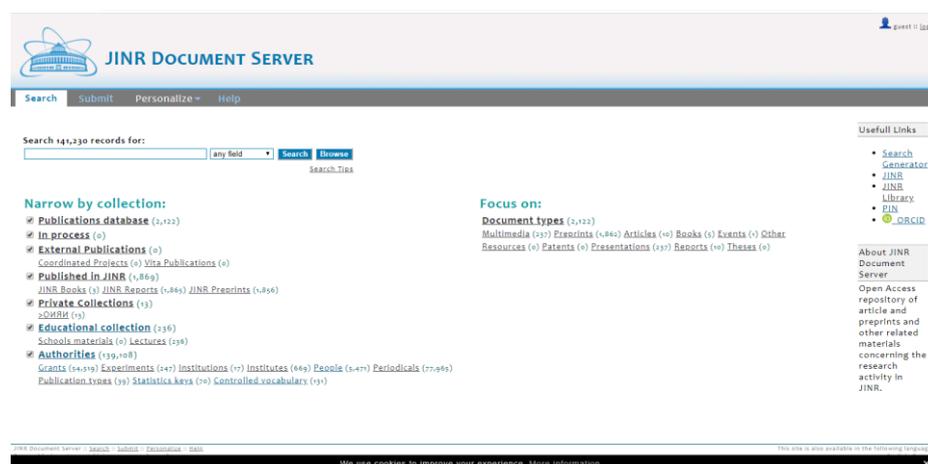


Fig. 2. Web interface of the JINR Document Server.

We consider JDS as a CRIS & OAR component of the JINR CIS. It reflects the results of the intellectual activity and must provide a record of all R&D activities, as well as retain the corresponding output. With the addition of the JOIN² (Just another INvenio INstance) [9] layer, it covers projects (funding), people (expertise), the organizational structure (groups), events, facilities and equipment (machines and experiments). As a repository, it provides a set of services to manage and distribute digital resources.

2 Implementation of the JDS Prototype Based on the JOIN² System

2.1 JOIN² Project and Prerequisites for Migrating to JOIN²

The aggregation of institutional information systems, namely, people, projects, funds and other management systems, is indispensable for the exchange and effective, consistent reuse of data. This task cannot be solved only at the system level. People are

required to continuously manage all the resources: employees (personnel manager), projects (research project manager), finances (financial director), materials and equipment (facility manager) and bibliographic information (bibliography specialist, librarian, content manager, identification manager). The core mechanism for the aggregation is the Authority Control subsystem, which provides control and communication of Authority Records with resources of the corporate information system. Authority Records denote objects representing persons and organizations, thematic terms, geographical entities, unified names, projects, grants and relations between them. Organized according to well-defined rules, they authoritatively identify objects and terms. While holding own authority records to identify entities of local relevance, potentially including horizontal and vertical relations between them, the inclusion of standard unique identifiers, such as DOIs for publications or ORCIDs for people, to interface with external systems is equally important. Data sources for the Authority Control subsystem represent institutional repositories, bibliographic databases, dictionaries, ontologies and author identification systems (international and institutional). The Authority Control procedure also provides variations on the forms of names, for example, different versions of the author's name. The use of unique identifiers (both internal and international) enables the disambiguation of authors' names and thus associates content (e.g. bibliographic records) with (unique) people. The Authority Control mechanism provides reliable and up-to-date information reflecting the state of research and development: publication lists, scientific reporting, input to bibliometric and scientometric reporting. The advantages of Authority Control are consistent data of high quality along with the minimization of manual data entry by end users, thereby reducing input errors.

Authority Control lies at the heart of the JOIN² project [10], which values the quality of bibliographic metadata and implements the support of Authority Records.

JOIN² is a shared repository infrastructure that brings together eight research institutes for the development of a full-fledged scholarly publication database and repository based on the Invenio v1.1 open-source framework for large-scale digital repositories. The JOIN² members have consolidated their successful development workflow and collaboration and created a product that can meet the needs of a heterogeneous group of research centers [11]. JOIN² partners are the libraries of Deutsches Elektronen-Synchrotron DESY (Hamburg/Zeuthen), Deutsches Krebsforschungszentrum DKFZ (Heidelberg), Deutsches Zentrum für Neurodegenerative Erkrankungen DZNE (Bonn), the Joint Institute for Nuclear Research JINR (Dubna), Forschungszentrum Jülich (Jülich), GSI Helmholtzzentrum für Schwerionenforschung (Darmstadt), Maier-Leibnitz-Zentrum (Garching), Museum Zitadelle (Jülich) and Rheinisch-Westfälische Technische Hochschule Aachen (RWTH Aachen University) [9, 12-17]. JOIN² enforces a well-defined publication workflow that is shared by all the project instances.

Today, JOIN² features seven systems in production with two more (DZNE and JINR) to come. More than 28.000 staff members and more than 6.000 visiting scientists have full access to its functionalities. JOIN² systems serve more than 475.000 records, including more than 68.000 publications with a freely accessible full text and 135.000 shared authorities [18].

After some initial trials to flesh out the functionality of JOIN² for reuse in JDS, in 2017 JINR decided to become a partner [19], and in 2019 a Memorandum of Understanding between JINR and DESY on behalf of JOIN² was signed (Appendix 1 to the Cooperation Agreement between DESY and the Joint Institute for Nuclear Research). The pre-production version of JDS based on the JOIN² project software is available at lt-jds-join2.jinr.ru.

The participation of JINR in the project will enhance the functionality of the JINR Open Access institutional repository via code reuse and further joint development.

The main challenges for adopting the JOIN² solution to JINR are related to:

- multilingual authority records, e.g. to ensure seamless handling of authors' names in the Cyrillic and Latin script;
- adaptation of the default workflows to JINR issues;
- efforts to customize forms for easy data entry.

2.2 JDS-JOIN² Prototype

Keeping track of all (full coverage is the ideal case) publications of JINR employees is a significant challenge. There is an urgent need for a systematic approach to collect and preserve publications in a standardized way, to avoid multiple inputs of information and enable code reuse. The long-standing experience of the JOIN² partners is extremely useful and valuable for this activity.

One central component of JDS is the Collection of Authority Records containing Grants, Experiments, Institutions, Institutes, People, Periodicals and their links with bibliographic records. Some other JDS features, which were enhanced during the migration to JDS-JOIN², are records with media files (video lectures, seminars, tutorials), data import using DOI, ISBN, and IDs from arXiv, WoS, Medline, PubMed and INSPIRE and private collections with working group identification.

Next, we will consider the main characteristics of the JDS-JOIN² prototype.

Software. The prototype is implemented using open-source technologies:

- JOIN²;
- Invenio v1.1.7;
- Python 2.7;
- RDMS MySQL;
- CentOS 6;
- Apache HTTP Server.

User interface. The Invenio platform provides a wide range of features for users:

- Web interface for submitting publications;
- Sending messages to other users;
- Commenting and discussing;
- User-defined baskets;

- User-defined automated email notification alerts;
- Basket-sharing within user groups.

Multimedia content. JDS embraces multimedia collections of video lectures for young scientists, posters, audio lectures, etc.

- Video;
- Audio;
- Poster;
- Photo;
- Media submitted by URL;
- Data submitted by users and verified by managers.

Multimedia represents a crucial part of the content in the JINR institutional repository.

Submission of new records. The JOIN² system covers several levels of user data validation. When adding a new publication to the system, the autocomplete functionality based on authority data helps the user to eliminate the ambiguity and duplication of the information entered. The next step is the verification of the information filled in by the user by the employee(s) responsible for the group the user belongs to. This reduces or eliminates mistakes in spelling or wrong association of publications, provides a high level of standardization in cataloging and increases the completeness and accuracy for later information retrieval.

The submission of the publication comprises:

- Importing data from DOI, ISBN, arXiv, WoS, Medline, PubMed, INSPIRE;
- Enabling "exact matches" of the author based on a unique ID;
- Normalizing as much as possible through authority control;
- Several verification layers of user data provide reliable, consistent information to end users.

JOIN² three-step workflow for submitting publications. One of the major concepts, around which the JOIN² system is developed, is a three-step workflow:

1. A user, i.e. "Author", makes the initial input of the publication using the import functionality (e.g. by DOI) or filling in all information manually, adds funding sources, grants, institutes and a full text (if needed).
2. After the user input, the record is checked by one of the editors. "Editor", i.e. a person associated with the involved research group(s), can be a project manager or a scientific secretary, who checks all data and makes the first proofread. Once approved, the publication's bibliographic data becomes visible on the Internet.
3. During the last step, the record is checked again by "Staff", i.e. usually library personnel, for a final proofread. In this step, the staff also decides whether and how the full text can be released to Open Access (e.g. adding, if necessary, an embargo period or a specific license).

The roles of “User”, “Editor” and “Staff” are illustrated in the publication workflow diagram below (Fig. 3).

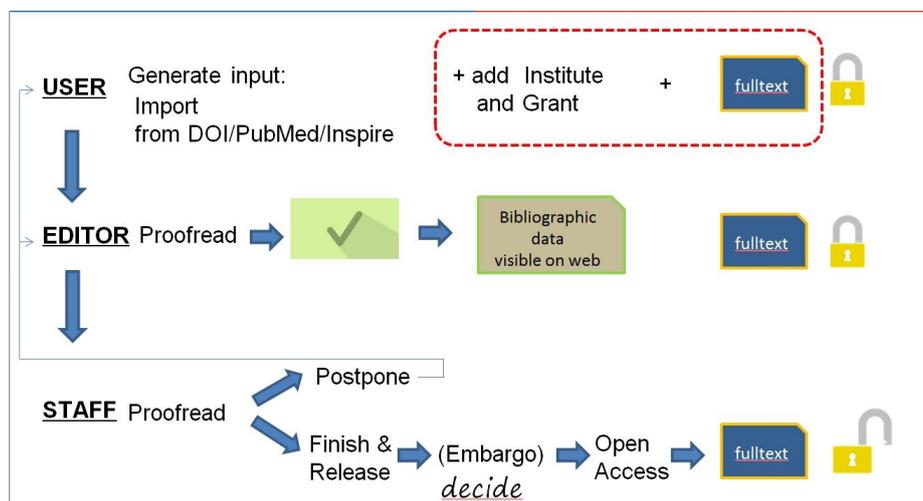


Fig. 3. JOIN2 three-step publication workflow diagram.

Main users of JOIN² systems. Users such as “Author”, “Editor” and “Staff” work directly with the institutional repository. In addition to these users, there are other important contributors to JOIN² systems who provide technical support of the system; these are “Technical Support Engineer/Developer” and “System Administrator”:

- “Technical Support Engineer/Developer” is responsible for regularly updating the JOIN²-Invenio software, revising and enhancing the functionality of the JOIN² system.
- “System Administrator”, i.e. a person who ensures the regular operation of the JOIN² server, including information security issues.

Accordingly, there are five groups of JOIN² system users: author, editor and staff/expert, technical support engineer/developer and system administrator.

Authorities and Private Collections. Since it is planned to integrate JDS into the JINR corporate information system as a CRIS & OAR unit, it is essential to provide efficient and consistent reuse of data of employees, projects, grants, etc. Authority Records (more generally described in 2.1) handle this task. They are used to unambiguously identify objects that allow, on the one hand, to take into account all variants of names when searching for information and, on the other hand, to distinguish between different entities with the same name, e.g. Koren'kov, V.V.; Korenkov, V.V.; V.V. Korenkov; Vladimir Korenkov; Vladimir Vasilyevich Korenkov; Korenkov, Vladimir Vasilyevich; Кореньков, Владимир Васильевич; В.В. Кореньков; Владимир Васильевич Кореньков; Владимир Кореньков; Кореньков, В.В. (see Fig. 4).

Information | References (0) | Citations (0) | Keywords | Discussion (0) | Usage statistics | Titles | Links | Holdings

Korenkov, Vladimir Vasilyevich

Кореньков, Владимир Васильевич
 Also known as: Koren'kov, V. V.; Korenkov, V. V.; V. V. Korenkov; Vladimir Korenkov; Vladimir Vasilyevich Korenkov; В. В. Кореньков; Владимир Васильевич Кореньков; Владимир Кореньков; Кореньков, В. В.

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Fig. 4. Authority Record of a person. Note the multiple forms of the name in Cyrillic, as well as in the Latin script, and the association of identifiers, e.g. from INSPIRE.

JDS Authority Records are:

- Grants;
- Experiments;
- Institutions and local institutes;
- People;
- Periodicals.

Some noteworthy features of JDS Authority Records are:

- Periodicals, Experiments, Grants and Institutions records form a unified base, which is shared between all the JOIN² partners;
- link with bibliographic records;
- access to Private Group Collections: only members of the contributing group are allowed to work with restricted materials.

Search Generator and Advanced Search. The Search Generator simplifies the handling of authority-based queries; users can choose different items to refine their search query. This is a highly useful tool for obtaining ad hoc publication lists. Advanced search allows the user to experiment with different kinds of queries, including default exact word matching, phrase searching and regular expression matching, as well as filtering on specific indexes such as “fulltext”, “issn”, “experiment”.

Statistics and Reporting. JOIN² encompasses a module for statistics and reporting with export to PDF. The exported PDF file can be styled manually using LaTeX, al-

lowing even complex scientific texts, including formulae, to be used. The report comprises a publication list of bibliographic information with links to the system. The interface of the statistics module displays counters by journals, impact factor ranges, funding sources and other parameters relevant for the purposes of official reporting at most scientific institutes. The statistics tool enables the creation of various types of reports that reflect and facilitate research activities of the institute. It is noteworthy that it can be used by scientists to handle publication lists or citations in their work, as well as by staff for reporting.

Export of a publication list. Users can export a list of their publications into their website or to various bibliographic formats. In addition, JOIN² provides the ability to export a list of publications within an experiment or by a research group as a URL and to include this list on a website.

2.3 Joining of JINR to the JOIN² project

Two teams from JINR and JOIN² are working in close cooperation on the adaptation of the default JOIN² workflows to JINR issues. The most significant results of joint work are listed below.

User authorization. User authorization in the JOIN² system embraces two parts: 1) checking if the user exists in the HR database; 2) applying specific rules for the user inside the JOIN² repository.

For authorization of JINR users, a module to obtain the necessary information from the HR department was developed and integrated, and support of JINR SSO (Single Sign-On) was implemented in JDS.

Creation of JINR authority records. The creation of authority records for people is closely related to Part 1 of authorization. An additional module extracts data from the HR database, returning, as a result, normalized records that meet all the requirements. In the context of a publication database, authors and institutes must be normalized to enable clear semantics and lack of ambiguity. For example, one needs to recognize the author despite the fact that he/she has changed the name, or a different form of the name is used for the authorship of different articles (e.g. John Smith, J. Smith, Smith, J., etc.). In the case of institutes (JINR departments), the ability to correctly identify the institute, even if an abbreviation or an alternative name is used, or when the institute changes some of its attributes over time, is required. In JOIN², normalization is accomplished by defining specific authority records for people, institutes and other relevant entities.

The necessary generation of Authority Records for the *Topical plan for JINR research and international cooperation* (PTP) turned out to be quite challenging: it comprises several peculiarities and a complex hierarchical structure. However, these records are essential for linking publications with funding sources.

At Helmholtz-Gemeinschaft (Association of German Research Centers to which five (DESY, DKFZ, DZNE, FZJ, GSI) of the JOIN² partners belong) there is a funding scheme called *Programmorientierte Förderung / Programme-oriented funding* (POF) in place, and the JOIN² system was designed to work with it. After close scrutiny it was found that POF and PTP had fairly similar hierarchies and usage patterns, and it appeared that abstract modelling of POF by means of authority records was flexible enough for the adoption of PTP as well. This enabled the inclusion of PTP with the same specification as POF with slight changes in the whole JOIN² system. The situation with POF-PTP highlights the strength of the JOIN² system as a general basis that allows one to meet specific goals of JINR with minor modifications.

Russification of information (localization). Enhancements required to handle the Cyrillic characters for the correct display of Authority Records were implemented. Moreover, they allow the system to handle any language covered in utf-8.

Adaptation of the institute structure — hierarchy of institutes (departments) and restricted collections. Additional modules were elaborated in close cooperation with HR to create an institutional structure of institutes (departments) with access rules to collections. For example, HR staff members have access to HR collection records and do not have access to records belonging to the collection of the experimental group.

The setting up of collections of documents and web forms for submitting publication. Web forms to input publications and collection trees of documents were improved taking into account all types of JINR publications.

Process of submitting publications and their verification. At JDS, the three-step workflow of submitting publications (see 2.2) was slightly modified. Due to the new information system for users, it was decided to add some functionality for “Technical Support Engineer/Developer” when using JDS for the first time. They will be like a layer between “Author” and “Editor” with partial tasks of “Developer’s” roles and will also be responsible for entering bibliographic information and uploading the full text to the repository (on behalf of “Author”), consulting “Author”. “Staff” will be changed to “Expert” in case no librarian personal is involved at the first time of using JDS.

3 Transition to Invenio 3

3.1 Invenio 3

One of the immutable principles of the existence of information and communication technologies is their continuous evolution in terms of hardware and software. Currently, JOIN² uses Invenio 1.1.7 as its base software, meanwhile, Invenio developers have focused on the development of Invenio v3, which is a re-write of the entire framework

from scratch. Since Invenio v3 is a flexible framework (and not an off-the-shelf product), every implementation requires code development.

Several repositories have already been built on the basis of Invenio v3, e.g.:

- Zenodo — General purpose research data repository.
- CERN Open Data — Open data repository for CERN.
- CERN Videos — Digital Asset Management system with video encoding support.

3.2 Invenio 3 challenges

With Invenio v3, records are internally stored as JSON. To validate the structure of the stored data, the JSON Schema must be used. Unlike Invenio v1, where the data model was fixed to be MARC-21 (serialized in XML), Invenio v3 makes no assumptions on the data model as such and does not even provide a default model. Given the library background of the JOIN² members, the JOIN² project uses the MARC-21 data model of Invenio v1, despite its imperfections marked as a key point in choosing a system.

In our opinion, using the MARC-21 standard is a solid foundation for our transition to Invenio v3 and provides a good connection between different functionalities and use cases. The use of MARC-21-Authority-based records allows JOIN² to identify people, grants, experiments, facilities, affiliations and funding information using standard interchangeable, shared records. In addition, a shared set of almost 80 thousand journal records has been derived and is maintained. This set profits from the MARC-21 format, which enables the reuse and enrichment of data obtained from other library systems using common MARC-21 and RDA concepts [20].

Despite the considerable effort required, the JOIN² collaborating parties acknowledge the need to move forward from the current implementation based on Invenio v1. Invenio v1 relies on the old version of Python (v 2.7) that no longer receives security updates from 1 January 2020, making the current implementation unsustainable.

A group of the JOIN² partners is currently testing the implementation of the new Invenio v3 data model, mastering the bridge between the new and old versions and making progress.

4 Conclusion

JOIN² aims at making information and knowledge accessible and visible through a unified information hub-like solution, which all partners use. A distinctive feature and practical value of the project is that partner institutions join forces to enrich the functionality of the software platform and share Authority Records to enhance data quality, reduce human errors and eliminate redundant work. As a result, unique experience and competence are accumulated; an interactive enrichment of local teams takes place.

JOIN² covers all the aspects of JINR needs for an institutional repository. There is no doubt that the JDS-JOIN² prototype of an institutional repository, developed as an

extension of JOIN² (see section 2.2 for the added functionality), has significant advantages over the previous solution of JDS, which was based on Invenio without JOIN² enrichments. Several user groups have already provided a positive feedback on the JDS-JOIN² collaboration. The prototype is an evolutionary process, and the production system will be finalized in the near future. We believe that the JDS-JOIN² implementation will satisfy the information needs of target users.

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