



16th International Conference on Current Research Information Systems (CRIS 2024)

The role of CroRIS in promoting Open Science in Croatia

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Abstract

CroRIS brings together information on scientific activities across Croatia into one central system. This not only makes research data more visible and accessible but also ensures it can be easily shared with others, meeting international standards for data exchange. Looking ahead, CroRIS is set to expand its features, improving how it works with digital repositories and managing research data. These updates aim to make the research process more connected, easier to navigate, and more efficient, highlighting Croatia's dedication to open science. This commitment helps foster global collaboration and makes scientific research more open and accessible to all.

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Peer-review under responsibility of the scientific committee of the 16th International Conference on Current Research Information Systems

Keywords: interoperability; transparency; open science practices; research ecosystem

1. Introduction

In an era marked by rapid knowledge creation, open access has become essential for accelerating progress. Open science, by advocating for the unrestricted dissemination of research findings, methodologies, and data, fosters enhanced collaboration and innovation, thereby amplifying societal benefits. Integral to this movement, it's essential to highlight the significance of digital repositories. These repositories are vital in ensuring open access, serving as dedicated platforms for the storage, preservation, and public dissemination of research outputs, including scholarly articles, datasets, and other academic materials. They are foundational to the open access movement, aiming to

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eliminate barriers to information and encourage a culture of sharing and collaboration among researchers worldwide [1].

Mirroring the significance of digital repositories, Current Research Information Systems (CRIS) play a critical role by offering deep insights into the workflows that underpin institutional research activities, enabling effective teamwork across various research support units, including research libraries [2]. This not only facilitates the implementation of Open Access and Research Data Management (RDM) policies but also promotes a more integrated and transparent approach to managing research information.

CRIS systems significantly bolster open science initiatives through a suite of key functionalities that streamline and enhance the research ecosystem. At their core, they facilitate metadata aggregation and standardisation, which involves the collection and uniform formatting of metadata from diverse courses, simplifying the search and access process for research outputs. This is complemented by their interoperability capability, ensured through adherence to international standards, allowing data to be seamlessly shared and understood across various platforms and institutions. Additionally, by enhancing the visibility and facilitating impact analysis of research activities and outputs, CRIS systems are a fundamental aspect in promoting wider engagement with research findings, thereby amplifying their societal impact.

Within this broader context, the Croatian Research Information System (CroRIS) plays a crucial role in bolstering open science practices in Croatia, driving significant transformations across the research ecosystem.

2. Current status and development of CroRIS

CroRIS was developed as a key component of the “Scientific and Technological Foresight” strategic project initiated by the Croatian Ministry of Science and Education. This project, aimed at advancing the nation’s scientific and technological landscape, received co-financing from the European Union through the European Regional Development Fund. The Croatian Ministry of Science and Education, the Ruđer Bošković Institute (RBI), and the University of Zagreb, University Computing Centre (Sccc) reached an agreement to ensure the nationwide implementation, development, and maintenance of CroRIS. This partnership underscores a commitment to fostering a robust infrastructure for scientific research and innovation across Croatia.

The primary objective of CroRIS is to establish a comprehensive, integrated, and interoperable system that consolidates all pertinent information related to Croatian scientific activities. By doing so, CroRIS aims to enhance the accessibility, transparency, and efficiency of scientific research, thereby supporting the broader goals of knowledge dissemination, collaboration, and technological advancement within the country and beyond.

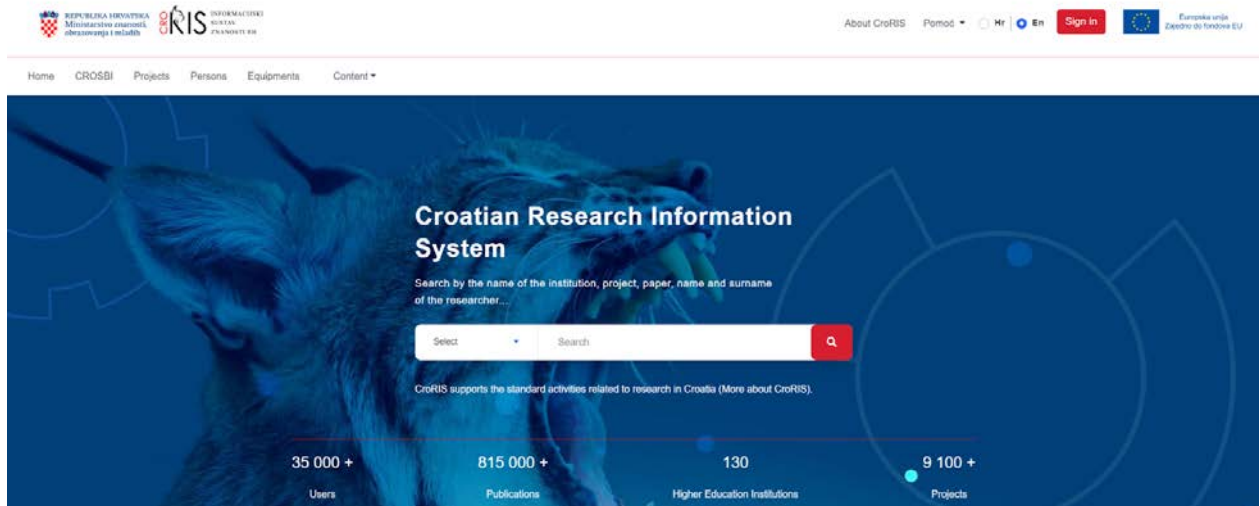


Fig. 1. Homepage of Croatian Research Information System (CroRIS)

Before the development of CroRIS, there was no centralised research information system in Croatia. Instead, information on Croatian research activities was scattered across various independent information systems, each focusing on different aspects of research activity [3]. Prominent among these were the Croatian Scientific Bibliography (CROSBI), the Database of Project Activities in Science and Higher Education in Croatia (POIROT), and the Database of Scientific Instruments (Šestar), all developed by the Ruđer Bošković Institute (RBI). Additionally, the Digital Academic Archives and Repositories (Dabar) was a collaborative effort involving numerous institutions and individuals from the academic community [4]. These systems—CROSBI, POIROT, and Šestar—were initially designed to function independently but were intended to be interoperable. With CroRIS, these systems have been integrated as distinct modules within a single, unified platform. This integration represents a significant advancement in the centralization and management of research information, streamlining access and enhancing the efficiency of information dissemination across the Croatian scientific community.

During the integration of various separate systems into CroRIS, several challenges were encountered, particularly in aligning with the principles of open science. Ensuring data consistency across various platforms, managing the interoperability of different metadata standards, and addressing the technical complexities of unifying distinct databases were among the primary obstacles. The disparate nature of the original systems meant that data was often structured differently, needing extensive efforts to standardise and harmonise this information within CroRIS. This standardisation was essential for making research outputs easily discoverable and accessible, thereby supporting the open science mandate of eliminating barriers to information. The integration process aimed to create a seamless, comprehensive system that could facilitate the open exchange of knowledge and enhance the transparency and efficiency of scientific research in Croatia.

By launching CroRIS, the Croatian research community now benefits from a centralised information system that unifies all data on scientific activities, replacing the previously separated systems. CroRIS is composed of several key modules, including:

- Ministry of Science and Education Registers
- Persons
- Projects
- CROSBI (Croatian Scientific Bibliography)
- Equipment and Services

- Patents and Products
- Events
- Journals (authority files)
- Organisational Units

Each module within CroRIS is interconnected, allowing seamless transitions between different types of information. This interconnectedness enables users to navigate from one record to another across various modules effortlessly. For example:

- From a researcher's profile, users can access information about their publications, project involvement, and the equipment they use.
- From a project record, users can find related publications, assigned institutions, and the equipment used for the project.
- From a publication entry, users can explore links to related projects, associated institutions, and the equipment involved in the research.

This integrated system significantly enhances the efficiency and transparency of managing research data. It provides a comprehensive overview of scientific activities, supporting better decision-making, collaboration, and the dissemination of knowledge.

The successful integration of diverse systems into CroRIS was underpinned by the implementation of advanced data management strategies. Key initiatives such as adopting the Common European Research Information Format (CERIF) for metadata standardisation and utilising API technologies for seamless data exchange were highly significant in enabling CroRIS to effectively support open science practices.

CroRIS is based on the CERIF standard, a robust framework that facilitates the exchange of information between different CRIS systems [5]. This standardised format establishes a robust framework for comprehensive research information management. By adopting CERIF, CroRIS ensures that all entities are characterised by detailed and consistent metadata descriptions, promoting interoperability and accessibility. However, certain entities, particularly publications, exhibit a greater level of richness and detail in their metadata descriptions.

Currently, the alignment of CroRIS metadata with the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH) is in its final phase. This alignment ensures comprehensive and standardised data representation, enhancing interoperability with OpenAIRE, other CRIS systems worldwide, and various open access platforms. Additionally, the equipment and services module of CroRIS has already adjusted its entry fields to meet the requirements of the European Open Science Cloud (EOSC), further reinforcing its commitment to open science and data interoperability.

All metadata within CroRIS can be accessed through a user-friendly application programming interface (API), which facilitates seamless integration and efficient data retrieval. CroRIS offers a diverse array of APIs tailored to meet various informational needs, including APIs for Organization Units, Researchers, Projects, Equipment, and the Croatian Scientific Bibliography (CROSBI). Notably, except for data pertaining to researchers, all APIs are openly accessible to the public, promoting transparency and broad usability. This open access to metadata enhances the ability of users to integrate and utilise data across different systems, thereby supporting a wide range of research and informational applications.

CROSBI records on publications provide comprehensive details about the availability of publications in open access, including links to access the papers via Green, Diamond, or Gold routes. These records also indicate whether

the publications have undergone peer review and allow users to input information regarding any Article Processing Charges (APCs) paid for open access publishing. These features significantly enhance the visibility of Croatian research outputs in the open access domain, enabling more robust functionality and potential analysis of the Croatian research publishing landscape. This comprehensive data supports greater transparency and provides valuable insights into the dynamics of open access publishing in Croatia.

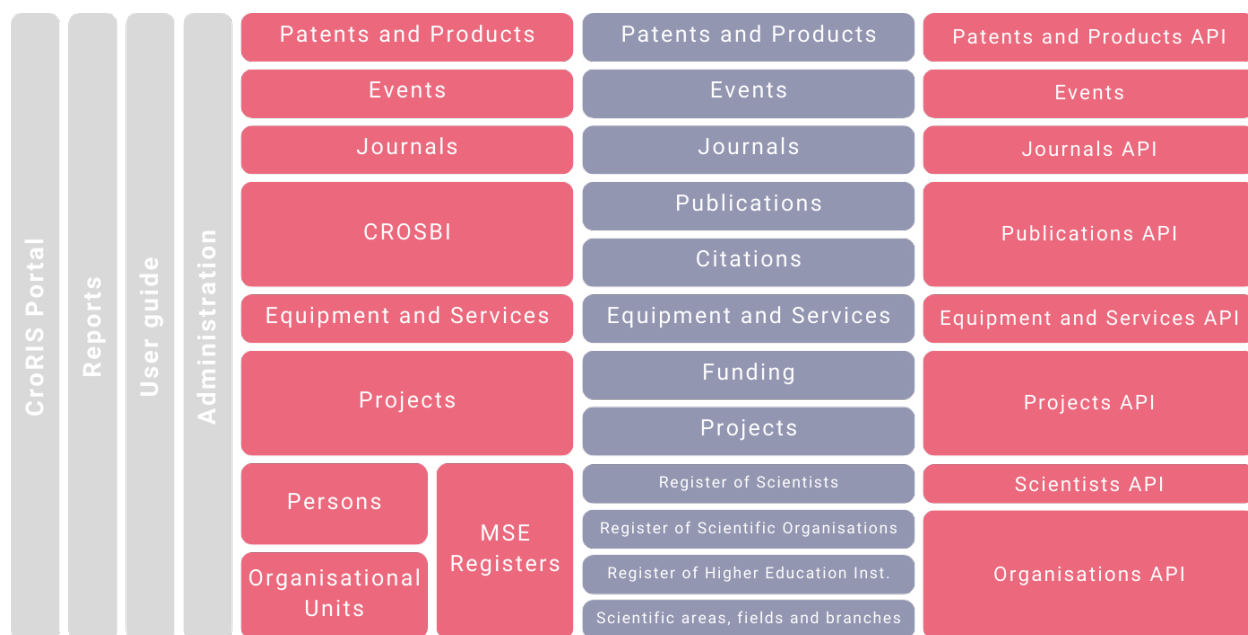


Fig. 2. CroRIS Programme Modules [7]

3. Future plans and strategic directions

As Croatia continues to advance its academic and research infrastructure, CroRIS is essential in its evolution. Future developments in CroRIS are not just about enhancing its current functionalities, but also reimagining how research outputs are managed, accessed, and utilised within the national and international research landscapes. The strategic directions planned for CroRIS are aimed at fostering a more integrated, accessible, and efficient ecosystem for researchers and institutions alike.

A focal aspect of CroRIS's future development is interoperability with the Dabar infrastructure, which facilitates creation and provides maintenance of open access institutional and thematic digital repositories and archives. Although Dabar was not integrated into CroRIS, further development incorporating a high level of interoperability between CroRIS and Dabar is planned for the future. This interoperability foresees that once the full-text is deposited to Dabar, it will be possible to initiate the creation of a CROSCI bibliographic record. The process of entering publications will also extend in the reverse direction. Once users input the bibliographic record of a publication into CROSCI, they can seamlessly transfer that record to the relevant institutional repository, along with storing the corresponding version of the paper that can be made available in OA. The determination of the institutional repository will be based on the corresponding institutions linked to the CROSCI record.

Another significant task which is planned for this year is the transfer of full-text files stored in the previous CROSCI system, which served also as an orphan repository, to institutional repositories in Dabar. Since the new CROSCI is a

bibliographic database, those files were not transferred to CroRIS. The current plan is to make these files available to related institutional repositories on Dabar, allowing repository managers to decide how they would like to handle these files. Should these files be published in a reputable institutional repository under OA, Dabar will relay information back to CROSBİ, including the URL from the institutional repository where the file is accessible in OA.

To enhance the utility and effectiveness of CroRIS, future developments will also focus on integrating RDM plans and research data as distinct entities in CroRIS. DMPs are increasingly becoming a critical, sometimes mandatory, part of grant applications. In 2022, the Croatian Science Foundation (HRZZ) introduced the Research Data Management Plan, mandating that project leaders not only prepare, but also store and publish their DMPs in institutional repositories in OA [6]. Dabar has been instrumental in facilitating the storage of DMPs. CroRIS plans to further this integration by incorporating DMPs as bibliographic entries with direct links to Dabar or other infrastructure where they are accessible in OA. Furthermore, there is a continuous effort to integrate bibliographic records for research data stored in various data repositories, including those hosted on the Dabar infrastructure into CroRIS. This strategic move aims at optimising RDM and enhancing accessibility and visibility within the scientific community.

The full interoperability will strengthen the link between research information stored in the data repositories, and other important data, including funding, related institutions, individuals, projects, etc.

This integration of DMP's and information about research data in CroRIS will significantly augment its value by enhancing efficiency in data management processes and ensuring efficient access to, and preservation of, research data. By integrating these features, CroRIS will offer researchers and institutions a comprehensive platform that facilitates seamless data sharing and collaboration while supporting adherence to data management best practices, thus promoting data integrity and the reproducibility of research outputs. Additionally, aligning CroRIS with the OpenAIRE interoperability guidelines and ensuring its indexing by OpenAIRE Explore as a CRIS system will further enhance its visibility and interoperability within the European research ecosystem. These future developments are set to transform CroRIS into an even more valuable asset for the research community, enabling more effective management and dissemination of research outputs.

Currently, the framework within the Events module allows for the documentation of events as separate records, which are connected to various other entities within the system, primarily publications and the CROSBİ module. Future developments predict the inclusion of additional types of events, such as workshops and lectures. However, recognizing the need for a more comprehensive and transparent approach, the future development of CroRIS is set to introduce an innovative feature. This enhancement will not only continue the practice of logging events as distinct records but will also significantly expand the scope of information captured within these records. Specifically, it will include details about the individuals participating in these events, specifying their roles and capacities. Additionally, it will catalogue the organising institutions, thereby shedding light on the organisations and people behind these events. Further development is also planned for the Persons module, which will enable the linking of relevant data directly from individual profile pages. This broader and improved approach aims to provide a more detailed and interconnected view of events, enriching the overall functionality and usability of the CroRIS system.

4. Conclusion

CroRIS is a comprehensive national information system designed to consolidate all relevant information regarding Croatian scientific activities. Serving as the official source for measuring, reporting, and evaluating national scientific productivity, CroRIS integrates various interconnected modules to create a cohesive and efficient system. Its alignment with the OAI-PMH protocol will ensure interoperability with the EOSC and other open-access systems, enhancing data exchange and accessibility. CroRIS data are publically available, exchangeable and interoperable. There are already functionalities that are enabling monitoring of open access and open science like information about APCs, open access availability of publications, adjustment of fields with (EOSC) requirements. Future developments, such as interoperability with the Dabar repositories and the implementation of Research Data Management, will

further solidify CroRIS's adherence to open science principles.

All these advancements are not just technical updates; they represent a move towards increasing the transparency and accountability of processes within the CroRIS system. Such progression will enhance the system's ability to support research and development activities, ensuring that stakeholders have access to clear, comprehensive information. Moves of this nature are anticipated to significantly contribute to the system's overall effectiveness, making it a more robust tool for managing Croatia's research infrastructure and fostering collaboration within the scientific community.

CroRIS not only embodies Croatia's commitment to open science but also highlights the transformative potential of centralised research information systems in enhancing scientific collaboration and accessibility. By providing seamless access to interconnected research data, CroRIS promotes transparency, openness, and the dissemination of research outcomes, thus advancing the ideals of open science at the national level.

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