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Open Science Infrastructure in Croatia: Examples and Trends

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ABSTRACT

This paper will present examples of open science infrastructure and trends in Croatia as well as a view of librarians' role in development and support of open science infrastructure. The aim of this paper is to showcase several parts of the Croatian open science infrastructure which were formed with the idea of Open Access in mind and with heavy involvement of librarians. Croatian national e-infrastructure for academic and scientific community has been in development since the founding of the University Computing Centre (SRCE) within the University of Zagreb in 1971. SRCE has become a major national infrastructural ICT institution and is involved in most of the open science infrastructure projects in Croatia. Open Access has been a key point of Croatian e-infrastructure since the 90's when the Open Access movement started in 1997 with the launch of the first version of the Croatian scientific bibliography – CROSBI developed by the Ruđer Bošković Institute Library. From the beginning, it offered an option of storing a full text file alongside the bibliographic record which was an advanced concept at that time. HRČAK is a central Open Access portal launched in 2006. It offers Open Access to papers from Croatian scientific and professional journals as well as journals for the popularization of science and culture. DABAR (Digital Academic Archives and Repositories) was launched in 2015 as a digital object repository for higher education and research institutions in Croatia. It was the result of cooperation between SRCE and National and University Library in Zagreb (NSK) who recognised the need for this key component in the Croatian e-infrastructure. Repositories in DABAR are encouraged to register with Open DOAR and OpenAIRE. Croatia is moving forward with Open Access and Open Science Infrastructure with the launch of the Croatian Research Information System CroRIS in 2023.

Introduction

Croatia is the youngest European Union (EU) member and one of the smallest EU members with a population of around 3.8 million. It has ten public Universities with around 150 thousand students. Public Universities are comprised of autonomous Faculties who are separate legal entities. This is not the case with the usual higher education systems, where Universities function as integrated Universities, with their constituents (in most cases Faculties) lacking such a high level of autonomy ([Eurydice, 2024](#)). This difference is most evident in each Faculty in Croatia having its own administration, campus, staff, and area of learning ([Narodne novine, 2022](#)). University of Zagreb serves as a good example with the majority of its 31 Faculties being dispersed throughout the city of Zagreb, two in city of Varaždin, and one in city of Sisak. There are 71 Faculty libraries in Croatia and 9 University libraries as of 2023. National and University Library of Zagreb serves both as the University library of the University of Zagreb and the central library of Croatia ([Adresari Knjižnica u Republici Hrvatskoj, n.d.](#)). The fact that Croatia has a very specific dispersed University structure might have been a contributing factor and one of strong incentives for development of a functional and sustainable national e-infrastructure.

Open Science and Open Science infrastructure

Open Science is a movement aimed at making scientific research and data more accessible, transparent, and collaborative ([UNESCO, 2021](#)). There are numerous Open Science policies on different levels, from institution, to national, to European Union (EU) ([openscience.eu, n.d.](#)). EU's Open Science policy states that Open Access is at the centre of European Research policy. Open Science infrastructures are one of the necessary enablers of Open Science ([European Commission, n.d.](#)). They are digital tools, platforms, and resources that support the sharing and collaboration of scientific research data and findings. Open Science policies and recommendations place emphasis on the importance of Open Science infrastructures: EU's Open Science policy states 8 ambitions for Open Science and UNESCO recommendation on Open Science defines 7 areas of action ([openscience.eu, n.d.](#); [UNESCO, 2021](#)). 10 Years of the IFLA Open Access Statement: A Call to Action, 2022 identifies an important goal for IFLA and its members in promoting sustainable investment in Open Science infrastructures

Croatia Open Science infrastructure

Croatia has a long history of Open Science practices since its earliest days with a continuing support and close cooperation of librarians and information experts. Two of the visionary institutions, which will be mentioned in further text, who were nurturing Open Science practices in Croatia are University Computing Centre (SRCE) and Ruđer Bošković Institute Library. The issue with Open Science infrastructure in its early days in Croatia was that its development was not systematic, there was rarely any interoperability, and resources were spent in developing similar but separate systems instead of centralised platforms. A prime example of this issue was development of separate institutional repositories, often using different platforms with no interoperability. The situation began to change in 2012 with the adoption of the Croatian Declaration on Open Access to Scientific Information ([Budín et al., 2012](#)). It enabled a more systematic approach to Open Access in Croatia and paved the way for development of an encompassing e-infrastructure which will be discussed later.

University Computing Centre (SRCE)

Founded in 1971 under University of Zagreb, SRCE (in Croatian: heart) is a central national infrastructural information and communication technology institution in Croatia. Since its founding it has been involved in most of the Open Science infrastructure projects in Croatia. SRCE has a long history of nurturing an Open Science approach. It supplies both hardware and software solutions for a range of projects, as well as continuous expert support on a national level. SRCE also organises workshops available in person as well as online. In 2006 the Authentication and Authorisation Infrastructure of science and higher education in Croatia (AAI@EduHr) was launched with SRCE as its coordinator and developer. AAI@EduHr is a key element of Croatia's e-infrastructure, as only institutions listed in the registry of Ministry of Science, Education, and Youth are eligible to become members. From 2010 SRCE began a systematic development of the data layer of e-infrastructure in Croatia. In 2012 SRCE backed the Croatian Declaration on Open Access which is in line with

SRCE policies on Open Access and Open Science ([SRCE, 2023](#)). In 2014 SRCE went a step further and brought forth its Policy on Open Access which has been updated in 2022 ([SRCE, 2022](#)). SRCE maintains a close cooperation with librarians and information experts. SRCE has been the Croatian national Research Data Management (RDA) node since 2019 with its main goal being support of the construction of a sustainable and reliable national data infrastructure aligned with FAIR data principles. Since 2020 it has been a full member of European Open Science Cloud ([EOSC Association](#)). It was nominated as a Croatia mandate organisation by the Ministry of Science, Education, and Youth. Its duties as a member of EOSC are to coordinate initiatives for Open Science and building the Croatian Open Science Cloud (HR-OOZ) ([SRCE, 2023](#)).

Croatian Scientific Bibliography (CROSBI)

In 1997 the first version of Croatian scientific bibliography (CROSBI) was launched with the support of the Ministry of Science, Education, and Youth and it marked the beginning of the Open Science movement in Croatia. It was designed, developed, and maintained by Ruđer Bošković Institute Library. CROSBI was a pioneering concept in Croatia in many ways as a crucial part of the Croatian Open Science infrastructure. Its main objective was forming a bibliography of Croatia's scientific output, but it was also one of the first Open Access repositories in Europe since it offered the option of attaching a full-text file to the bibliographic record. CROSBI content was created by authors (scientists) themselves by self-archiving with access to the platform granted via their credentials from the Ministry of Science and Education Register of Scientists and Artists or their AAI@EduHr identity from 2007. Librarians and/or information experts developed the metadata schemes, standards, and control of the created content. From 2017 the role of administrators was decentralised offering institutions from the system of science and higher education the option of having an administrator who would curate their institution's output. This functionality was important since CROSBI data was used in the reaccreditation process of higher education institutions in Croatia from 2017. Ruđer Bošković Institute Library held workshops for prospective administrators. Until 2023 there were 154 institutions who appointed an administrator (mostly librarians and information experts). CROSBI stopped being an independent platform in 2023 and was incorporated into the Croatian Research Information System (CroRIS) ([CROSBI, n.d.](#); [Orel, 2024](#)).

Central Portal for Croatian Open Access Scientific and Professional Journals (HRČAK)

The original idea of an initiative which would develop a platform for Open Access journals came from the Croatian Information and Documentation Society (HIDD) which comprises a group of information experts and librarians ([Tóth, 2004](#)). The Central Portal for Croatian Open Access scientific and professional journals (HRČAK; in Croatian: hamster) was launched in 2006 with the support of the then Ministry of Science, Education, and sport, today/s Ministry of Science, Education, and Youth. The platform was developed by SRCE, who worked in close cooperation with HIDD ([HRČAK, n.d.](#)). The HRČAK Advisory Board decides about the directions of development of the platform. It comprises a variety of experts, from publishers and

editors to a wider academic and professional community ([HRČAK, n.d.](#)). HRČAK is a platform that not only enables Open Access, but also offers tools for publishers to make Open Access publishing possible such as Open Journal Systems (OJS) and Open Monograph Press (OMP). Publishing on HRČAK is free for journals or conference proceedings. OJS gives support to the journal publishing and editing process while OPM gives support to journals as well as conference proceedings publishing and editing process. HRČAK is interoperable with Digital Academic Archives and Repositories (DABAR) while interoperability with Croatian Research Information System (CroRIS) is in the works. As of the time of writing this paper, HRČAK had more than 540 journals and more than 29,000 Open Access articles ([HRČAK, n.d.](#); [SRCE, n.d.](#); [SRCE, 2023](#)).

Digital Academic Archives and Repositories (DABAR)

Launched in 2015, Digital Academic Archives and Repositories (DABAR; in Croatian: beaver), is a key element of Croatian Open Science infrastructure, being an important component of the data layer. DABAR offers a simple solution for creating and managing dependable and interoperable institutional and thematic repositories for digital objects to all legal entities from the academic and scientific community. Individuals cannot form their own personal repositories on the platform. It was developed by SRCE in cooperation with the academic and scientific community including the National and University Library in Zagreb (NSK) who recognised the need for this key component in the Croatian e-infrastructure. DABAR is being systematically and continuously improved by work of SRCE and active Working Groups which comprise librarians, information experts and programmers ([Dabar, n.d.](#)). Digital objects being stored range from student theses, papers published in a journal, dissertations, conference papers, books, book chapters, videos, data management plans, images, audio, etc. All digital objects in DABAR are archived in accordance with FAIR principles: findable, accessible, interoperable and reusable. Repositories in DABAR are encouraged to register with Open DOAR and OpenAIRE. DABAR has incorporated the option of self-archiving, and it is up to the administrator of each repository to allow its use. In most cases, DABAR institutional repository administrators are librarians of their respective institutions. As of the time of writing of this paper, DABAR had more than 170 repositories and more than 270,000 total published digital objects with 51.9% of them being Open Access. As one of its newest additions it offers data set storage for researchers ([SCRE, n.d.](#); [Dabar, n.d.](#)).

Croatian Research Information System (CroRIS)

Launched in 2023, the Croatian Research Information System (CroRIS; in Croatian: Cro bobcat) provides comprehensive, complete, interoperable, and reliable information about all elements of the science system in Croatia. CroRIS was funded by the European Structural and Investment Funds and Ministry of Science, Education, and Youth, designed and executed by SRCE and Centre for Scientific Information (CZI) of the Ruđer Bošković Institute. CZI has formed a division for CroRIS which is dedicated to continuing development and user support of CroRIS. CroRIS is designed to provide information to a very wide user base, including the public, with most of the information being available without the need to register. Even though information is mostly public, only users with AAI@EduHr credentials can register to the portal and contribute. Each

institution in CroRIS has its coordinator who has access to all the modules of CroRIS and there is a sub level of administrators per module. Modules available at the time of writing this paper are: CROSBI, Projects, Persons, Equipment and Services, Reports, Journals, Patents and Products, Events, Register MZO, and Organizational units. The modules were independent and separate systems which have now been incorporated into one platform. CROSBI no longer serves as a repository after being incorporated into CroRIS, but it is now a purely bibliographic database while DABAR took over the repository role. Librarians and information experts are heavily involved in the development and administration of CroRIS ([SCRE, n.d.](#); [SCRE, n.d.](#); [Udovičić & Orel, 2024](#)).

The Future

Science, research and higher education rely on principles, values, and practices of open science and thanks to that effectively contribute to faster progress, sustainable development and international relevance of Croatia. ([Prijedlog Hrvatskogplanaza Otvorenu Znanost, 2023](#))

This vision was brought forward by the Working Group for drafting the proposal of the National Open Science Plan of the Croatian Open Science Cloud Initiative (HR-OOZ). SRCE launched HR-OOZ in 2021. The Initiative is a result of joint work by many stakeholders in science and higher education system. Main goals of the Initiative are to bring forth a clear national policy for Open Science, to make the infrastructure sustainable as well as interoperable on a national level, and with the EOSC and other relevant European initiatives. The Proposal for a National Open Science Plan is yet to be officially accepted ([Croatian scientific and educational cloud, 2021](#)).

Croatian Scientific and Educational Cloud (HR-ZOO) is a project that was being implemented from 2017 to 2023 and produced a core component of the national research and innovation e-infrastructure. It was co-financed by the European Union. HR-ZOO comprises of five data centres, a collection of significant computer resources for advanced calculations, data storage resources, and a team of top tier experts to ensure specialised support to researchers and professors. The aim of the project was to ensure a long-term viable and sustainable connectivity, interoperability, and storage resources for scientific and academic community in Croatia. HR-ZOO has the capacity to support all the existing e-infrastructure elements previously mentioned (translated names: beaver, hamster, bobcat) ([SRCE, n.d.](#)).

Through the use of national and international research infrastructures, Croatia will excel in internationally competitive research and will strengthen international cooperation and the visibility of Croatian science, economy, and society as a whole. ([Ministry of Science and Education, 2023](#))

Brought forth by the Ministry of Science, Education, and Youth, this vision is at the centre of future developments and investments in Open Science infrastructure in Croatia. The assessment of the Research Infrastructure Development Roadmap of the Republic of Croatia 2023–2027 is that there is still a serious fragmentation in Croatian scientific and innovation system and that efforts and investments should be made to

bridge the gaps and achieve long-term sustainability of research infrastructures. Among its four key aims is promoting Open Access and cooperation with stakeholders, including higher education institutions and civil society alongside other research infrastructures and businesses ([Ministry of Science and Education, 2023](#)) (Research Infrastructure Development Roadmap of the Republic of Croatia 2023 –2027, 2023).

CroRIS is envisioned as a long-term tool to identifying the strengths and weaknesses as well as deciding the direction of the development of the Croatian system of science and education. It should become a cornerstone of visibility, transparency, and public access to scientific and academic community as well as their results ([SCRE, n.d.](#)).

Conclusion

Croatia is a small country with big aspirations and a drive to make them happen. In the past thirty years Croatian scientific and academic community in collaboration with librarians and information experts has built and impressive Open Science infrastructure. The fact that each Faculty in Croatia has its own separate library might have been an advantage in the development of the Open Science infrastructure up to date, but also could be an advantage for future projects as well. This paper serves only as a small cross-section of Open Access practices and Open Science infrastructure in Croatia and efforts of institutions as well as individuals that were invested in building and maintaining them.

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