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Research Information Infrastructure in Ukraine: first steps towards building a national CRIS

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Abstract

Development and implementation of Current Research Information Systems (CRIS) is one of the most transparent and practical approaches to curate research information on a national level. The process of building and implementing such systems is a complex and time consuming where successful results heavily depend on the established research information infrastructure of a country, the interoperability of the systems and the quality of the information which reside in them. The purpose of this paper is to analyse the existing Ukrainian Research Information Infrastructure and identify which databases could be reused and integrated with a national Ukrainian Current Research Information System (URIS). The analysis showed that there are functional databases and registries that collect data on research activities and could be used as a data sources for the URIS. In particular, the Unified State Electronic Database on Education is a potential data source on higher educational institutions, the National Repository of Academic Texts — on metadata on research output, internal database of the National Research Foundation of Ukraine and database on research projects maintained by Ukrainian Institute of Scientific Technical and Economic Information — on projects. Secondly, it was identified that Ukrainian research infrastructure lacks complete, up-to-date registry on researchers. Finally, we discussed the challenges and solutions for further steps in building national CRIS.

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1. Introduction

Data is an integral part of science. The authors of “The Fourth Paradigm: Data-intensive Scientific Discovery” call modern science “data-intensive” and emphasize that research involves three ubiquitous processes: collection, management and data analysis [1]. In the course of scientific endeavours, researchers produce data arrays of different volumes and formats, which are often impossible to process without the use of specialized software. Similarly, in the past years we observed pressing needs in processing and analysing research information that describes various research activities, including research outputs and context in which research is being conducted [2]. Such research information is needed from all scientific stakeholders, for research discovery and measurement, project planning, initialization and evaluation of research activities [3]. Furthermore, a comprehensive snapshot of research information is of significant importance for scientific communication and it serves as an underlying base for fact-based decisions [4].

Development and implementation of Current Research Information Systems (CRIS) is one of the most transparent and accountable approaches to curate research information circulation. Back in 2006, researcher S. Hornbostel emphasized that in order to avoid turning a large amount of research information into a data graveyard, it is crucial to introduce Current Research Information Systems, in an effort to link this information and make it suitable for further use [5]. This opinion is still relevant in light of today’s increasing production of research information and its poorly curated distribution.

Researchers S. Bittner and A. Muller, in their article on social networks and information research systems, define Current Research Information System as a system of software tools used by actors in the research process at different stages, from documentation of information on research projects to research data management and assessment of the results obtained [6]. M. Jettena and co-authors state similarly, saying that modern CRIS’s cover the full range of research information and serve as a single point of access to information about research projects, funding sources, research organisations, research groups, scientists, equipment used for research and projects’ time span. [7]

In recent years, P. de Castro has noted a widespread uptake of institutional as well as roll-out of national research information systems in Europe and Asia [8]. For instance, among the countries that have successfully implemented CRIS’s at the national level are Slovakia, Norway, the Netherlands and India. In Finland, Croatia and Peru systems are under construction. Commonly, the development of a nationwide CRIS heavily depends on the established research information infrastructure of a country and quality of the information which resides in it. To date, Ukraine does not have a functional system, therefore it is important to investigate state of arts of Ukrainian research infrastructure (Figure 1).

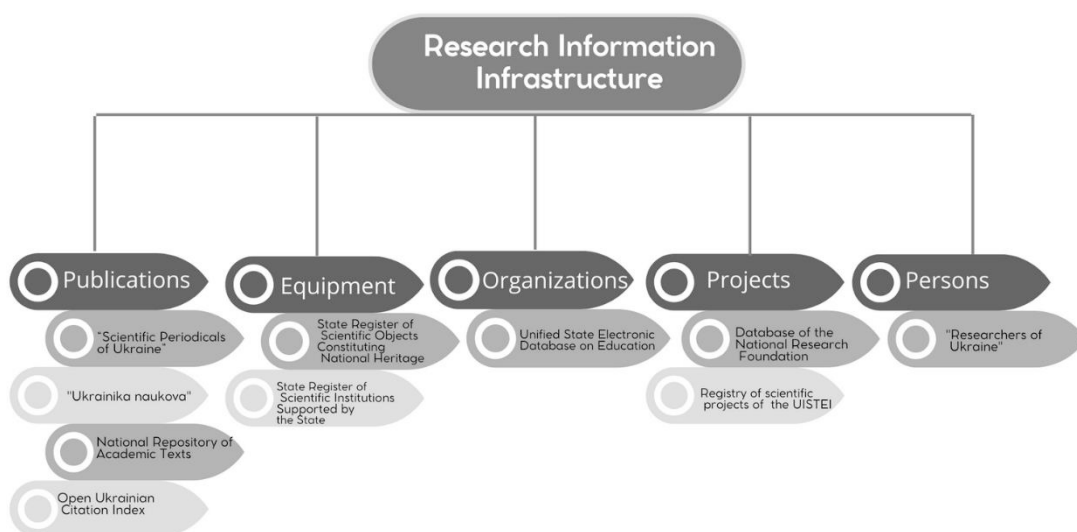


Fig.1 Research Information Infrastructure in Ukraine

This paper aims to provide a descriptive review and analysis of the existing Ukrainian research information landscape with particular emphasis on those infrastructure blocks, which are crucial elements in building a Nationwide Research Information System.

2. Ukrainian Research Landscape

Ukraine is home to 619 higher education institutions, including 281 universities and the National Academy of Science which itself is an umbrella organization that consists of 160 research institutions. In 2021, 78 860 research and teaching staff were involved in the implementation of research projects, among them 51 427 were researchers, 7 117 — technicians and 20 316 — supporting staff.

According to Article 48 on financial support of scientific and technical activities of the Law of Ukraine "On Scientific and Scientific-Technical Activities" of 26.11.2015 №848-VIII, funding for research in Ukraine is in several directions, in particular:

- State budget and local budgets
- Funds of institutions, organizations and enterprises
- Ukrainian and foreign customers
- Grants
- Other sources not prohibited by the law [9].

The amount of the state budget is determined annually as a share of gross domestic product. Public funds are allocated for the activities of research institutions, conducting research, scientific and technical (experimental) developments by institutions of higher education, academies, institutes, funding of certain scientific and technical programs, projects and grants. In the state budget for 2022, adopted by the Verkhovna Rada of Ukraine, the total amount of state budget expenditures on scientific and scientific-technical activities is UAH 14.3 billion ($\approx$ EUR 458 millions). This is UAH 2.1 billion ($\approx$ EUR 67.3 millions) more than in 2021 and is 17.2% growth by 2021. [10]

Among funding instruments and modalities the Ministry of Education and Science of Ukraine (MES) and the relatively newly established National Research Foundation of Ukraine (NRF) are the core ones. The MES gives direct financial allocations to public universities and public research institutions. The amount of allocated funding depends on several parameters, namely number of students admitted to a university with correlation of study costs, applicants' results of External Independent Evaluation (ZNO), quality indicators of educational and research activities of an institution [11]. The NRF supports basic research, as well as applied scientific research and developments. Accordingly, the NRF provides individual, collective and institutional grants. It is important that these grants can be used not only to support, develop and carry out scientific research, but also to develop material and technical bases, create research infrastructure, support key public laboratories, as well as ensure mobility and support for young scientists. In 2021, the NRF funded 216 scientific research projects totaling UAH 271.7 million ($\approx$ EUR 8.7 millions) [12].

Besides, nearly 4.000 applications for inventions, 9.000 applications for useful models and 2.500 applications for industrial patterns are being submitted annually. Metadata that accompanies all these various research activities is increasingly fragmented and resides in different, heterogeneous systems or in some cases, is not available in a machine-readable format. Such a situation makes the reporting process tiring and highly time consuming as institutional research offices have to search in several different systems, including proprietary, subscription databases like Web of Science and Scopus. That is when Ukrainian Research Information System offers a possibility to gather research information efficiently and to make it available for various different purposes.

2.1. Data sources on researchers

Information about scientists is central to the Ukrainian Research Information System (URIS). Today in Ukraine, there is only one publicly available database about researchers – portal “Scientists of Ukraine”, developed and maintained by the National Library of Ukraine named after V. Vernadsky (NLUV), which as of June 2022 had 150.775

records. The portal is systematized by fields of knowledge, scientific degrees and titles, regions as well as departmental and institutional subordination. The register is intended for the search of scientific publications and personal promotion. Profiles of researchers are automatically formed on the basis of dissertation abstracts of candidates and doctors of sciences defended in Ukraine after 1996. The list is automatically replenished as abstracts arrive at the NLUUV fund. That means that information on PhD students and their contribution to Ukrainian science domain cannot be found there. Apart from that, the portal lacks administrative control, information on existing researchers oftentimes is incomplete and outdated. Another barrier, which makes usage of data from the Scientist of Ukraine portal nearly impossible, is lack of API capabilities.

2.2. Data sources on Research Infrastructure

According to Ukrainian legislation, the term “research infrastructure” is defined as a set of tools, resources and related services used by the scientific community to conduct research at the highest level, covering the most important items of scientific equipment or sets of instruments, knowledge-based resources, communications-based infrastructure and other unique structures. Research infrastructures can be locally located, virtual or distributed, public or private [9]. In April 2021, the Government approved the Concept of the State Target Program for the Development of Research Infrastructures in Ukraine for the period up to 2026, which provides the restoration and development of the research infrastructure system of Ukraine. Partial information on research infrastructure is reflected in two official registries maintained by the MES:

- State Register of Scientific Objects Constituting National Heritage (consists of 138 items)
- State Register of Scientific Institutions Supported by the State (consists of 3084 items)

The *State Register of Scientific Objects Constituting National Heritage* collects unique objects that cannot be reproduced. The *State Register of Scientific Institutions Supported by the State* lists research performing organizations and higher education institutions whose activities are of crucial importance for science, economy and innovations. Both registries collect data via paper forms, which have to be sent to the MES.

2.3. Data sources on publications

The Ukrainian infrastructure for storing information on scientific publications is represented by three systems:

The portal “*Scientific Periodicals of Ukraine*” – a depository of electronic copies of journals and collections of scientific works of Ukrainian researcher, created by the National Library of Ukraine named after V. Vernadsky. This project was launched in 2009 to enforce the Law of Ukraine “On Basic Principles of Information Society Development in Ukraine for 2007-2015” and the joint Order of the Higher Attestation Commission of Ukraine and the National Academy of Sciences of Ukraine “On approval of the Order of transfer of electronic copies of periodical printed scientific professional editions for storage in National Library of Ukraine named after V. Vernadsky”. Today the portal presents 2 863 titles of journals, 52 382 issues and 1 269 762 full texts of articles. It is important to note that the deposit takes place in compliance with the embargo period. Unfortunately, due to the imperfection of the technical solution and the lack of API the possibility of importing data from it remains as a challenge.

National Repository of Academic Texts (NRAT) – is a nationwide distributed electronic database, which accumulates, stores and organizes academic texts. The owner of the resource is the Ministry of Education and Science of Ukraine, and the administrator is the Ukrainian Institute of Scientific and Technical Expertise and Information. The NRAT consists of a central repository and local repositories maintained by institutional participants, which include the following types of academic texts in electronic form:

- dissertations for scientific degrees and abstracts of dissertations
- qualification graduation theses of higher education applicants

- articles in scientific journals, including all articles (set of articles), on the basis of which a scientific degree was awarded
- monographs, including those on the basis of which the degree was awarded
- scientific publications
- reports in the field of scientific and scientific-technical activities
- deposited scientific works
- textbooks, manuals and other scientific and educational works
- publications posted by authors on Internet platforms for the exchange of scientific publications [13].

The portal is expected to use capabilities of the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH) and SWORD (Simple Web-service Offering Repository Deposit) in the future. At the moment of writing this paper portal was under construction.

Open Ukrainian Citation Index (OUCI) – is a search engine and a citation database that comes from all publishers that use the Crossref Cited-by service and supports the Initiative for Open Citations [14]. OUCI is designed to make it easier for scientists and librarians to search for scientific documents, to help managers collect statistics and to expand the reading audience of Ukrainian scientific journals. To date, the database includes 1 652 Ukrainian scientific journals from 366 publishers and 407 924 publications in all fields of knowledge. The service was launched in 2018, and was originally planned to be a CRIS module, but now operates as a standalone service.

2.4. Data sources on organizations

The *Unified State Electronic Database on Education (USEDE)* – is an integrated information and telecommunication system, the technical means of which are located within the territory of Ukraine, and consists of a set of automated workstations integrated into a single information system through secure communication channels using remote access technology. The USEDE has a connection to public communication networks with differentiated access rights and provides protection against violations of the integrity of information. Protection of information in the USEDE is provided by creating a comprehensive system of information protection with confirmed compliance.

Connection to the USEDE of higher education institutions began in 2012, professional (vocational and technical) educational institutions – in 2013, and departments of education – in 2014.

As of January 1st 2021, 673 higher education institutions that are legal entities and 517 of their separate structural subdivisions are registered to the USEDE; 1,081 institutions of professional (vocational) education, which are legal entities and 93 of their separate structural units; 366 other institutions that are legal entities and provide professional (vocational and technical) education or provide vocational and technical training, and 31 of their separate structural units; 1,453 regional, district, local government bodies in the field of education [15].

According to Article 74 of the Law of Ukraine “On Education”, the obligatory components of the USEDE are:

- Register of subjects of educational activity
- Register of education applicants
- Register of documents on education
- Register of external independent evaluation certificates
- Register of student (pupils) tickets
- Register of pedagogical workers
- Register of certificates of pedagogical workers

The list and amount of information contained in the registers and the procedure for their maintenance are established by the central executive body in the field of education and science. The database has two types of access: some sub-registries are publicly available, some with limited access.

2.5. Dataset about project

In Ukraine, research projects performed by research institutions, higher educational institutions and enterprises, which are fully or partially financed from the state budget, are subject to the mandatory state registration and accounting. The procedure of registration is carried out by the Ukrainian Institute of Scientific, Technical and Economic Information, which is also a holder of a database which stores records of these projects. After registration, each project receives a unique identifier and the so called “Card of Research Project”, which contains information on funding, organization and project managers. This information is publicly available via NRAT. Another database that collects data on projects is the internal database of the National Research Foundation. It is important to note, that in 2021 NRF joined the Crossref Funding Registry, which eases the mechanism for ensuring that references to the NRFU’s project are available in scientific publications that contain information on the results of research conducted with grant support from the Foundation.

3. Ukrainian Current Research Informational System

On the wave of nationwide digitalization and continuous rise of research information, the Ministry of Education and Science of Ukraine decided to establish the National Electronic Research Information System. The official decree №1 / 1-13 "On the establishment of the National Electronic Scientific Information System “URIS” was passed on January 13th, 2020. The development of the system and its implementation is entrusted to the State Scientific and Technical Library of Ukraine (SSTL).

To begin the process of choosing program solution of system and approach, the team surveyed the local stakeholders. Findings indicated that minority of institutions of higher education in Ukraine built in-house systems while a significant number continues using Microsoft Excel for collecting research information. Thus, after multiple consultation with national and foreign experts a decision to build national CRIS from scratch had been made. Another factor that contributed to this was the MES intention to gradually extend the system functionality and make it a booking gate for technological services and research infrastructures. It is expected that in the future access to governmental services related to research domain will be available via URIS as well. Set of criteria for FAIR research information in open infrastructures, which was jointly developed by the German National Library of Science and Technology (TIB) and the State Scientific and Technical Library of Ukraine are set to be the core guidelines in the system’s construction [16].

Ukrainian Current Research Information System is based on the CERIF data model and consists of five central databases, which store information on researchers, research performing organizations, research outputs scientific equipment and projects. The development of the system is planned to be conducted in 4 phases:

- *Phase I*
Development of the technical task and general architecture of Ukrainian Research Information System. Definition of metadata sets for each entity. Design of workflows.
- *Phase II*
Set up and configuration of the platform. Basic modules development. Set up and configuration of add-on modules.
- *Phase III*
Design and implementation ETL technologies for data import and implementation of integrations with synchronized resources.
- *Phase IV*
Data import and synchronization. Validation of implementation and put into operation.

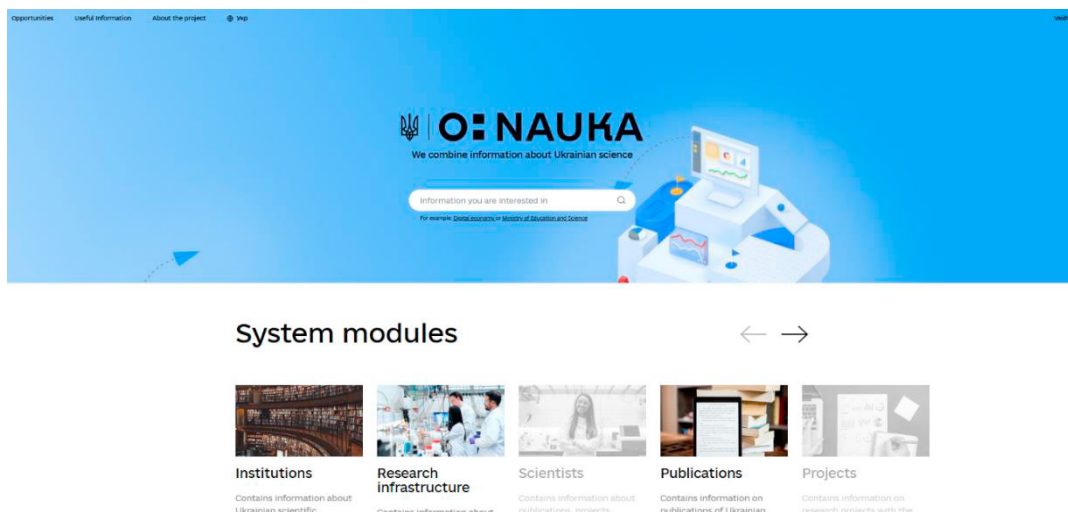


Fig. 2. Home page of Ukrainian Current Research Information System

4. Conclusions

The result of this study has a diagnostic character and provided us with a clear picture about status quo of research information in Ukraine. As the analysis shows, current research information infrastructure is unsatisfactory and needs to be improved and optimized. The data contained in a number of systems are not complete and reliable. A number of systems have outdated technical solutions that make it nearly impossible to import data from them. Therefore, this state of affairs negatively affects the circulation of research information within the country and hinders accounting, monitoring and evaluation processes.

Nevertheless, some block of research infrastructure is well established and can be reused in frame of building national CRIS system. Future system will fill the gaps with missing parts of information and bring wide range of benefits to the various stakeholders, for instance it will help researchers with quicker access to information and lessen administrative burden, will enable funders easily track the result and return on the work they have supported, will assist businesses in finding a new perspective technologies, enhance decision-making process of officials and lastly, will raise awareness among citizens in regard to national science.

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References

- [1] Hey T, Tansley S, Tolle K. The Fourth Paradigm: Data-Intensive Scientific Discovery. : 287.
- [2] Jeffery K, Houssos N, Jörg B, Asserson A. Research information management: the CERIF approach. *Int J Metadata Semant Ontologies*. 2014;9(1):5–14.
- [3] Blümel I, Dietze S, Heller L, Jäschke R, Mehlberg M. The Quest for Research Information. *Procedia Computer Science*. 2014 Jan 1; 33:253–60.
- [4] Biesenbender S, Petersohn S, Thiedig C. Using Current Research Information Systems (CRIS) to showcase national and institutional research (potential): research information systems in the context of Open Science. *Procedia Computer Science*. 2019;146:142–55.
- [5] Hornbostel S. From CRIS to CRIS: Integration and Interoperability. *Proceedings of the 8th International Conference on Current Research Information Systems* 2006; 29–38.

- [6] Bittner S., Müller A. Social networking tools and research information systems: Do they compete? *Proceedings of the ACM WebSci*. Germany: ACM, 2011. P. 1–4
- [7] Jetten M, Simons E, Rijnders J. The role of CRIS's in the research life cycle. A case study on implementing a FAIR RDM policy at Radboud University, the Netherlands. *Procedia Computer Science*. 2019; 146:156–65.
- [8] de Castro P, Kimidi SS, Palavesm K. The rise of current Research Information Systems (CRIS): The case of the Indian Research Information Network System (IRINS). *IndiaRxiv*. 2020. Available from: <http://dx.doi.org/10.35543/osf.io/uv5pg>
- [9] On scientific and scientific and technical activity. Official web portal of the Parliament of Ukraine. Available from: <https://zakon.rada.gov.ua/laws/show/848-19>. [Accessed 15 April 2022]
- [10] On the State Budget of Ukraine for 2022. Official web portal of the Parliament of Ukraine. Available at: <https://zakon.rada.gov.ua/laws/show/1928-20>. [Accessed 20 May 2022]
- [11] Lysiak L, Petrova Y, Tsiupiak P. Financial provision of higher education in Ukraine: Status and improvement directions. *Efektivna ekonomika*. 2020;(12). Available from: <http://dx.doi.org/10.32702/2307-2105-2020.12.15>
- [12] NFDU reports [Internet]. Org.ua. Available from: https://nrfu.org.ua/about-us/zvity-nfdu_1/. [Accessed 15 April 2022]
- [13] NRAT - National Repository of Academic Texts, Ukraine. 2019. Available from: <https://nrat.ukrintei.ua/>. [Accessed 12 June 2022]
- [14] Cheberkus D, Nazarovets S. Ukrainian open index maps local citations. *Nature* [Internet]. 2019;575(7784):596. Available from: <http://dx.doi.org/10.1038/d41586-019-03662-6>
- [15] Unified State Electronic Database on Education. Gov.ua. Available from: <https://info.edbo.gov.ua/about/>. [Accessed 15 April 2022]
- [16] Hauschke C, Nazarovets S, Altemeier F, Kaliuzhna N. Roadmap to FAIR research information in open infrastructures. *J Libr Metadata*. 2021;21(1–2):45–61. <http://dx.doi.org/10.1080/19386389.2021.1999156>