
SUMMARY

1. The implementation of European principles of open science in Ukraine is a national task closely linked to the progression towards EU integration. As part of this campaign, the NAS of Ukraine has set its own goals:

- improving the visibility of the research results of NAS scientists in the open science information environment using modern technical and information tools;

- extending access for the scientific community to the scientific results of the NAS of Ukraine, both in Ukraine and internationally;

- supporting the use of research results, their dissemination using modern open science mechanisms, broadening the knowledge of the scientific community in foreign countries about scientific publications and research data of NASU scientists;

- increasing the reliability, credibility, and reproducibility of scientific results.

Open science already provides Ukrainian scientists with new opportunities: free permanent cloud repositories for their own data and teamwork, access to data from other researchers (for experiments, use, comparison); access to most publications without the help of foreign colleagues or membership fees; simplification and acceleration of data processing, formatting, visualisation, etc. Open science, combined with the progress of artificial intelligence, changes the way we work with scientific information groundbreakingly, and we as researchers have no choice but to embrace this revolution. Therefore, our task is to use it most effectively for the benefit of Ukrainian science and the state.

2. The concept of open science was initiated by EU institutions in 2015–2016 as a development of public initiatives by European scientists in 2001–2002 regarding open access to scientific knowledge and finding an alternative to the high cost of subscriptions to scientific journals. Measures to provide open access to scientific articles and data, scientific and technical information in EU policy documents, and the 2008–2012 Framework Programme for Research and Innovation were developed with

the introduction of more active dissemination of scientific research results in society and access to research infrastructures and research data.

One must note the EU's legal experience in influencing the development of open science, mainly through support for public initiatives, project funding, adoption of recommendation documents, identification of measures to be voluntarily implemented by Member States, regulation of open access conditions in research funding agreements, and the introduction of legislative regulation only on specific issues. In our opinion, this is related to the significant dynamics of the open science progress and ensuring its broader development in the absence of overregulation.

At the same time, despite 20 years of promoting open access to scientific knowledge in the EU, the problem of restricted access to scientific articles released by private publishers, which issue the majority of scientific journals, remains unresolved. No alternative system to private publishers for publishing scientific journals with funding from the EU and its Member States has been created either. Legislative decisions to establish the possibility of publishing manuscripts of peer-reviewed articles by some Member States in 2013–2016, regardless of the restrictions imposed by publishers, have not yet led to the establishment of such provisions in the EU as a whole.

There are also no studies on the impact on the EU economy and the effectiveness of the research on the implementation of open science principles, since open access to research results intended to be commercialised is not provided. So the scope of open access to research results is objectively limited.

The challenges of open science in the EU in these circumstances are the introduction of effective means for scientists to obtain and exchange information for improving research performance and the formation of a broader dialogue between science and society. A current issue is the invention of mechanisms combining the openness of research results with simultaneous restriction of access to sensitive or competitive information due to various political, economic, and military interests of countries around the world, and non-disclosure of research results intended for commercialisation, in particular, know-how.

A key feature of Ukraine that sets it apart from EU member states is its significantly higher level of open access to published scientific articles, which was introduced by the National Academy of Sciences of Ukraine and the Higher Attestation Commission of Ukraine in 2008. Specific measures for the development of open science in Ukraine are contained in the National Plan for Open Science 2022, as well as the Roadmap for Ukraine's Integration into the European Research Area.

Legal challenges in Ukraine include: at the level of scientific institutions and higher education institutions – the adoption of a system of local

acts, recommendations, and agreements based on the principles of open science; at the state level – implementation of EU acts relating to open access (Directives (EU) 2019/1024, (EU) 2019/790, etc.), ensuring the protection of trade secrets and confidential information. A balanced approach is needed to the application of certain types of Creative Commons public access licences to scientific articles and other works, which would prevent the spread of unoriginal derivative works, as well as the introduction of a mechanism for providing open access to official works.

One challenge is the refusal to publish scientific research reports through the National Repository of Academic Texts, which is not the case in the EU. In the context of Russian aggression, this could lead to the spreading of sensitive information about the strengths and weaknesses of the Ukrainian economy, scientific research, and society. There is a need to stop the mass violation of copyright resulting from the publication of scientific reports and dissertations in the repository without concluding licence agreements with rights holders, as well as ensuring the protection of commercial secrets and confidential information contained in scientific reports when they are submitted to UkrISTEI, as required by Ukrainian legislation and EU policy documents and acts.

The attempt to regulate the field of open science, as envisaged by the draft Law of Ukraine “On Amendments to Certain Laws of Ukraine Regarding the Implementation of Open Science Principles,” poses a threat. Discussions on the draft law have proven that it does not comply with EU and EU Member State legislation on open science or with the requirements for the public licences application, and needs to be amended.

The creation of open science infrastructure at the National Academy of Sciences of Ukraine (NASU) in 2023–2024, taking into account the experience of the EU, and the adoption of a system of regulations in this area, was a significant challenge for NASU institutions implementing the OPENS project. Through the efforts of experts and the Working Group on Open Science of the NAS of Ukraine, a systematic approach to the development of open science tools was introduced: The Concept for the Implementation of European Principles of Open Science in the NAS of Ukraine for 2024–2030, Regulations on Open Science at the NAS of Ukraine, as well as special acts, recommendations, and model agreements. Intractable problems included regulating the use of open access licences that would not lead to the generation of derivative works, and resolving the issue of using official works to ensure open access to them.

The practice of implementing open science principles has demonstrated the need to develop model licence agreements relating to the publication of scientific articles and scientific journals, the publication of preprints and research data, including adherence agreements.

The system of regulatory acts of the NAS of Ukraine in the field of open science, regulatory decisions and recommendations on the use of CC BY-

NC-ND and CC BY-ND licences, as well as the regulation of the conclusion of additional agreements to employment contracts (contracts) with employees of NAS of Ukraine institutions regarding property rights to official works and official research data for open access, are relevant for dissemination and application in the practice of scientific institutions and higher education institutions in Ukraine.

The current challenge is to promote the opportunities provided by the Repository of open research data of the NAS of Ukraine, the Preprint Archive of the NAS of Ukraine, the Universal Publishing Platform of Journals of the NAS of Ukraine, and other infrastructure elements for use by employees of scientific institutions of the NAS of Ukraine, developing local regulations drafts in the field of open science for scientific institutions, improving the regulatory and legal framework for the functioning of the open science infrastructure at the NAS of Ukraine as part of the national system of open access to knowledge and the European Open Science Cloud.

3. In the Ukrainian scientific community, the implementation of FAIR principles is in its early stages, but there are already promising examples of institutional practice. The implementation of FAIR principles requires a coordinated combination of technological solutions, educational and methodological support, and motivational mechanisms for users. In this context, the experience of the DataverseUA Repository demonstrates that even in a country where a national open research data policy is still in its infancy, effective local implementation of FAIR principles is possible.

Considering what data should be shared and how, it is easier to understand why this should be done. The first benefit is saving effort in combining data from different scientific works for comparison. The second is overcoming the limitations imposed on data by the traditional format of scientific publication. There is no place in a journal for large amounts of illustrative material, large high-resolution images, three-dimensional models, or any other way to convey dynamics other than inserting several images of sequential states. In contrast, data posted on the internet makes it possible to do all this and much more, increasing the persuasiveness of scientific conclusions and reducing the distance to potential use, application, and implementation.

FAIR principles form the basis of high-quality scientific communication, provide research transparency, and promote reproducibility and transdisciplinary use. Despite current challenges, Ukraine has the potential for full integration into the European scientific data space. The example of the DataverseUA Repository is significant evidence that the development of FAIR infrastructure is possible even at the policy-making stage, provided there is strategic support, openness to innovation, and close cooperation with the international scientific community.

4. The Virtual Competence Centre for FAIR Data Management has achieved significant results in developing infrastructure and promoting FAIR standards among the scientific community in Ukraine. It is necessary to reform the Virtual Competence Centre for FAIR Data Management into the Competence Centre for Open Science and Research Data Management of the NAS of Ukraine to continue effectively spreading knowledge about the possibilities of open science and participating in international open science projects.

The updated Centre should focus on improving its work in the following areas.

Expansion of training programmes: creation of new courses on the use of modern data management tools, metadata automation, and data quality assurance.

Developing national policy: initiating recommendations for Ukrainian scientific institutions and the Centers for the collective use of scientific equipment to standardise data management processes in accordance with FAIR principles.

Attracting new users: conducting information campaigns and collaborating with institutions to promote DataverseUA and the Centre's services.

Development of international cooperation. The Centre has significant potential for developing international cooperation through joint participation in international projects, namely, the Centre's involvement in European initiatives, EOSC, GAIA-X, and Horizon Europe.

An important aspect is the exchange of knowledge – the organisation of international seminars and webinars with the participation of experts from EU countries to exchange experience and best practices in data management, as well as the search for grant support to attract resources for technical assistance and improvement of the Centre's infrastructure.

The development of a global cooperation network, i.e. establishing links with leading European research institutions and universities and cooperating with EOSC to implement joint projects for the development of open science and open innovation in Ukraine, in particular in the development of the EOSC National Centre project and its implementation based on scientific institutes of the National Academy of Sciences of Ukraine and universities of the Ministry of Education and Science.

These outlooks ensure the sustainable development of the Competence Centre for Open Science and Research Data Management of the NAS of Ukraine, increasing its efficiency and integrating Ukrainian science into the international research space.

5. The preprint archive is a significant component of the Open Science Infrastructure of the NAS of Ukraine, which creates conditions for quickly informing the scientific community of Ukraine and the world about the

latest research results of NASU employees, copyright protection, and scientific priority.

The concept of open science provides for open access to research data and requires the inclusion of references to published data in manuscripts of printed scientific works. This creates the need for the simultaneous publication of preprints to establish and protect scientific priority and secure copyrights to ideas that may directly result from the published data.

The Preprint archive of the NAS of Ukraine is hosted on the virtual servers of the Presidium of the NAS of Ukraine. Its hardware is maintained and protected by employees of the Institute of Software Systems of the NAS of Ukraine, and its software is serviced by administrators from the V.M. Glushkov Institute of Cybernetics of NAS of Ukraine. Reliable storage of information is guaranteed by regular backups of preprints and databases in the data storage facility of the SCIT supercomputer complex at the V.M. Glushkov Institute of Cybernetics of NAS of Ukraine.

Courtesy of the Preprint Archive, employees of the NAS of Ukraine have the opportunity to publish preprints in the national language using a Ukrainian-language user interface. The right to publish preprints is granted by the management of the NAS of Ukraine, permanently unrestricted. The Preprint Archive does not require recommendations from third parties or compliance with additional requirements, nor does it review the text of the preprint. Published preprints receive a DOI, and they quickly become available for reading, printing, distribution, and citation by Ukrainian and foreign scientists through the automatic transfer of their metadata to international search engines.

6. The modern scientific paradigm, reinforced by the technological capabilities of highly developed digital communications, tends towards the concept of open science as a movement towards the free circulation of knowledge and equal access to scientific information in societies at different levels of development. The Vernadsky National Library of Ukraine is actively involved in the implementation of open science initiatives through the realization of large-scale projects for free access to academic publications. The first stage of creating one of them – the Repository of Scientific Texts of the NAS of Ukraine – involved the introduction of an open-access archive of academic periodicals, the website “Journals of the NAS of Ukraine.” The current state of implementation of the Repository of Scientific Texts of the NAS of Ukraine gives reason to speak of the achievement of almost complete resource coverage of the journals of the NAS of Ukraine and a high level of integration of Ukrainian academic periodicals into international scientific information systems.

Current work on the development of the Scientific Text Repository of the NASU is focused on filling it with non-periodical texts to represent the publication activity of the Academy’s scientists in full, update the inter-

related scientific portfolios of researchers and institutions, and integrate them into international metadata collection platforms. Thanks to this, the Repository of Scientific Texts of the NAS of Ukraine, as part of the Library Portal of the NAS of Ukraine, will become a full-fledged research information management system, suitable for dynamically reflecting the current state of development and integration of science, useful for researchers, publishers, analysts, and administrators of scientific activity.

Given the challenges facing Ukraine today in terms of security, energy, and migration risks, it is the research infrastructure of open science that performs a consolidating function and prevents the scatter of knowledge and achievements of Ukrainian scientists.

7. In the digital age, universal publishing platforms are becoming the foundation of modern scientific communication, promoting the open, secure, and ethical dissemination of knowledge. Global practice demonstrates the priority of such platform characteristics as openness, reliability, ethics, and technical uniformity. Support for commonly accepted exchange formats, integration with identifiers (DOI, ORCID), synchronisation with international indexes (Scopus, Web of Science), and the availability of APIs create conditions for effective interaction and dissemination of scientific results.

Global trends in the development of universal publishing platforms open up new horizons for Ukrainian science. The implementation of such platforms, based on the initiatives of the National Academy of Sciences of Ukraine – OPENS and OPENS2, in particular, is a strategic step towards ensuring openness, security, ethics, and unification of scientific communication. This not only complies with international standards but also creates a reliable basis for the sustainable development of scientific activity in Ukraine in the context of modern socio-economic challenges.

The NAS of Ukraine plays a system-building role in the development of the Ukrainian scientific publishing ecosystem. Its initiatives in the field of open science, digital platforms, ethical standards, and international visibility are a significant element of the strategic transformation of Ukrainian science. Further institutional support for open access, digital tools, unified publishing solutions, and inter-editorial coordination paves the way for the creation of a universal academic environment that will meet the highest global standards of open, high-quality, and effective scientific communication.

All the work carried out during the creation of the Universal Publishing Platform of the NAS of Ukraine, conditional upon supporting and continuing, will help transform the existing periodicals of the NAS of Ukraine on various topics into open access journals that will provide real-time information in a virtual environment about the results of scientific research carried out at the Academy with an universal “entry point” to the Universal Publi-

shing Platform, which will be linked not only to global aggregators, but also to open data bases and scientific preprints of the NAS of Ukraine in EOSC.

Promising areas for further work may include: updating and improving the Universal Publishing Platform; introducing metadata and text exchange between the National Library of Ukraine and the “Akademperiodyka” publishing house into the work practice of all journals available on the platform; updating the provisions on journals and their editorial policies in accordance with the current requirements of virtual aggregators; developing rules for journals on working with hyperlinks to preprints and research data; introducing electronic editing tools into the work practice of a larger number of journals; involving other journals of the NAS of Ukraine in the Universal Publishing Platform, migrating (creating) their archives; continuing work on submitting scientific journals for consideration to DOAJ and WOS; continuing work on submitting scientific books to WOS.

8. The above discussion addresses the issue of integrating electronic information resources, which is relevant and essential for building automated information systems with autonomous, distributed, heterogeneous information sources to ensure open access to them at the modern level.

Approaches to solving the problem of building such aggregators are considered, and the Open Archives Initiative approach, which has gained widespread practical application, is described in detail. The essence of the approach is to provide a single unified interface for web access to electronic information resources located in interoperable repositories by organising the sharing, publication, and archiving (harvesting) of metadata for such resources.

The general information model of the approach is presented, the roles of data and service providers are explained, the scheme of their interaction with aggregators, etc., is described, and the architecture of the system for integrating scientific electronic libraries of the NAS of Ukraine is presented.

An analytical review of common open-source software that supports the approach to the formation of open harvesting systems was performed.

VuFind software was selected to build the NAS of Ukraine Harvester based on the requirements formulated for the open science infrastructure at the NAS of Ukraine and the tasks set by the Targeted Scientific and Technical Program “OPENS,” the extensive capabilities of which are described in detail in this section.

The NASU Open Science Harvester developed and described here has already proven its effectiveness in a short period of time, as evidenced not only by its integration into other international scientific information aggregators but also by statistical indicators.

9. The main portal and shared services of open science are a set of essential service elements that ensure the integration of the Open Science Infrastructure of the NAS of Ukraine into a single system.

The software products described in this section are installed on the virtual servers of the Presidium of the NAS of Ukraine. Their hardware is maintained and protected by employees of the Institute of Software Systems of the NAS of Ukraine, and administrators from the V.M. Glushkov Institute of Cybernetics of the NAS of Ukraine maintain their software.

The main open science portal is the entry point to all Open Science Infrastructure services and a web resource that provides up-to-date information on opportunities, support, implementation processes, significant events, and prospects for open science at the Academy, in Ukraine, and beyond. From a practical point of view, the Main Open Science Portal is the Open Science Infrastructure of the NAS of Ukraine.