

Governance, Validation, and Responsible Metrics in National Research Information Systems: Comparative Evidence from Ukraine and Slovakia

National research information systems play an increasingly central role in supporting evidence-based research governance, yet the ways in which these systems ensure data quality, structure validation workflows, and apply research metrics vary considerably across countries. Ukraine's URIS system and the Slovak national CRIS provide two distinct but complementary examples of how large-scale infrastructures can manage hundreds of thousands of research records while maintaining high standards of accuracy, transparency, and interoperability. In Ukraine, more than half a million submissions undergo a combined manual and automated validation process coordinated by the State Scientific and Technical Library of Ukraine, forming the backbone of national research assessment and reporting. Slovakia, meanwhile, has developed its own frameworks for quality control and verification, embedded in long-standing national evaluation practices and supported by established governance structures.

Examining these systems side by side offers an opportunity to understand not only their technical components, but also the governance models that define who is responsible for data curation, how competencies are distributed, and which mechanisms ensure accountability. As countries seek to scale their infrastructures and align with international standards, questions of interoperability across institutions, platforms, and national boundaries become particularly salient.

A comparative perspective is equally relevant for the use of research metrics. Both systems rely on analytics to inform policy decisions, evaluate institutional performance, and monitor research activity. Yet global discussions around responsible metrics, including the principles promoted by DORA and related initiatives, highlight the risks of simplistic or misapplied indicators. Studying how Ukraine and Slovakia navigate these issues can shed light on approaches that mitigate bias, reduce distortions in performance monitoring, and strengthen trust in national evaluation processes.

By bringing these elements together data quality practices, validation workflows, governance arrangements, and the responsible use of metrics this study aims to provide insights of practical value to the broader CRIS community. Understanding how national systems operate in different contexts can help inform the design of infrastructures that are robust, scalable, and aligned with FAIR and Open Science principles.

2. Overview of the two systems

URIS serves as the national spine for research information in Ukraine, providing a centralized environment where institutions submit records, national bodies run analytics, and policy actors draw evidence for funding and evaluation decisions. It aggregates metadata and full-text links from institutional repositories, university CRIS installations, and individual submissions into a unified dataset of over half a million records.

Data validation follows a two-layer workflow: institutional curators verify affiliations, identifiers (DOI, ORCID), and metadata locally, while a national validation team, coordinated by the State Scientific and Technical Library of Ukraine, ensures cross-institutional consistency. This approach supports FAIR principles, open science, and transparent evaluation.

URIS underpins key operational and policy functions:

- Submission and evaluation of academic competitions and research grants.
- Institutional reporting to ministries and funders.
- System-level evaluation of research organizations, providing verified metrics and dossiers.

Analytics provide decision makers with dashboards, longitudinal analyses of publications, collaboration networks, and open-access compliance. Planned features include modules for scholarly journals and support for early-career researchers and PhD candidates, strengthening talent pipelines.

Governance is layered: institutional stewards manage local curation, national validators apply cross-cutting rules, and a governance board oversees policies on identifiers, metrics, and reporting. By centralizing submissions and documenting validation, URIS fosters fair, consistent, and transparent assessment.

Taken together, URIS functions not only as a metadata repository but also as an operational instrument of national research governance, linking everyday administrative tasks to long-term evidence-based policy.

2.1. Slovak CRIS ecosystem

In Slovakia, the scientific ecosystem comprises several interconnected levels: from policy-makers, through funding and evaluation bodies, to institutions, researchers, and research infrastructures. This ecosystem is gradually being shaped by reforms aimed at increasing openness, fairness, and accountability in the allocation of financial resources and in making research outputs accessible to the public.

Issues of credibility and transparency of the ecosystem relate particularly to the functioning of grant agencies, the management of scientific data, open access, and the implementation of open science principles. However, a robust ecosystem is needed not only where research outputs are openly shared, but also where transparency permeates the research process from the outset, enabling more rigorous and collaborative research (Thibault et al., 2023)³.

Data on science and research constitute a fundamental element of the modern governance of the research and innovation ecosystem. They enable the systematic monitoring of scientific capacities, activities, outputs and impacts, thereby forming the basis for effective policy-making, long-term strategic planning and international benchmarking.

A key actor in the field of science and research data processing in Slovakia is the CVTI SR. CVTI SR has long been responsible for building, developing and operating several nationwide information systems, tools and registers serving research institutions within the remit of the Ministry of Education, Research, Development and Youth of the Slovak Republic.

The main system is the **SK CRIS** – National Research Information System, containing structured data on research projects undertaken by Slovak organizations, their outputs, a map of research infrastructure, a register of research organizations and a database of researchers. It supports capability assessments and statistical surveys of research and development potential and has previously been used to administer selected national grant schemes.

Among the key information systems and registers operated by CVTI SR are:

CREPČ – Central Register of Publication Activity, a comprehensive bibliographic database of publications produced by Slovak higher education institutions, used for the evaluation of publication activity, statistical reporting for university funding, accreditation processes, periodic evaluation of research, development, artistic and other creative outputs, and for the implementation of performance-based funding.

CREUČ – Central Register of Artistic Activity, a bibliographic database of artistic outputs of Slovak higher education institutions.

CRZP and **ANTIPLAG** – Central Register of Theses and Dissertations and Antiplagiarism System, which securely stores digital theses and performs automated originality checks.

SCIDAP – National Open Digital Repository for Publications, preserving and providing access to full-text publications produced by Slovak research institutions.

SVD – National Open Digital Repository for Research Data, enabling the secure storage and open dissemination of research datasets.

Data processing within these systems is shaped by different legislative frameworks and serves diverse purposes, resulting in heterogeneous processes and varying degrees of obligation for research actors.

Despite this heterogeneity, these data sources form a coherent ecosystem due to the use of international standards, data models and classifications for describing the entities and attributes represented in the databases. These shared principles provide the foundation for the development of a robust and high-quality research information infrastructure.

3. Governance Models

3.1. Roles and Responsibilities

In national CRIS systems, clear delineation of roles and responsibilities is essential to ensure data quality, accountability, and operational efficiency. In Ukraine, the governance of URIS is structured around multiple layers. The State Scientific and Technical Library of Ukraine plays a central coordinating role, establishing metadata standards, defining validation procedures, and managing national-level oversight. Universities and research institutions are primarily responsible for the initial curation of their records, ensuring that local submissions conform to prescribed formats and that authorship and affiliation data are accurate. System developers maintain the technical infrastructure, implement automated validation routines, and provide ongoing support for integrations with institutional CRIS installations. National evaluation bodies and policy agencies rely on the curated datasets to conduct research assessment, institutional accreditation, and monitoring of funded projects, while also providing feedback to the governance board regarding needed updates to data standards or analytical workflows.

This layered governance model balances institutional autonomy with centralized oversight. Universities retain control over their internal data workflows, enabling contextual knowledge to inform initial curation, while the SSTL ensures consistency and comparability across institutions. Formalized protocols define how responsibilities are distributed and include mechanisms for conflict resolution, error correction, and audit trails. Transparency is enhanced through documentation of validation decisions and open reporting of metrics, which together foster trust in the system among stakeholders.

² ZHARINOVA, A. H., DOHTIEVA, I. O., & ZHARINOV, S. S. (2025). The Role of the State Scientific and Technical Library in the Context of Digitalization of Public Administration in the Sphere of Science. *University Library at a New Stage of Social Communications Development. Conference Proceedings*, (10), 235–246. https://doi.org/10.15802/unilib/2025_344006

³ Thibault, R.T., Amaral, O.B., Argolo, F., Bandrowski, A.E., Davidson, A.R., & Drude, N.I. (2023). Open Science 2.0: Towards a truly collaborative research ecosystem. *PLoS Biology*, 21(10). <https://doi.org/10.1371/journal.pbio.3002362>

3.2. Decision-Making Procedures

Decision-making within URIS is structured to be both evidence-driven and participatory. Changes to data standards, metric definitions, and system functionalities follow a formalized approval process. Proposals typically originate either from institutional stakeholders, who identify operational needs, or from national policy authorities, who require adjustments for evaluation and reporting purposes. These proposals are reviewed by a governance board composed of representatives from universities, research institutes, the SSTL of Ukraine, and technical teams. The board evaluates proposals based on feasibility, compliance with national policies, interoperability requirements, and alignment with international best practices such as FAIR principles.

Once approved, technical teams implement changes in coordination with institutional curators to ensure smooth adoption. For example, updates to metadata schemas, new validation rules, or the introduction of additional analytical indicators are tested on sample datasets before full deployment. Feedback loops are embedded in the process: institutions report implementation issues, and adjustments are made iteratively. This structured decision-making ensures that modifications to the system are transparent, traceable, and aligned with the broader objectives of maintaining high-quality data, supporting responsible metrics, and enabling robust national research evaluation.

4. Data Quality: Approaches and Mechanisms

4.1. Data Architecture and Quality Control

The URIS system employs a multi-layered approach to ensure the integrity, consistency, and completeness of research data at a national scale. At its core, URIS combines automated algorithms with manual oversight to maintain high-quality metadata across more than half a million records. Automated processes include normalization routines that standardize institutional names, map author identifiers such as ORCID, match DOIs, and parse bibliographic fields. Deduplication algorithms identify and merge duplicate records, preventing inflation of output counts and ensuring reliable analytics. Compliance with metadata schemas is continuously verified, and missing or inconsistent fields trigger alerts for human review.

Manual curation complements these automated processes. Institutional curators review submissions for accuracy, verifying author affiliations, project attributions, and completeness of metadata. Complex cases, including ambiguous author names or collaborative outputs involving multiple institutions, are escalated to national validators coordinated by the State Scientific and Technical Library (SSTL). This layered architecture allows URIS to detect, flag, and correct inconsistencies efficiently while retaining audit trails that document every change, ensuring transparency in data provenance.

4.2. Ukrainian Model: Integration and Centralization

URIS’s approach is characterized by strong centralization of validation protocols combined with local institutional engagement. All national research competitions, grant applications, institutional reporting, and accreditation processes are channeled through the system. Each record undergoes a first pass at the institutional level, followed by secondary national-level validation, guaranteeing uniformity across universities and research centers. Integration with institutional CRIS installations allows seamless data ingestion while preserving the ability for institutions to correct or enhance metadata. This model not only supports consistent reporting but also provides a robust foundation for analytics, policy evaluation, and evidence-based decision-making.

4.3. Comparison Ukrainian and Slovak systems

The Slovak system is highly centralized. It is managed by a central government body. This model is similar to all national CRIS systems across Europe. However, the Slovak CRIS does not operate institutional systems, which are voluntary. Grant agencies also have their own systems that are connected to SK CRIS using API integration interfaces.

The SK CRIS is integrated with several reference registers. At the national level, it is a Register of Legal Entities, at the international level, primarily the identification of researchers via ORCID is more used.

Data entry is governed by the legislation, therefore all stakeholders are motivated to cooperate in entering the required data, especially about research projects and organizations.

Aspect	Ukraine (URIS)	Slovakia (SK CRIS)
Governance	Layered governance: institutional curators, national validators, governance board	Centralized government management by Ministry of Education
Validation	Two-layer validation (local + national) ensures consistency and transparency	Data entry regulated by law; integration with reference registers ensures quality
Integration	Institutional repositories, university CRIS, individual submissions	Reference registers (national and international), grant agency systems
Policy use	Supports academic competitions, grants, institutional evaluation, and	Supports R&D assessment, statistical surveys, and government reporting

Aspect	Ukraine (URIS)	Slovakia (SK CRIS)
	analytics	
Data access & openness	Publicly accessible metadata and full-text links; FAIR principles	Publicly accessible; adheres to FAIR and open science principles
Scale & coverage	>500,000 records; national-level governance of research information	~700 certified organizations; annual surveys and assessments; about 30 000 records of R&D projects; more than 40000 records of researchers; about 30000 records of research infrastructure; more than 900000 records of research results

5. Validation Workflows

5.1. Ukraine's Unique Case: Large-Scale Dual Validation

URIS employs a dual-layer validation workflow to manage the complexity and scale of national research data. The process begins with primary validation conducted by institutional data stewards. These curators check records for compliance with metadata standards, verify author affiliations, and ensure proper project attribution. Automated checks flag missing fields, inconsistent identifiers, or potential duplicates, which the curators either correct or escalate.

Secondary validation is carried out at the national level by a dedicated team at the SSTL. This team applies cross-institutional rules to harmonize data, resolve conflicts, and confirm identifier accuracy. Complex scenarios, such as multi-institutional collaborations, disputed authorship, or ambiguous funding sources, are carefully reviewed through manual inspection. The system logs all modifications and retains a full audit trail, providing accountability and traceability for downstream analyses.

5.2. Slovak experience

High-quality research information is a prerequisite for research institutions today. In research management, the importance of high data quality has grown steadily in recent years. Data quality plays an important role not only in terms of interpretation and usability of the data, but also when evaluating external data sources; data quality is crucial for the perceived utility and the acceptance of implemented systems (Azeroual & Schöpfel, 2019)⁴. It includes four aspects:

- Completeness of all the necessary information
- Correctness of the information in the system
- Consistency of the information in the system
- Timeliness, the information is up to date (Azeroual et al, 2020)⁵

It should be emphasized that data validation within the science support systems operated in Slovakia, but mainly within SK CRIS, is a necessary condition for implementing the principles of FAIR and open science into these systems and, above all, for increasing the credibility and acceptance of these data by users.

Successful validation requires the fulfillment of several conditions:

- Implementation of metadata standards and international methodologies ensuring the quality and complexity of data in accordance with best practice.
- Data entry forms and xsd schemas of integration interfaces must be defined in accordance with standards and have built-in control algorithms (not only mandatory fields and templates, selection menus, but also duplicity control).
- Data quality is ensured by integration with other systems, mainly with reference registers (in Slovakia, for example, the register of legal entities, the register of natural persons) and international systems of permanent identifiers (ORCID, DOI, ISNI, etc.)

In Slovakia, we have undertaken the implementation of Open Science and the FAIR principles for research data collected not only within SK CRIS, across all systems under our management. We focus on the implementation of unique identifiers, data management, metadata quality control, and the integration of various data sources into broader units with the character of research infrastructures. The aim is to ensure that collected data are used not only at the national level, but also it be made available for international comparison.

⁴ Azeroual, O., & Schöpfel, J. (2019). Quality Issues of CRIS Data: An Exploratory Investigation with Universities from Twelve Countries. *Publications*, 7(1), 14. <https://doi.org/10.3390/publications7010014>

⁵ Azeroual, O., Saake, G., Abuosba, M., & Schöpfel, J. (2020). Data Quality as a Critical Success Factor for User Acceptance of Research Information Systems. *Data*, 5(2), 35. <https://doi.org/10.3390/data5020035>

To support these integration efforts, the Slovak Centre of Scientific and Technical Information (CVTI SR) has developed the Comprehensive Information System for the Acquisition, Processing, Preservation and Dissemination of Scientific and Bibliometric Data and Publications, and for Providing Access to Tools and Applications Supporting Research and Development (abbreviated as KOMIS).

As part of strengthening integration objectives, several related functionalities have been implemented in the Slovak Research Information System (SK CRIS), specifically:

- Implementation of researcher ID federation. The system now supports internationally used persistent identifiers (PIDs), specifically ORCID, ResearcherID and Scopus ID, as well as the national identifier ID of a Higher Education Teacher from the register of university employees.
- Integration with the Register of Legal Entities (using a national-level PID for organizations, namely the Identification Number of an Organization – IČO). The Register of Legal Entities is a reference register. Integration with this register enables SK CRIS to retrieve data on organizations by validating their IČO. This applies the “once only” principle, ensuring that users do not need to re-enter information already available in the national register.
- Extension of recorded research outputs to include DOIs and URLs of the full text of publications.

The Information System on Research, Development and Innovation (SK CRIS) is defined by Act No. 172/2005 Coll. on the Organization of State Support for Research and Development and on Supplementing Act No. 575/2001 Coll. on the Organization of Government Activities and the Organization of Central State Administration, as amended. It is mentioned as the “information system of the Ministry of Education for the provision of services and information in the field of research and development” and at the same time as the public administration information system (ISVS).

The SK CRIS information system integrates data on science and research in Slovakia within the register of R&D organizations, the register of R&D projects, the register of researchers, the register of R&D results and the map of research infrastructure. The system administers the process of assessing the ability to conduct research and development (Section 26a of Act No. 172/2005 Coll.), as well as the supplementary statistical survey of the research and development potential of the Ministry of Education, Science, Technology and Innovation of the Slovak Republic. The system creates reference data (data on the assessment of competence to perform R&D) and provides it to relevant entities, mainly to grant agencies. The data of the registers are predominantly open data and are therefore also available to the public without the need for authentication to the system.

The SK CRIS is operated in the Data Centre for R&D and is integrated with other systems in the field of education. These are the systems of the grant agencies of Slovak Republic APVV, VEGA and KEGA, which, in accordance with the applicable legislation, annually import data on completed projects into the R&D project register. The R&D results register is partially populated through a connection with the *Central Register of Publication Activities* (CREPČ) via an integration API interface. The connection with the national *Register of Legal Entities* in the form of consuming reference data ensures the quality and timeliness of data on research and development organizations according to the “once is enough” principle.

The information system SK CRIS serves mainly as a source of data on science and research in Slovakia. The collected data are publicly available and presented in accordance with the principles of FAIR and open science. They serve the central government bodies, the scientific community and the public. Analytical teams create various outputs and analyses from the data. Let us mention the most important ones:

1. Assessment of competence to perform research and development

The process of assessing research and development organisations begins with the submission of an application, in which organisations provide data on personnel capacities, publication activity, projects carried out, research infrastructure, etc. The submitted application forms are subsequently assessed by an assessment committee. It checks the correctness of the data entered and decides whether to grant the certificate or not. The certificate is granted for 6 years, therefore the assessment process is not a one-off. The assessment process ensures high-quality data for the system. The output of the process is detailed profiles of research organisations, which are highly motivated to provide high-quality and complete data. The number of certified organizations is around 700 and approximately 500 organizations undergo this process annually.

2. Additional statistical survey of research and development potential

The survey concerns all organizations, not only those with a R&D certificate. The questionnaire is therefore completed by a larger number of organizations from all research and development sectors: academic, state, business and non-profit. The questionnaire is completed online via the SK CRIS system and it is a source of valuable data, mainly on the project activities of organizations. We record approximately 500-600 completed questionnaires annually and other organizations declare that they did not conduct research in the monitored period. The output of the process is statistical reports, published on the Central Information Portal for Research, Development and Innovation (www.vedatechnika.sk).

3. Report on the state of research and development in the Slovak Republic and its comparison with foreign countries

This is a document prepared annually by the Ministry of Education, Research, Development and Youth of the Slovak Republic. The document is submitted to the Government of the Slovak Republic, which discusses it at its session. We contribute to this document by analysing the project and publication activities of research organizations and researchers in Slovakia. SK CRIS data on project activities for the relevant year are analysed. We regularly record around 5,000 research projects solved in the monitored year. The analysis contains several indicators divided by scientific disciplines, R&D sectors, organizations, etc. The output is a document that serves as a basis for forming state science policy and it is also available to the public.⁶¹

⁶ Ministry of Education, Research, Development and Youth of SR (2024a). Správa o stave výskumu a vývoja v Slovenskej republike a jeho porovnanie so zahraničím za rok 2023. [Report on the state of research and development in the Slovak Republic and its comparison with abroad for 2023.] <https://www.minedu.sk/data/att/108/33300.81834d.pdf>

6. Efficiency, Scalability, and Responsible Metrics

Both URIS (Ukraine) and SK CRIS (Slovakia) illustrate how national CRIS can operate at scale while maintaining high data quality, transparency, and policy relevance.

URIS combines automated and manual validation: institutional curators manage local ingestion and initial quality control, while national validators ensure consistency and deduplication across institutions. SK CRIS similarly enforces data quality through standardized metadata, integration with national reference registers, and legislative mandates. Both approaches enable stable operation of hundreds of research institutions and the processing of hundreds of thousands of records. Lessons learned include the importance of clearly defined validation protocols, audit trails, and coordinated workflows that balance speed with precision.

Interoperability

Both systems support technical and semantic interoperability to enable national and international integration. URIS aligns metadata with CERIF standards, uses persistent identifiers (ORCID, DOI, ROR), and follows open protocols to allow cross-border data exchange. SK CRIS integrates national registers and supports internationally recognized researcher identifiers. Together, these design choices promote FAIR principles, open science, and participation in comparative research assessment and benchmarking.

Responsible use of metrics

URIS and SK CRIS both provide analytics for evaluation, policy decisions, and institutional reporting. Metrics are applied following responsible assessment frameworks (DORA, Leiden Manifesto), emphasizing transparency, reproducibility, and context-aware interpretation. Deduplication, identifier verification, and structured validation reduce distortions from misattribution or duplicate records. Affiliation and funding data are tracked to prevent misrepresentation, ensuring fair, evidence-based evaluation at both individual and institutional levels.

Comparative perspective and lessons learned

URIS emphasizes layered governance and dual validation, offering strong cross-institutional comparability.

SK CRIS relies on legislative enforcement, reference registers, and structured certification of research organizations.

Common best practices include: persistent identifiers, combination of automated/manual validation, alignment with FAIR/Open Science principles, and transparent audit trails.

Challenges differ: URIS faces volume management and emerging system integration, while SK CRIS must ensure legal compliance and maintain integration with multiple registers and grant agencies.

These insights highlight how different national CRIS models can achieve robust governance, scalable operations, and responsible use of metrics, offering comparative evidence for other countries seeking to strengthen research information systems.

7. Discussion

Both URIS (Ukraine) and SK CRIS (Slovakia) illustrate how national CRIS can support high-quality research governance through centralized coordination combined with structured institutional engagement.

The Ukrainian URIS demonstrates a layered governance model with dual-level validation: local institutional curators manage initial data curation, and a national validation team ensures cross-institutional consistency. This workflow, together with audit trails and integration of competitions, grants, and reporting, provides strong data quality, transparency, and scalability.

Similarly, the Slovak SK CRIS enforces data quality through legislative mandates, integration with national reference registers, and standardized metadata. While SK CRIS is highly centralized and does not operate institutional CRIS directly, it achieves consistency and reliability through defined assessment procedures, annual surveys, and certification of research organizations.

Key common practices in both systems include:

- Use of persistent identifiers (ORCID, DOI) to ensure unambiguous attribution.
- Integration of automated and manual curation to maintain accuracy.
- Alignment with FAIR principles and open science policies.

Challenges differ slightly: URIS faces high record volumes and the need to coordinate emerging national and international systems, whereas SK CRIS must ensure compliance with legal requirements and maintain integration with multiple reference registers and external grant systems.

Comparative evidence highlights that central oversight combined with local or institutional input is essential for balancing

efficiency, data quality, and stakeholder trust, providing lessons for other national CRIS implementations..

8. Conclusions

The comparative analysis of URIS and SK CRIS demonstrates that well-governed, high-quality research information is crucial for national research evaluation and policy.

Both systems implement centralized validation workflows, ensure transparency, and integrate with national and international infrastructures, supporting reliable, evidence-based assessment of research outputs, institutional accreditation, and funding allocation.

URIS emphasizes layered governance and cross-institutional validation, while SK CRIS relies on legislative frameworks, reference registers, and structured assessment procedures. Despite different operational models, both systems promote FAIR/Open Science principles, responsible use of metrics, and transparent evaluation.

These national experiences show the potential for sharing best practices between countries, improving interoperability, and fostering international collaboration in research information management. Both systems provide foundations for future development, including enhanced support for journals, early-career researchers, and advanced research analytics.