



Strategies for enhancing the credit and recognition of research artefacts

This policy brief outlines strategic actions to enhance the credit and recognition of non-traditional research artefacts, such as curated datasets, research software, workflows and training materials, within European research assessment systems.

Executive summary

The ELIXIR-STEERS Policy Brief on strategies for enhancing the credit and recognition of research artefacts outlines strategic actions to enhance the credit and recognition of non-traditional research artefacts, such as curated datasets, research software, workflows and training materials, within European research assessment systems. These outputs, essential to Open Science, often remain undervalued in traditional evaluation frameworks.

The ELIXIR-STEERS project proposes a coordinated, comprehensive approach that builds on existing infrastructures, supports community-led initiatives and aligns with European priorities, including EOSC and CoARA. The proposed framework aims to foster a more inclusive, transparent and sustainable research ecosystem by recognising the full spectrum of scientific contributions beyond traditional publications. The framework contains life science-relevant examples from ELIXIR Europe but is designed to be domain-agnostic and extensible across research areas.

Key recommendations include:

- 1. Advancing recognition of non-traditional research artefacts:** Ensure that research assessment systems formally acknowledge a wider range of outputs (e.g. data, software, training materials) that are foundational to modern scientific research.
- 2. Strengthening and aligning existing infrastructures:** Leverage and coordinate existing platforms and initiatives to enable scalable, interoperable and sustainable recognition practices across life science disciplines.
- 3. Enhancing credit recognition in organisational frameworks:** Institutions and funders should embed non-traditional research artefacts in internal evaluation, promotion and funding frameworks to support more equitable, transparent and accurate research assessment practices.
- 4. Establishing career paths for research digital professionals:** Develop and embed institutional career structures that support professionals involved in producing and maintaining non-traditional research artefacts, ensuring long-term sustainability.

Target audience

This Policy Brief is intended for European research policy makers and stakeholders involved in shaping frameworks for research assessment, Open Science implementation and career progression across the EU. Specifically focusing on research software, workflows and training materials, it addresses key challenges related to the inclusive, transparent and sustainable attribution of these non-traditional research artefacts. It outlines strategic recommendations and proposes concrete actions and recognition mechanisms that align with ongoing EU initiatives and priorities.

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Policy background

The ELIXIR-STEERS project¹ focuses on expanding and leveraging the framework through which scientific contributions are credited and recognised, with a specific emphasis on non-traditional research artefacts² such as software, tools, workflows, data and training materials. These outputs are central to the life sciences and increasingly vital in the context of Open Science³, but usually remain insufficiently acknowledged within current academic recognition and reward systems. Formal credit and recognition are essential for incentivising contributions.

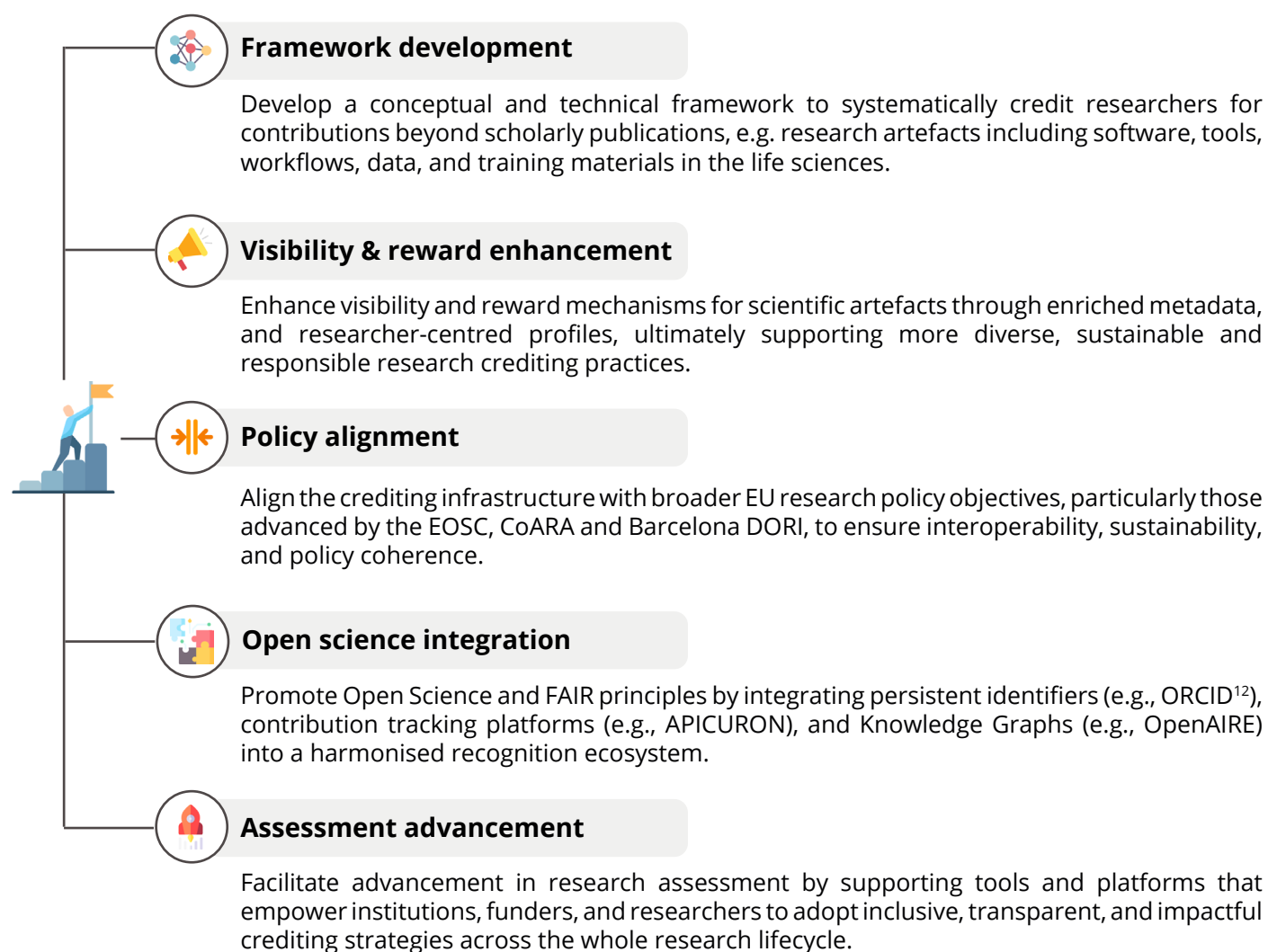
To address this gap, ELIXIR-STEERS, in collaboration with EOSC EVERSE⁴ is developing a proof of concept implementation that integrates and enhances existing crediting platforms like APICURON⁵ and BIP! Scholar⁶, using open infrastructures to expose and aggregate information, thereby providing credit for research artefacts traditionally overlooked in standard scholarly metrics. This approach is in alignment with the principles of the Barcelona Declaration on Open Research Information (DORI)⁷, aiming to promote transparency, accessibility and interoperability in research evaluation systems.

This work aligns directly with the evolving landscape of European research policy, particularly the European Open Science Cloud (EOSC)⁸, the Coalition for Advancing Research Assessment (CoARA)⁹, Barcelona DORI and the GraspOS project¹⁰, all of which emphasise the need for responsible, transparent, and inclusive approaches to research assessment. It also supports EU strategic objectives in fostering FAIR (Findable, Accessible, Interoperable, Reusable)¹¹ data practices and the recognition of diverse research outputs across disciplines.

By contributing to the transformation of research assessment practices, ELIXIR-STEERS aims to enable a more inclusive ecosystem that acknowledges the full spectrum of scientific contributions, fosters collaboration, and accelerates innovation in life sciences research and beyond.

Objectives

In response to the policy gaps identified, the following policy objectives provide a strategic roadmap for European policy makers, funders, and research institutions to foster an assessment culture where the full spectrum of research artefacts is properly credited and recognised:



Recommendation 1

Advancing recognition of non-traditional research artefacts

Contemporary research increasingly depends on research outputs such as data, software, workflows and training materials. Despite their centrality to scientific progress, these contributions are still often disregarded for inclusion in formal recognition and reward mechanisms. Addressing this imbalance is essential for fostering and promoting a more equitable, effective research environment.

Current recognition strategies remain largely publication-centric, often overlooking these essential outputs. In this context, research assessment systems must acknowledge the full range of contributions that underpin the research lifecycle. Over the past years, the key relevance of these non-traditional research artefacts has been widely acknowledged by the research community at large and is central to initiatives focused on reforming research credit, recognition, and assessment, like CoARA.


Recognising these outputs helps address the current oversimplification in how research contributions are valued, where traditional publications are often prioritised, and non-traditional research outputs lag behind in recognition.




Recommendation 2


Strengthening existing infrastructures & supporting community-led initiatives


An effective ecosystem for recognising non-traditional research artefacts is already in place and offers significant opportunities for wider adoption and integration. ELIXIR-STEERS project *Milestone 3.1 Strategy for inclusion of credit for research assets decided*¹³, has mapped key components of this ecosystem, which collectively support the documentation, tracking and visibility of research artefacts beyond publications. These include:

 **Research publishing platforms** (e.g. GitHub, Zenodo¹⁴ and ArXiv¹⁵) for documenting, citing and sharing research software and training assets.

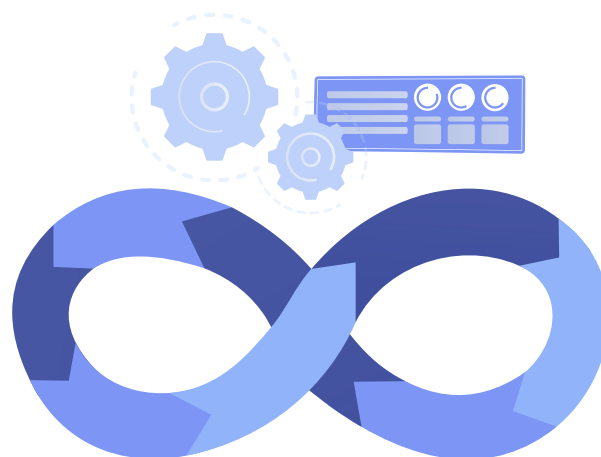
 **Researcher persistent identifier (PID) providers** (e.g. ORCID), which enable attribution across systems.

 **Metadata enrichment platforms** (e.g. Crossref¹⁶) to support discoverability and impact assessment.

 **Researcher contribution trackers and research achievement gamification platforms** (e.g. APICURON¹⁷), which visibly link individual contributions to specific research artefacts and incentivise researcher engagement.

 **Academic profile platforms** (e.g. BIP! Scholar¹⁸), which enhance researcher visibility by showcasing diverse outputs and metrics.

While these infrastructure components provide essential technical capacity, their impact remains limited without coherent policy alignment, active promotion, greater awareness among researchers and institutions, and broader adoption. To realise the full potential of these tools, their adoption must be aligned with policy frameworks and their interoperability enhanced (as outlined in Section C and Annex 1). Actions should focus on ensuring these systems are integrated across research areas and disciplines, and that they support recognition practices that are FAIR, inclusive, and scalable.



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Recommendation 3

Enhancing credit recognition in organisational frameworks

Recognition of non-traditional research artefacts must be embedded within institutional and national research assessment frameworks. This requires:

- Ensuring that contributions to research data, software, workflows and training materials are formally rewarded alongside traditional publications.
- Supporting community-led initiatives that drive institutional change in recognition practices, including:
 - HiddenREF¹⁹ (UK), promoting the submission of non-traditional research outputs in national evaluations and recognising excellence through awards;
 - Software citation standards and initiatives, such as CodeMeta²⁰, Citation File Format (CFF)²¹ and FORCE11 software citation working group²², providing structured frameworks for acknowledging software contributions;
 - WorkflowHub²³ and OpenEBench²⁴, facilitating the sharing and formal citation of computational workflows and contributing to transparent and reproducible science.



- Standardising contribution roles across research artefacts using structured schemas, such as Contributor Roles Ontology (CRO)²⁵, CodeMeta and CFF, to enable consistent attribution, facilitate interoperability and support transparent evaluation mechanisms as outlined in the *EVERSE D5.1 Landscape analysis of existing rewards and mechanisms for research software and training activities*²⁶.
- Ensuring policy frameworks explicitly reference and reward contributions to research artefacts beyond publications.

Aligning technical infrastructure with policy objectives and community practice is essential to establishing a recognition system for non-traditional research artefacts that is inclusive, aligned with FAIR principles and capable of supporting diverse scientific contributions across all stages of the research lifecycle. This approach reinforces broader European initiatives such as the EOSC and the Barcelona DORI²⁷, positioning Open Science as a cornerstone of research assessment reform. A recognition system built on the principles of openness, inclusivity, and interoperability will enhance the integrity of research evaluation and foster more sustainable and equitable academic careers.

Recommendation 4

Career paths for research digital professionals

Establishing dedicated career paths for research digital professions - such as Data Stewards, those who develop and deliver training, those who develop standard operating procedures and Research Software Engineers (RSE) - is essential to ensuring the long-term sustainability of those whose work focuses on the production of non-traditional artefacts.

This need is driven by the track record of skilled professionals in areas such as data management, software development, training and workflows. Recognition and support for these roles should be embedded within institutional frameworks, with career structures defined in collaboration with project leaders, current role-holders and human resource professionals, ensuring alignment with organisational structures.

Encouragingly, awareness of this need has been growing over the past decade. The most advanced example can be seen in the career pathway for Research Software Engineering - a term first coined in 2012 - where national-level initiatives have since been established. Early discussions in this space focused on recognition, particularly around credit and software citation, to ensure that software artefacts and their authors receive appropriate acknowledgement. This conversation, along with associated technical developments, continues to evolve, such as in dedicated publications like 'Recognizing the value of software: a software citation guide'²⁸.

Simultaneously, the human infrastructure supporting these outputs has gained increasing attention. The formation of RSE groups within institutions has driven the formalisation of roles and the definition of career trajectories. One of the most comprehensive examples is the career path framework developed at University College London (UCL)²⁹, ranging from Junior RSE all the way up to professorial equivalent. These job descriptions have been collected as part of an 'evidence' bank to help inform and kickstart similar efforts on creating career pathways and inspire similar efforts in other institutions.

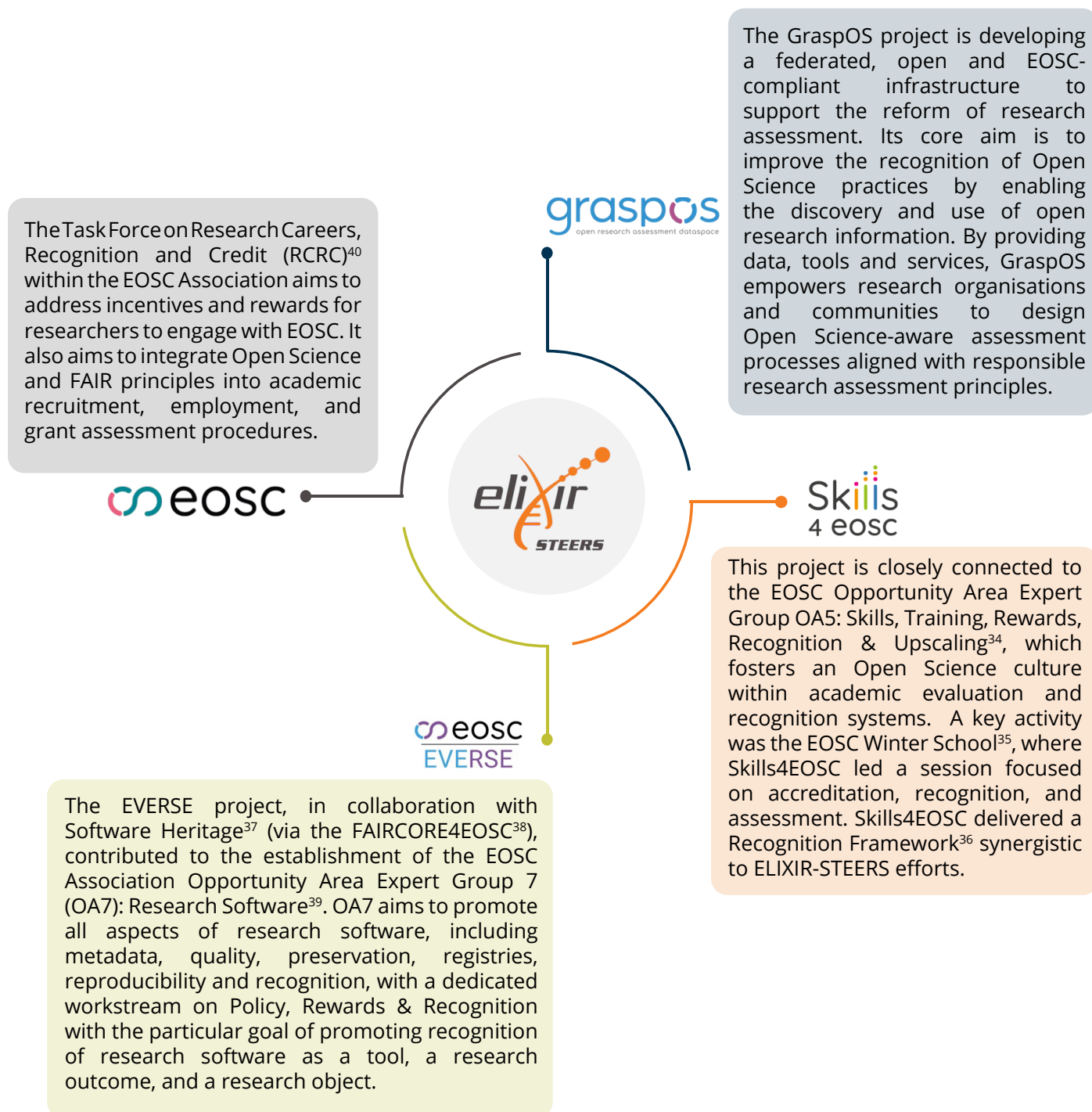
In cases where non-traditional artefacts are produced as part of traditional roles (e.g. academics, research fellows, statisticians, or embedded RSEs), the conceptual frameworks and recognition models developed within the RSE community can serve as useful analogues. Additionally, initiatives such as HiddenREF in the UK have played a key role in highlighting and celebrating these contributions, influencing organisational attitudes towards the national research evaluation frameworks such as the Research Evaluation Exercise in the UK (REF) with their 5% manifesto³⁰. As a result, institutions are increasingly encouraged to submit non-traditional outputs as part of their formal research assessment submissions.

A related supporting document developed in the context of ELIXIR-STEERS, "Towards Inclusive Research Assessment: Recognizing Research Artefacts Beyond Publications"³¹, provides a structured categorisation of research artefacts (and related activities) with examples from life sciences use cases. It complements this policy brief by offering practical guidance and an overview of non-traditional research artefacts and is designed to bring attention to the need for dedicated recognition and related career pathways for activities contributing to valuable research artefacts beyond publications.

Contributions to EU projects

When examining EU-level funded activities, Horizon Europe (FP9) must be recognised as a primary framework for supporting initiatives and projects, particularly those that influence research software and its associated practices. Nonetheless, other complementary efforts and frameworks that emphasise the recognition of research artefacts, such as the European Open Science Cloud (EOSC), should also be considered, along with efforts at national, regional, local and institutional levels to support such activities. Among the EOSC Association Opportunity Area Expert Groups³², one is in Skills, Training, Rewards, Recognition & Upscaling. This Opportunity Area focuses on fostering a culture of Open Science within academic evaluation and recognition systems.

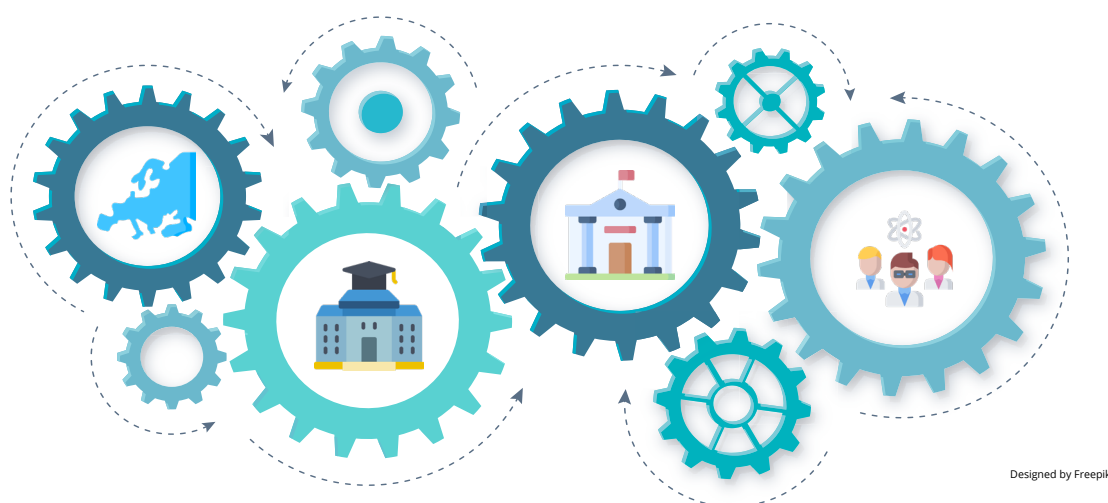
Notable examples of projects funded at the European level include EVERSE and Skills4EOSC³³, which are aligned with EOSC, and the ELIXIR-STEERS project, which belongs to the dedicated arm that fosters the further development of EU-wide research infrastructures like ELIXIR.



Synergies with stakeholders

The effective implementation of a comprehensive credit and recognition framework for non-traditional research artefacts depends on coordinated action across multiple stakeholders. Each plays a pivotal role in ensuring that research assessment systems evolve to reflect the full diversity of scientific contributions.

- **European and national policymakers and funding bodies:** (e.g. European Commission⁴¹, Horizon Europe⁴² and EOSC Association) set strategic priorities and promote policies that embed inclusive and transparent recognition practices at national and EU levels.
- **Research institutions and universities:** incorporating recognition mechanisms through human resources practices and career progression criteria, e.g. their support for the development of research software engineers, data stewards, and training professionals is essential to sustaining the research workforce.
- **National research assessment agencies:** (e.g. UK REF) determine evaluation standards and are instrumental in the formal recognition of non-traditional outputs in national and regional research assessment exercises.
- **European research infrastructures and scientific communities:** (e.g. ELIXIR and other ESFRI⁴³ Life Science RIs) piloting recognition systems, providing use cases, co-developing implementation pathways, and advocating for domain-appropriate practices.
- **Technical infrastructure providers:** (e.g. ORCID, Crossref, APICURON, BIP! Scholar and Zenodo) designing and maintaining the technical backbone that enables attribution, discoverability, and tracking of research contributions.
- **Scientific societies and community-led initiatives:** (e.g. HiddenREF and FORCE11) shaping disciplinary norms, raising awareness, and accelerating cultural change towards broader recognition of diverse outputs.
- **Researchers and research professionals:** (e.g. Research Software Engineers, Data Stewards and training coordinators) acting as both contributors and beneficiaries, researchers are central to the success of any recognition system. Their engagement ensures that frameworks are relevant, adopted, and refined through real-world experience.



Achieving the EU's objectives in research assessment reform and responsible research practices relies on the active involvement and alignment of all aforementioned relevant stakeholders, and implementing the recommendations in this brief will:

- Ensure increased visibility and formal recognition of essentials, but often overlooked, non-traditional research artefacts,
- Foster more inclusive and transparent research assessment mechanisms across Europe,
- Strengthen support and career advancement for digital research professionals, embedding their roles in institutional frameworks,
- Maximise the reuse of high-impact research artefacts and promote responsible research evaluation,
- Build institutional capacity to assess a broader range of non-traditional research contributions across the entire research lifecycle.

Challenges and policy considerations

Cost and expertise of widening research artefact review

Review panels for grants and jobs are often overwhelmed, making it costly to add new assessment criteria. Evaluating non-traditional artefacts like software requires specialised expertise that may not be present on all panels. A phased rollout, supported by diverse panels with the right skills, is needed to manage this transition.

Framework cohesion and modularity

A successful framework must be both cohesive, ensuring a standardised approach across institutions, and modular enough to adapt to specific contexts. For example, the criteria used to assess a data curator should focus on curation-specific metrics while still fitting within the overarching structure, preventing the framework from being too rigid or too vague.

Sustainable funding and infrastructure

The technical platforms and skilled personnel that underpin a new crediting system require stable, long-term support. Relying on a patchwork of teams funded by short-term project grants is unsustainable. Securing dedicated funding is critical to ensure these systems remain operational, potentially through a centralised European body.

Global interoperability

A key advantage of current bibliometrics is their status as a global standard. For any new framework to gain widespread traction and eventually replace them, it must be designed for global interoperability, allowing for frictionless adoption by institutions both within and beyond Europe.

Institutional change management

Implementing assessment reform at the institutional level is a significant challenge. A standardised yet customizable rollout plan is needed to prevent imbalances between institutions. This requires dedicated leadership, active stakeholder engagement, and clear communication of benefits to overcome resistance and ensure a smooth transition.

Long-term governance and maintenance

The crediting framework cannot be static; it requires continuous governance to remain relevant as research practices evolve. This includes updating criteria for new artefacts and actively monitoring for and mitigating attempts to “game the system,” a known vulnerability of traditional bibliometrics.

Community-defined granularity

Defining the appropriate level of credit - from a single code commit to an entire software repository - is a major challenge. The most effective approach is to empower specific research domains to define what constitutes a valuable contribution for their community, supported by guidance from Europe-wide frameworks and the metrics available through technical platforms.



Next steps

As an immediate priority, engagement should be extended to other ESFRI LS-RIs to map existing practices around credit and recognition as a priority. Coordinated outreach through the EOSC Life Cluster, ESFRI forums and other venues will support harmonisation of credit and recognition practices beyond ELIXIR and the STEERS project scope. Through identifying synergies and contrasts in methods to address research artefact credit and recognition, and strengthening the proposed framework. Additionally, then looking across domains and working in domain-agnostic venues such as CoARA working groups could further bolster these efforts.

Conclusion

ELIXIR-STEERS is driving researcher assessment reform in the life sciences by addressing critical gaps in research credit and recognition. This policy brief presents a dual-pronged strategy – combining technical infrastructure solutions with actionable policy recommendations – to ensure that valuable yet often overlooked research artefacts receive appropriate attribution. Outputs such as curated datasets, software, workflows, and training materials are vital to scientific progress and must be recognised accordingly.

European policymakers and stakeholders are urged to adopt the strategic objectives and key actions outlined in this brief to foster a more equitable, and high-impact research ecosystem – one that fully acknowledges the diversity of scientific contributions beyond traditional bibliometrics.

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Annex 1: Community-specific examples and implementations

Concrete examples of communities adopting credit and recognition strategies for research artefacts beyond publications are essential to serve as exemplars for broader implementation in the life sciences and beyond. Through the work of ELIXIR-STEERS in defining a Community Engagement Scoreboard¹ of infrastructure components usage and research software best practices, several examples of ensuring credit and recognition of research software artefacts have been captured amongst the ELIXIR Community² expert groups. The following highlights a selected subset of ELIXIR Communities that leverage credit and recognition mechanisms for research software, including services and practices used to implement these.



3D-BioInfo Community³

Registering & Crediting Tooling Software:

This expert group focuses on the development and application of computational methods for the analysis and visualization of 3D biological data, including structural biology and imaging. This group is reliant on diverse sets of community developed software tools made available in dedicated software registries. To incentivise the development and sharing of such tools, structured recognition is provided to attribute credit to these activities. Specifically, to achieve software sharing incentivisation, the group leverages the bio.tools tooling registry where a dedicated 3D-Bioinfo tool⁴ page is maintained. Credit is attributed to the national Node contributing, bio.tools page maintainers, the software tools and corresponding developers using ORCIDs. Tool publications are also cross-linked to aid citation of published tools and further boost recognition in a structured format.



Biodiversity Community⁵

Crediting Software Workflows:

This expert group addresses data management, analysis, and integration challenges related to biodiversity research, including species distribution, genomics, and ecological data. A key focus of biodiversity research is developing deployable computational workflows of tools chained together to rerun reproducible and consistent analysis across data. This is important for example with new species data where consistent workflows are needed across projects and ensure cross-comparable methods and results. Computational workflow creation and maintenance is vital work and to ensure ample credit and visibility of this the group makes use of WorkflowHub to register and share workflows for example in dedicated biodiversity collections⁶. This provides a citable DOI for the workflow and includes credit to the workflow publisher such as through their ORCID visibility on the website. This promotes community recognition, facilitates reuse, and acknowledges the essential contributions of workflow developers.



Intrinsically Disordered Proteins Community⁷

Crediting AI/ML Software Transparency:

This expert group focuses on intrinsically disordered proteins, including their properties, functions, and the bioinformatics tools and resources required for their study. A significant amount of work goes into developing research software such as predictive AI/ML models capable of generating intrinsically disordered protein structures. Model development is undertaken in regular competitions led by the expert group such as a Critical Assessment of Protein Intrinsic Disorder Prediction (CAID)⁸, and to incentivise contributions, a focus is on the visibility of this work such as dedicated pages on OpenEBench. Additionally, the DOME Registry⁹ is used for ML transparency disclosures and is leveraged for CAID work. This requires manual curation and the curator's CAID entries are attributed back to ORCIDs using APICURON to ensure credit and recognition for their model transparency curation work is attributed visibly on ORCID profiles.

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