Seven Guiding Principles for Open Research Information

Magchiel Bijsterbosch (SURF)

Alastair Dunning (Delft University of Technology)

Darco Jansen (Universiteiten van Nederland, UNL)

Max Haring (University of Amsterdam)

Sarah de Rijcke (Leiden University)

Maurice Vanderfeesten (Vrije Universiteit Amsterdam)

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Introduction

Picture this:

- A postdoctoral researcher in marine biology is hired on the basis of her impressive h-index and citation count;
- A university committee decides which NWO Gravity proposal to submit, based on a predictive analytics tool that utilises global trends in grant awards;
- A government panel for the Dutch *Nationaal Groeifonds* makes its selection based on metrics provided by a commercial company;
- A journal editor publishes controversial research, hoping to raise the impact factor of her journal.

But what if not all publishing venues for marine biology are equally well covered by the underlying data sources? And what if her high scores resulted from choosing a large commercial publisher over an academic society to publish the work? And how about potential biases included in the algorithms that shaped the decision of the university committee? And did the metrics of the commercial company

provide skewed support for particular thematic areas? More fundamentally: do such data and analytics informed decision-making undermine critical values such as academic independence and communality? Can Mertonian norms for science be upheld if leadership decisions and the integrity of the global academic corpus rely on market mechanisms and related – often opaque – technologies?

The corpus of science and scholarship is a common good, and access to it a universal right[1]. As part of this corpus, the infrastructures for research metadata – such as those mentioned in the examples above – should serve the community and be designed, used, and maintained according to scholarly values.

Such services and infrastructures should be community-owned, transparent, democratic, open, inclusive, and enabling. They should increase opportunity and choice for all stakeholders, rather than close down options. They should allow for inclusive innovation and allow others to build on the work of the academic community; and give others the rights to do so rather than restrict rights and create scarcity. They should enable expansion of the knowledge commons.[2]

In order for the academic community to uphold scholarly values for metadata infrastructures, sustained coordinated strategic action is vital. *A crucial first step is to establish principles that open up research metadata and data analytics, and to ensure the research community understands what is at stake and agrees on the principles.* These principles are outlined below. Adoption of these principles is essential if we are to cope with the increasing commercial development across the entire research life cycle without transparency or clarity on whether this supports the interests of the research community.

Secondly, we need policy adoption (by governments, funders, academic institutions) and investments – at scale – in open infrastructures. The development of policy and the direction of the necessary investments requires a clear, effective governance, uniting the research performing organisations and funders.

The Guiding Principles as formulated in this document aim to help:

1. guide academic institutions with decisions in information management of research in their organisations;
2. form a collective frame in which academic institutions jointly formulate policy and steer investments in infrastructure;
3. provide clear rules of engagement for collaborations involving publicly funded academic data and metadata.

Scope of the Principles

The principles focus on information about research; or the metadata that describes research outputs in the broadest sense, including publications, software and data sets. This also includes derived or enriched metadata, i.e. metadata that is created by collecting and analysing existing primary metadata (for example: title, abstracts, and reference lists). The definitions at the end of the document give more precise description of how we have used terms such as metadata.

The principles are not about the data objects that are created by researchers as part of their research (commonly known as research data).

While the values enshrined in the Mertonian norms should also apply to research data, there are additional challenges in embedding these values that require further thought. Therefore, the research output itself is out of scope of these principles.

Also out of scope are the educational and administrative tools and services that are now commonly embedded into university life. As with research data, a broader dialogue is required about the values that the use of these services brings (or undermines) to the academic environment. But that is far beyond the purpose of this current document.

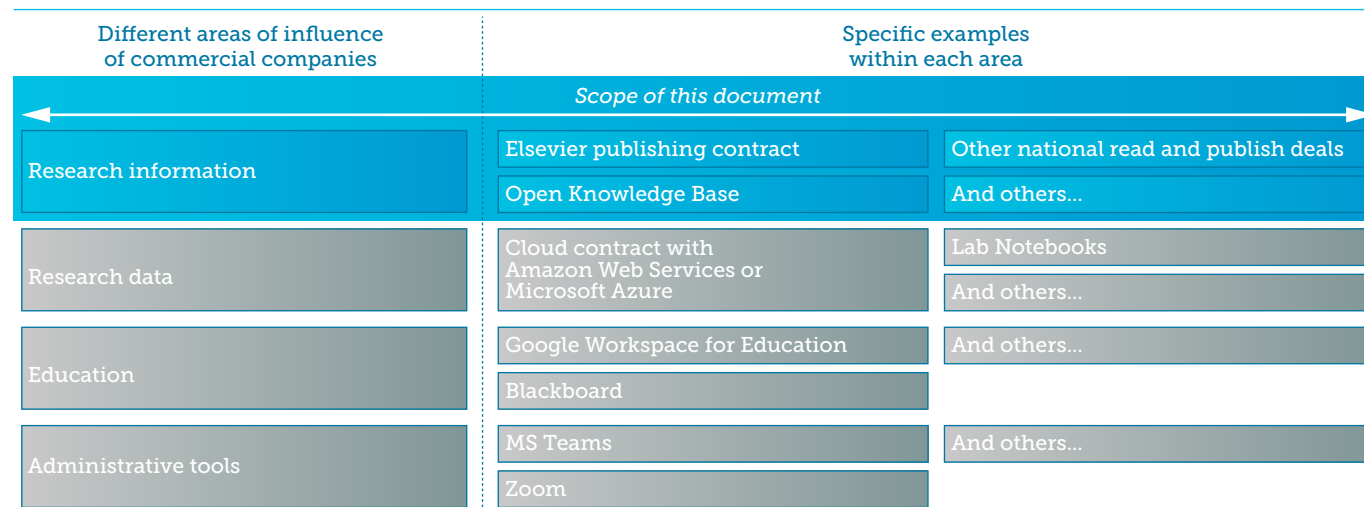| Different areas of influence of commercial companies	Specific examples within each area	
Scope of this document		
Research information	Elsevier publishing contract	Other national read and publish deals
	Open Knowledge Base	And others…
Research data	Cloud contract with Amazon Web Services or Microsoft Azure	Lab Notebooks
		And others…
Education	Google Workspace for Education	And others…
	Blackboard	
Administrative tools	MS Teams	And others…
	Zoom	

Diagram showing the scope of this document. The influence of commercial companies affects many aspects of university life. These specific Guiding Principles focus on Research Information, i.e. services and data related to scholarly communication.

A closer look – complimentary services & network effects

Research is increasingly data-driven. This not only holds true for research methods, but also for how research is managed, communicated, and evaluated – partly in response to the need to account for public spending.[3] Indeed, the area of *research intelligence* is fuelled by large-scale data collection, aggregation and analysis. It provides new prospects for assisted decision-making on funding opportunities, publishing venues and alternative metrics. Such types of analysis are based on products (such as articles, datasets and software) and by-products (such as metadata about funding and collaborations) of research. Of a total of €17.5 billion annual investment in Dutch research and development, 30% is funded and 34% performed by public institutions.[4] It is therefore essential that research intelligence undertaken in these institutions is done in accordance with values central to science and the academy.

Third parties (whether non-commercial or commercially driven) develop new services that add value within this ecosystem – as they have done in the past (e.g. in the print publishing era). Some of these third parties enact gravitational effects on the market – significant additional value is accrued through complimentary services, yielding network effects.[5] This holds true for publishing platforms

and related information services, as well as for commercial cloud providers offering services to process and store research data.

The consequences of these developments may be positive, resulting in new opportunities for research contributions and information use. On the other hand, as vital functions of the scholarly enterprise become increasingly dependent on such services, it is critical that knowledge institutions carefully consider risks involved in becoming too dependent on specific third parties and their tightly integrated solutions. Equally, such third parties must respect and commit to these academic values if they wish to collaborate.

The *Guiding Principles for Open Research Information* are intended as clear rules of engagement for the research community in partnering with third parties, in developing new infrastructures and services related to research intelligence and scholarly communication. They should provide clarity on what we expect, what we need, and what can and cannot be done with our metadata.

Wider context

This document has emerged in a specific context and at a particular moment in time. A context that still reflects mechanisms and options introduced over the past decades. Knowledge institutions should scrutinise this context if they are serious about reasserting core values and about its commitment to open science and scholarship.[6]

A first iteration of the Guiding Principles was drafted under time pressure of agreeing the Framework Agreement (in December 2019) between the Dutch knowledge institutions and Elsevier. The formal contract was then signed in May 2020 bundles open access and services related to research metadata. It lasts until 2024. The first version of the Guiding Principles has partially been embedded in the contract and the related governance. In particular, the governance allows the knowledge institutions to demand openness of new research metadata services created by Elsevier.[7] In addition, feedback from an open consultation relating to the first version of Guiding Principles were incorporated into this document.[8]
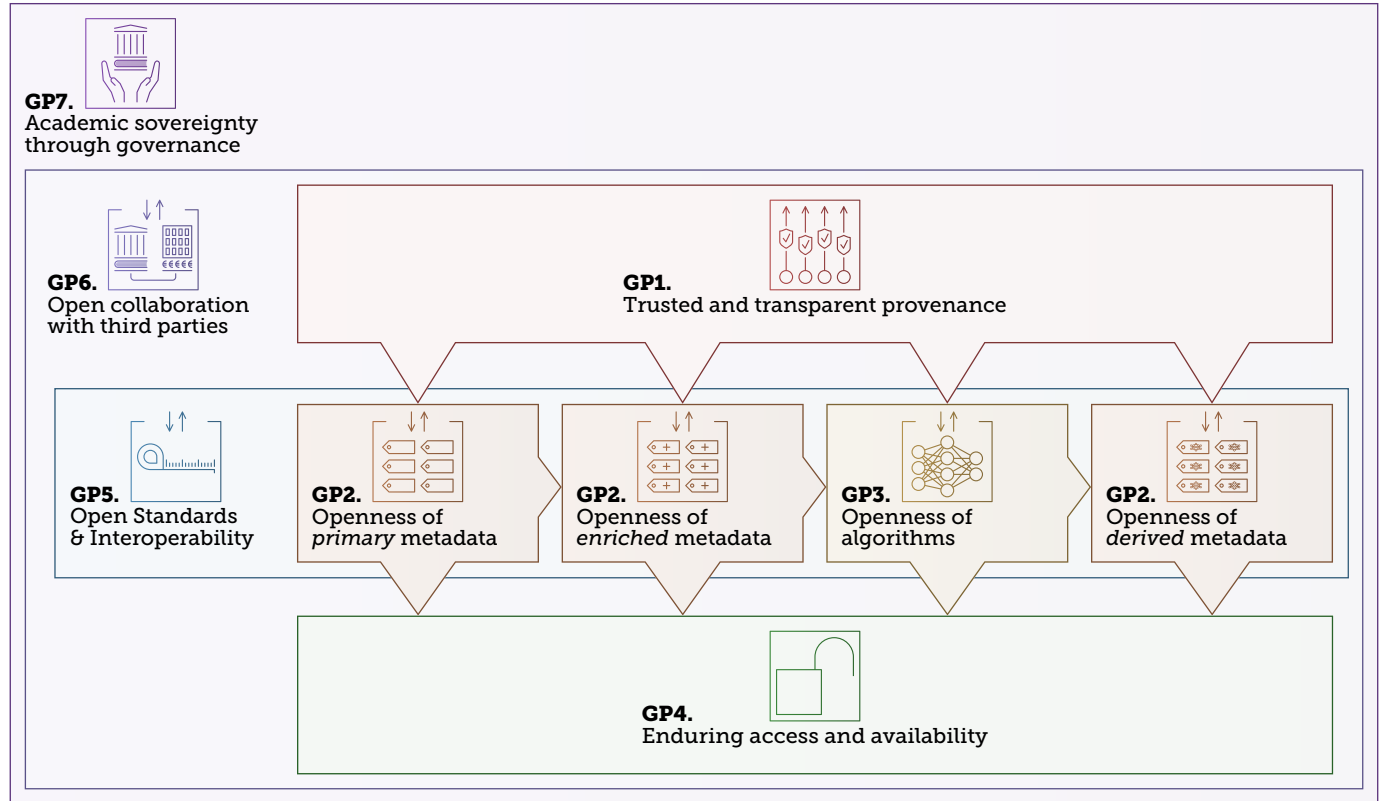
Of course innovation often comes from commercial parties. Some companies have worked for decades on building tightly integrated infrastructures with smooth interfaces that seemingly offer convenient solutions. But are academics still in the driving seat? Or do they now find themselves in a situation in which short-termism and availability of commercial software suites leads to choices that are perhaps not aligned with community values?

The present document aims to expand on existing principles (Principles of Open Scholarship; SPARC[9], Educopia Values and Principles[10]; the UK Forum for Responsible Metrics Guidance for institutions on environment indicators[11]) in the context of research metadata. It also aligns with the commitments made by the Dutch research community to reform research practice, support responsible uses of metrics, and enable open research. These commitments have already been embedded in a range of initiatives in the NL (e.g. the new Strategy Evaluation Protocol[12], the shared ambitions in Dutch academia for a modernisation of the system of Recognition and Rewards[13] and the Dutch ambitions in Open Science[14]). These specific principles here do not focus on the responsible use of research metrics and the need for a new balance between quantitative and qualitative goals. But if such metrics are to be used they will be based on the principles elaborated below.
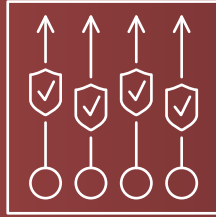
Principles

As indicated by the diagram on the right, the seven principles are related to one another. Academic Sovereignty is the broader value driving the principles. This demands Open Collaboration, which in turn requires specific principles to be embodied in our research information systems and tools – Trusted and Transparent Provenance, Open Standards and Enduring Access.

GP7.
Academic sovereignty through governance

GP6.
Open collaboration with third parties

GP1.
Trusted and transparent provenance

GP5.
Open Standards & Interoperability

GP2.
Openness of *primary* metadata

GP2.
Openness of *enriched* metadata

GP3.
Openness of algorithms

GP2.
Openness of *derived* metadata

GP4.
Enduring access and availability

Relation between the seven principles.

GP1.
Trusted and transparent provenance

"Within any infrastructure or service for research metadata, the provenance of the metadata, and the related algorithms, must be clear."
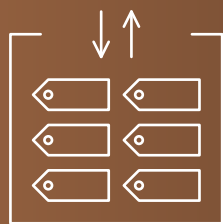
Rationale

Research metadata underpins decision-making processes in many aspects of university life. To ensure fair and accountable decision-making, the provenance of that scholarly information needs to be public. This provides accountability to all stakeholders affected by such decision-making processes.

Implications

Knowledge institutions:

- will not make use of research metadata services or infrastructures that do not display clear provenance;
- will ensure agreements with third parties contain terms that allow for trusted and transparent access to scholarly information:
  - Provenance information should include information on how metadata has been created and modified over time;
  - Processes used by the third party to create metadata should be replicable by others.

Examples

- Digital Preservation requires an Open Provenance Model[15]
- Provenance explained by Dutch Linked Data community[16]
- Wikidata requests references to each data statement made[17]

GP2.
Openness
of Metadata

"Knowledge institutions must release metadata related to research output as openly as possible, ideally as CC0."

Rationale

Open metadata is essential for the smooth flow of scholarly information. Without open metadata, the findability, transparency, and trust of research outputs (articles, research data, software, standards, protocols, etc.) is severely hindered.
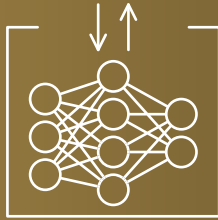
Implications

- Knowledge institutions use third-party services to store or process metadata related to research output. Within contractual agreements with third parties, the institution or its proxy (e.g. SURF, UNL, NFU, etc) must ensure agreements concerning the openness of metadata, including any post-publication enrichments, are put in place.
- By applying CC0, knowledge institutions ensure metadata stored in services related to research intelligence and scholarly communication is available for re-usage by others. The curation of the metadata can be outsourced, if the conditions for openness are safeguarded.

Examples

- Metadata on cultural heritage released as CC0 – Europeana releases 20 million records into the public domain using CC0.[18]
- The Initiative for Open Citations assembles and promotes the unrestricted availability of scholarly citation data.[19]

GP3.
Openness of Algorithms

"Algorithms and other techniques and methodology used to analyse and report on scholarly outputs must be available for public inspection."

Rationale

'Black-box' algorithms inhibit transparent, fair decision-making, for instance in choices relating to scholarly evaluation and recognition. Equally, the deployment of closed algorithms creates dependencies (i.e. vendor lock-in) on third-party services. Consequently, both the data used and produced and the mathematical rules / recipes of algorithms used, should be open.
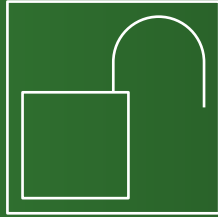
Implications

- Knowledge institutions contract third-party services to analyse metadata related to research output. Within contractual agreements with third parties, the institution, or its proxy, must ensure agreements concerning the openness of algorithms are put in place.
- All stakeholders should explore best practices and standards for ensuring the results algorithms are reproducible.

Example

- Within the Elsevier agreement contract for 2020-2024, a framework has been established to guide the open science projects. This framework requires Elsevier to publish the 'recipes' behind any algorithm they make use of.

GP4.
Enduring access and availability

"Knowledge institutes and third-party services must facilitate complete, non-discriminatory and enduring access to primary metadata and enriched metadata without functional, technical, legal, or financial limitations."
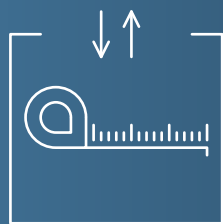
Rationale

Scholarly communication is constantly producing new outputs and interactions. Research metadata are created on an ongoing basis, through manual data entry but also through enrichment via algorithms. Without the open availability of this data, transparency and accountability are impaired.

To support this aim, research metadata should be considered as a public resource that can be accessed immediately and is available enduringly. When cancelling a licensed service, the knowledge institutions must be allowed to transfer derived data to ensure enduring access to that data and the associated decisions.

Implications

- All third-party services used by knowledge institutes to store or process metadata, need to have agreements in place that ensure enduring access and accessibility.
- Access to scholarly output may be separate from access to software or user interfaces.
- Public organisations may collectively provide a platform to bring together the data obtained from multiple third parties.

Examples

- The Dutch Digital Cultural Heritage Strategy includes a data repository, a well-documented API that is open for access, and options for data export.[20]
- The CLOCKSS initiative is a community-governed and -supported digital preservation archive for scholarly content.[21]
- The National Library of the Netherlands (KB) has defined preservation policies to provide guidance for implementation of all the processes needed to guarantee long-term preservation of the digital objects.[22]

GP5.
Open Standards
& Interoperability

"All stakeholders must agree to work towards common definitions and open standards for exchanging and describing both metadata and algorithms."

Rationale

Open Standards are a precondition for realising a trusted, transparent infrastructure for scholarly communications. Because continuous innovation of information services and technology makes for an ever-changing data landscape, Open Standards are essential to ensure the usability of meta(data) now and in the future. Standardised scholarly metadata that is accessible and separated from associated services and tools allows for competition without platform or vendor lock-ins.

Implications

- An open, inclusive dialogue between all relevant parties is needed to establish open standards, involving both public knowledge institutes and any third-party that delivers a service dealing with scholarly output or metadata. Decisions shall be documented; specific decision-making processes that are context-dependent will be developed, documented and communicated to all relevant stakeholders;
- Once established, all parties must commit to implementing open standards for exchanging, harbouring and describing metadata. By engaging in this dialogue, parties must commit themselves to implementing agreements and sharing in the costs that invariably come with making and maintaining infrastructures interoperable.

- Knowledge institutions are responsible for adherence to the open standards and definitions and, where needed, make the investments necessary to improve metadata quality up to the required level.

Examples

- The OpenAIRE Guidelines for sharing publications, datasets, and CRIS metadata so these can be accessed through the OpenAIRE infrastructure.[23]
- The Edustandaard initiative describes open standards that allow portability of electronic educational resources and student metrics across teaching platforms.[24]
- The W3C defines what an Open Standard entails; transparent, relevant, open, impartial, available, maintained.[25]
- The European Interoperability Framework provides a wider (policy) context on openness, for example.[26]

GP6.
Open collaboration with Third parties
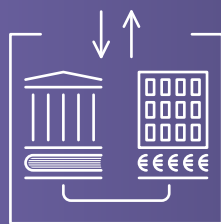
"Knowledge institutions and third parties must engage in open collaboration where innovation, competition, and public value are recognised and respected cornerstones."

Rationale

Within scholarly communications, there is an increasing tendency of certain third parties to become *de facto* monopolies. The accumulation of services provides such parties with unassailable advantages in creating value. To avoid further entrenchment of this situation, open collaboration is required. This will restore healthy competition, lower the barrier for entry to newcomers, and facilitate network effects between third parties to spark innovation.

Implications

Knowledge institutes and other stakeholders should:

- critically assess their existing services and contracts and identify where open collaboration is possible;
- work collectively, identifying common interests and thereby enabling open collaboration (e.g., the development of an Open Knowledge Base[27]);
- not invest in mega-applications that contain multiple bundled services. Rather, they should create smaller procurement lots and work towards a sustainable overarching technical architecture of services that are connected and communicate with each other based on open standards. This permits multiple third parties to operate in a flexible ecosystem that is adaptable for future change and innovation;

- create tender conditions in the procurement process that allows smaller third parties and start-ups to be on a level-playing field when offering services to the research analytics and scholarly communication ecosystem;
- avoid vendor lock in by defining exit strategies and ensuring the means to enact those strategies are in place.

Examples

- OCRE | Open Clouds for Research Environments is an open collaboration platform, where procurement lots of cloud services are defined, called for tender, and offered in a catalogue.[28]
- Edustandaard: The Edustandaard initiative facilitates open collaboration between public and private parties on conventions on the usability of open standards.[29]

GP7.
Academic sovereignty through governance

"A suitable governance structure must be established in order to fully implement the principles, and to ensure that stakeholders remain engaged and share accountability towards the community goals and values."

Rationale

Research metadata is part of the public domain. To manage and maintain the status of this research metadata, we need to ensure a) the provision of management information between stakeholders, b) the governance of decisions concerning the underpinning infrastructure, c) conflict resolution and d) active steering of new developments. The monitoring and control of evolving principles, standards and collaborations underpinning scholarly capital must be governed by knowledge institutes representing the academic community. The governance structure is inclusive to all parties in the ecosystem, including third parties, on the premise that they subscribe to the principles.

Implications

- Through the governance, the stakeholders share accountability towards each other for the implementation of the guidelines.
- Stakeholders shall agree on a decision making process to address the balance of power and any conflicts of interest e.g. through voting rights or by adopting a layered structure.
- A clear mandate shall be defined describing mutual rights from, changes to, and enforcement of the principles defined in this document.
- The governance will include an arbitration agreement to resolve disputes in compliance with the principles, agreed upon standards, and collaborations.

Examples

- The ORCID researcher identifier is governed by a Board of representatives from a broad cross-section of stakeholders, the majority of whom are non-profit. The ORCID Board is responsible for ensuring the organization is acting in the best interests of ORCID stakeholders.[30]
- The European Open Science Cloud Association is a partnership with the European Commission, with statutes and rules of participation.[31]
- Edustandaard has a governance structure with different boards and working groups, to preserve the interests of parties involved and to oversee the implementation implications of migration to new versions of a standard.[32]

Towards an Implementation of the Guiding Principles

Data concerning the output and operation of scientific research is of vital importance to research policy and the broader pursuit of knowledge. The handling and analysis of data related to publications and other scholarly output has a crucial impact on judgements about research success of scientists, institutions and countries. Traditionally, this metadata related to scholarly communications has been managed in discrete, unconnected, and sometimes closed commercial systems. In this context the board of Association of Universities in the Netherlands (previously called VSNU, now UNL), The Netherlands Federation of University Medical Centres (NFU) and The Dutch Research Council (NWO) installed an expert taskforce on Responsible Management of Research Information and Data.[33]

This Taskforce first developed a set of guiding principles (V1.0, March 2020) and handed them over to the negotiating team with Elsevier.[34] These GP1.0 were implemented in the contract with Elsevier (transformed into collaboration principles) and approved by UNL, NWO and NFU early May 2020. During the summer of 2020 the Guiding Principles V1.0 were opened for public consultation; revisions were incorporated in 2021. The many comments have significantly contributed to this revised version of the principles.

Required actions for the board of knowledge institutions

In principle, three kinds of actions must be made by knowledge institutions:

1. Endorse (or ratify) the Guiding Principles. Agree to pro-actively apply these into their own systems and systems of third parties.

2. Set up a nationwide governance structure overseeing and reporting on this to: ensure the sustained development of the principles and related frameworks; work on innovation with commercial parties; reinforcing the position of public institutions.

3. Invest jointly in those systems most essential to the functioning of higher education and scientific research safeguarding these principles (related for example to the realisation of an Open Knowledge Base).

These decisions are needed to ensure the next steps in securing the quality of research information and academic sovereignty, to prevent vendor lock-in to services of commercial parties, and provide conditions for new contracts with third parties. Additional legislation and regulations might be needed in order to safeguard public values and strengthen the position of universities.

Recommended governance model

The implementation of the Guiding Principles requires collective action from all stakeholders. While we consider the research information landscape to be part of the public domain, the finite available funds to support the infrastructure – which are either tied up in contracts or in development and operational costs – are a scarce resource that requires effective and coherent allocation.

At present, there is no governance model in place to steer a top-down implementation, nor is it deemed feasible to establish such a structure. Instead, we propose a framework of networked governance to further maintain and update the Guiding Principles, promote their implementation, and monitor their uptake. This framework is based on the principles of a clear separation of powers, while limiting the proliferation of new bodies. We propose a governance arrangement that separates between:

Governance of principles
The governance of the principles is concerned with the discourse, advocacy and management of the development of the principles themselves, preferably in an international context. It has characteristics of both a standards body as well as a strategic forum to discuss the effectiveness of the current

Different areas require **Governance of Principles**	Examples of areas to be addressed in **Governance of implementation**	
	Monitoring Taskforce	
Research information	Elsevier publishing contract	Other national read and publish deals
	Open Knowledge Base	And others…

Diagram of possible governance arrangement.

principles. Through opinions it may give clarity on the interpretation of the principles and publish revisions or annotations where needed. It presents collective choice arrangements for their implementation. It does not, however, govern the implementation itself.

Governance of implementation
This part of the governance oversees the implementation of principles in contracts and (infrastructure) innovation programmes and projects dealing with research information, e.g. information services, read and publish deals, and CRISs. It is responsible for applying the principles in contract negotiations or infrastructure design, but is not responsible for the principles and their development.

Monitoring of the landscape
Between the governance and implementation of the principles, we propose monitoring the uptake of the principles in the implementation as a critical function to inform decision-making. Furthermore, it is important to scout new

developments, to provide independent advice on where principles should apply and how they have been applied. These findings should be evidence-based and reported on a regular basis to the governance of principles.

This governance arrangement is organised according to the principle of subsidiarity. This allows for effective national organisation while minimising central overhead and recognising autonomy of knowledge institutions. Individual institutions may have hundreds of small contracts in the research information domain, for which collective management may not be necessary.

Decisions on scope and applicability of the principles are informed by monitoring functions, discussed as part of the governance of principles, and implemented through a fit-for-purpose organisation. Over time, the governance network may evolve and coalesce with parallel or serial developments in other information domains – e.g. research data, education data, clinical data – as well

as at the international level. The last should be considered especially critical in order to establish sufficient critical mass in a globalised market of information services.

To support the network interactions for research information, we propose the following initial actions:

Set up a development forum
For the scope of research information, the NPOS steering board can serve as an initial starting point, provided there are strong links to UNL-SOO, -SSPG and -SBF and the NFU-O&O and -S&F steering boards, to connect research policy, public accountability, information policy and financial implications.

When scaling up to other domains (e.g. education) or sectors (e.g. universities of applied sciences), the function of a development forum may spin off.

Enumerate implementation structures
These refer to the existing structures, e.g. contract-specific arrangements, programme and project boards overseeing the development of infrastructures, and institutional specific bodies. This should be an exhaustive list, in order to provide clarity on scope and applicability of the Guiding Principles.

Assign the monitoring task
It is proposed that this is coordinated by the UNL, further assisted by centres of expertise such as SURF, CWTS etc. Its first task is to take stock and enumerate structures and contracts of where it is desirable to apply the principles.

From the perspective of a participatory, inclusive governance, thought should also be given to including private entities and representatives of the market, such as is the case in the European Open Science Cloud.

While the proposed forum could indeed evolve in such a direction, the inclusion of other interests places stronger requirements on effective conflict resolution mechanisms. To simplify dynamics during the initial stages, it is therefore recommended to start with the initial coalition of UNL, NFU and NWO, and gradually expand into other information domains and areas of the public sector, international boundaries, and finally, the private sector. Meanwhile, the existing implementation structures typically already include a level of representation from the supplier side, e.g. the governance of the Elsevier Contract.

A summary of the actions needed for implementation of the Guiding Principles is shown on the next page.

	Short term (<6 mths)	Medium term (1-3 yr)	Long term (>3 yr)
I. Development Forum	• Ratify/endorse the guiding principles in at least the UNL, NWO and NFU boards. • Establish the NPOS as forum to manage the principles for the Research Information domain • Formulate shared goals and desired level of accountability • Connect and align with related national initiatives, e.g. UKN	• Promote discussion of Guiding Principles and publish revisions • Explore an effective way to connect and expand methods for the research information domain to other domains such as research data, education, and clinical data • Explore ways to scale up to other sectors, i.e. research institutes and universities of applied sciences. • Connect and align international institutions, e.g. EOSC, EUA, LERU, Science Europe, etc. • Present collective choice arrangement on desired scope and applicability in an implementation agenda	• Evaluate shared goals and accountability • Review effectiveness of governance model • Consider the position of private entities and/or market parties
II. Implementation structures	• Implement Guiding Principles in upcoming contracts at institutional level • Implement Guiding Principles in upcoming contracts at collective level (SURF, UKB publish and read deals, OKB development)	• Based on the agenda, review contracts renewals and projects for the adaptation of Guiding Principles. • Implement new structures as recommended by Development Forum	• Ongoing implementation of new and updated contracts depending on current effectiveness of governance model
III. Monitoring Taskforce	• Take stock of projects, contracts and infrastructures that ideally should be governed by the guiding principles.	• Evaluate contracts, make suggestions for improvement • Annual report to forum on progress of implementation and new developments • Public report on progress and practices.	

Table summarising key actions of the three parts of the governance structure.

Definitions

Algorithm: a recipe / method / mathematical representation that demonstrates the workings and mathematical integrity behind the (re)creation of derived metadata.

Data and Metadata: structured information related to research output. This can be descriptive data (= metadata), usage data, APC costs, etc. When the term data is used we mean collections of metadata records related to research output.

Derived metadata: metadata that is derived from Primary metadata, adding value to the prime record or aggregation. (eg. citation graphs, topic clustering, etc.)

Ecosystem: Scholarly communication and Research Analytics services that are connected in terms of using input data from the output data of another service.

Enriched metadata: Data referring to or about Research Output or Primary Metadata that is obtained from an external source and is added or linked to (enriches) the primary records.

Keywords: The words "Must", "Must Not", "Required", "Shall", "Shall Not", "Should", "Should Not", "Recommended", "May", And "Optional" in this document are to be interpreted as described in RFC 2119[35].

Knowledge Institutions: Dutch universities, academic medical centres, NWO and KNAW institutes, and other institutes for fundamental and applied research.

Primary metadata: metadata (eg. title, keywords, abstracts, reference lists, etc) that is born from an intellectual creative process, or facts that are assembled in a distinct structure.

Proxy institutions: Organisations that act on behalf of the Dutch Knowledge Institutions, such as UNL, NFU, SURF.

Research Analytics / Intelligence: Analysis with Research Information.

Research Information: Information about Research Output; this includes the (primary, enriched and derived) metadata.

Research Output: articles, research data, software, standards, protocols, etc. and related metadata (eg.title, abstract, keywords, references, roles, affiliations, etc)

Stakeholders: Knowledge Institutions, Proxy Institutions and Third-parties.

Third Parties: not-for-profit organisations, commercial organisations, knowledge institutions, proxy institutions, individuals, etc who contribute and extract primary and derived metadata to the common resource pool.

Acknowledgements

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