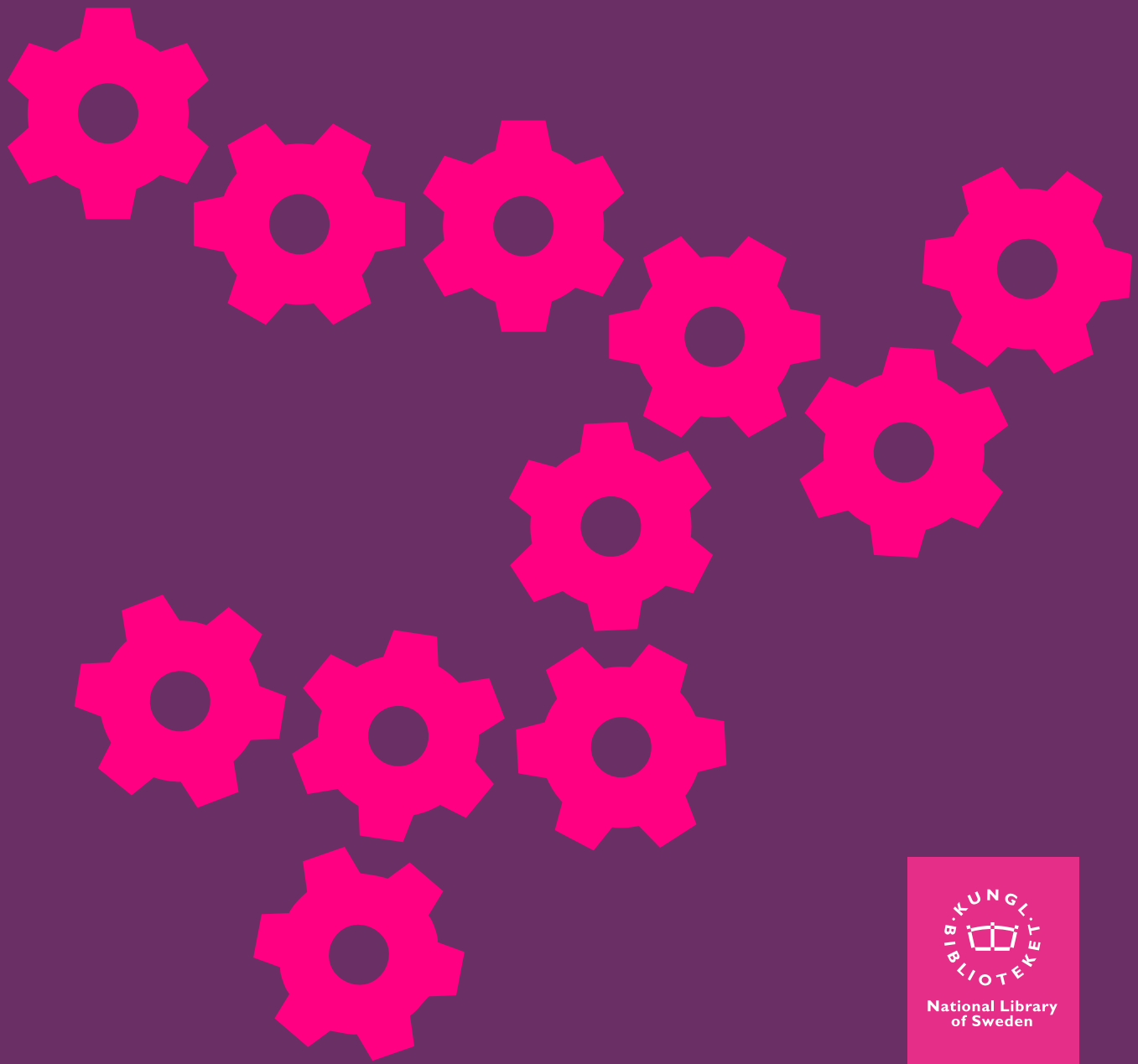
National guidelines for open science



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National guidelines for open science

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National guidelines for open science

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National guidelines for open science – to promote and strengthen research

These national guidelines are intended to provide support and guidance for the different stakeholders in Sweden who have overarching responsibility in the transition to open science. The purpose of the work on open science is to contribute to improving both the quality of science and the interaction between research and the surrounding society. Through open science, a foundation for future research is laid, built on transparency, reproducibility, and increased opportunities to benefit from scientific information. Open science fosters knowledge growth, innovation, competitiveness, and more efficient use of resources.

The development towards open science takes place in an international context. UNESCO's Recommendation on Open Science from 2021 is a framework with principles and approaches for creating globally equitable access to scientific results and research processes, aiming to accelerate the implementation of the global Sustainable Development Goals. At the EU level, open science has been an important policy priority for several years. This has been expressed both in efforts to create common knowledge and understanding, and in conditions for research funding and infrastructural support for open science.

The purpose of these guidelines is to outline the direction for the continued development towards open science in Sweden, specifying which key actors are responsible for what, as well as how the guidelines are to be monitored and updated over time. Each actor is responsible for determining how these guidelines can and should be applied within their respective organisations. At the same time, continued coordination between actors, based on common priorities, is of great importance.

The guidelines serve as a link between, on the one hand, international efforts and recommendations, and on the other hand, the ongoing work at the national level that needs to be developed primarily within research performing and research funding organisations. The Association of Swedish Higher Education Institutions (*Sveriges universitets- och högskoleförbund*, SUHF) has developed a roadmap for open science, with accompanying guidance for implementation, which clarifies the responsibilities of higher education institutions and the actions that are needed to accelerate development. While the national guidelines focus specifically on the *direction* for open science in Sweden, SUHF's roadmap and guidance are more focused on *how* open science should be implemented. They are, in this way, similar to the guidance and recommendations from expert agencies such as the National Library of Sweden (*Kungliga biblioteket*, KB), the Agency for Digital Government (*Myndigheten för digital förvaltning*, Digg), the Swedish Research Council (*Vetenskapsrådet*, VR) and other funders.

Conditions for open science

These guidelines should be viewed in light of the following principles, and in their implementation, consideration must be given to the regulations governing research in Sweden.

Academic freedom

Open science requires that academic freedom be maintained – that research problems may be freely chosen, research methods may be freely developed, and research results may be freely published.

Good research practice and legal requirements

Open science is based on the notion that greater and faster progress is achieved through collaboration and the sharing of knowledge, in a broad sense. At the same time, research must be conducted responsibly, taking into account laws and other regulations in the research domain. Likewise, good research practices must be followed.

Merit evaluation and incentives

A prerequisite for successful implementation of the guidelines is that open science is acknowledged and recognised as meritorious in the contexts where researchers, whether individually or in larger groups, as well as research performing organisations, are evaluated and assessed.

Reform of assessment systems is already underway in Sweden as a result of international developments. This is occurring, for example, through support of and involvement in declarations such as the Declaration on Research Assessment (DORA) and organisations such as the Coalition for Advancing Research Assessment (CoARA). Both of these initiatives aim, among other things, to create better conditions for open science through reform of merit systems and incentive structures.

Implementation at the overall level

Timeline 2030

The national direction for open science has previously been established in the research policy bill from 2020 (Prop. 2020/21:60). The stated goal is for results of research funded with public funds to be published with immediate open access starting in 2021, and for the transition regarding open access to research data to be fully implemented by 2026 at the latest.

These guidelines offer a foundation for increased efforts to achieve these existing goals, while a holistic view of open science highlights the need for further development in key areas.

The timeframe for achieving the overarching goals in the guidelines for open science is designated as 2030 to ensure sufficient time for the necessary changes to take effect. This reflects a long-term approach to development. With 2030 as the time horizon, open science is also clearly linked to the broader objectives of Agenda 2030 for sustainable development.

Monitoring

To gain an overview of the progress towards open science in Sweden, the guidelines should be monitored on a regular basis. The monitoring should focus on the achieved results in the transition to open science, as well as on the extent to which the guidelines have had the intended effect.

The national work for open access to scholarly publications and research data are monitored by KB and VR respectively. The higher education institutions evaluate and monitor policies and strategies, both individually and collaboratively. Knowledge and experiences gained from this monitoring work, including best practices from other countries, should be utilised in the monitoring and design of future work.

The overall monitoring efforts need to be coordinated for a holistic view and common development. This should be done in collaboration between research performers, research funders and expert agencies. Such coordination may include the exchange of knowledge and experience between the actors, as well as collaboration on monitoring and further development of the guidelines.

Further development of the guidelines

In light of the guidelines' focus on the transition as an ongoing process, as well as the ongoing and somewhat unpredictable changes in our environment, the conclusion is that the guidelines should be periodically updated.

These updates should be conducted collaboratively among research performers, research funders and expert agencies every three years, beginning in 2027.

Current situation and development

Open science, based on UNESCO's Recommendation, entails making scientific knowledge open access, available, and reusable for everyone. Open science encompasses all scientific disciplines, subject areas, and approaches to conducting research. The overarching goal is that openness and transparency contribute to strengthening the quality of science and trust in research. Open science fosters increased scientific collaboration and facilitates the exchange of knowledge, benefitting both science and society.

These guidelines are a response to one of the actions UNESCO highlights as important for contributing to development – the development of national policies for open science that take into account the conditions and circumstances unique to each country.

Open science, as outlined in UNESCO's Recommendation, covers many areas. Open access to scholarly publications and to research data are two areas that have been the focus for just over 20 years. Consequently, the transition within these domains has progressed relatively far in Sweden. However, some previous challenges remain, while new ones have been identified. This development has highlighted an increased need for knowledge of and open access to the processes used in research, here referred to as open research methods. Development within open educational resources and public engagement in science has been ongoing for some time, but in investigations in recent years, they have been found to have untapped potential. Another area is the need to develop national and international infrastructures that can support the other areas.

The guidelines cover the following six areas, in which development is ongoing and which therefore are prioritised and crucial to fully develop in Sweden:

- Open access to scholarly publications
- Open access to research data
- Open research methods
- Open educational resources
- Public engagement in science
- Infrastructures supporting open science

Within each area, a number of goals and priorities are formulated, and actors and areas of responsibility are identified. The goals and priorities vary depending on the current situation and development within the areas. There are both priorities to create the conditions for favourable development and goals to achieve.

An accompanying background report, **Rapport om nationella riktlinjer för öppen vetenskap – Bakgrund och framtagande**, gives detailed descriptions of the current situation, scope, and basis for the guidelines. There are also references to investigations, recommendations, and policies related to open science, both nationally and internationally. For a deeper understanding, the guidelines and background report should be read together.

Areas within open science

Open access to scholarly publications

Open access to scholarly publications means that everyone who has a need for or interest in research results can access and benefit from them, regardless of financial resources or organisational affiliation. This includes researchers at universities and university colleges or other research performing organisations, professionals in the public sector such as schools and healthcare, as well as the business sector, the media, and the general public.

Making scholarly publications immediately open access creates better conditions for scientific knowledge to be disseminated and utilised more quickly and for results, methods and theories to be scrutinised, discussed, and supplemented. Open access to scholarly publications can help improve the quality, efficiency and impact of research.

Goals and priorities:

- That all types of scholarly publications produced wholly or partially with public funds are published with immediate open access.
- That publication takes place with an open license, in accordance with the FAIR principles, and with support from guiding information provided by KB.
- That costs associated with open access publishing are not borne by either readers or individual authors.
- That publishing costs are transparent and decrease over time without affecting Swedish researchers' ability to disseminate research results in the form of scholarly publications.
- That measures are taken to promote authors retaining the economic copyright to their works.

Actors and areas of responsibility:

KB is an expert agency in the field and has been mandated by the government to coordinate, monitor, and promote collaboration in the work for open access to scholarly publications.

Research performing and research funding organisations should establish or develop policies that encompass immediate open access to all types of scholarly publications. It is also crucial that research funders’ and research performers’ policies for open access to scholarly publications are harmonised.

Costs for scholarly publishing should, to the greatest extent possible, be managed at the national level in collaboration between research performing and research funding organisations. In cases where contract negotiations occur with publishers or other service providers, this is conducted within the framework of the Bibsam Consortium on behalf of participating organisations. A common goal is to reduce publishing costs over time.

Costs for open access books are often substantial, and a specific strategy for how to handle them should be developed in collaboration between research performing and research funding organisations.

Research performing organisations have a responsibility to carry out initiatives to increase knowledge of copyright issues among researchers, teachers, students, and relevant support staff.

Research performing and research funding organisations can explore the possibility of establishing policies or strategies that promote researchers' ability to disseminate their works while complying with formal transfer of economic copyright to publishers.

Open access to research data

Open access research data can be more easily discovered, reviewed, shared, cited and reused. This contributes to raising the quality of research by allowing more researchers to validate and build upon previous findings. Data produced within or funded by the public sector are a strategic national resource for the development of society, business and the public sector. Use and reuse of data can foster transparency, innovation and efficiency, and provide a basis for decision making and research.

In the guidelines, research data refers to data, including metadata, that is collected or produced within the framework of research activities. Working for a transition to open access primarily means that assessments of opportunities for open access to research data (including metadata) become a natural part of data management planning. When research data are made available as digital information freely accessible on the internet, this means that open access has been achieved.

Not all research data can be open access, or they may only be accessible to a certain extent, due to legislation or other requirements. The assessment of openness should be based on the principle of "as open as possible, as closed as necessary". When there are obstacles to making research data fully open, the focus should be on making metadata that describes the research data openly available.

In order for open research data to be reusable, for example in further developing and reproducing results, they should be made available according to the FAIR principles.

Goals and priorities:

- That research data produced within the framework of publicly funded research is made available, by 2026 at the latest, according to the principle of "as open as possible, as closed as necessary".
- That research data, including metadata, is made accessible in accordance with the FAIR principles and with guidance provided by VR and Digg.
- That strategic orientations and supportive and technical measures facilitating open access to research data exist at all appropriate levels and in working methods, processes, and routines.
- That cost-effective management of open access to research data is ensured. As a first step, costs associated with making data open access according to the FAIR principles should be clearly identified.
- That research performing organisations, including research infrastructures, give researchers access to adequate support, knowledge-raising initiatives, and reliable,

suitable, and interoperable technical solutions that enable open access to research data according to the FAIR principles.

Actors and areas of responsibility

VR is an expert authority in the area and has been mandated by the government to coordinate, monitor and promote collaboration in the work for open access to research data.

Guiding information from VR and Digg provides strategic and practical support for organisations in their work with open access to research data. This information can serve as a support for strategic decisions or for the practical implementation of open access to research data. It also outlines the legal requirements placed on state-run universities and university colleges regarding making research data and associated metadata available.

The Swedish National Data Service (*Svensk nationell datatjänst*, SND) has a clear role as a national resource, infrastructure and knowledge hub, thus contributing to making open research data available.

Open research methods

Open research methods contribute to an improved quality of research and a more efficient utilisation of insights gained from previous research. They enable reliable systematic reviews, where the results from multiple studies are synthesised. Such reviews involve identifying potential sources of error and assessing the risk of bias in individual studies. Open research methods can allow researchers to avoid investing resources in developing approaches that already exist.

To enable use of open research data, conducting of peer review and confirmation of the validity and usability of research results as well as verification of how they have been reached, descriptions of the workflows used in research need to be openly accessible. When all stages of the research process are made accessible, such as protocols, software, source code, and computational models, these can also be reused in similar contexts or they can be evaluated, developed and applied in adjacent and new areas. New procedures and methods thereby become more rapidly available for others to use.

Within all research areas, describing methods and approaches is part of publishing research results. Detailed information about methods and procedures is generally needed for results to be reproduced or research objects to be reused in new contexts. Methods for and knowledge of how such information can be made available vary among different research contexts. Therefore, in many areas there is a great need for competence development in making research methods available. To facilitate machine reuse of research methods, when feasible and appropriate, open research methods should be accompanied by sufficient metadata to meet the FAIR principles. Support for the establishment of standards and common approaches therefore needs to be developed.

Goals and priorities

- That methods, protocols, and program code are made available as open as possible and as closed as necessary to ensure transparency in the data collection and analysis processes.
- That research methods are always documented and made available at a sufficiently detailed level.
- That research methods are made available in such a way and with sufficient metadata that the FAIR criteria are met.
- That research performing organisations, including research infrastructures, give researchers access to adequate support, knowledge-raising initiatives and reliable, suitable and interoperable technical solutions that enable open access research methods.
- That standards for sharing research methods are used and developed within and based on experiences from different research areas and with regard to international development.
- That reuse of research methods is facilitated through the use and specification of open licenses, when applicable.

Actors and areas of responsibility

Research performing organisations need to contribute to developing support, guidance and technical solutions to make it easier for researchers to provide sufficiently detailed information about the workflows used in the research.

Research performing organisations also need to contribute to developing forms of collaboration between different disciplines to identify needs and develop standards.

Research funders, together with research performing organisations, need to develop policies, guidance, and infrastructural support for open research methods, as this is related to making research data accessible and providing infrastructures that support open science.

Open educational resources

Open educational resources can be used in many learning contexts. There are opportunities and applications in adult education and clubs and associations, as well as in continuing education. An important context is that of formal education, including preschool, primary and secondary school, and in particular, higher education.

The purpose of instruction and educational resources at universities and university colleges is to disseminate research-based knowledge to students and, ultimately, to the society as a whole. Open educational resources can contribute to a more equitable and accessible education, reduce costs for pupils and students, enable adaptation to individual needs, and promote collaboration and knowledge sharing. Open educational resources are based on the

idea of a culture of sharing and collaboration. By providing high-quality materials that others can use and build upon, open educational resources promote knowledge exchange and collaboration among teachers and teaching staff.

Open educational resources require an open licence that allows users to adapt the material to their needs. This enables teachers and other teaching staff to modify and edit open educational resources to meet specific requirements and goals in their courses.

The incentives to create, use and reuse open educational resources are weak. Therefore, there is a need to develop incentives, in particular regarding how the creation of open educational resources can be a component in the evaluation of teachers at universities and university colleges.

Goals and priorities

- That universities and university colleges have policies and guidance for the production and use of open educational resources.
- That open educational resources and their metadata are shared with open licences and, to the greatest extent possible, in accordance with FAIR principles, with the aim of promoting dissemination and reuse.
- That the work on open educational resources at universities and university colleges is coordinated.
- That the need for and prerequisites for a common platform for collecting and disseminating open educational resources are investigated.

Actors and areas of responsibility

Research performing and educational organisations establish or develop policies that promote the creation and use of open educational resources as well as guidance for teachers and other teaching staff. A particularly important aspect is the development of incentives for the creation and use of high-quality open educational resources.

Research performing organisations with an educational mission should be responsible for collaboratively investigating the need, prerequisites and opportunities for a common platform that collects open educational resources at universities and university colleges.

Public engagement in science

An important aspect of open science is to bring the scientific process closer to society and its citizens.

There are various approaches and forms within research for involvement, dialogue and collaboration with the public. They go by names such as citizen science, user participation, scientific crowdsourcing, citizen dialogue and co-creation. They are all characterised by researchers and the public collaborating to generate new knowledge, develop new research

themes or shed light on pressing societal issues. Public engagement in science may be limited to one part of the research process, such as data collection or analysis, but may also include other parts, such formulation of research questions, development of methods and dissemination of results.

A strong motivation for public engagement in science is the way in which it contributes to quality in research and the manner in which new knowledge and understanding are created. The interaction between research and the public - including individuals as well as organisations – provides research better opportunities to address issues and questions that stakeholders perceive as relevant and urgent. This interaction can also contribute to increased understanding of scientific processes and confidence in research.

Involving the public in the research process is a way to collaborate with the surrounding society, promoting mutual exchange, which is the responsibility of Swedish universities and university colleges according to the Swedish Higher Education Act.

There are points of intersection between forms of public engagement in science and science communication. Both aim to promote a greater understanding of and interest in scientific processes, thereby building trust in research. Science communication and participation are therefore not always distinct activities but can often reinforce each other, especially when it comes to recruiting participants and communicating to the public the value of participating in research.

Goals and priorities

- That principles and methods for involving the public in science are developed, known, and established within all research disciplines where it is relevant for the quality and advancement of research.
- That research performing organisations offer enhanced methodological support and knowledge-raising initiatives for researchers on how the public can be engaged in science.
- That research funding organisations develop policies and assessment criteria around collaboration, co-creation, and public engagement in science.

Actors and areas of responsibility

Research performing organisations and research funders should collaboratively develop principles and methods for how public engagement in science can contribute to research quality and ensure adherence to good research practices. This work should leverage the knowledge and experience of existing infrastructures for citizen science and of expert organisations.

Research performing organisations need to develop methodological support and conduct knowledge-raising initiatives for researchers on how the public can be engaged in science.

Research funders need to develop policies and assessment criteria for collaboration, co-creation, and public engagement in science.

Infrastructures supporting open science

Suitable and user-friendly infrastructures are crucial to enabling researchers and organisations to embrace open science. With such infrastructures, systems, services, and protocols, research results can be made openly accessible to other researchers, agencies, businesses, organisations and the public. They enable research results to be collected, stored, managed, and made accessible in a standardised manner, facilitating both collaboration within research fields and utilisation by other actors in society and industry. Open access services and repositories contribute to increased accessibility and use of research results.

Operation and development of infrastructure that supports open science takes place in individual organisations or through collaboration between organisations, nationally and internationally. The infrastructures are typically supported by a combination of membership fees and/or grant funding and are operated by public research organisations or as non-profit initiatives.

Swedish research relies on international services and infrastructures for open science. These are often an important prerequisite for research results to be discovered, linked together and disseminated, and it is often here that the use of standards and best practices is developed and established. There is a particular need to support such open services and infrastructures at the national level. The starting point should be that investments benefit many, that the services are operated by non-profit organisations, and that they follow established definitions and recommendations for open infrastructures.

There is a particular need to use established standards and solutions to link together the various outputs of research, which may be dispersed among multiple sites. The use of persistent identifiers is crucial for ensuring long-term durability in links between different types of research outputs, such as research data, publications and research methods. The development and use of established and robust standards and services enables accessibility in line with the FAIR principles. This also facilitates monitoring and evaluation of open science, thereby contributing to its development.

Goals and Priorities

- That international services and infrastructures supporting open science are funded nationally in a coordinated manner.
- That particular support is provided to non-profit infrastructures for open access publishing.
- That infrastructures that enable sufficient and future-proof sharing of open research methods are developed.
- That standards and technical solutions that link publications, research data, and methods are used and developed.

Actors and areas of responsibility

Research performing organisations hosting digital infrastructures such as repositories and platforms enabling open access to research data and scholarly publications, for example, ensure that these infrastructures are developed according to research needs and, as much as possible, based on open source code and open standards.

Research performing organisations should collaborate to identify and implement common standards and technical solutions for linking publications, research data and methods to enable the sharing of open research methods.

Research funders and research performing organisations are responsible for ensuring that funding for infrastructures supporting open science aims for long-term sustainability and benefits for Swedish research.

Funding for international services and infrastructures supporting open science should be coordinated by the expert agencies KB and VR to ensure efficiency and long-term viability.

Actors and their areas of responsibility

The research and innovation system is complex both in terms of content and organisation, encompassing various fields of science and research, where both public and private research performers and research funders of various types and sizes operate. These guidelines are designed for publicly funded research but can also provide guidance in other contexts.

This section identifies actors and areas of responsibility on an overall level. Within each area, actors and areas of responsibility are highlighted in a more concrete way that is specific to the field.

Researchers

A key starting point for the work with open science is that research is conducted by researchers - individually and in groups - and that responsibility for the research processes and results lies primarily with those conducting the research. A transition to open science needs to occur in the everyday research practices involving research data, in scholarly publishing, and throughout the research process. *How* a transition to a more open science is achieved will vary among different scientific disciplines, research areas, and institutions. It is a necessary consequence of the freedom of research that the responsibility for driving processes and activities towards a more open science needs to be formulated and implemented where the research is conducted.

Researchers have a responsibility to continuously work towards open science in their daily practices by developing approaches themselves and by applying the approaches and routines

developed by relevant organisations and within specific fields. Researchers’ seeking of support and guidance also enhances an organisation's capabilities.

Research performing organisations

Organisations engaged in research activities have a responsibility, as employers and actors within the research and innovation system, to promote open science. This involves providing concrete support in the form of knowledge and expertise, technical tools and infrastructures, such as platforms and storage space, as well as the development and implementation of norms and regulations, information and training, and more. The university and university college libraries have played a leading and pioneering role over the years in the work for open science and have highly developed competence in the field.

In cases where open science requires personnel and/or financial resources, research performing organisations need to take responsibility for necessary priorities. How this is done also needs to be managed within the framework of each organisation.

Through their joint appropriation directions, universities and university colleges are tasked with developing the work with open science. SUHF plays a significant role in coordinating the higher education sector's work with open science.

Agencies that conduct or fund research and development need to develop and refine policies for open science that align with the national guidelines.

Research performing organisations, together with research funders, need to develop incentive structures that promote and value open science, such as in merit assessment and research evaluation. This work needs to align with international and national initiatives aimed at reforming how research is evaluated.

Research performing organisations, with universities taking a leading role, are responsible for developing and implementing policies and incentives for open science, as well as providing resources, support, and guidance to enable this work.

Research funders

Public research funders have a designated responsibility to contribute to the transition to open science. This includes work with policies and conditions related to research grants and work with funding, for example, publication channels or infrastructures for open science.

Funders also play a crucial role in driving development forward by developing incentive structures that promote and value open science, for example in evaluations of merit, together with research performing organisations.

Research funders other than the public ones are also important actors and can work to set standards through policies and conditions that promote open science.

Research funders need to collaborate with universities and other key actors on incentives, norms and rules as well as payment streams and funding of open science.

Expert agencies

Given the multitude of actors and organisations that play important roles in the transition to open science, there is a clear need for coordination and coordinated leadership of the work.

Through their government instructions, KB and VR are responsible for coordinating open access to publications and research data, respectively. Digg is responsible, through its instructions, for promoting the availability and reuse of open data from the public sector. Continuing clear mandates and coordination tasks are essential prerequisites for the process of transition towards an open research and innovation system to function.

Expert agencies with mandates regarding open access need to continue monitoring the national work on open access to scholarly publications and research data. A broader monitoring of the transition to open science needs to be developed, along with periodic monitoring and updating of the national guidelines for open science. This may also involve and include other agencies, not least research performing organisations, primarily universities and university colleges.

Other agencies and actors

Other agencies and actors operating within or closely related to the research and innovation system need to actively follow developments and ensure that their work contributes to the transition to open science by, for example, developing policies on dissemination and sharing of research results. This includes agencies with specific research-related mandates, such as agencies with responsibility for archives and for agencies' work with digitisation of materials that can in turn be used in research.

Other organisations representing civil society or specific interests have an important role to play in creating a common understanding of open science, for example by raising awareness of open science in various contexts or by disseminating research publications and other research information to the public.

Support and guidance

Policies and strategies

Research performing and research funding organisations should develop or update policy documents outlining strategic directions for open science relevant to their areas of operation. Such overarching and general documents set norms for the organisation but should also be formulated to align with the policy documents of other organisations. They can advantageously be developed and grounded through collaboration between organisations in the same sector. To ensure that policies and guidelines are both implemented and rooted within the organisation, it is important to establish conditions for coordinating efforts for open science within the organisation. The national guidelines should be the basis for local

policy documents on open science, especially regarding the overarching goals for the various areas within open science.

Strategies and action plans that are animating, with concrete goals to achieve, along with implementation measures, may need to be developed. SUHF's roadmap for open science is an example of a strategy developed and decided upon through broad collaboration. The roadmap and accompanying guidance clarify the responsibilities of Swedish higher education institutions and the measures needed to accelerate the work on open access to research data and research results.

Education and guidance

There is a need for education about open science for students, relevant professional support staff and researchers at all levels. The training can be a formal part of, for example, doctoral studies or an informal part of, for example, the universities' work with staff competence development.

As an increasing number of researchers and organisations embrace open science, the need increases for concrete guidance for how individual researchers and associations should adopt established open science practices throughout the research process. Research performing organisations should ensure that there is guidance in the form of documents, support functions and opportunities to establish and disseminate knowledge about concrete practices, such as data management plans. The need for local, subject-specific or national guidance should be assessed.

Research performing organisations should offer coordinated support and guidance to researchers on legal issues and assessments that may arise at the intersection of open science and law, to ensure that researchers and others receive equitable support. This concerns, in particular, copyright issues and questions regarding personal integrity and information security.

Resources and targeted investments

The establishment of open science entails investments and reallocation of resources by research performing and research funding organisations. Progress towards open science, as outlined in these guidelines, entails long-term investments in the establishment and maintenance of infrastructure, support functions, skills development, and specific activities.

Targeted investments in all areas of open science are desirable so as to establish and support existing national solutions and infrastructures, as well as subject-specific and interdisciplinary solutions that promote open science. Special efforts should be made so that infrastructures that support open science can be maintained and developed to meet the needs of research.

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