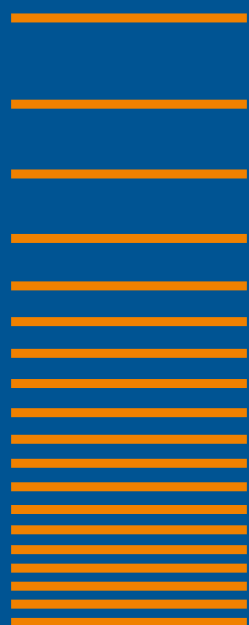


Amsterdam Call for Action on Open Science

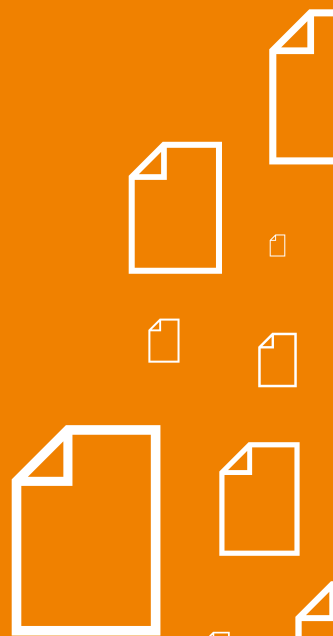


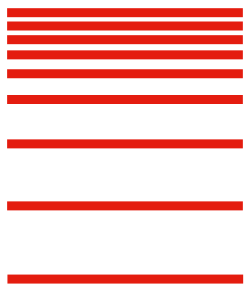
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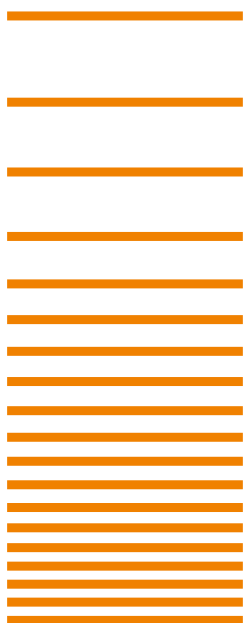
Disclaimer

This document is a living document reflecting the present state of open science evolution. It is based on the input of many participating experts and stakeholders of the Amsterdam Conference 'Open Science – From Vision to Action', hosted by the Netherlands' EU Presidency on 4 and 5 April 2016. Participation in the conference does not constitute formal commitment to the content of this Call for Action.





Amsterdam Call for Action on Open Science



I am open access

Open science

Open science is about the way researchers work, collaborate, interact, share resources and disseminate results. A systemic change towards open science is driven by new technologies and data, the increasing demand in society to address the societal challenges of our times and the readiness of citizens to participate in research.

Increased openness and rapid, convenient and high-quality scientific communication - not just among researchers themselves but between researchers and society at large - will bring huge benefits for science itself, as well as for its connection with society.

Open science has impact and has the potential to increase the quality and benefits of science by making it faster, more responsive to societal challenges, more inclusive and more accessible to new users. An example of this potential is the response to the outbreak of viral diseases such as Ebola and Zika. Access to the most recent scientific knowledge for a broad group of potential contributors, including new or unknown users of knowledge, has brought solutions closer. Open science also increases business opportunities.

The speed at which innovative products and services are being developed is steadily increasing. Only companies (notably SMEs), entrepreneurs and innovative young people that have access to the latest scientific knowledge are able to apply this knowledge and to develop new market possibilities.

Citizen science brings research closer to society and society closer to research.

A speedy transition is needed

For Europe to remain at the forefront and to ensure sustainable growth in the future, open science holds many promises. Reality, however, has not caught up yet with the emerging possibilities. The majority of scientific publications, research data and other research outputs are not freely accessible or reusable for potential users. Assessment, reward and evaluation systems in science are still measuring the old way.

Although these issues are recognised and countless initiatives have been developed during recent years, policies are not aligned, and expertise can be shared more and better. There is a strong need for cooperation, common targets, real change, and stocktaking on a regular basis for a speedy transition towards open science.

The good news is that there is political and societal momentum. More and more researchers are supporting the transition and are moving towards open science in the way they work. Organisations from the scientific community are urging politicians to act. The European Commission and the Council of the European Union have expressed that they are prepared to take a leading role to facilitate and accelerate the transition towards open science.

From vision to action

This Call for Action is the main result of the Amsterdam conference on ‘Open Science – From Vision to Action’ hosted by the Netherlands’ EU presidency on 4 and 5 April 2016. It is a living document reflecting the present state of open science evolution. Based on the input of all participating experts and stakeholders¹ as well as outcomes of preceding international meetings and reports, a multi-actor approach was formulated to reach two important pan-European goals for 2020:

1. **Full open access for all scientific publications**

This requires leadership and can be accelerated through new publishing models and compliance with standards set.

2. **A fundamentally new approach towards optimal reuse of research data**

Data sharing and stewardship is the default approach for all publicly funded research. This requires definitions, standards and infrastructures.

To reach these goals by 2020 we need flanking policy:

3. **New assessment, reward and evaluation systems**

New systems that really deal with the core of knowledge creation and account for the impact of scientific research on science and society at large, including the economy, and incentivise citizen science.

4. **Alignment of policies and exchange of best practices**

Practices, activities and policies should be aligned and best practices and information should be shared. It will increase clarity and comparability for all parties concerned and help to achieve joint and concerted actions. This should be accompanied by regular monitoring-based stocktaking.

Twelve action items with concrete actions to be taken

Twelve action items have been included in this Call for Action. They all contribute to the transition towards open science and have been grouped around five cross-cutting themes that follow the structure of the European Open Science Agenda as proposed by the European Commission. This may help for a quick-start of the Open Science Policy Platform that will be established in May 2016. Each action item contains concrete actions that can be taken immediately by the Member States, the European Commission and the stakeholders.

¹ Stakeholders include research funders, Research Performing Organisations (including researchers, libraries and support staff), publishers (including information service providers) and businesses.

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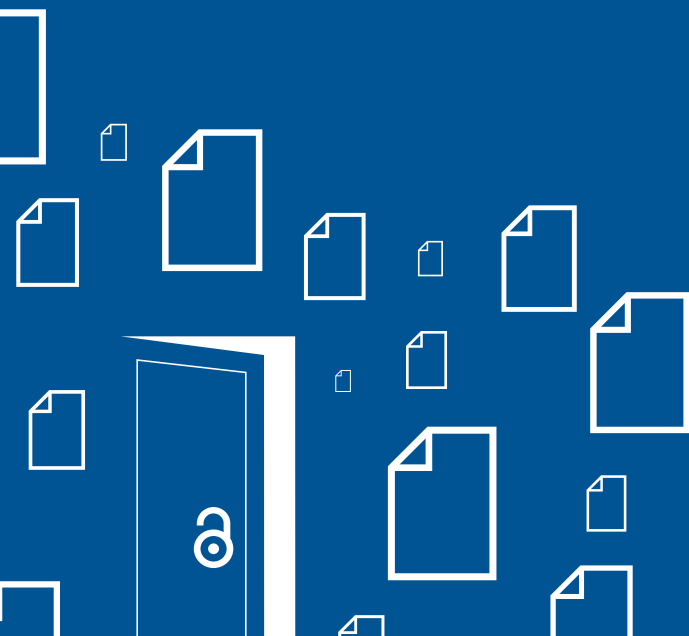
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Removing barriers to open science



1. Change assessment, evaluation and reward systems in science

The problem

Open science presents the opportunity to radically change the way we evaluate, reward and incentivise science. Its goal is to accelerate scientific progress and enhance the impact of science for the benefit of society. By changing the way we share and evaluate science, we can provide credit for a wealth of research output and contributions that reflect the changing nature of science.

The assessment of research proposals, research performance and researchers serves different purposes, but often seems characterised by a heavy emphasis on publications, both in terms of the number of publications and the prestige of the journals in which the publications should appear (citation counts and impact factor). This emphasis does not correspond with our goals to achieve societal impact alongside scientific impact. The predominant focus on prestige fuels a race in which the participants compete on the number of publications in prestigious journals or monographs with leading publishers, at the expense of attention for high-risk research and a broad exchange of knowledge. Ultimately this inhibits the progress of science and innovation, and the optimal use of knowledge.

The solution

- Ensure that national and European assessment and evaluation systems encourage open science practices and timely dissemination of all research outputs in all phases of the research life cycle.
- Create incentives for an open science environment for individual researchers as well as funding agencies and research institutes.
- Acknowledge the different purposes of evaluation and what 'right' criteria are. Amend national and European assessment and evaluation systems in such a way that the complementary impact of scientific work on science as well as society at large is taken into account.
- Engage researchers and other key stakeholders, including communications platforms and publishers within the full spectrum of academic disciplines. Set up assessment criteria and practices, enabling researchers to exactly understand how they will be assessed and that open practices will be rewarded.

Concrete actions

- **National authorities and the European Commission:** acknowledge that national initiatives are reaching their limits, and that this is an area for a harmonised EU approach.
- **National authorities, European Commission and research funders:** reform reward systems, develop assessment and evaluation criteria, or decide on the selection of existing ones (e.g. DORA for evaluations and the Leiden Manifesto for research metrics), and make sure that evaluation panels adopt these new criteria.
- **Research Performing Organisations, research funders and publishers:** further facilitate and explore the use of so-called alternative metrics where they appear adequate to improve the assessment of aspects such as the impact of research results on society at large. Experiment with new approaches for rewarding scientific work.
- **Research communities, research funders and publishers:** develop and adopt citation principles for publications, data and code, and other research outputs, which include persistent identifiers, to ensure appropriate rewards and acknowledgment of the authors.

- **Research communities and publishers:** facilitate and develop new forms of scientific communication and the use of alternative metrics.

Expected positive effects

- An end to the vicious circle that forces scientists to publish in ever more prestigious journals or monographs and reinforcement of the recognition for other forms of scientific communication;
- A wider dissemination of a wider range of scientific information that benefits not only science itself but society as a whole, including the business community;
- A better return for the parties that fund research.

2. Facilitate text and data mining of content

The problem

The growing amount of digitally available research data and publications enables researchers to search and analyse these sources with the help of special software (text and data mining, TDM). The use of TDM techniques is already of great importance in some research fields (such as bio-genetics and linguistics) and interest in these technologies is growing rapidly.

Usually, authors are obliged to transfer their copyrights before publication, as a result of which the scientific community also relinquishes control over the way in which its publications are used. It has not been possible thus far to mine freely in legally accessed content made available by academic publishers. This obstructs science itself, including the distribution of scientific knowledge beyond the scientific community, and also impedes the use of TDM by private parties, especially SMEs, depriving them of the ability to explore new market possibilities. This ultimately hinders innovation.

The solution

- Reform copyright legislation to allow text and data mining for academic purposes and preferably also for societal and commercial purposes for users who already have legal access to content.
- Encourage researchers not to transfer the copyright on their research outputs before publication.

Concrete actions

- **European Commission:** put forward proposals for copyright reform during 2016, so as to facilitate the use of TDM for academic purposes and preferably also for societal and commercial purposes.
- **National authorities, national parliaments, European Commission, Council and European Parliament:** adopt and implement rules and legislation that make TDM easier for academic purposes and preferably also for societal and commercial purposes.
- **Research funders and Research Performing Organisations:** actively stimulate authors to retain control over their research output, including articles and books. This can be achieved by setting preconditions for funding and by introducing licensing systems.
- **Publishers:** allow text and data mining for users of their content who already have legal access, and expose content in a structured and machine actionable way.

Expected positive effects

- Broader uptake of new analysis techniques, especially in the area of big data;
- Reduced costs for scientific work in the area of TDM/big data;
- Advancement of science, new solutions for societal challenges and more innovation.

3. Improve insight into IPR and issues such as privacy

The problem

Working towards an open science environment with optimal opportunities for reuse of research data can be perceived as contradictory to the adequate safeguarding of intellectual property rights (IPR) for companies that invest in public-private partnership projects and researchers who want to use their own results. This is a fallacy, because rules and legislation to protect the IPR of private parties will continue to exist in the future. In fact, project partners will be stimulated to think about their data policy. Opt-outs and careful examination by partners of what to share and what not to share within projects will ensure that private parties will still be able to profit from their investments, and researchers will still be able to use their own results. Public-private and public-public cooperation can be hindered by a lack of clarity about this issue during the transition.

The re-use of personal data for scientific purposes also needs some further thinking. A deeper insight in the tension between privacy and open science is needed.

The solution

- Clarify IPR regimes to all parties involved in public-private partnership projects and potential new parties who are not aware of the possibilities.
- Set rules and conditions for public funding of research in which open (data) is the default standard.
- Implement 'privacy by design' to overcome legal and operational uncertainty.

Concrete actions

- **Research funders and the European Commission:** set open data as the default standard for publicly funded research and communicate clearly that this does not equate to relinquishing intellectual property in public-private and public-public partnerships.
- **Research Performing Organisations and private partners:** think actively about what to share and what not to share and avoid automatically choosing the safest option (i.e., not sharing).
- **Research funders and Research Performing Organisations:** develop and set standards on privacy by design also in negotiations with other partners on reuse of data.

Expected positive effects

- Continuous engagement of private parties in public-private partnership projects;
- New solutions, products and services, to be developed by actors who do not currently have access to the data they need, or even do not know that the data exists and can be useful for their business;
- Privacy-enhancing conduct in research projects, thus safeguarding trust.

4. Create transparency on the costs and conditions of academic communication

The problem

There are concerns that the current academic publication system is unsustainable for Research Performing Organisations. In order to achieve a cost-effective, efficient and dynamic system of academic communication stakeholders need to gain appropriate insight into its costs and conditions. This is particularly relevant in the transition phase to open access when both Big Deals and article processing charges (APCs) are being used.

The solution

- Introduce greater transparency in costs and conditions connected with academic communication as soon as possible so as to enable a better transition to open access.

Concrete actions

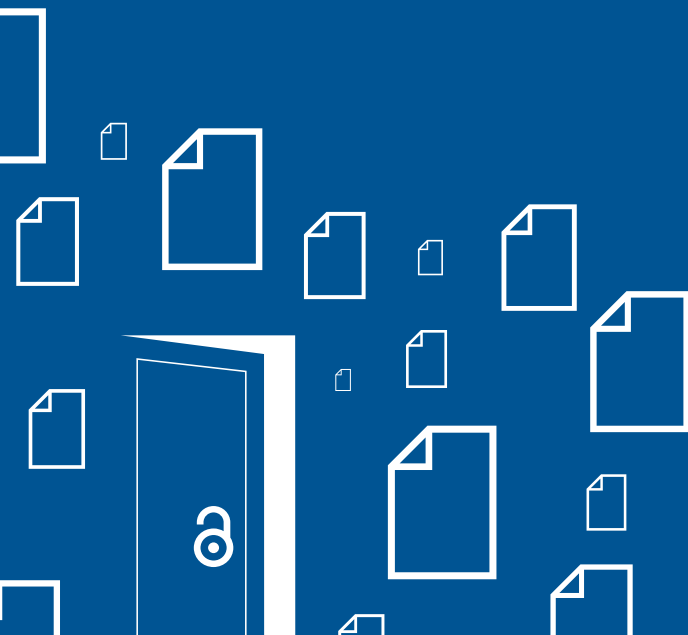
- **National authorities and European Commission:** give strong political backing to Research Performing Organisations in their negotiations with publishers.
- **Research Performing Organisations:** collaborate closely, e.g. form consortia, to negotiate with publishers, in order to reach agreements in which fair open access is the default standard.

- **National authorities:** work with all other stakeholders to create a comprehensive and transparent system for gathering and sharing information on the costs and conditions of academic communication.
- **National authorities, Research Performing Organisations and publishers:** require details of public spending to be fully transparent and abolish non-disclosure clauses in contracts.
- **European Commission:** provide guidance to clarify the relevance of EU competition law to the exchange of information on the costs and conditions of academic communication.

Expected positive effects

- Greater transparency will contribute to a level playing field in academic communication, which will benefit small and intermediate as well as new innovative publishers and entrepreneurs;
- Lower overall costs for academic communication;
- Fair pricing.

Developing research infrastructures



5. Introduce FAIR and secure data principles

The problem

Research outputs generated with public funding should be accessible for reuse. In the scientific process, many different kinds of output are generated, depending on the scientific discipline, the sources of data and the type of analyses that researchers perform. For sharing and reusing data in the open science environment, it is important to provide clarity about the quality of the data offered and to have effective agreements in place for better reuse of data. If data is to be archived and made suitable for reuse, it must be clear to third parties how the data is structured and what information it contains.

The solution

- Develop Principles & Guidelines for Data Management Plans and data stewardship.
- Create optimal conditions for sharing research output by introducing a quality hallmark for the FAIR principles, data, and data management requirements: research output should be Findable, Accessible, Interoperable and Reusable.

Concrete actions

- **National authorities and the European Commission:** state that research output produced with public funding should, in principle, be accessible for reuse. Promote the FAIR principles. Provide for a bottom-up and discipline-based approach and elaboration.
- **National authorities and Research Performing Organisations:** put in place an institutional data policy which clarifies institutional roles and responsibilities for research data management and data stewardship.
- **Research funders:** implement Data Management Plans (DMPs) as an integral part of the research process, make them a precondition for funding, standardise them and make the costs incurred eligible for funding.
- **Research funders:** introduce positive incentives for FAIR data sharing by valuing data stewardship and efforts to make data available and by acknowledging and rewarding those who compile the data. Require data to be cited according to international standards. Encourage the sharing of expertise that enables disciplines/regions to learn from each other.
- **Research funders:** set the default in data sharing to open access, but allow a choice of access regimes: from open and free downloads to application and registration-based access. Conditions can be dependent on the nature of the data, common practice within a specific academic discipline, legal (privacy) frameworks, and legitimate interests of the parties involved.
- **National authorities and research funders:** educate data stewardship experts, recognise their profession and provide them with career opportunities. They will act as a bridge between IT and science.

Expected positive effects

- Increased quality of research;
- Better adherence to the principles of good scientific research and conduct to foster research integrity;
- Increased impact of publicly funded research;
- Secure sharing and reuse of research outputs, which will foster science and innovation.

6. Set up common e-infrastructures

The problem

New modes of scientific analysis and scholarly communication need a safe and user-friendly environment to analyse data and other research outputs such as scientific articles and monographs. For example, ‘machine actionability’ (the ability to find and read texts and data through the use of computers) is needed. Besides a physical infrastructure, data scientists and other experts are needed to further develop the use of this infrastructure and to enrich, analyse and handle the massive data inputs.

The solution

- Align practices in Europe and beyond, and work towards a sustainable federated European Open Science Cloud (EOSC) that aims to accelerate and support the current transition to more effective open science and open innovation in a Digital Single Market. It should enable trusted access to services and systems and promote the reuse of shared data across disciplinary, social and geographical borders.
- Encourage the development of e-infrastructures as a service, by making sure that the various ICT components are aligned and provide a joint service. This should be done by building on the success of existing systems, while reducing current fragmentation through the creation of an ecosystem of infrastructures.
- Put in place an open infrastructure supporting open access to publications based on work in progress to secure proper governance, technical interoperability, financial sustainability and exit strategies.

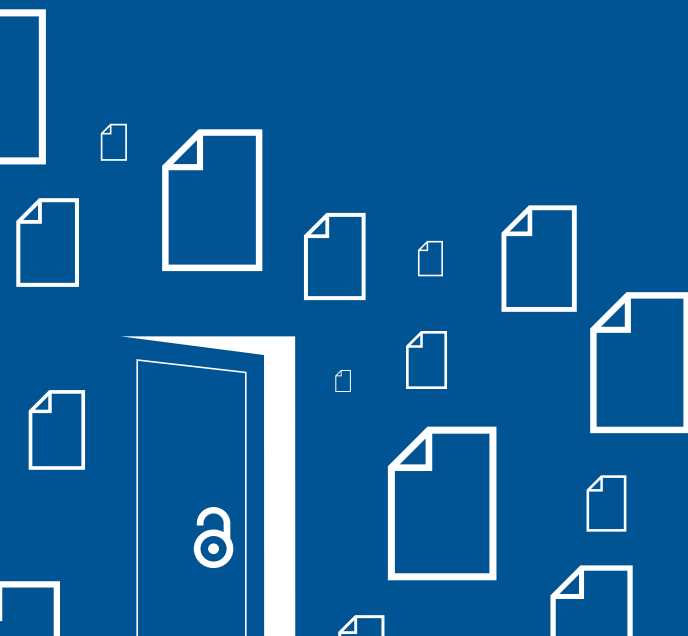
Concrete actions

- **European Commission and national authorities:** explain that a European Open Science cloud will be an infrastructure service for society as a whole, and set up effective and inclusive governance.
 - **European Commission and national authorities:** set up concerted funding initiatives to develop data expertise in Europe. Assess what is needed in the infrastructure landscape (hardware, computing, storage, software, services, governance, etc.).
 - **National authorities, research funders, Research Performing Organisations and e-infra organisations:** set up and manage local and national e-infrastructures and facilitate researchers in the selection and use of services. Explicitly address the issue of financial viability and user-friendliness of the services.
 - **National authorities, research funders, Research Performing Organisations, e-infra organisations and publishers:** support work in progress and further develop Principles for Open Scholarly Infrastructures to set up concerted mechanisms and fund initiatives to maintain a register of key open access services that address sustainability, governance, usage and interoperability.
- Publish the recommendations on funding and risks in a workshop in order to derive a generic approach for such services in general.
- **National authorities, research funders, Research Performing Organisations and e-infra organisations:** set up rules of engagement for all contributors (users, e-infrastructure providers, funders etc.) in the European Open Science Cloud. For e-infrastructure service providers this includes certification schemes.
 - **European Commission:** via the structure of the European Open Science Policy platform, set up a task force to agree on a business model, including a transition plan towards that model, for the European Open Science Cloud. Align with other existing working groups that are examining business models for cloud services. Set up pilots to test proposed models.

Expected positive effects

- Ability to make full use of data-driven research, including by computers;
- An efficient infrastructure to capture the big data challenge;
- A huge acceleration in the reuse of scientific data, with significant positive effects on science and the economy;
- Academics and professionals can start to take open access infrastructures as a starting point and focus on increasing open access to publications

Fostering and creating incentives for open science



7. Adopt open access principles

The problem

The existing types of publishing are not necessarily conducive to open access nor to the desired degree of transparency in the science system. In addition, entry obstacles can be identified for researchers, incumbent publishers and new publishers, with an inhibitive effect on innovation in knowledge transfer. Moreover, the current subscription models are not financially viable.

Although digitisation, globalisation and the development of the Internet have tremendously changed and accelerated communication in general, the academic communication process remains fairly traditional and currently involves increasingly unbearable costs. Excessive time periods between submission and publication, payment walls, embargos and other access barriers impede the transfer of knowledge. This obstructs the evolution towards an open and transparent academic process and the associated knowledge exchange with society at large.

The solution

- Provide a framework for developing new publishing models, which can be achieved by creating a concise set of open access principles for publishing models. This should be done by the stakeholders.

Concrete actions

- **Publishers, research funders and Research Performing Organisations:** promote mutual understanding and agree on open access principles like transparency, competition, sustainability, fair pricing, economic viability and pluralism.
- **Research funders and Research Performing Organisations:** realign and coordinate activities, as both funders and research organisations pay for subscriptions and article processing charges.

Expected positive effects

- A framework for further development of open access publishing models and services.

8. Stimulate new publishing models for knowledge transfer

The problem

Although digitisation, globalisation and the development of the Internet have tremendously changed and accelerated communication in general, the scientific communication process remains fairly traditional. Excessive time periods between submission and publication, payment walls, embargos and other access barriers impede the transfer of knowledge. This obstructs the evolution towards an open and transparent academic process and the associated knowledge exchange with society at large. We train students to use scientific literature but when they leave universities they can no longer access. This should change. Innovative models for knowledge transfer, like citizen science and crowdsourcing, are primarily seen as 'nice to have' and are not sufficiently embedded in regional and national research and innovation strategies.

The solution

- Encourage the development of publishing models that provide free access for readers/users.
- Bring in more competition into the academic publishing market; we need sustainable long-term funding for open access publishing models and auxiliary open access services (like DOAJ).
- Foster the development of new models for academic communication, beyond the traditional scientific articles.
- Explore alternative ways of releasing research results, of commenting on them and of measuring their impact.
- Facilitate bringing in new users – such as citizens – into the research process.

Concrete actions

- **All partners:** mobilise stakeholders for a fair, balanced and innovative publishing system by fostering structured dialogue among all stakeholders and sharing expertise and best practices. Take stock of the information needs among SMEs and explore how open science can help fill those needs.
- **National authorities and European Commission:** give political backing to universities in their negotiations with publishers about access to content.
- **Research Performing Organisations:** collaborate closely in negotiations with publishers, in order to reach agreements in which open access is the standard. Include citizen science into the mainstream.
- **Publishers, Research Performing Organisations and individual researchers:** experiment with new, faster ways of publishing, such as immediate publishing based on open peer review (flipped publishing). No longer accept disclosure clauses.
- **Publishers, Research Performing Organisations, individual researchers and research funders:** promote widespread application of citizen science as a knowledge transfer. This includes that the output of citizen science projects should be accessible.
- **National authorities, European Commission and research funders:** encourage parties to develop new models for knowledge distribution and for the various academic disciplines using start-up money, and guarantee sustainability in the long term by adequate funding. Broaden the Open Library of Humanities to the Open Library of Sciences for library consortia.
- **Research funders and Research Performing Organisations:** provide start-up money for alternative open access publishing models so that they can become established and sustainable. Provide less specific funding tracks, more flexible funding (including open science components in research proposals, faster calls), better promotion of funding possibilities for young/ new/innovative stakeholders, including small-scale initiatives. Have specific research output translated to specific target groups, such as patients.

- **Research funders:** bring in new users, allow for new forms of funding, like crowdfunding. Think in 'terms of 'problem spaces' and develop Joint Open Science Initiatives (JOSIs) around a societal challenge. Make cross-border funding easier and fund risky projects more aggressively. Be critical in financing commercial entities with a poor record on open science adoption.
- **Research libraries:** act as publishers of open access for their institutions; create a database of open science best practices.
- **Publishers, Research Performing Organisations and individual researchers:** remove barriers to citizen science by charging no APCs and allowing citizens without institutional support to publish as well. Allow for the publication of negative results/data.
- **Funders, publishers, Research Performing Organisations and research libraries:** support discipline-based foundations that help flip subscription journals to FAIR open access by providing funds for APCs and transition by 2020.
- **Universities, university libraries, publishers and funders:** promote 'bulk' processing of APCs to reduce administration overload among researchers.

Expected positive effects

- Quicker, more effective knowledge transfer;
- Involving far more actors in the innovation of models for academic communication;
- Transparency in costs and fair pricing.

9. Stimulate evidence-based research on innovations in open science

The problem

Initiatives aiming to facilitate the transition towards open science are urgently needed. Many initiatives are already being undertaken. It is important to investigate and monitor the extent to which stakeholder actions contribute to innovations in open science. Results of such evidence-based research must be shared to show which actions we should support to move forward and which actions to abandon. Communication on successes is needed, but also on failures and actions that do not work.

The solution

- Facilitate evidence-based research on innovations in academic communication, while selecting and financially supporting new models.
- Adopt an evidence-based approach for mainstreaming open science.
- Demonstrate the benefits of opening scientific processes for scientists as well as society.
- Investigate how stakeholders can contribute to innovations in open science.
- Define and disseminate good practices and corresponding principles.

Concrete actions

- **All stakeholders:** explore other ways of sharing result outputs, to serve the purpose of open science. Let the public participate in the selection of scientific topics through online platforms.
- **National authorities and European Commission:** actively contribute to peer learning about national policies, e.g. within the framework of the development of the European Research Area (ERA).
- **Publishers:** allow for publications from grass-root initiatives on citizen science, from outside academic institutions.
- **National authorities and European Commission:** set up research programmes on developments in open access/open science to answer questions regarding the optimal road to open science, the advantages of open science for society at large etc.
- **Research funders:** investigate how funding streams could be innovated to make science more open and innovative. Show best practices. For instance, finance research on the level of grant-based funding (in any discipline) that allows science to perform at its best and finance research on how to best align funding schemes with open access principles. Accept uncertainty and pilots in open science research

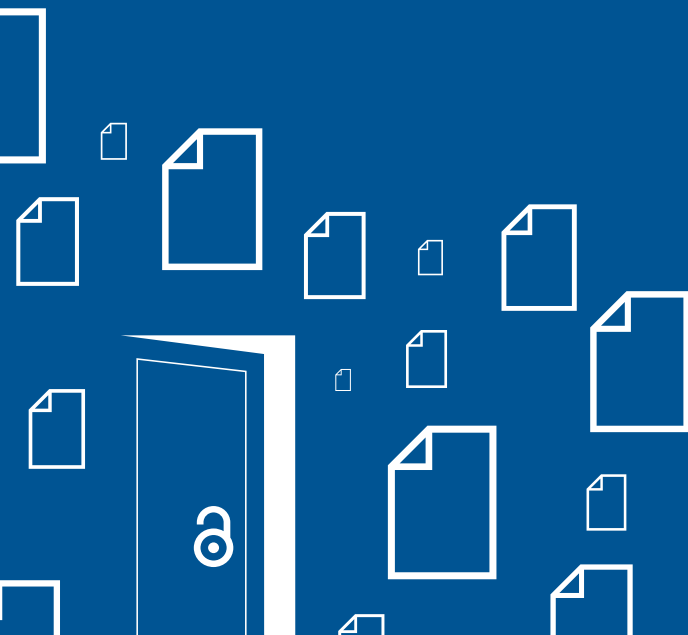
(more flexible funding, smaller scale, faster). Create a funding mechanism to explore paybacks to open science.

- **Researchers and research institutes:** collaborate in research into innovations in open science.
- **Research libraries:** raise awareness, participate in EU projects, collect best practices, create a forum to share experiences.

Expected positive effects

- A quicker transition to mainstreaming open science;
- An evidence-based approach that helps to make the right choices in achieving open science.

Mainstreaming and further promoting open science policies



10. Develop, implement, monitor and refine open access plans

The problem

The transition towards open access has been a lengthy process thus far, resulting in a lack of clarity for all parties involved and increased costs. Policies are numerous and differ between organisations and countries. There is no clear pan-European target. Besides, there is little comparable information on the status and development of open access in the various countries, and on the costs of access to academic publications. Although some information is already being collected and exchanged at various levels, the overall approach is fragmented and data cannot always be compared.

The solution

- Reinforce and align open access strategies and policies at the national level and facilitate their coordination among all Member States.
- Unify and accelerate initiatives by stakeholders, national authorities and the European Commission by exchanging information at the European level, for example about the targets set in the various Member States and how those targets should be achieved.
- Formulate a clear pan-European target: from 2020 all new publications are available through open access from the date of publication.
- Implement monitoring and stocktaking at regular intervals about the progress made by all parties: the Commission, the Member States and stakeholders.

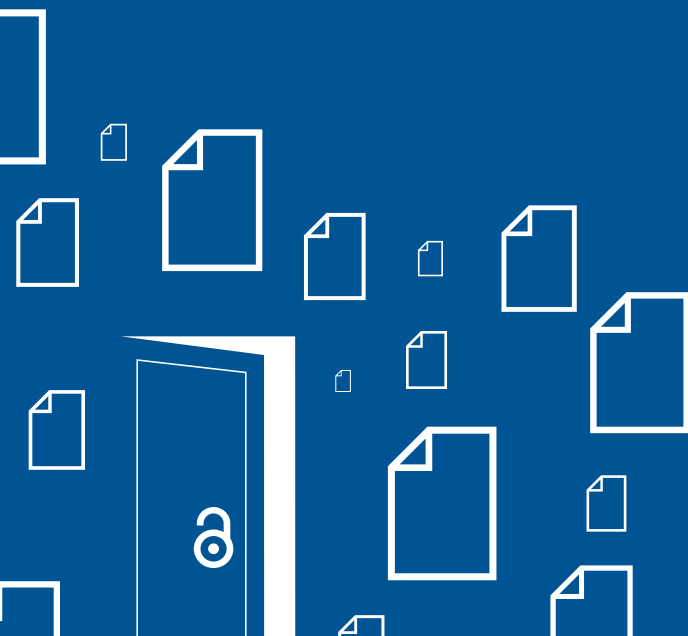
Concrete actions

- **National authorities and the European Commission:** agree on a 100% target for 2020 and regular monitoring and stocktaking. Establish standards, systems and services for monitoring and reporting, and monitor progress through the European Research Area (ERA) Monitoring Mechanism (EMM) and through the National Points of Reference on Open Access, and regularly refine plans to achieve these targets based on information from monitoring.
- **Research funders and Research Performing Organisations:** develop open access plans, including the provision of necessary infrastructures and services, share expertise and use harmonised data, e.g. by setting up and coordinating platforms for monitoring and networks of expertise.

Expected positive effects

- A clear target combined with increased momentum and critical mass, leading to real change;
- More clarity for researchers on how to meet open access requirements;
- Better insight into available open access initiatives and developments.
- Continual improvement and refinement of implementation plans.

Stimulating and embedding open science in science and society



11. Involve researchers and new users in open science

The problem

While researchers in various areas have long supported open science principles, the ways in which science is currently institutionalised will need to be modified to enable the implementation of those principles.

There are career barriers; there are conflicting demands and researchers receive conflicting messages about the value of open science to their work. The guidance they receive is too generic and sometimes contradictory. In addition, there are strong constraints for opening science to society (e.g. citizen science) and there is a lack of knowledge among researchers about the wide variety of methods to open up scientific processes. The same holds for private parties involved in science, e.g. through public-private partnerships.

Although the potential impact of open science on society by making scientific knowledge available to new users is huge, many potential new users are unaware of this, or they lack the skills to find relevant information. With the enormous growth of freely available publications and data, new users might get lost in their search for information, or draw wrong conclusions.

The solution

- Raise awareness among all stakeholders of best practices in support of open science.
- Train and support students and researchers in open science principles, their societal responsibility and role, and in extending the impact of their work to society at large.
- Develop new types of services to researchers in support of open science and train support staff (for instance in ICT services and libraries) to deliver these services.
- Identify and acknowledge barriers to career progression at the European level.
- Involve researchers, by discipline if required, in compiling research data management and software sustainability protocols that fit their disciplines' requirements and needs, and publish those protocols for public reference.
- Foster the creation of programmes targeting real societal challenges, enhancing society's problem-solving capacity.
- Train and educate new user groups in searching and finding academic information.
- Identify the new users, what they need and how they can be helped and supported best.
- Build platforms of new user groups to create communities and ensure their permanent involvement.

Concrete actions

- **National authorities and European Commission:** acknowledge the value of open science in scientific evaluation and funding; develop strategies to involve new users in the scientific process through Horizon 2020.
- **Research funders and Research Performing Organisations:** adopt a positive, integrated approach of career progression systems to remove obstacles that impede open science practices; raise awareness and promote open science in universities and other knowledge institutions. Develop training and skills, tailored to each discipline, including ICT and library personnel etc. Involve new user groups through platforms and otherwise and give them the opportunity to take up a role when funding projects.
- **All actors:** foster the existing relations between science, society and business, and develop training and skills for all parties to help them seize opportunities that promote open science.

Expected positive effects

- A broader uptake of open science working practices among researchers;
- A quicker uptake of new working methods in the scientific community and faster development of new research tools;
- Better connections between science and society;
- Better science by involving citizens;
- Better, more and quicker solutions for societal challenges and better, more and quicker market opportunities;
- Development of new publishing models.

12. Encourage stakeholders to share expertise and information on open science

The problem

A great deal of expertise has been obtained on open access to academic publications, but more work is needed to explore and reach consensus on how open science can evolve. For example, there are issues on costs, data protection and data sharing.

The solution

- All relevant stakeholders should agree on a European roadmap for reaching consensus on open science, reinforcing Europe's competitiveness in science.

Concrete actions

- **National authorities:** establish a national plan for open science.
- **European Commission:** work together with all stakeholders to facilitate EU policies that add value to open science.
- **Research funders and Research Performing Organisations:** identify the appropriate platforms to further develop open science policies and elaborate a European roadmap.
- **All actors:** foster stronger relations between science, society and business actors to accelerate innovation and encourage sharing of new/effective ideas.

Expected positive effects

- Coherent and transparent plans for open science will reinforce Europe's competitiveness, and lead to better quality science and benefits for society.

