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COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

Towards better access to scientific information: Boosting the benefits of public investments in research

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

Towards better access to scientific information: Boosting the benefits of public investments in research

1. INTRODUCTION

The Europe 2020 strategy for a smart, sustainable and inclusive economy underlines the central role of knowledge and innovation in generating growth. Research results, including both publications and data collections, need to be circulated rapidly and widely, using digital media. This accelerates scientific discovery, enables new forms of data-intensive research and allows research findings to be systematically taken up by European business and industry. To spur scientific and technological progress, the European Union (EU) should review its policies and practices on disseminating scientific information, and take the necessary steps to improve access to the results of publicly-funded scientific research.

Example: Mapping the human genome will enable scientists to make progress in tackling serious diseases such as cancer, Alzheimer's and HIV/AIDS. It is estimated that government investments of $3.8 billion in the Human Genome Project, a US co-ordinated research endeavour including major European contributions, have had an economic impact worth $796 billion, created 310 000 jobs and launched the genome revolution. This is an excellent illustration of the power that open access to scientific information can have.

This Communication sets out the action that the Commission intends to take to improve access to scientific information and to boost the benefits of public investment in research. It also explains how open access policies will be implemented under 'Horizon 2020', the EU's Framework Programme for Research and Innovation (2014-2020). The Communication is accompanied by a Recommendation to the Member States, calling for improved policies and practices on access and preservation in the Member States.

This initiative springs from two mutually-reinforcing policy strands. One is the Digital Agenda for Europe[1], which sets out an 'open data' policy covering the full range of information that public bodies across the European Union produce, collect or pay for[2]. The other is the Innovation Union Communication[3], which outlines the EU's research and innovation policies and programmes.

The proposed measures build on earlier work, in particular the 2007 Communication on scientific information in the digital age[4] and the related Council Conclusions, the 2009 Communication on ICT infrastructures for e-Science[5] and the strategic policy developed for the European Research Area (ERA).

1 COM(2010) 245 final/2.
2 See 'open data' package adopted on 12 December 2011, COM(2011) 882.
3 COM(2010) 546 final.
4 COM(2007) 56 final.
5 COM(2009) 108 final.

To improve access to scientific information, Member States, research funding bodies, researchers, scientific publishers, universities and their libraries, innovative industries, and society at large need to work together. Europe's scientific information system must be made fit for the digital age so that the 'fifth freedom' of the EU — the free circulation of knowledge[6] — can become a reality.

2. WHY DOES BETTER ACCESS TO SCIENTIFIC INFORMATION MATTER FOR EUROPE?

Modern research builds on extensive scientific dialogue and advances by improving earlier work. Fuller and wider access to scientific publications and data will therefore help to:

– accelerate innovation (faster to market = faster growth);

– foster collaboration and avoid duplication of effort (greater efficiency);

– build on previous research results (improved quality of results);

– involve citizens and society (improved transparency of the scientific process).

What is at stake is the speed of scientific progress and the return on R&D investment, and in particular publicly-funded investment which has enormous potential for boosting productivity, competitiveness and growth. Wide, affordable and easy access to scientific information is particularly important for innovative small businesses (Small and Medium Enterprises, SMEs). A recent report[7] illustrates the difficulties that Danish SMEs face in accessing scientific information. The report indicates that, without speedy access to up-to-date scientific research results, it takes such firms on average 2.2 years longer to develop or introduce new products. Improving access to scientific information is also about increasing openness and transparency, which are essential features of responsible research and innovation[8], and it contributes to better policy-making in a variety of areas. Improved access will lead to more science-literate citizens capable of thriving in the complexities of the 21st century.

Discussions of the scientific dissemination system have traditionally focused on access to scientific publications — journals and monographs. However, it is becoming increasingly important to improve access to research data (experimental results, observations and computer-generated information) which form the basis for the quantitative analysis underpinning many scientific publications.[9]

3. THE COMMISSION'S VISION

The European Commission emphasises open access as a key tool to bring together people and ideas in a way that catalyses science and innovation. To ensure economic growth and to address the societal challenges of the 21st century, it is essential to optimise the circulation and transfer of scientific knowledge among key stakeholders in European research —

6 Conclusions of the European Council of 20 May 2008, Doc. no. 7652/1/08.

7 http://www.fi.dk/publikationer/2011/adgang-til-forskningsresultater-og-teknisk-information-i-danmark.

8 See Sutcliffe, 'A report on Responsible Research and Innovation'.

9 See 'Riding the Wave: How Europe can gain from the rising tide of scientific data', High Level Expert Group on Scientific Data, October 2010.

universities, funding bodies, libraries, innovative enterprises, governments and policy-makers, non-governmental organisations (NGOs) and society at large.

The vision underlying the Commission's strategy on open data and knowledge circulation is that information already paid for by the public purse should not be paid for again each time it is accessed or used, and that it should benefit European companies and citizens to the full. This means making publicly-funded scientific information available online, at no extra cost, to European researchers and citizens via sustainable e-infrastructures, also ensuring long-term access to avoid losing scientific information of unique value[10].

Science is changing profoundly. Computerised methods and machine applications will play a major role in data-driven science. The Commission envisions a future in which the data infrastructure becomes invisible and the information itself is an infrastructure from the user's perspective.

This vision in no way implies that researchers would be prevented from patenting their inventions[11] or that the protection of intellectual property rights in the EU would suffer.

Realising this vision calls for an innovative European scientific publishing sector that creates new areas of added-value beyond its traditional strengths, and builds on the new opportunities of the digital era.

4. WHERE DO WE STAND?

4.1. Access to scientific publications

Scientific publications are crucial for scientific dialogue and play a key role in the careers of scientists.

Scientific publishing is also a profitable business, notably in Europe. European publishers account for almost 50% of the articles published worldwide in the scientific, technical and medical fields. They have rapidly adapted to the digital age, using new tools to speed up the production and dissemination process, improving the searchability of content and deploying applications building on the underlying raw text and data.

Rising journal prices — library budgets under pressure

Over the last two decades, the subscription price of scientific journals (paper-based and electronic) has increased at a steady pace of around 3.5% above inflation per year[12]. This increase can partly be explained by the increased number of scientific articles published. Rising prices put a strain on university library budgets and research institutions, which constitute the bulk of subscribers to scientific journals.

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10 Communication of the Commission 'ICT infrastructures for e-Science' of 5.3.2009, COM(2009) 108 final.

11 Patenting is an effective way of disseminating knowledge in open access mode.

12 http://www.arl.org/bm~doc/arlstat09.pdf.

Open access

Given rising journal prices, there have been calls in the scientific community to move towards open access, a model which provides access, use and re-use free of cost to readers on the Internet. Two basic models exist:

> '**Gold' open access** (open access publishing): payment of publication costs is shifted from readers (via subscriptions) to authors. These costs are usually borne by the university or research institute to which the researcher is affiliated, or by the funding agency supporting the research.
>
> '**Green' open access** (self-archiving): the published article or the final peer-reviewed manuscript is archived by the researcher in an online repository before, after or alongside its publication. Access to this article is often delayed ('embargo period') at the request of the publisher so that subscribers retain an added benefit.[13]

A growing number of research funding bodies and universities around the world require researchers to provide open access to publicly-funded research results.[14] Many publishers have reacted to institutional mandates by allowing the self-archiving of manuscripts accepted for publication.[15] Currently some 20 % of all scientific articles are available in open access form, 60 % of which follow the 'Green' model.[16] Some publishers offer 'hybrid journals' that contain not only articles for which the author has paid a publication fee (and which the reader can therefore access for free) but also articles that are available only to subscribers or on a pay-per-view basis.

Open access policies do not affect the author's freedom to choose whether to publish or not. Nor do they interfere with patenting or other forms of commercial exploitation. The decision regarding whether to patent and commercially exploit research results is typically taken before publication. Open access to journal articles comes into play only if and when a researcher decides to publish.

4.2. Access to research data

Until now, scientific research results have been disseminated essentially by publishing articles. There is no well-established practice of publishing the underlying data. Research undertaken by the PARSE-Insight[17] project showed that only 25 % of researchers share their research data openly, 11 % make it available for researchers within their research discipline and 58 % make it available only within their specific research group.

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13 This model allows for certain variations. The length of the embargo period and the version that may be archived at different moments in time vary, e.g. depending on the agreements between publishers and authors. Online repositories are managed either by academic institutions or funding bodies, or organised so as to cover specific subjects.

14 See the ROARMAP register: http://roarmap.eprints.org/.

15 Some 57 % of publishers' default policies allow self-archiving of the accepted manuscript, see http://www.sherpa.ac.uk/romeo.

16 Björk et al., Open Access to Scientific Journal Literature: Situation 2009, available on www.plosone.org/article/info:doi/10.1371/journal.pone.0011273.

17 'Permanent access to the records of science' project, co-funded by the EU under FP7, www.parse-insight.eu.

As a result, many of the publicly-funded research results that exist in the form of data are not made widely available for others to verify or build upon, and this makes research investment highly inefficient.

Some research funding bodies have therefore started requiring that researchers deposit research data in suitable data infrastructures, but this practice is not yet widely followed.

When making research data available, European and national data protection rules must be taken into account, as well as concerns regarding trade secrets or national security.

4.3. Preservation of scientific information

There are considerable economic and social benefits to be gained from the long-term preservation of information, knowledge and know-how for use by future generations. The UK research funding organisation JISC carried out a cost/benefit analysis of the preservation of research data. It found that preservation efforts lead to a four-fold return in terms of cost saving alone[18].

Member States are currently amending their legislation on the depositing of digital material.[19]

Special attention must also be given to preserving scientific software and models in order to keep information re-usable and re-producible. Open standards, formats and open source software solutions can help ensure this.

4.4. The international context

The move towards open access is a worldwide trend. Currently there are more than 200 academic institutions or research funding organisations mandating open access for publications across the world.[20] The European Federation of National Academies of Sciences and Humanities recently adopted a declaration on 'Open Science in the 21st century', calling for "an open sharing of research results and tools".[21] The accessibility of research data is also being discussed in several international fora, including the OECD and UNESCO.[22]

5. WHAT ARE THE BARRIERS TO CHANGE?

The Internet has great potential for improving access to scientific information, but this potential is not yet being fully exploited.

A key issue affecting access to and preservation of scientific information is the level of investment in the scientific dissemination system. The economic and societal potential of better access to scientific information will not be realised if budgets for accessing and preserving information are insufficient.

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18 http://ie-repository.jisc.ac.uk/279/2/JISC_data_sharing_finalreport.pdf.

19 Commission staff working paper accompanying the Communication of the Commission on the digitisation and online accessibility of cultural material and digital preservation, SEC(2011) 1274 final.

20 http://roarmap.eprints.org/.

21 http://cordis.europa.eu/fp7/ict/e-infrastructure/docs/allea_declaration.pdf.

22 http://www.oecd.org/dataoecd/9/61/38500813.pdf.
http://unesdoc.unesco.org/images/0021/002158/215863e.pdf.

Another problem is that action by the different Member States is uneven and, with some exceptions, uncoordinated. Concerted efforts, building on the definition and exchange of good practices, could lead to economies of scale and efficiency gains.

5.1. Barriers hindering the transition to open access to scientific publications

It is perceived that moving too fast towards open access may destabilise the scientific publishing sector and thus the scientific information system. A shift towards open access must take into account that the process of selecting, reviewing and publishing articles has a cost. This can be done by providing funds for open access publishing ('Gold' open access) and by ensuring that researchers who self-archive ('Green' open access) meet funders' requirements even when agreeing to embargo periods during which the publishers can generate revenue through subscriptions.

The transition towards open access must be coordinated and transparent. In the case of the 'Gold' model, any increased expenditure must be accompanied by a proportional decrease in subscription costs. Mechanisms also need to be developed to curb 'Gold' open access fees in the medium and long term. Some universities[23] and research funding organisations[24] are currently experimenting with such issues.

As regards the 'Green' model, some researchers may fail to consider complying with open access mandates via self-archiving because they lack the necessary information or infrastructure. They may also fear contractual disagreements with publishers.[25] Furthermore, policies mandating open access are often not sufficiently enforced.[26]

5.2. Barriers hindering access to, use and re-use of research data

The lack of organisation and clarity about responsibilities in improving access to and use of scientific data are major barriers to change. E-infrastructures and thematic data infrastructures for storing and providing access to data are now rapidly emerging worldwide, but the financing models to ensure long-term access are often lacking. In addition, interoperability among countries and disciplines remains an issue.

Many researchers and innovative enterprises are reluctant to share what they perceive to be 'their' data and are concerned that others will unfairly benefit from their efforts. Researchers, moreover, may not want to invest time in the practicalities of depositing their data.[27] Systematic reward and recognition mechanisms for data sharing, such as citation mechanisms and measurements of the data citation impact, are not yet in place.[28]

5.3. Barriers to long-term preservation

The lack of financial and organisational models is a major problem in this area. Often preservation support structures are created for specific projects, limiting funding to a certain period. Funding is short-lived, fragmented and does not provide long-term solutions.

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23 See the COPE fund, http://www.oacompact.org/.

24 See the 'Sponsoring consortium for open access publishing in particle physics', www.scoap3.org.

25 See the report 'PEER Behavioural Research: Authors and Users vis-à-vis Journals and Repositories, final report', p. 51 et seq., available on: www.peerproject.eu.

26 See the PEER report, precit., at p. VI.

27 Report 'To share or not to share: Publication and Quality Assurance of Research Data Outputs', available on: http://eprints.ecs.soton.ac.uk.

28 There are some initiatives emerging such as datacite.org.

The technical challenges of preserving large volumes of data remain unsolved, in particular in fields such as astronomy and earth sciences that study constantly changing conditions.

National rules and practices for legally-required data depositing are now being adapted to include digital material, but exactly what material is covered and how, differs from one EU Member State to another. The 2011 Commission Recommendation on digitisation and digital preservation[29] points to specific areas to be addressed.

6. ACTION AT EUROPEAN LEVEL

6.1. What has the Commission done so far?

6.1.1. Developing policy

If Europe is to reap the benefits of wider access to scientific research results, clear policies are needed — both national and European. The 2007 Council Conclusions on scientific information in the digital age set out a range of Member State measures with target dates, but progress has been uneven[30]. An updated set of actions to improve access to and preservation of scientific information should therefore be recommended to the Member States.

6.1.2. Implementing open access in Community research funding

As a major research funding body, the Commission has led by example by imposing certain conditions on the beneficiaries of its research grants. Following its 2007 Communication on scientific information in the digital age the Commission set up a pilot scheme for open access to publications resulting from projects under the Seventh Framework Programme (FP7).[31] Launched in 2008, this scheme covers 20% of the FP7 budget and spans several thematic areas. Grant recipients are required to self-archive and to make their best effort to ensure open access to articles within six or twelve months after publication, depending on the research area. This requirement relates to articles, but not to underlying data.[32]

A May 2011 survey[33] of projects covered by the pilot scheme showed that most respondents found self-archiving easy or very easy in terms of manpower and time. Three quarters of the respondents expressing an opinion agreed or strongly agreed with an open access mandate for data in their research area, provided that all relevant aspects (e.g. ethics, confidentiality, intellectual property) are considered and addressed.

6.1.3. Ensuring EU-wide interoperability

In recent years, the Commission has supported the development of e-infrastructures for science, including scientific data infrastructures, measures to make national infrastructures more interoperable, and the preparatory phases for the setting up of sustainable European

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29 Recommendation of 27.10.2011, C(2011) 7579 final.

30 See the report 'National Open Access and Preservation policies in Europe, 2011, http://ec.europa.eu/research/science-society/document_library/pdf_06/open-access-report-2011_en.pdf.

31 Open Access Pilot in FP7; http://ec.europa.eu/research/science-society/index.cfm?fuseaction=public.topic&id=1300&lang=1 .

32 However, the European Research Council (ERC) considers it essential that data underlying peer-reviewed publications are deposited immediately after publication and in any case not later than 6 months after the date of publication (ERC Scientific Council Statement on Open Access).

33 Survey on open access in FP7; http://ec.europa.eu/research/science-society/document_library/pdf_06/survey-on-open-access-in-fp7_en.pdf

thematic data infrastructures identified in the ESFRI[34] Roadmap. Since the beginning of FP7 the Commission has committed over €150 million to infrastructure initiatives. A central project in this context is OpenAIRE[35], an e-infrastructure to deposit and access peer-reviewed articles and datasets resulting from EU-funded projects.

6.2. What are the next steps?

6.2.1. Working with the Member States

In parallel with this Communication, the Commission has adopted a Recommendation to the Member States on access to and preservation of scientific information. The Commission will work with national points of reference, designated by each Member State, to draw up common principles and standards.

6.2.2. Leading by example: Open access in Horizon 2020

In Horizon 2020, both the 'Green' and 'Gold' models are considered valid approaches to achieve open access. All projects will be requested to immediately deposit an electronic version of their publications (final version or peer-reviewed manuscript) into an archive in a machine-readable format. This can be done using the 'Gold' model (open access to published version is immediate), or the 'Green' model. In this case, the Commission will allow an embargo period of a maximum of six months, except for the social sciences and humanities where the maximum will be twelve months (due to publications' longer 'half-life')[36].

The eligibility of 'Gold' open access publishing costs will be maintained in Horizon 2020. The Commission will also consider whether and under what conditions open access publication fees can be reimbursed after the end of the grant agreement.

The Commission encourages authors to retain their copyright and to grant licences to publishers, according to the rules applying in Member States.

In addition, the Commission will to set up a pilot scheme on open access to and re-use of research data generated by projects in selected areas of Horizon 2020. The Commission will also encourage, where appropriate, the publication of software codes used to produce or process the data. In designing and implementing the pilot the Commission will take into account possible constraints on making research data openly accessible which may pertain to privacy, national security or data, and know-how and knowledge brought into projects as inputs. Generally, the pilot scheme will not apply to projects whose primary aim would be contradicted by making research data accessible.

Online access to scientific information resulting from EU-funded projects will be further improved, building on the OpenAIRE infrastructure and its National Open Access Desks.

Guidance will be given to researchers and academic institutions on how to comply with the requirement to provide open access.

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34 European Strategy Forum for Research Infrastructures (http://ec.europa.eu/research/infrastructures/index_en.cfm?pg=esfri)

35 Funded by FP7, http://www.openaire.eu/.

36 The maximum embargo periods will be laid down in the model grant agreement for Horizon 2020. The Commission will monitor and evaluate their implementation as part of the overall open access policy and review them in case of specific problems, in particular with regard to the social sciences and humanities.

As set out in the Open Data Communication, the Commission will start operating an e-infrastructure that will make the Commission's own publications and research data as well as those of other European institutions and agencies easily accessible and usable. In parallel, metadata definitions with high re-use potential will be identified and promoted.

6.2.3. Working with the stakeholder community

The European Commission will continue its dialogue with and monitor the impact of its open access policies on all stakeholder groups interested in open access to publications and data as well as digital preservation. These stakeholders include academic institutions, research centres and their libraries, scientific publishers, enterprises including SMEs, researchers, policy-makers and governments, citizens' organisations, and NGOs.

6.2.4. Funding infrastructures and relevant projects for responsible research and innovation

The European Commission will continue to fund projects related to open access. In 2012-2013, the Commission will spend €45 million on data infrastructures[37] and research on digital preservation. Funding will continue under the Horizon 2020 programme.[38]

During the same period, the Commission will support experimentation with new ways of handling scientific information (e.g. new peer-review methods and ways of measuring article impact).

6.2.5. Coordination beyond the EU

Beyond the EU, the Commission will continue working with its international partners and scientific communities to promote open access. EU action on open access can inspire third countries and third country stakeholders to develop their own policies. A specific area in which EC policy will benefit the global scientific community is interoperability and sustainability of data infrastructures.[39]

7. CONCLUSION

Wide, fair, sustainable and easy access to publicly-funded scientific information and its sustainable preservation for re-use can make a significant contribution to Europe's economic growth and help it address the societal challenges of the 21st century.

In this Communication, the Commission sets out measures to ensure that the results of Europe's publicly-funded research are fully accessible for researchers, businesses and citizens. Some of these measures need to be implemented by Member States, while others will be carried out by the Commission.

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37 These infrastructures are publicly funded and provided for non-economic activities such as pure dissemination of knowledge.

38 See EC proposal for Horizon 2020 Specific programme (COM(2011)811 final). This is subject to the adoption of the Horizon 2020 legal basis and without prejudice of the final decision on the Multiannual Financial Framework 2014-2020.

39 See also the forthcoming Communication 'Enhancing and focussing European international cooperation in research and innovation: A strategic approach'.

The Commission invites the European Parliament and the Council to show their support for the objective of open access to scientific information by playing their part in adopting the necessary policies and in supporting the planned projects and infrastructures.

Access to and preservation of scientific information: key measures

Policy measures

– Recommendation to the Member States on access to and preservation of scientific information, 2012.

– Work with national points of reference designated by Member States to draw up common principles and standards, from 2013.

– Work with national points of reference to structure and monitor progress on access and dissemination, from 2013.

Open access to results of EU-funded research

– Establish open access to scientific publications as a general principle in the Horizon 2020 programme and set up the conditions for optimal compliance, from 2014.

– Maintain the possibility of reimbursing open access publishing fees as part of the Horizon 2020 programme, from 2014.

– Provide a framework and encourage open access to research data in Horizon 2020, taking into account any restrictions that may be needed in order to protect intellectual property or legitimate commercial interests, from 2014.

Funding for infrastructures and projects

– Continue funding relevant projects in Horizon 2020, from 2014.

– Provide €45 million for infrastructures supporting open access to research articles and data, and for research on digital preservation, 2012-2013.

Coordination beyond the EU

– Promote open access policies and the interoperability of data infrastructures with international partners.

Targets:

– By 2014, policies for open access to scientific articles and data will have been established in all Member States at all relevant levels.

– By 2016, the share of publicly-funded scientific articles available under open access EU-wide will have increased from 20% to 60%.

– 100% of scientific publications resulting from Horizon 2020 will be available under open access.