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**COMMISSION STAFF WORKING DOCUMENT**
***Accompanying the document***

**Commmission Recommendation**

**on access to and preservation of scientific information**

{C(2018) 2375 final}

# 1. Introduction

On 17 July 2012, the Commission adopted a policy package[1] containing a series of measures aiming to improve access to scientific information produced in the European Union (EU). As part of this package, Commission Recommendation 2012/417/EU on 'access to and preservation of scientific information'[2] addressed the Member States and called for improved policies and practices on open access to scientific publications and research data, as well as on the preservation and re-use of scientific information. The Commission also recommended that each Member State designate a national point of reference (NPR), to liaise with the Commission on the issues identified in the Recommendation and to coordinate the measures listed therein. This initiative arose out of two strands: the Digital Agenda for Europe[3], which set out an open data policy covering the full range of information that public bodies across the Union produce, collect or pay for, and the Innovation Union Communication[4], which outlined the Union's research and innovation policies and programmes.

Recommendation 2012/417/EU was adopted on the basis of:

- a public hearing held on 30 May 2011;
- an online public consultation on scientific information in the digital age, which took place from July to September 2011 and received 1140 replies from 42 countries together with 19 position papers;
- an impact assessment.[5]

The impact assessment concluded that '[the] *implementation of a policy framework through soft law offers the best balance between enabling wider and quicker access to scientific information, and taking into account how science and scholarly publishing have evolved over the past centuries. To mitigate the inherent non-binding character of a recommendation, which per se cannot guarantee that action will be taken by all Member States, a recommendation should foresee a close monitoring role for the Commission.* […] *The objective would be to define and move towards convergence, while allowing a certain degree of flexibility for Member States to take their national specificities into account within a European framework, as well as for all stakeholders to endorse improvements. In this context, a recommendation would be both a proportionate and effective instrument*.'

This staff working document evaluates whether and how Recommendation 2012/417/EU needs to be revised following the rapid developments in the research and innovation ecosystem and in relation to the development of open science in Europe. Relying on consultations with Member States (through the NPRs) and stakeholders (through workshops and a public online consultation, in the framework of the Public Sector Information Directive review), the Commission has investigated whether more needs to be done in this area at Union level, by reviewing the Recommendation. Its ultimate goal is to improve the efficiency of research, boost innovation and further establish the EU as a global leader in science.

This staff working document concludes that Recommendation 2012/417/EU has been a very valuable and impactful tool, and that it is still relevant for policymaking. However, in order to remain relevant in the future, it requires a technical update (revision) to reflect recent developments in research

[1] Scientific data: open access to research results will boost Europe's innovation capacity (press release, 17 July 2012)
[2] OJ L 194, 21.7.2012, p. 39.
[3] Communication 'A Digital Agenda for Europe' (COM(2010) 245 final/2)
[4] Communication 'Europe 2020 Flagship Initiative: Innovation Union' (COM(2010) 546)
[5] Commission Staff Working Document: Impact assessment accompanying the document Commission Recommendation on access to and preservation of scientific information in the digital age (SWD(2012) 222)

practices relating to open science, and to take into consideration recent EU policies, such as the Digital Single Market Strategy[6] and the Communication on the European Cloud Initiative.[7] The Recommendation is being revised in parallel with a review of Directive 2003/98/EC on the re-use of public sector information[8], in order to maximise the potential of public and publicly funded research data in general. In particular, the Recommendation is expected to support the transposition of that Directive – if adopted as proposed[9] – by helping Member States and stakeholders in defining policies on access to and preservation of scientific information.

# 2. Objectives and impact of Recommendation 2012/417/EU

## 2.1. Objectives

Recommendation 2012/417/EU was developed with the objective of providing stronger support to innovation and contributing to economic growth by improving the conditions for access to, use and re-use of scientific information and enabling the development of the European Research Area (ERA).

The specific objectives were to[10]:

- make scientific publications openly accessible online for free, as far as possible and as soon as possible;
- make research data resulting in whole or in part from public funding openly accessible online, for free;
- preserve scientific information (publications and data) for future generations;
- facilitate access to scientific information (publications and data) across Member States.

The operational objectives were to:

- stimulate the implementation of open access policies for scientific publications by those Member States which increase the number of openly accessible publicly funded publications (from the current 20 % to 60 %), increase the number of open access mandates and improve the funding conditions for open access publishing;
- stimulate the implementation of open access data policies by those Member States which require that research data resulting from public funding is input into an e-infrastructure;
- support the set-up and the maintenance of digital e-infrastructure so that research data can be preserved more easily and promote effective deposit systems for scientific information originally available in digital form;
- ensure full interoperability between e-infrastructures across and outside the Union, promote federated access to scientific content and promote coordination of policies and exchange of good practices and stakeholder dialogue at Union level.

[6] COM(2015) 192
[7] COM(2016) 178
[8] OJ L 345, 31.12.2003, p. 90.
[9] COM(2018) 234.
[10] SWD(2012) 221 final

## 2.2. Impact

The Commission has been monitoring the impact of Recommendation 2012/417/EU and progress on achieving its objectives in the following ways.

1. As recommended in Points 8 and 9, through Member State reporting via the NPRs[11]. Two reports have been produced so far: in 2015 for the period 2012-2014[12] and in 2017 for the period 2015-2016 (the latter exercise is planned for publication in spring 2018, in parallel with the revision of the Recommendation).
2. Through events organised in Member States to discuss progress, based on the reporting from NPRs. Meetings have been organised every year since 2013. The fifth meeting of the NPRs took place on 5 December 2017 in Brussels.[13]
3. Through desk research.

### 2.2.1. Effectiveness

As explained above, the Recommendation aimed to stimulate implementation and support the set-up and maintenance of relevant policies across Member States. Given its non-binding nature, it was understood and even expected that some objectives would be only partially achieved. However, the Recommendation has still been largely effective, as is shown below.

Member State reporting through the NPRs

The Commission used the second reporting exercise to take stock of the effectiveness of the Recommendation. The NPRs were consulted on the preparation of an extensive questionnaire requesting quantitative and qualitative information on progress made at Member State[14] level on the various aspects of the Recommendation, including policies on:

- open access to scientific publications;
- research data;
- e-infrastructure, dissemination, preservation and re-use of research;
- rewards and skills; and,
- collaboration and transparency.

The initial general questions asked Member States to assess the impact and value of the Recommendation at the Union and national levels. In the framework of the 2017 reporting exercise, preliminary results were presented during the NPR meeting in December 2017. The final report is due to be released in parallel with the revised Recommendation, in spring 2018. The relevant survey results are summarised below.

[11] The NPRs are formally considered an Expert Group. See the Register of Commission Expert Groups: Commission expert group on National Points of Reference on Scientific Information (E03477).

[12] *Access to and Preservation of Scientific Information in Europe. Report on the implementation of Commission Recommendation C(2012) 4890 final*, Commission, 2015.

[13] The minutes are available in the Commission's transparency register at https://goo.gl/8MruoT.

[14] 31 countries have assigned NPRs so far. This includes all 28 EU Member States plus three associated countries (Norway, Switzerland and Turkey). For ease of reading, we collectively refer to them as 'Member States' in the discussion of the NPR reporting in this section.

*Overall impact of the Recommendation*

- 23 Member States stated that the Recommendation's impact at EU level was positive, and seven considered it to be strongly positive (Figure 1).
- 21 Member States stated that the Recommendation's impact at the national level was positive, six considered that it was strongly positive and three stated that it had no impact (Figure 2).

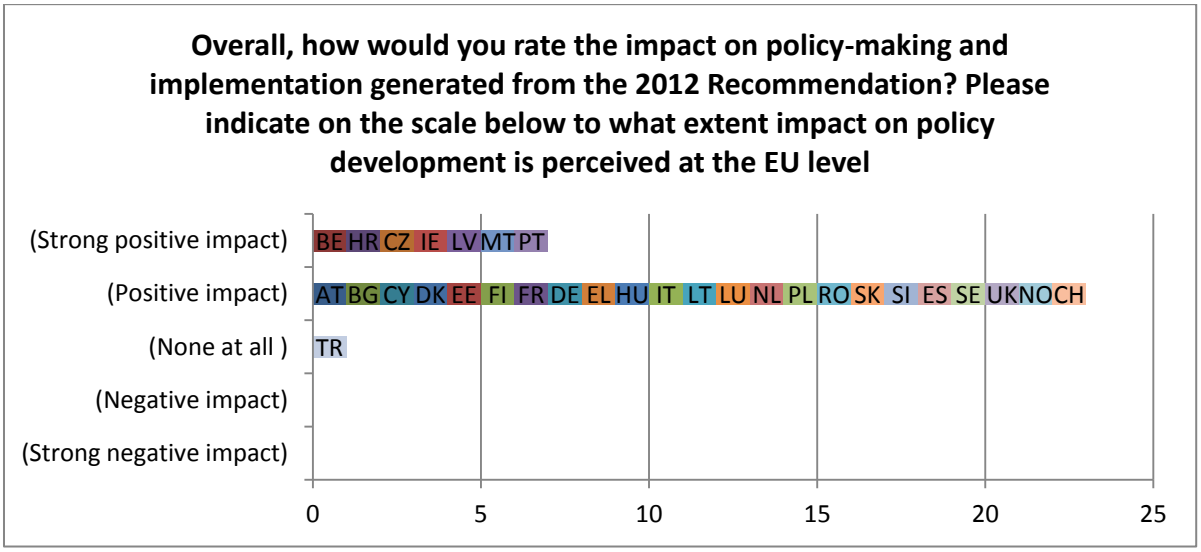


**Figure 1: Impact of the 2012 Recommendation at EU level, as perceived by respondents**

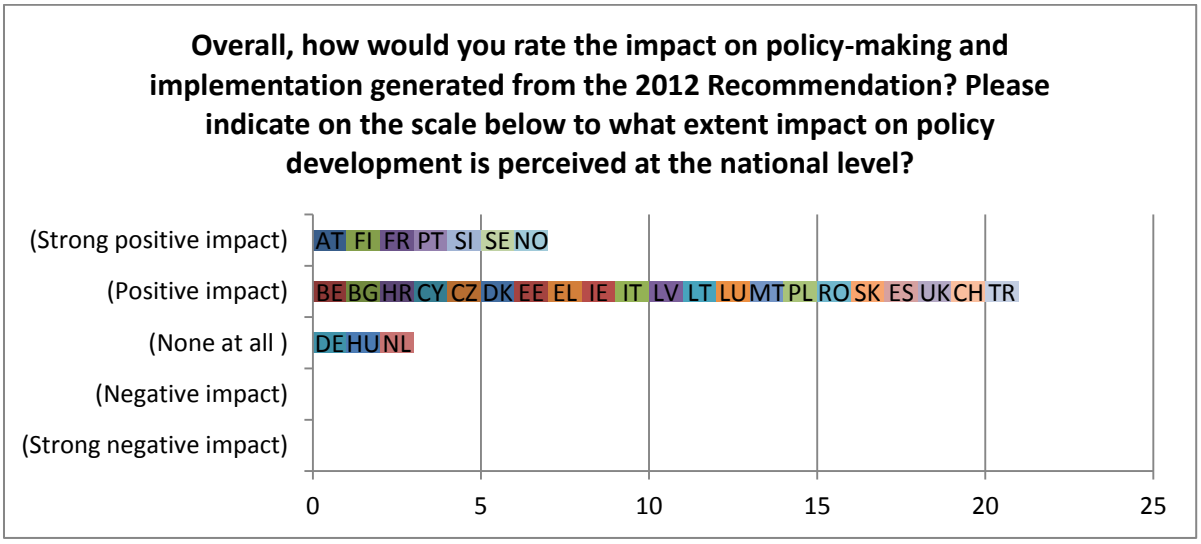


**Figure 2: Impact of the 2012 Recommendation at national level, as perceived by respondents**

Based on the information that Member States presented in the latest NPR exercise, it can be concluded that the 2012 Recommendation has led to the creation of policies in some Member States, but that more could be done. Most Member States reported a slight improvement since the previous reporting period (2012-2014), and some reported significant improvement. Therefore, it can be stated that the 2012 Recommendation has been mostly perceived as very valuable.

Impact of the Recommendation on specific areas

*Scientific publications*

With regard to specific areas addressed by the Recommendation, Member States reported a very high number of policies related to open access to publications that have been adopted, implemented or are under discussion at the national level (Figure 3). In parallel, they reported that some but not all of their funders or research-performing institutions and higher education institutions have the relevant policies in place at institutional level. All of these are improvements over the situation in the first reporting period, with more Member States developing policies in this area, and more Member States with no policies in place starting to discuss such policies at national level.[15] It is nonetheless clear that more work can be done, since many Member States have not yet implemented any policies and are only at the discussion stage.

Half of the Member States reported open access publishing and self-archiving as equally preferred paths in their policies. In a third of the cases, policies require deposit of scientific publications in a repository, while four Member States reported that they prefer open access publishing.

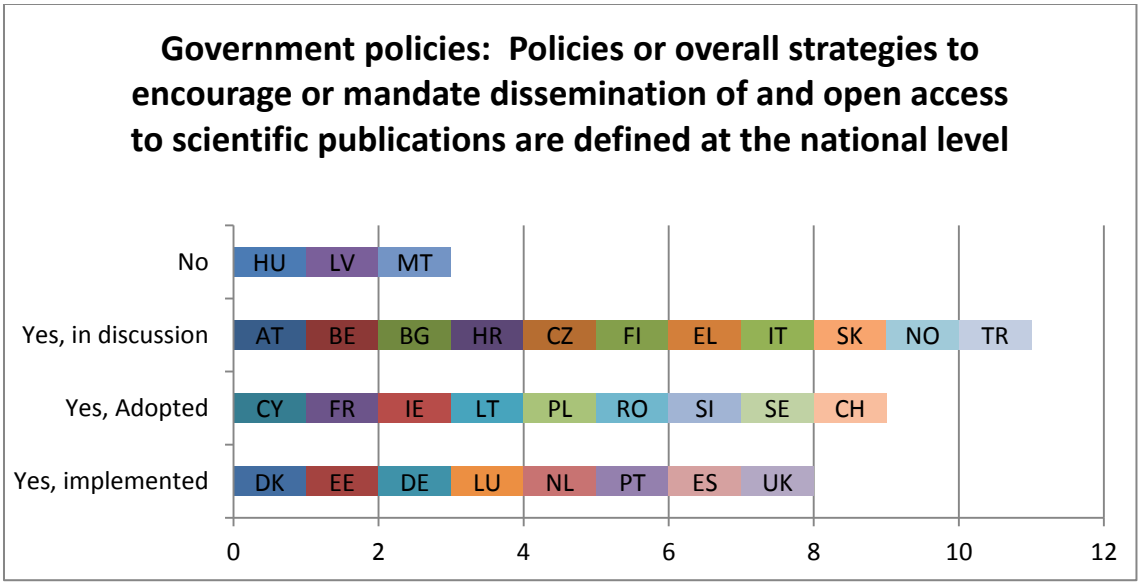


**Figure 3: Reporting on national level strategies or policies relating to open access to publications**

[15] *Access to and Preservation of Scientific Information in Europe. Report on the implementation of Commission Recommendation C(2012) 4890 final*, Commission, 2015, p. 16.

*Research data*

For open research data policies, most Member States reported ongoing discussions about relevant policies, but such policies are not yet implemented (Figure 4). Additionally, many of them reported that they do not support research data management using national funds. Therefore, while there has been some progress as compared to the previous reporting period, more action is necessary here.[16]

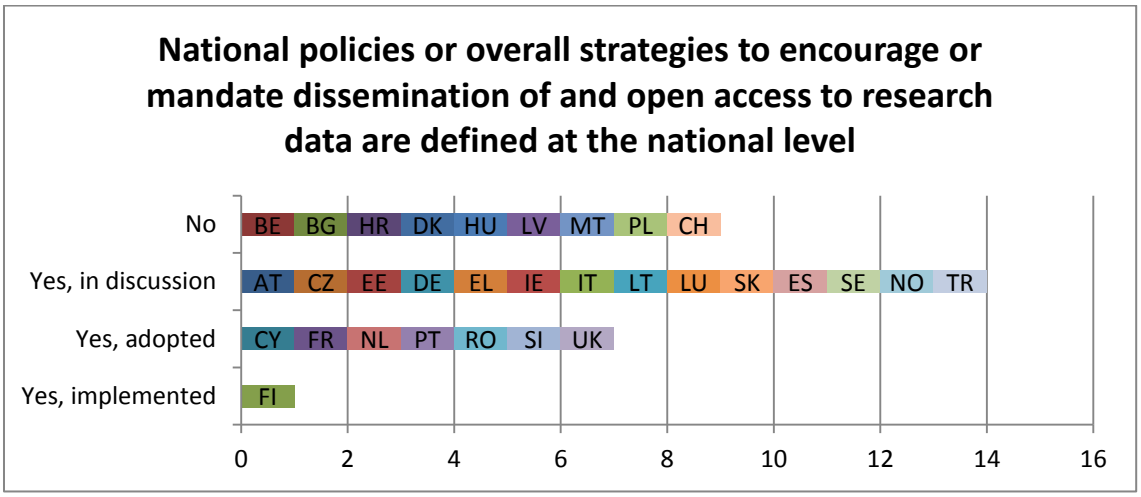


**Figure 4: Reporting on national level strategies or policies relating to open access to research data**

*E-infrastructure, dissemination, preservation and re-use*

Similarly, it appears that more work is necessary on developing policies relating to e-infrastructure and the preservation of scientific information, where most Member States report ongoing interest in the form of policy discussions, but no adopted policies (Figures 5 and 6). It is, however, also clear from the reporting that there is progress and intense activity in terms of developing standards and achieving interoperability of e-infrastructure for scientific information across the EU, in particular through participation in Horizon 2020 projects (Figure 7).

[16] *Access to and Preservation of Scientific Information in Europe. Report on the implementation of Commission Recommendation C(2012) 4890 final*, Commission, 2015, pp. 21-28.

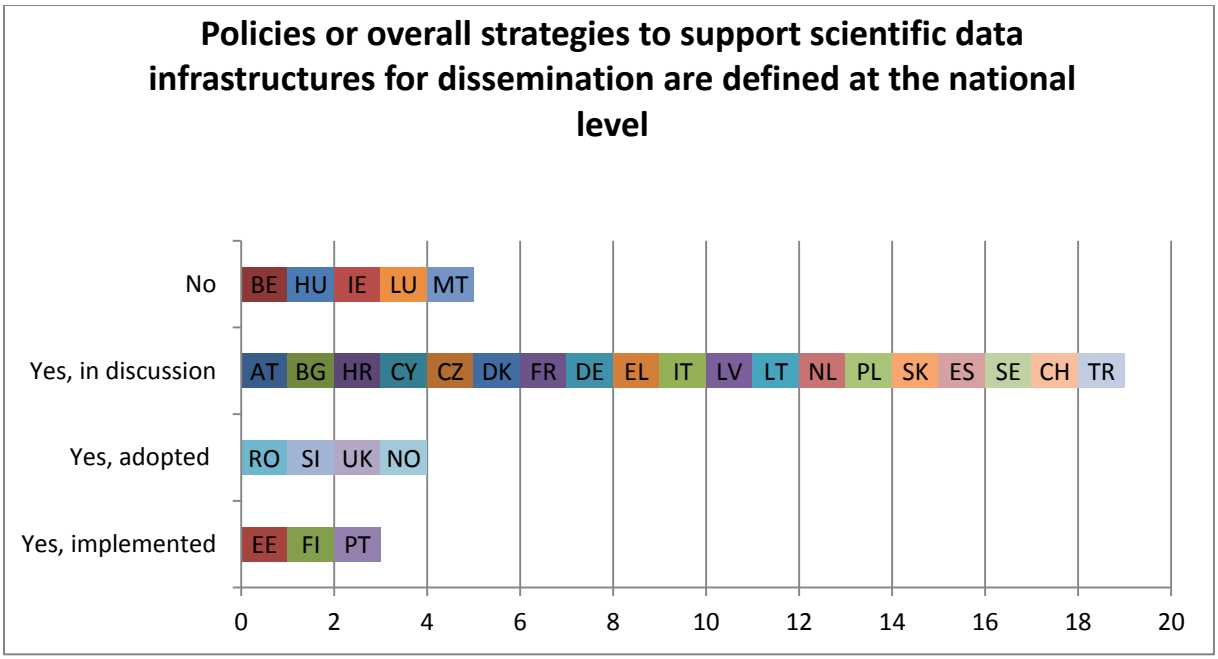


**Figure 5: Reporting on national level strategies or policies that support national data infrastructure**

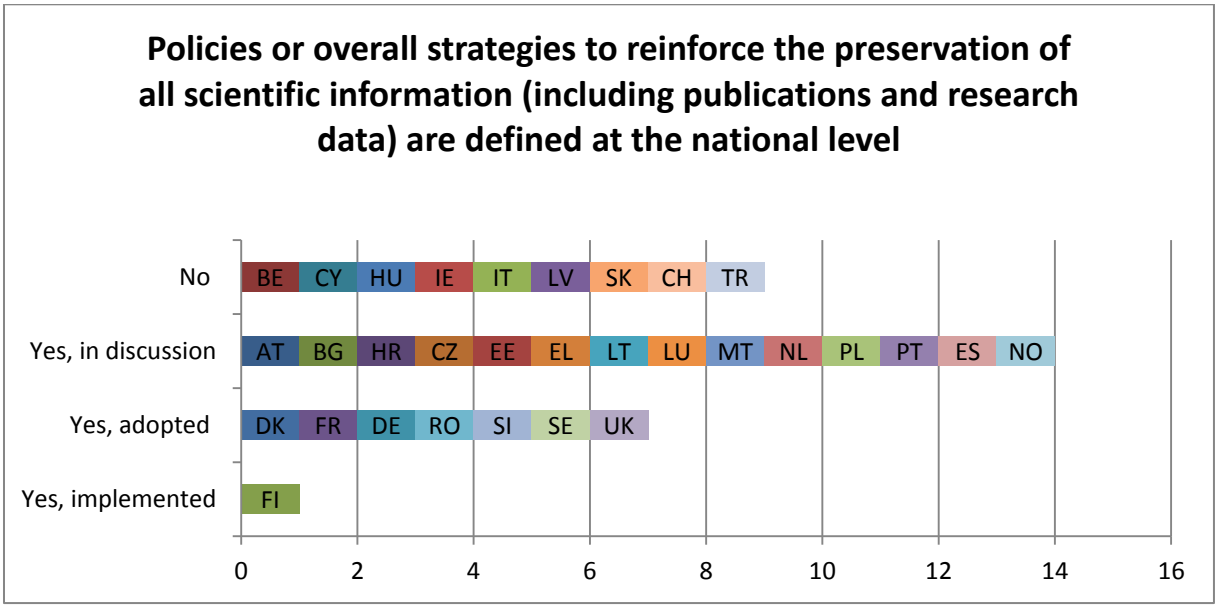


**Figure 6: Reporting on national level strategies or policies that support the preservation of scientific information**

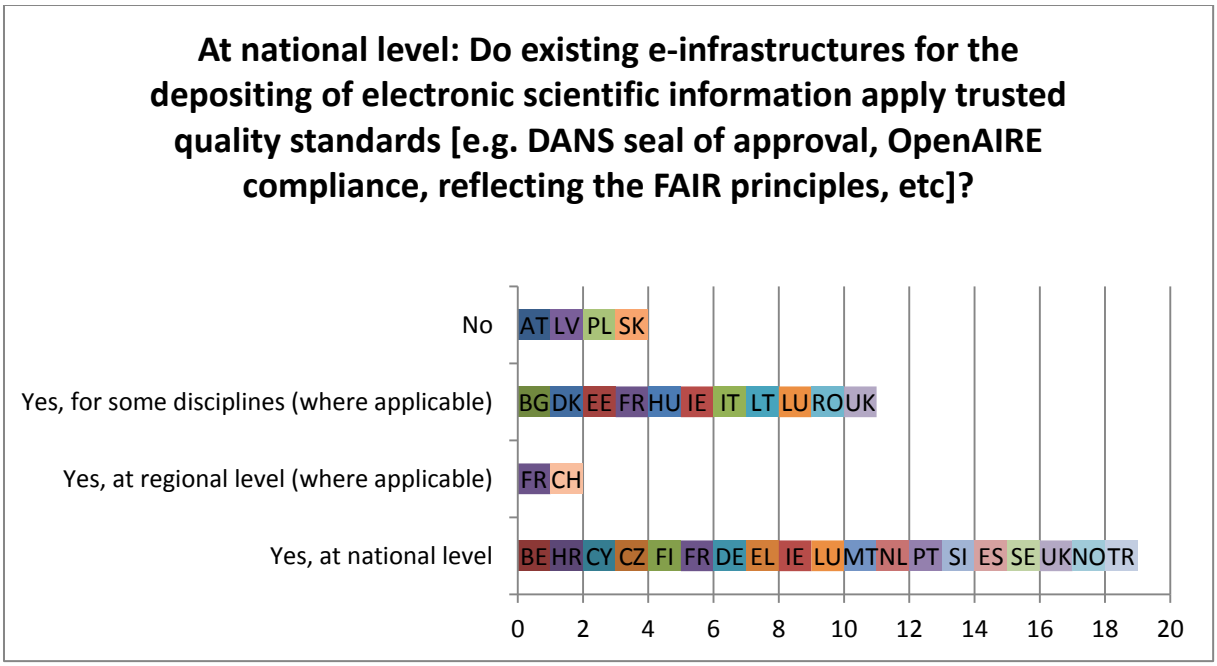


**Figure 7: Reporting on infrastructure quality standards**

*Other areas*

The NPR reporting shows that national policies are underdeveloped in certain areas, in particular:

- **text and data mining (TDM) and copyright issues**, where most Member States reported they have no specific policies;
- **open science skills and rewards** for open access and open science practices, where some institutions (e.g. universities, research centres) are active, but there does not appear to be any action at national level;
- **measuring** the growth of research data — Member States overwhelmingly report measuring the development of open access to publications, but not to research data;
- **measuring** and evaluating the impact of open access/science practices and the wider impact on society (new/alternative metrics).

Fifth meeting of the NPRs (5 December 2017)[17]

In the meeting that took place on 5 December 2017 in Brussels, the Commission presented the preliminary results of the NPR report which will be published in spring 2018. The discussion that followed indicated that most Member States believe that they have made progress towards fulfilling the objectives of the Recommendation: this is happening at varying speeds and with varying emphasis on open access to publications, research data and/or infrastructure. Some Member States are already addressing the broader topic of open science (e.g. by setting up roadmaps, agendas, working groups), as opposed to only open access or access to and preservation of scientific information, as suggested in the Recommendation. Many Member States showed an interest in knowing more about and participating in the European Open Science Cloud and are developing national plans in this regard.

[17] Commission expert group on National Points of Reference on Scientific Information (E03477); European Commission Transparency Register.

The Commission also asked Member States for their opinions on whether Recommendation 2012/417/EU should be revised, and if so how, and whether it would be valuable to move from soft to hard policy implementation. As shown in Figure 8, nearly two-thirds of Member States believe that harder measures are needed. Moreover, after the meeting eight Member States submitted written opinions on the need to revise the Recommendation.

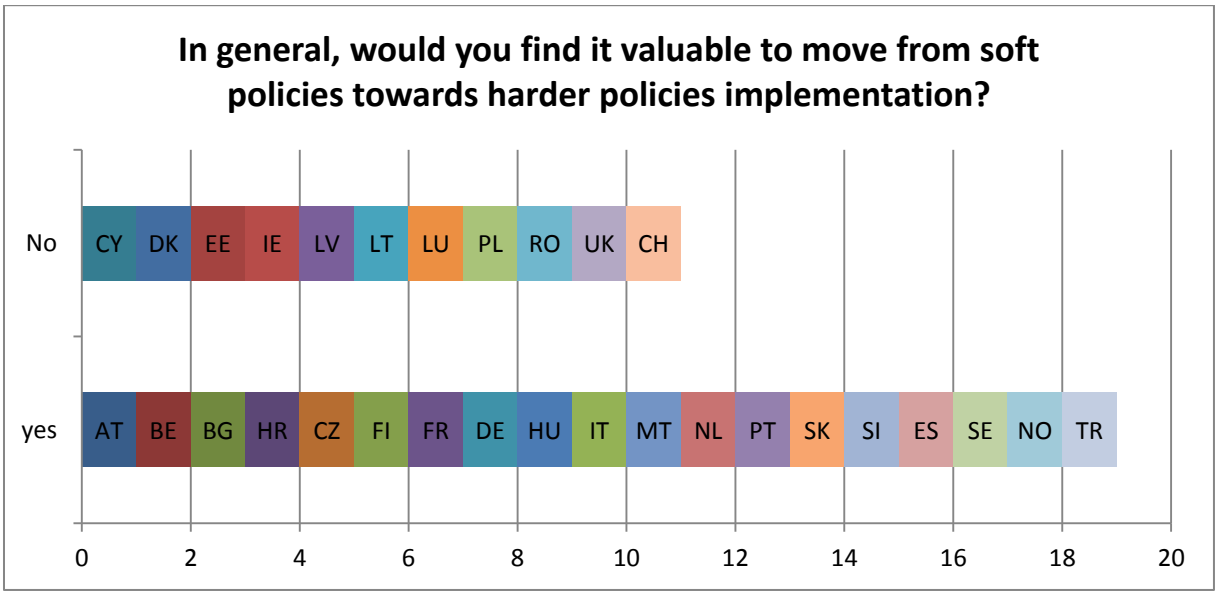


**Figure 8: Reporting on the value of moving from soft to hard policies**

All this indicates that Member States would welcome, as a minimum, a revised, updated set of recommendations, including additional or better defined recommendations. It is important to note that some Member States have based their national activities on Recommendation 2012/417/EU.

Desk research

Research on the growth of open access in general, and in the EU in particular, points to the same conclusions as the information provided by the NPRs: there has been progress, but more can be done to ensure open access to publicly funded research results and reap the expected benefits for research and innovation, the economy and society in general.

It should be noted that there is no one way of looking at the increase in the use of open access, but rather that specific elements of it can be examined to provide an overall understanding of the situation. This includes, for example, the availability of open access publications, policy development and the growth in the number of repositories. An examination of these different aspects shows a very clear ascending trend in open access in recent years. In terms of open access policies and infrastructure in particular, the EU appears to be at the forefront.

Various studies show a general increase in open access publishing of journals, as evidenced through the Directory of Open Access Journals (DOAJ).[18] As regards repositories, the registry of repositories (OpenDOAR) shows continuous global growth in the number of repositories. It also shows that 45.7 %

[18] www.doaj.org.

of repositories are in Europe.[19] Studies also show the steady growth of open access policies, in particular among research institutions (Figure 9). The 'Roarmap' policy registry indicates that 558 out of the 898 policies registered there in January 2018 are in Europe.[20]

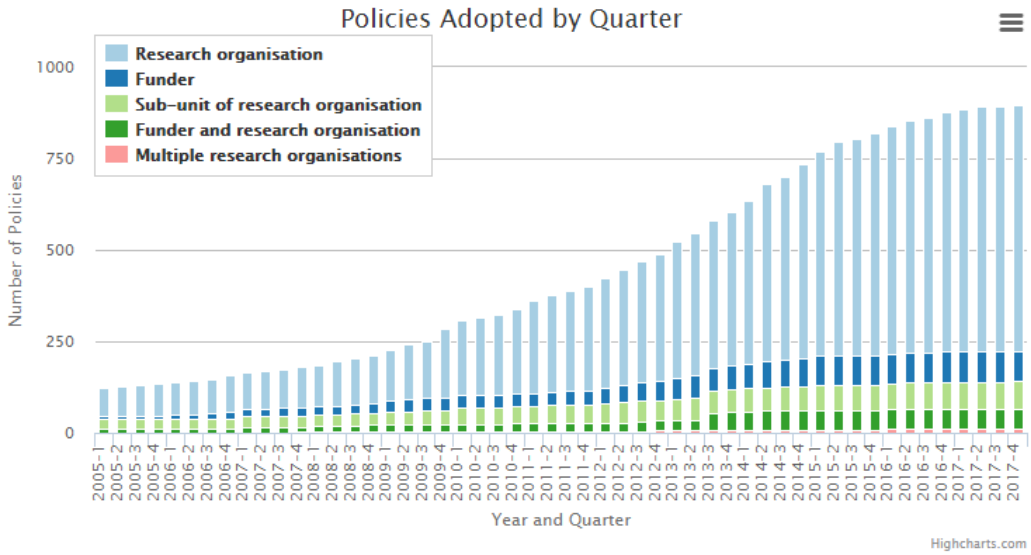


**Figure 9: Development of open access policies (source: Roarmap)**

With regard to open access to research data, it is clear both from the NPR reporting and from studies carried out on this topic that there is, or has been until recently, a lot less focus on data policies. It follows that policies and practices in this area are less developed than policies related to publications.[21]

### 2.2.2. Efficiency

The implementation of Commission Recommendation 2012/417/EU is having a positive impact across the Union, as detailed below.

The impact of open access and open science on research reaches far-and-wide, but several studies have attempted to quantify it, including at EU Member State level.[22] By increasing research efficiency and impact, open access and open science can facilitate research excellence and boost economic growth across the EU, and in doing so have a strong economic and social impact.[23]

The economic impact can be measured according to different methodologies, more or less accurately and in the absence of one commonly accepted standard of calculation. Modelling studies suggest that

[19] www.opendoar.org.
[20] http://roarmap.eprints.org/.
[21] Caruso, J., Aurore N. and Archambault, E. *Open Access Strategies in the European Research Area*, Science Metrix, August 2013. For an overview of research data policies across Europe in early 2015 see RECODE project. Deliverable D5.1: Policy guidelines for open access and data dissemination and preservation.
[22] Access to Research and Technical Information in Denmark - Report to The Danish Agency for Science, Technology and Innovation (FI) and Denmark's Electronic Research Library (DEFF), ISBN (web): 978-87-923-7287-1.
[23] Tennant JP, Waldner F, Jacques DC *et al.* 2016. The academic, economic and societal impacts of Open Access: an evidence-based review. *F1000Research* 2016, 5:632 (doi: 10.12688/f1000research.8460.3).

there are many economic benefits, especially in the long term[24]. For example, according to one study, the effect of the open access policy on US federal agencies would, over a transitional period of 30 years, bring profits of about USD 1.6 billion, and up to USD 1.75 if no embargo period for publications is in place.[25] Another model, on the economic benefits of open access in the Union, can be translated into annual gains of EUR 4.8 billion for government R&D expenditure and EUR 1.1 billion for higher education R&D expenditure (both GERD - Gross domestic expenditure on R&D). [26] A concrete example of the value of data and services offered by the European Bioinformatics Institute (EMBL-EBI), a major intergovernmental infrastructure on bioinformatics, points to high economic benefits from increased access to data and infrastructure services. A relevant study estimates that the value of future impacts of research that could not have been done without access to these data and services is about GBP 330 million annually and up to GBP 2.5 billion over 30 years. The use value of this infrastructure has been estimated at GBP 2.3 billion per year, while is about seven times its annual operational cost of GBP 47 million per year.[27]

It has also been shown that open access and open science have an impact on society, and improve people's lives. Apart from making information and resources equally accessible to all, there are now case studies that show the direct impact of open science on health improvement, for example through the resulting increase in the speed of new drug discovery.[28] Finally, open access and open science help involve citizens in the research process (for example through citizen science), and thus have an impact on lifelong learning and making sure that citizens are well-informed about 21st century challenges.[29]

However, open access also involves costs, for instance when implementing policies that pertain to the infrastructure that supports access to and preservation of scientific information (for example repositories or data centres), or to supporting coordination activities at national level (training, awareness raising, meetings, administration, etc.). The preparation of budgets is also influenced by variables such as how a Member State chooses to implement open access, for example primarily through public infrastructure (e.g. Portugal) or through open access publishing fees paid to publishers (e.g. UK).[30] Infrastructure used for scientific information can be considered a long-term investment and many European countries were already engaged in its development before the publication of the Recommendation. At the time of the publication of the Recommendation in 2012, the problem with this infrastructure, especially repositories, was fragmentation and lack of interoperability across the

[24] Estimating the Potential Impacts of Open Access to Research Findings, J. Houghton et al., Economic Analysis and Policy, Vol. 39 No.1, March 2009.

[25] OECD (2015), 'Making Open Science a Reality', *OECD Science, Technology and Industry Policy Papers*, No 25 OECD Publishing, Paris. http://dx.doi.org/10.1787/5jrs2f963zs1-en, p. 11.

[26] The model was developed based on EU-27 data, the assumption of a 20 % return on research investment and an annual increase of 5 % in open access to research results. Vickery G: Review of recent studies on psi re-use and related market developments, European Commission, 2011, p. 39.

[27] Ch. Beagrie, N. Beagrie, J. Haughton, *The Value and Impact of the European Bioinformatics Institute*, Full report, 2016.

[28] A case study on malaria, see Wells TN, Willis P, Burrows JN, Hooft van Huijsduijnen R. Open data in drug discovery and development: lessons from malaria. *Nat Rev Drug Discov*. 2016 Oct;15(10):661–2. pmid: 27516171 and most recently an Oxford Martin Policy Paper calling for open science for drug discovery: Bountra, Ch., Hwa Lee, W., Lezaun, J. 2017. *A New Pharmaceutical Commons: Transforming Drug Discovery*, University of Oxford.

[29] Summary discussion on citizen science in OECD (2015), 'Making Open Science a Reality', *OECD Science, Technology and Industry Policy Papers*, No 25, OECD Publishing, Paris. http://dx.doi.org/10.1787/5jrs2f963zs1-en, .pp. 84-86.

[30] *Monitoring the transition to open access*, Universities UK, December 2017. The report shows a sharp rise in expenditure for article processing charges (APCs) in the UK, subsequent to a policy favouring open access publishing.

EU.[31] The Recommendation has provided an EU-wide structure for the development of such infrastructure.

In addition, the Commission has invested Horizon 2020 funds into research infrastructure to render national infrastructure interoperable and compliant with internationally agreed standards. Besides, through Horizon 2020 policy support actions, it has facilitated the development of coordinated open access policies and related training across the EU, for Member States to align with the Recommendation and the requirements of Horizon 2020. Thus, the Commission has borne the costs of helping, at EU level, to create scale and scope and facilitate open access and open science. Moreover, the European Structural and Investment Funds (ESIF) invests significantly in information and communications technology (ICT); further synergies and complementarities with the ESIF would strengthen the efficiency of this recommendation.[32]

Considering the above, Recommendation 2012/417/EU can be considered to be efficient, but its efficiency would increase if updated to reflect current policies and recent developments in open science, and hence provide more comprehensive guidance to Member States.

### 2.2.3. Relevance

The objectives of Commission Recommendation 2012/417/EU were and continue to be very relevant to the needs and problems facing our modern society. Open access to scientific information improves the efficiency of research, fosters interdisciplinary research and collaboration, improves transparency and ultimately leads to better research. It can also lead to faster responses to society's needs, whether in the domain of health, education, climate, food or other areas. After a decade of solid growth in open access policies and practices, studies are gradually starting to demonstrate the direct impact of open science on various scientific fields. Some of the impacts of open access and open science have been discussed in the previous section.

The EU's intervention in the form of the Recommendation has been fully aligned with wider EU policy goals and priorities, and more specifically with the flagship initiatives 'Digital Agenda for Europe'[33] and the 'Innovation Union'[34]. Under the Digital Agenda, publicly funded research should be widely disseminated through the open access publication of scientific data and papers. The Innovation Union calls for a European Research Area to be set up. The 2012 Recommendation contributes to its creation, and specifically to the 'optimal knowledge circulation' aspect.[35] In terms of more recent policies, the 2012 Recommendation contributes to implementing the digital single market strategy, one of the EU's ten priorities between 2015 and 2019. As part of the digital single market strategy, the Commission adopted in April 2016 a Communication on a 'European Cloud Initiative — Building a competitive data knowledge and economy in Europe'.[36] This aims to develop a trustworthy and open environment (the European Open Science Cloud) for the scientific community to store, share and re-use scientific data and results. The revision of Commission Recommendation 2012/417/EU results

[31] Commission Staff Working Document: Impact Assessment Accompanying the document Commission Recommendation on Access to and Preservation of Scientific Information in the Digital Age (SWD (2012) 0222 final), Commission, 2012, p. 23.
[32] In the current European Regional and Development Funds (ERDF) programmes over EUR 875 million were programmed by Member States to ICT infrastructure (e.g. large-scale computer resources or equipment and over EUR 1.5 billion to a very high-speed broadband connectivity).
[33] COM(2010) 245 final of 26 August 2010.
[34] COM(2010) 546 final of 6 October 2010.
[35] Communication 'Towards better access to scientific information: Boosting the benefits of public investments in research' COM(2012) 401 final of 17 July 2012.
[36] COM(2016) 178 final of 19 April 2016.

from this Communication. In addition, this 2012 Recommendation does not take into account more recent policy developments in the Union, as discussed in Section 3 of this document.

### 2.2.4. Coherence

To achieve the objectives of Recommendation 2012/417/EU, Member States were recommended to take action in six distinct, yet intertwined and complementary, areas:

- define clear policies and associated planning for open access to scientific publications;
- define policies for open access to research data;
- define policies for the preservation and re-use of scientific information;
- develop e-infrastructure to support the system for disseminating scientific information and develop European and global synergies;
- engage in multi-stakeholder dialogues at national, EU and international level;
- participate in structured coordination and dialogue among Member States and report on progress to the Commission, through the NPRs.

Efficient policies on open access to publications and data are necessary to increase the amount of openly accessible scientific content, as are preservation policies that ensure that materials continue to exist in the future and can be re-used. Additionally, the Recommendation calls for action related to the infrastructure that supports scientific information (for example repositories for scientific information and data) and for the creation of global synergies for the federation of such infrastructure. The Recommendation is therefore comprehensive and coherent in including all the elements that are necessary for the policies to be successfully implemented.

The Recommendation is also consistent with other EU policies and actions (see Section 3 on policy developments), in particular with Horizon 2020. The EU research and innovation programme finances infrastructure for open science as well as various research and coordination projects in open science. It also makes open access to scientific information a mandatory requirement for all beneficiaries of Horizon 2020 (with certain opt-out possibilities regarding research data). As such, Horizon 2020 supports the objectives of the Recommendation. It has led to research funding organisations across the EU aligning their policies with those of Horizon 2020, as well as to the related development of national policies. Through Horizon 2020, the Commission has supported policy development and coordination across Member States, as well as the development, coordination and federation of infrastructure designed for scientific information, most recently in the context of the European Open Science Cloud (see Section 3).

The Recommendation is also coherent with open data policies that encourage public bodies across the EU to make their data available for re-use. In the field of public and publicly funded research data, the current policy framework is a combination of hard law (Directive 2003/98/EC on the re-use of public sector information — the PSI Directive) and soft law (Recommendation 2012/417/EU on access to and preservation of scientific information). In order to maintain consistency between open data and open access policies, the reviews of the PSI Directive and the Recommendation are being conducted in parallel.

The objectives of the Recommendation are also aligned and coherent with action taken by countries and institutions across the globe as they, too, increasingly require open access to scientific publications and research data, especially when public funding is involved. For example, in 2013 in the United States, the White House's Office of Science and Technology Policy (OSTP) issued a policy memorandum directing all federal agencies with R&D expenditure of over USD 100 million to develop plans to 'ensure that the public can read, download, and analyse in digital form final peer-reviewed manuscripts or final published documents within a timeframe that is appropriate for each type of research conducted or sponsored by the agency.' On 17 January 2014, President Obama signed

a federal omnibus spending bill that included an open access mandate: section 527 of the Consolidated Appropriations Act, 2014 (H.R.3547) states that agencies that have research budgets of USD 100 million or more operating under the portion of the bill covering labour, health and human services, and education are required to provide online access to peer-reviewed articles that report on federally-funded research within 12 months of publication. At the institutional level, more than 44 open access mandates are being implemented in the US, notably by universities such as Harvard, Yale and the Massachusetts Institute of Technology. In Asia, both the Chinese Academy of Sciences and the National Science Foundation of China have open access policies for the research they fund.[37] Most recently, in autumn 2017 the G7 released a statement in full support of open science, including open access to publications and data, and of international alignment of policies and infrastructure.[38] Finally, the OECD has been a frontrunner with respect to assessing and recommending open access to publications and data since 2005, with its Declaration on Access to Research Data from Public Funding'[39]and subsequent relevant work, most recently on open science policies and practices.[40]

It is important to note that within the cohesion policy, coherence should be sought with the smart specialisation strategies concept, which is is a precondition for investments in research. Several Member States and regions have defined in their strategies priority areas of investment in ICT-related research and economy fields.

### 2.2.5. EU added value

Research and innovation are not limited by national boundaries, but form part of an international and collaborative process. Technology can facilitate this process, however it alone cannot resolve all issues. A common framework and aligned policies are necessary at Union level. The added value of the Recommendation and related actions (for example Horizon 2020) is in the guidance it gives Member States to develop their policies and, most importantly, align them with other Member States. EU-level intervention helps Member States and other countries create a seamless environment for researchers, with aligned requirements that promote research collaborations as opposed to obstructing them. Furthermore, the social challenges that research is called to address, for the most part, defy national boundaries.

The European Research Area aims to provide such a structure at EU level and facilitate coherence. It is a common space in which researchers should be able to circulate as easily as possible and, in particular, be able to build on research experiences and results across Member States. Like the European Research Area, Recommendation 2012/417/EU is based on the idea that research policy, and research dissemination policy in particular, are best addressed at Union level for reasons of efficiency and coherence, and to promote policy alignment.

Member States have expressed their support for open science and their belief that access to scientific information should be addressed at Union level in several Council Conclusions, most recently in the 2016 Council Conclusions on 'The transition towards an open science system' (RECH 208 TELECOM 100). In this document, they state that open science has the potential to contribute to Europe's growth

[37] More information is available in the Sherpa Juliet registry of funder policies at http://v2.sherpa.ac.uk/id/funder/894 and http://v2.sherpa.ac.uk/id/funder/893, respectively. These policies were announced in 2014, see R.V. Norden, Chinese agencies announce open access policies, Nature News, 19 May 2014, doi:10.1038/nature.2014.15255, http://www.nature.com/news/chinese-agencies-announce-open-access-policies-1.15255.

[38] https://goo.gl/q29vZw.

[39] https://legalinstruments.oecd.org/Instruments/ShowInstrumentView.aspx?InstrumentID=157.

[40] *Making Open Science a Reality*. OECD Science, Technology and Industry Policy Papers, ISSN: 2307-4957 (online), 2015.

and competitiveness, and call on the Commission to further develop open science policy in cooperation with Member States and stakeholders.

# 3. Policy developments

Since the publication of the Recommendation in 2012, there have been significant policy developments in closely related matters, which are are discussed below.

## 3.1. Open science

Significant changes in research practices have taken place in the last few years, made possible by developments in ICT and infrastructures and the increasing proliferation of data, usually referred to as 'open science'. Open science builds on the early and broad sharing of research results in open access[41] modes, supports citizen and business participation in the research process, and requires the use of new, more inclusive and fit-for-purpose approaches and indicators for evaluating research. At the moment, although the benefits of open science are widely acknowledged, the research system is in flux. Changes at the national and institutional level are required in order to reflect the latest developments and create systemic change. Leading by example, the Commission has already reflected upon and implemented its response to some of these developments through Horizon 2020 (for example the open research data pilot to contribute towards sound research data management[42]) and has sought expert advice on how to implement more improvements in future work programmes.[43] The Recommendation, a document expected to continue to have impact on Member States and their higher education institutions, should reflect these developments.

In particular, Recommendation 2012/417/EU does not reflect recent developments in areas such as:

- Research data management: significant advances have been made in recent years regarding research data management and what is called FAIR data (Findable, Accessible, Interoperable and Re-usable data)[44]. Data management plans have been found to be quite important in establishing sound practices early in the research process, and are a requirement for Horizon 2020 beneficiaries.[45] Metadata standards, training researchers on research data management and maintaining research data 'as open as possible, as closed as necessary' have been identified as important issues to be addressed. The Commission has sought advice regarding FAIR data in its policies through an expert group on this topic.[46]

[41] "Under a policy of open access, researchers and others put the results of their research (publications and/or data, for example from experiments) onto the Internet so that people can view or download the results free of charge. Open access means scientists will have better access to articles and data resulting from publicly funded research – irrespective of their or their host institution's financial means." (European Commission, MEMO 12/565)

[42] http://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/open-access-dissemination_en.htm

[43] The Commission has sought expert advice through a series of expert groups on new generation indicators, incentives and rewards, skills, the future of scholarly communication and FAIR data. Additionally it receives advice through the Open Science Policy Platform, a stakeholder-driven platform. https://ec.europa.eu/research/openscience/index.cfm?pg=home .

[44] https://www.force11.org/group/fairgroup/fairprinciples.

[45] http://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/open-access-dissemination_en.htm.

[46] Expert Group no E03464; information available in the transparency register at http://ec.europa.eu/transparency/regexpert/.

- Incentive schemes and reward systems for researchers to share data and commit to other open science practices and new, transparent and fair indicators to evaluate research and research performance have been identified as important elements that make open science possible. The inability of research systems to develop in this direction is a major obstacle.[47] The Commission has sought and received advice on this issue in view of the next Framework Programme for Research and Innovation, and the Recommendation should also address the fact that incentives and rewards systems should be in place to promote the uptake of open access and related open science practices.[48]

- The skills and competences of researchers and staff from academic institutions have been identified as important to address in the context of institutional changes.[49] Researchers and university staff should be trained in and educated on issues of open access, research data management, data stewardship and data science. This is also in line with the Communication on the Digital Education Action Plan (COM(2018) 22 final).[50]

- There have been significant developments related to open science infrastructure at European and global level. The development of data and publication repositories as infrastructure that supports access to and preservation of scientific information, and the interoperability and standards of these and related types of infrastructure, have been areas of significant advancement and collaboration. However, the European Cloud Initiative Communication[51] acknowledges that the lack of interoperability and fragmented access to digital services remain the major obstacles to efficient and interdisciplinary research in Europe today. As a solution, the Communication proposes the creation of the European Open Science Cloud (EOSC). The Commission has started work on making the EOSC a reality.

- Text and data mining and technical standards that enable re-use: significant developments have taken place with regard to technologies that allow the mining of information (text and data), as a new way of gleaning information out of large volumes of often disparate sources. Simultaneously, discussions are taking place regarding the legal conditions that facilitate or limit text and data mining. The Recommendation needs to acknowledge these developments, in accordance with and without prejudice to applicable copyright legislation.

2016 was a seminal year in the articulation of policies relevant to open science. Early in 2016, the Commission published a report on "Open Innovation, Open Science, Open to the World – a vision for Europe" in which, following a foreword from President Juncker, Commissioner Moedas presented key conceptual insights. A draft agenda for the development of open science in Europe was consequently

[47] See related reports on metrics: Wilsdon, J., et al. (2015). *The Metric Tide: Report of the Independent Review of the Role of Metrics in Research Assessment and Management*, HEFCE. DOI: 10.13140/RG.2.1.4929.1363, p. viii-ix.

[48] *Next-generation metrics: Responsible metrics and evaluation for open science*. Report of the European Commission Expert Group on Altmetrics, European Commission, 2017, doi:10.2777/337729; *Evaluation of Research Careers fully acknowledging Open Science Practices.* Rewards, Incentives and/or recognition for researchers practicing Open Science, European Commission, 2017, doi: 10.2777/75255.

[49] *Providing researchers with the skills and competencies they need to practice Open Science*. Open Science Skills Working Group Report, European Commission, 2017, doi: 10.2777/121253.

[50] "The way forward: […] Strengthen open science and citizen science in Europe by piloting dedicated training, including continuous professional development courses on open science in higher education institutions at all levels (students, researchers, educators)."

[51] European Cloud Initiative — Building a competitive data and knowledge economy in Europe, COM(2016) 178 final, of 19 April 2016.

prepared[52], which outlined a number of policy actions aiming to make open science a reality in the European Union: fostering open science; removing barriers to open science; developing infrastructure for open science; making open access to research results mainstream; and embedding open science in society.[53] Subsequently, the Commission set up a high-level expert group comprising stakeholders from the Open Science Policy Platform (OSPP), to ensure a stakeholder-driven approach to implementing open science policies.[54] The OSPP comprises 25 representatives of European branch organisations such as universities, research organisations, publishers and research funders. It advises the European Commission on open science. More specifically it advises on the ambitions set for open science such as the future of scholarly communication, the European Open Science Cloud, new generation metrics, citizen science, research integrity, skills, rewards and FAIR data.

In parallel, the May 2016 Competitiveness Council reinforced the significance of open science for Europe and urged the Commission and Member States to take specific actions to make it a reality, in particular with respect to the goals of an agenda for open science in Europe: removing barriers and fostering initiatives; implementing full open access to scientific publications by 2020; and implementing policies for the optimal re-use of research data.[55]

## 3.2.Infrastructure for open science

Related to the promotion of open science, the 2016 Communication on the 'European Cloud Initiative - Building a competitive data knowledge and economy in Europe'[56] announced the European Open Science Cloud (EOSC). The EOSC aims to give the EU a global lead in terms of scientific data infrastructure by enabling researchers, as well as citizens and businesses, to easily access the wealth of research data available in the EU. In order to implement the EOSC, a new model that is both scalable and flexible needs to be put in place to keep up with the emerging needs of the scientific community and support the whole research data lifecycle.

The Commission is providing and planning the necessary financial support to implement the EOSC by means of projects under Horizon 2020. Actions were included in the work programme (WP) 2016-2017, and in the WP 2018-2020, for an aggregate budget of about EUR 600 million. This includes the launch in 2018 of the INFRAEOSC dedicated call for proposals, which will support notably the integration of services and the federation mechanism; the setting/operationalization of the principles of FAIR data (findable, accessible, interoperable and re-usable); the development of a FAIR-compliant certification scheme for data infrastructure and the connectivity of the pan-European Research Infrastructures such as the ESFRI projects and landmarks. A catalogue of EOSC services, including both thematic and generic services – for data storage, management and analytics, simulation and visualisation, distributed computing, etc. – will help researchers to discover, select and use the services they need.

Additionally, in line with the Communication on the European Cloud Initiative, the Commission held an EOSC stakeholder summit that resulted in the EOSC Declaration in 2017.[57] It also undertook to

[52] https://ec.europa.eu/research/openscience/pdf/draft_european_open_science_agenda.pdf#view=fit&pagemode=none

[53] European Open Science Agenda (draft).

[54] More information is available at https://ec.europa.eu/research/openscience/index.cfm?pg=open-science-policy-platform and at the European Commission's expert group transparency register, no (E03436).

[55] Council Conclusions 'The transition towards an Open Science system' (9526/16) adopted on 27/05/2016

[56] COM(2016) 178 final, of 19 April 2016.

[57] Information on the EOSC Declaration and the Summit is available at: https://ec.europa.eu/research/openscience/index.cfm?pg=open-science-cloud.

discuss the possibilities for EOSC funding and governance with Member States, as well as to develop a roadmap to implement the communication.[58] The Commission staff working document[59] provides a comprehensive overview on the EOSC implementation so far, and presents an implementation plan and a roadmap for the European Open Science Cloud, as foreseen by the Communication on the European Cloud Initiative. The document serves as a basis for further consultation with Member States and other relevant stakeholders, such as the European Parliament, on the next steps for this initiative.

## 3.3.Open data policy and initiative on public and publicly funded data

The Commission recognised the economic importance of information in the Green Paper 'Public Sector Information: A key resource for Europe'.[60] This led to the adoption of a Directive on the re-use of public sector information (PSI Directive) in 2003.[61] This Directive aimed to improve access to and the re-usability of information held by public sector bodies by creating a level playing field for all parties interested in developing added-value products or services, including with the public sector bodies as data holders, some of which had become active on commercial markets for such products or services. Subsequently, the discussion recognised the increasing digital encoding of information as electronic 'data'. A broader call to open data, in particular government data, was supported by governments around the world, with the UK, Spain and the US as pioneers. Further to this, the Commission proposed[62] to strengthen the policy on re-use of public sector information by introducing a right to re-use data for all publicly accessible information. This led to a revision of the Directive in 2013.[63] The revised Directive sets out the principle that all accessible data held by a public sector body should in principle also be re-useable for commercial and non-commercial purposes by all interested parties under non-discriminatory conditions for comparable categories of re-use and in principle at a maximum of the marginal cost linked to the distribution of the data.

With the increased capacity of data analytics and the advent of 'big data', the Commission has, in recent years, also examined other elements of data-driven innovation,[64] as part of its digital single market strategy. In a 2014 Communication,[65] it discusses the enabling factors of a thriving data economy, including access to computing infrastructure and storage, state-of-the-art analytics software, high-quality data and data science skills, and the importance of a supportive regulatory framework. In the Communication "Building a European data economy" adopted in early 2017,[66] the Commission examined, in particular, barriers to a truly European data economy resulting: (a) from restrictions in national law and administrative practice forcing companies to store and process their data within a particular Member State (data localisation restrictions), and (b) barriers to business-to-business data access and transfer as a result of an inadequate legal framework supporting data 'trading'. The latter

[58] The Commission is exploring possibilities for the governance and financing of EOSC through the OSPP (see OSPP recommendations of May 2017), as well as through the high-level expert group on the EOSC (report 2016). It will discuss an EOSC implementation plan in a staff working document that is currently under preparation.
[59] SWD(2018)83
[60] COM(1998)585.
[61] Directive 2003/98/EC on the re-use of public sector information of 17 November 2003, OJ L 345 of 31/12/2003, p. 90.
[62] COM(2011) 877 final of 12 December 2011.
[63] Directive 2013/37/EU of 26 June 2013 amending Directive 2003/98/EC.
[64] See: OECD, Data-driven innovation. Big Data for growth and well-being, 2015.
[65] COM(2014) 442 final of 2 July 2014.
[66] COM(2017) 9 final of 10 January 2017.

focuses on the free flow of data across borders and data localisation restrictions. Based on this and on the ensuing stakeholder dialogue, in September 2017 the Commission put forward a legislative proposal on the free-flow of non-personal data,[67] which proposes to ban national restrictions on the localisation of such data unless justified on the grounds of public security. As concerns barriers to business-to-business data, the Digital Single Market Mid-Term Review Communication[68] announced that the Commission will further examine the need for intervention.

Very relevant with respect to this Recommendation is the PSI Directive,[69] which has been reviewed in parallel to the review of this Recommendation[70]. As part of the stakeholder consultation process, a public online consultation on the review of the PSI Directive made it possible to gain an understanding of stakeholder positions on the future of open access.[71] There appears to be a consensus among stakeholders that publicly funded scientific research results should be as openly accessible and re-useable as possible (90 % of the 159 respondents to the online consultation took this view). In the online consultation, respondents also largely agreed (81 % of the 178 respondents) that there should be one common, harmonised policy for open access in the EU, which is binding on all research funding organisations and academic institutions in Europe; only 6 % of respondents disagreed to this. This position was also voiced by various stakeholders in position papers and by the League of European Research Universities during the PSI public hearing (Brussels, 19 January 2018).[72]

Both in the public online consultation and in workshops on this topic, a number of stakeholders stressed a structural similarity between government-held information (public sector information – PSI) and scientific research results resulting from public funding, in particular the re-use value of such data. However, stakeholders also pointed out some differences between these types of data that should be taken into account in future policymaking (e.g. financial sustainability of publishing businesses, preservation of intellectual property rights, protection of personal data and of trade secrets of commercial partners in research endeavours). Structural solutions that centre on the researcher, rather than universities or funding bodies, which do not add an unnecessary burden on them are needed. Other barriers identified include imperfect data management capabilities, the absence of easy-to-use licensing conditions and issues with working to common (meta)data standards.

# 4. The proposed way forward: update of Recommendation 2012/417/EU

The 2012 Recommendation on access to and preservation of scientific information is still a relevant document and, to a significant extent, efficient in achieving its objectives. Nonetheless, EU policy and legislative developments, recent developments in the research and innovation ecosystem and the constant evolution of scientific practices call for its revision. The purpose of this update is to align the Recommendation with new developments in open science and further strengthen its content, thus rendering it an even more powerful policy instrument that is fit for purpose.

Important developments in the research ecosystem that were identified as being of direct relevance to the Recommendation are research data management, incentive schemes and reward systems for open

[67] Proposal for a Regulation of the European Parliament and of the Council on a framework for the free flow of non-personal data in the European Union (COM(2017) 495 final).
[68] COM(2017) 228 final of 10 May 2017.
[69] Directive 2003/98/EC as amended by Directive 2013/37/EU.
[70] COM(2018) 234.
[71] https://ec.europa.eu/digital-single-market/news-redirect/621219
[72] http://ec.europa.eu/newsroom/dae/document.cfm?doc_id=50965

science, and the development of relevant skills and competences of researchers. European investment in infrastructure for open science and developments in the field of text and data mining were also noted, as well as the Council Conclusions on 'The transition towards an Open Science system' of May 2016.

At the same time, reactions from stakeholders have clearly shown that there is a consensus that publicly funded scientific research results should be as openly accessible and re-useable as possible. No stakeholder disagrees with the principle of open access. Discussions are thus focused on implementation elements. Similarly, 81% of the respondents in the public online consultation and 17 Member States expressed support in general for a harmonised EU policy with some hard law obligations. For this reason, in parallel with the update of the Recommendation on access to and preservation of scientific information[73], the Commission has proposed to introduce an obligation on Member States to adopt national open access policies[74]. The proposal makes clear, through a reference to the revised Recommendation in its recitals, that the recommended elements of such open access policies are to be found in the (revised) Recommendation. Additionally, the proposed revision of the PSI Directive would extend the scope of application to research data. The fact that research data have a particular potential to be re-used in the age of big data analytics and the development of applications of artificial intelligence suggests that the re-use of such data should be supported by limiting the restrictions put on such re-use. In order to avoid administrative burden on researchers, educational or research establishments, the proposal intends to extend the scope only to such research that has already been made publicly available by the researcher in an institutional or subject-based research data repository.

[73] C(2018) 2375.
[74] COM(2018) 234.