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1 The Development of Research Data Management Policies in Horizon 2020

Abstract: This article provides an overview of open research data and research data management in Horizon 2020. It describes the open research data pilot in Horizon 2020, which, as of 2017, has been extended to cover all thematic areas of Horizon 2020 ('open data as the default'). However, the Commission also recognises that there are also good reasons to keep data closed and thus allows individual opt-outs. Good research data management in a broader sense has emerged as a key issue in this context. The link between openness and general management of research data is provided by a key document mandatory for all Horizon 2020 projects which do not opt-out: the data management plan (DMP). In the 2016 update of the Horizon 2020 guidelines on data management it was made clear that the DMP should outline how projects make their data FAIR: findable, accessible, interoperable and re-usable. Initial experience with DMP assessment by research data management (RDM) experts in H2020 reveals that additional guidance on data management is needed for all groups of actors in research projects. Aspects such as data preservation, IPR or standards are too often not well developed in the DMPs that have been submitted so far. However, improved guidance and tools are expected to improve these competences. Nevertheless research projects with excellent RDM performance are not rare. Some high quality DMPs from H2020 projects have already been published online¹.

While costs for data management can be covered by the beneficiaries and are fully eligible for reimbursement in Horizon 2020 many project participants need information about the adequate level of spending for data management in projects. At the moment, those projects opting out of opening their research data do not have to provide a DMP. The authors believe that in the future all projects should produce a DMP, even if they choose to keep some (or even all) of their data closed. In this case, the DMP should still address the curation and preservation of such data.

1 Introduction

Data is becoming increasingly important for all aspects of the European economy and society. More and more data is being generated and it has been estimated

¹ <http://www.dcc.ac.uk/resources/data-management-plans/guidance-examples>, accessed 06152017

that big and open data can potentially add 1.9% to the EU's GDP by 2020 (Buchholtz et al. 2014, 6–7).

These gains can be derived from productivity increases, the opening up of public sector data and better decision making thanks to data-driven processes. The digital economy is therefore considered a key potential source for growth, innovation and ultimately employment (European Policy Centre 2010, 4), a fact that is reflected in the agenda of the Juncker Commission², which has made completing the digital single market a priority.³ It is important to point out that the trend of “datafication” does not only affect sectors traditionally associated with the digital economy – such as IT – but that all parts of the economy are producing or using computerised data. Big and Open Data have been estimated to have an impact on sectors as diverse as agriculture, public administration, health, retail, transportation and the work place. Data are a core asset that can create a significant competitive advantage and drive innovation, sustainable growth and development in all these sectors. In business, the exploitation of data promises to create added value in a variety of operations, ranging from optimising the value chain and manufacturing production to more efficient use of labour and better customer relationships (Kounatze 2013, 4).

2 On definitions of data

The ubiquity and pervasiveness but at the same time the variety of what is considered ‘data’ present important challenges in legislating on data related issues. It is all the more surprising, then, that so few studies, reports and press articles actually define what they mean when they discuss ‘data’. When, for instance, a data protection activist talks about ‘usage data’ from a social network this is something very different from what a particle physicist at CERN has in mind.

On the most general level the Cambridge Dictionary defines data as “information, especially facts or numbers, collected to be examined and considered and used to help decision-making or information in an electronic form that can be stored and processed by a computer” (Cambridge Dictionaries Online, 2014). In a research context, examples of data include statistics, results of experiments, measurements, observations resulting from fieldwork, survey results, interview recordings and images. Nowadays, the focus is on research data that is available in digital form. A further useful definition is provided by the United States Government’s Office of Science and Technology Policy (OSTP) in its Memorandum on

² https://ec.europa.eu/priorities/index_en, accessed 06152017

³ Juncker 2014, 5.

Increasing Access to the Results of Federally Funded Scientific Research where data is defined “as the digital recorded factual material commonly accepted in the scientific community as necessary to validate research findings including data sets used to support scholarly publications” (OSTP 2013, 5). In a research context, a further distinction can be made between

- Data generated primarily for research purposes – this is already an extremely broad field covering different definitions of data. What is considered data varies enormously, for instance in archaeology (e.g. pictures of a dig site), medicine (e.g. clinical trial data) or particle physics (e.g. accelerator data).
- Data not primarily generated for research purposes, which can, however, be used for research:
 - So called “Public Sector Information”, that is data collected by public authorities, such as statistics (e.g. census data, demographic and economic indicators), geospatial data (e.g. maps, sensor data), transport data (e.g. traffic information) or company and business registers.
 - Data that is “out there”, that is on the internet – for instance on social networks such as twitter or Facebook, including but not limited to usage data of these sites. The Twitter DataGrants pilot program, for instance, aims at giving a handful of research institutions access to Twitter’s public and historical data (Twitter 2014).

For the research sector a further proposed classification of data is as follows:

- a) Metadata / bibliographic data that describe data: metadata is found in online catalogues, archives, repositories, etc.
- b) Data underlying publications (i.e. the data needed to validate the findings presented in scientific publications), often presented as part of publications (“enriched publications”, with links to data).
- c) Curated data, for example data collections, structured databases (held in repositories and data centres, both institutional and discipline-based), including relevant workflows and protocols.
- d) Raw data and data sets: these are not curated and typically held on institute hard drives and in drawers.

3 The development of research data policy in Horizon 2020

The EU’s multiannual framework programme for Research and Innovation, Horizon 2020, dedicates nearly 80 billion € for research funding. In addition to

other results, it is expected to generate a significant amount of research data. It is therefore in the interest of the EU to ensure that best possible use of this data is guaranteed. One way to achieve this goal is by making the research data collected or generated in H2020 projects **findable, accessible, interoperable and re-usable** (FAIR).

However, while open access to scientific publications has been implemented for a decade and is increasing in terms of acceptance and use⁴, efforts to achieve open access to research data in EU research programs is more recent. The Commission did not have a policy on research data in FP7 but started to proactively address the issue in preparation for Horizon 2020. A 2011 online survey on scientific information in the digital age⁵ found that the vast majority of respondents (87 %) disagreed or disagreed strongly with the statement that there is no access problem for research data in Europe. The barriers to access research data considered very important or important by respondents were: lack of funding to develop and maintain the necessary infrastructures (80%); insufficient credit given to researchers for making research data available (80%); and insufficient national/regional strategies/policies (79%). There was strong support (90% of responses) for research data that is publicly available and results from public funding to be, as a matter of principle, available for reuse and free of charge on the Internet. Following up on the survey the Commission held a public consultation on open research data on 2 July 2013 in Brussels, which was attended by a variety of stakeholders from the research community, industry, funders, libraries, publishers, infrastructure developers and others⁶.

Horizon 2020 contains both large scale calls for consortia of research organisations and industrial companies as well as actions supporting individual researchers, SMEs, public private partnership and many more. These varying so-called “beneficiaries” of Horizon 2020 in principle own the results of the research conducted and are free to exploit it. However, the Commission has repeatedly highlighted the importance of optimising the circulation, access to and transfer of scientific knowledge and stressed that *research and innovation benefit from scientists, research institutions, businesses and citizens accessing, sharing and using existing scientific knowledge and the possibility to express*

⁴ More than 50% of research publications from 2012 were open access in 2014, according to data collected by Science Metrix (counting both gold, green and other open access). See <http://science-metrix.com/en/publications/reports>, accessed 06152017

⁵ European Commission 2012a see http://ec.europa.eu/research/science-society/document_library/pdf_06/survey-on-scientific-information-digital-age_en.pdf

⁶ European Commission 2013.

*timely expectations or concerns on such activities.*⁷ This recognises that all research builds on former work and depends on scientists' possibilities to access and share scientific information. Fuller and wider access to scientific publications and data can therefore help to accelerate innovation, foster collaboration and avoid duplication of effort by building on previous research results as well as making research more accessible for companies (in particular SMEs) and non-profit organisation. This is particularly valuable if exploitation is not undertaken by the primary beneficiary; added value can also be created through the re-use of data already generated. Data re-use has the potential to further increase the impact of the research funded by the European taxpayer and to support Horizon 2020 in its contribution to economic growth and job creation.

The Horizon 2020 regulation stated that "open access to research data resulting from publicly funded research under Horizon 2020 should be promoted, taking into account constraints pertaining to privacy, national security and intellectual property rights." (Regulation (EU) No 1291/2013, Recital 28) In order to "promote" open access to data, as stipulated by the legislator, the European Commission set up a flexible pilot scheme for research data from EU funded projects, anchored in the Horizon 2020 work programme (H2020 Open Research Data Pilot aka ORD pilot).⁸ The Commission considered it important that the ORD pilot would be designed in a way that would allow wide acceptance and uptake by the stakeholders in the research ecosystem. Issues and challenges of access to research data were therefore extensively discussed with individual researchers, industry, research funders, libraries, publishers, infrastructure developers and others in the form of i) a one day event where individual presentations and discussion could be heard and (ii) a written consultation period.⁹ It quickly became apparent that the ORD pilot would need to balance openness with IPR and commercialisation issues, privacy concerns, security as well as data management and preservation questions. Considerable efforts were therefore undertaken in 2013 in designing a pilot scheme that would be ambitious, pragmatic and flexible at the same time. The results led to a system which is very clear on (i) which thematic areas of Horizon 2020 are included in the ORD pilot, (ii) what kind of data is expected to be made open access and the implications for data management.

Based on this initial structuring, two additional factors were then taken on board: firstly it was recognised that there are also good reasons for NOT making data available in open access (see above), and projects were therefore given

⁷ European Commission 2012c.

⁸ European Commission 2014f, 19.

⁹ European Commission 2013.

several options to “opt out” of the ORD pilot, namely in cases which would create conflicts a) with the project’s obligation to protect results (in case of commercialisation¹⁰), b) conflicts with confidentiality obligations, c) conflicts with security obligations or d) with rules on protection of personal data. Finally, projects can also opt out if achieving the action’s main aim is jeopardised by making specific parts of the research data openly accessible. Secondly, due account was taken of the fact that project applicants might like to participate in the ORD pilot even when their project is *not* part of the so-called “core areas” (in 2014–16 some areas of the H2020 Work Programme participated ‘by default’ in the ORD pilot; starting from 2017 proposals from all areas participate unless they opt-out explicitly). In that case they will be given an opt-in possibility on a voluntary project by project basis. The options to “opt-out” or to “opt-in” are implemented as part of the electronic proposal submission process, through an easily clickable form.

The second issue to be resolved concerned the kind of data that was to be made available. An initial scoping exercise showed the enormous amount and variety of objects which have been classified as “data” (see section 2 above). It was therefore decided that the ORD pilot would primarily apply to data underlying scientific publications because (i) this data is presumed to be cleaned and structured since it has been used to create a publication (ii) there is a need to increase the reproducibility of the results reported in scientific articles. Projects can of course go beyond this initial requirement and also publish curated data not connected to a publication, or raw data; but they are not obliged to do so. Projects participating in the ORD pilot are obliged to outline which data they want to make open as part of a data management plan (DMP), which is a document outlining how the research data collected or generated will be handled during a research project, and after it is completed. It should be noted that both the decision on whether to participate in the ORD pilot or not is not part of the evaluation and selection for funding. In other words, proposals are not evaluated more favourably because they are part of the ORD pilot and will not be penalised for opting out of the pilot.

In the Work Programmes 2014–2016, this ORD pilot concerned selected areas of Horizon 2020. However, in the Communication “a European Cloud Initiative – Building a competitive data and knowledge economy in Europe” the Commission commits itself to “make open research data the default option, while ensuring opt-outs, for all projects of the Horizon 2020 programme” as of 2017. As of

10 “Horizon 2020 is the financial instrument implementing the Innovation Union, a Europe 2020 flagship initiative aimed at securing Europe’s global competitiveness”. <http://ec.europa.eu/programmes/horizon2020/en/what-horizon-2020>, accessed 06152017

the revised version of the Work Programme 2017, the ORD pilot has therefore been extended to all thematic areas of the Horizon 2020 Research and Innovation Programme.

For the uptake of the ORD pilot from 2014 to 2016 (when its scope was more restricted), figures show an opt-out rate of 35% in the core areas of the pilot. In other words 65% of projects in the core areas participate in the ORD pilot. The most important reasons for opt-outs were IPR concerns followed by privacy concerns and projects which do not expect to generate data. Outside the core areas, 14% of projects make use of the voluntary opt-in possibility.¹¹

4 Research data management in Horizon 2020

While the main aspect of the EU research data policy refers to *open access* to data, attention to *data management* has not been left out. The idea to focus on research data management in EU funding programs was first spelled out in the recommendations of the “Riding the Wave” report from the High Level Expert Group on scientific data (2010) which called for “EU and national agencies mandate that data management plans be created”¹² in order to gain strategic view of data value.

The 2011 online survey on scientific information in the digital age¹³ showed a wide support for data management among all stakeholder groups (national governments, regional and local governments, research funding organisations, university/research institutes, libraries, publishers, international organisations, individual researchers, citizens and respondents identified as ‘other’, among which there were NGOs, industries, charities, learned societies and scientific and professional associations). The majority of respondents considered the lack data management requirements as a barrier to enhanced access to research data. In particular this was the opinion of all respondents from research funding organisations, 80.8% of library respondents and 75.3% of publisher respondents. The issue of data management plans (DMP) in research projects was already present

11 Details on call specific uptake are available on the Open Data Portal at <https://data.europa.eu/euodp/data/dataset/open-research-data-the-uptake-of-the-pilot-in-the-first-calls-of-horizon-2020>, accessed 15062017

12 http://ec.europa.eu/information_society/newsroom/cf/document.cfm?action=display&doc_id=707, accessed 06152017

13 European Commission 2012a, see: http://ec.europa.eu/research/science-society/document_library/pdf_06/survey-on-scientific-information-digital-age_en.pdf

in some contributions by stakeholders. In particular the question on adequate timing of DMP submission was mentioned (whether in the research proposal or later as a project output). It is interesting to note that some respondents identified lack of skills and capacity for data management as additional barriers to access. Both aspects were addressed 1 year later in a Commission Recommendation to Member States¹⁴.

The inclusion of RDM in the EU research data policy is also supported by the fact that access to research data can be significantly improved by adequate data management, understood as proper data curation, storage and preservation, provision of metadata and documentation, etc. From the point of view of policy and project monitoring, the inclusion of DMP as part of the Horizon 2020 ORD pilot, provides additional means to assess project outcomes (among other aspects, DMPs are expected to define data sharing policies). The quality of DMPs delivered to the Commission and its agencies can be used to measure the evolution of data management skills in EU research, as well as to assess data sharing practises.

However, a policy is only as good as its implementation which means that data management policy needs to be backed by some guidance and tools. This is why the European Commission developed specific guidelines on Data Management, including a template for DMPs. As defined in the H2020 Model Grant Agreement¹⁵, project partners can use DMPs as a flexible tool to define what data will be shared, how and when.

The EC is one of many research funders currently requiring a DMP from its grantees. While there are clear advantages in requesting a DMP either at proposal stage or during project lifetime, the EC decided to apply a compromise approach: proposals are required to define an outline of their data management policy in general terms and this is evaluated as a sub criterion of the impact criterion. However, a full DMP is not required at the time of submission but only if the proposal is selected for funding and after start of the project (first version at month 6 after start and final version before end of the project)¹⁶.

The flexible approach of the ORD pilot thus extends to the DMP mandate, which is closely linked to it. While the DMP is obligatory for all research projects participating in the ORD Pilot, it can evolve and adapt to the project's needs during its lifetime. In addition, although a DMP template is provided in H2020

¹⁴ European Commission 2012e.

¹⁵ The H2020 MGAs can be found in the Participant Portal: http://ec.europa.eu/research/participants/portal/desktop/en/funding/reference_docs.html, accessed 06152017

¹⁶ The requirements referring to the proposal stage apply to all proposal, while those referring to selected projects apply only to Open Research Data Pilot projects.

and its use is recommended, it is currently not mandatory. While the data management aspects covered in the template are common to most research projects, the flexibility of the template allows discipline specific practices to be included. As a result of feedback received from stakeholders, independent experts, project coordinators and project officers, the guidelines and the DMP template were updated in July 2016¹⁷. The adaptation of the FAIR principles to data management is now part of the EC policy on research data as described in the updated guidelines. This change required also substantial modifications to the DMP template, which nevertheless continues to be optional. Therefore the use of the previous templates as well as other templates is allowed, if considered appropriate in the context of the project.

5 Experiences and preliminary lessons learned from Horizon 2020 RDM

A major change in the 2016 update of the H2020 guidelines on Data Management was the adaptation of the Fair Data Principles to the domain of RDM. In the Horizon 2020 context the FAIR principles provide also a strong connection between open research data policy and RDM practise. Since the DMP template is an integral part of the H2020 RDM approach, it became clear that this template should also be adapted. However, the H2020 DMP template is not a “strict technical implementation of the FAIR principles, it is rather inspired by FAIR as a general concept”.

Initial experience with DMP assessment by RDM experts in H2020¹⁸ reveals that additional guidance on data management is needed for all groups of actors in research projects (researchers, peer reviewers and funder administrators (“project officers”)) including roles supporting researchers with data management tasks (data librarians or IT professionals working in data centres). Aspects such as data preservation, IPR or standards are too often not well developed in the DMPs that have been submitted so far. However, improved guidance and tools are expected to improve these competences. While the UK DCC DMPOnline¹⁹ was

17 European Commission (2016). http://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/open-access-data-management/data-management_en.htm, accessed 06152017

18 These conclusions are based almost entirely on a DMP assessment pilot conducted by the EC Research Executive Agency (unit B3) in 2016 with H2020 Societal Challenge 6 projects.

19 <http://www.dcc.ac.uk/dmponline>, accessed 06152017

the first available DMP tool, some alternatives, often based on the DMPOnline, already exists, such as DMPTuuli²⁰ in Finland. Examples of DMPs can be found in the DMPOnline site as well as in the Zenodo repository²¹. Nevertheless research projects with excellent RDM performance are not rare. Some high quality DMPs from H2020 projects have already been published online²².

While costs for data management can be covered by the beneficiaries and are fully eligible for reimbursement in Horizon 2020 many project participants need information about the adequate level of spending for data management in projects. Decisions on data management costs call for better understanding of the value of research data, or for a “strategic view of data value”.

In H2020 DMP is mandatory for all projects participating in the ORD pilot. Due to the large flexibilities built in the pilot, total opt-out from it for reasons such as IPR or personal data protection seem to raise questions about data management. If no data sharing is possible, e.g. for serious data protection issues, excellent data management and hence a DMP, seem even more necessary. Following the “as open as possible, as closed as necessary” principle and the possibility to participate even if no data is shared beyond the project consortium members, the DMP remains the only strong mandate for pilot projects. But for any project with strong protection requirements (whether for privacy or commercial reasons), it seems even more important to manage research data professionally which will require adequate planning activities. Therefore the authors believe that a DMP is a necessary component in all research projects dealing with data.

Disclaimer: All views expressed herein are entirely of the authors, do not reflect the position of the European Institutions or bodies and do not, in any way, engage any of them.

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²⁰ <https://www.dmptuuli.fi/>, accessed 06152017

²¹ <https://www.zenodo.org/>, accessed 06152017

²² <http://www.dcc.ac.uk/resources/data-management-plans/guidance-examples>, accessed 02082017

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