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The Role of Repositories in Horizon 2020 and Horizon Europe Open Access and Data Management Requirements

A Comparative Perspective

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Abstract

The European Commission has been a trendsetter in requirements for open access to scientific peer-reviewed publications and for open research data / research data management. This article analyses the provisions and requirements as far as they regard repositories in the EU's Horizon 2020 and the Horizon Europe research funding programmes. Repositories are a cornerstone of the open access and open data / data management requirements in both programmes, with a strengthening of these requirements in Horizon Europe. This will influence researchers and research manager requirements for repositories, even beyond the Horizon programmes. The new requirements have the potential to significantly contribute to the transition towards open science if they are stringently implemented.

Keywords: Horizon 2020; Horizon Europe; data management; open data; repositories

Zusammenfassung

Die Rolle von Repositorien und die Open Access Datenmanagement-Anforderungen in Horizon 2020 und bei Horizon Europe. Eine vergleichende Perspektive

Die Europäische Kommission spielt bei den Anforderungen für den offenen Zugang zu wissenschaftlichen Publikationen und für offene Forschungsdaten bzw. Forschungsdatenmanagement eine Vorreiterrolle. Dieser Artikel analysiert die Bestimmungen und Anforderungen in Bezug auf Repositorien in den EU-Forschungsförderungsprogrammen Horizon 2020 und in Horizon Europe. Repositorien sind ein Eckpfeiler der Anforderungen für den offenen Zugang und die Verwaltung (offener) Daten in beiden Programmen, wobei die Anforderungen in Horizon Europe gestärkt wurden. Dies wird mitbeeinflussen, welche Anforderungen Forscher:innen und Forschungsmanager:innen an Repositorien stellen, auch über die Horizon-Programme hinaus. Die neuen Anforderungen haben das Potenzial, signifikant zum Übergang zur offenen Wissenschaft beizutragen, wenn sie stringent umgesetzt werden.

Schlagwörter: Horizon 2020; Horizon Europe; Datenmanagement; Open Data; Repositorium

1. Introduction

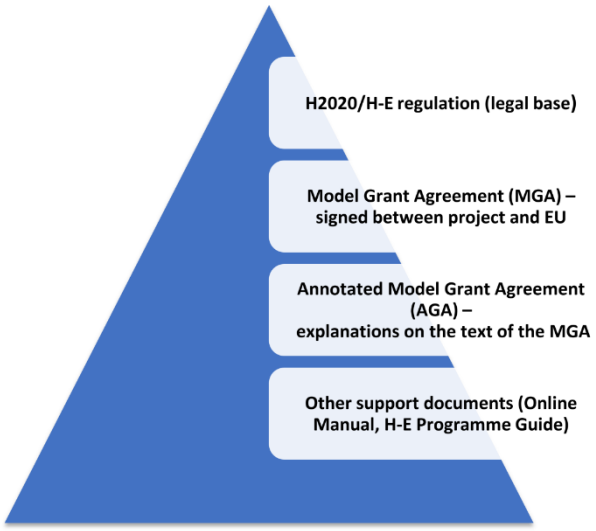
The EU Framework Programmes for Research and Innovation are a series of multi-year funding programmes aimed at promoting research and innovation within the European Union, going back to 1984. The programme from 2014-2022 was called Horizon 2020 and has, since 2021, been replaced by the successor programme Horizon Europe, which will run until 2027. Given its importance as a funding source for research in the EU and beyond (additionally to national funding and other smaller programmes), its legal and technical requirements have the potential to influence research practices and will, consequently, also impact what functionalities researchers and research managers require repositories to deliver.

Open access (OA) to publications and open data and data management have been integrated in both Horizon 2020 and its successor Horizon Europe on a number of levels. In this short article we will specifically look at the provisions and requirements regarding repositories[1] – both for publications and for research data – and compare the previous Horizon 2020 programme[2] and the current Horizon Europe programme in this respect.

The basis for this exercise is a number of EU documents: on the highest level the Horizon 2020 and Horizon Europe regulation constitute the legal base but also tend to be fairly general. On the intermediate level, the Model Grant Agreement (MGA) provides the legal obligations for EU project partners ("beneficiaries"). The Annotated Model Grant Agreement (AGA) further explains these requirements in greater detail. Finally, in Horizon 2020, the Online Manual is strategically placed in the online funding and tender portal (formerly participant portal) and is therefore easily accessible to grant holders and applicants. For Horizon Europe, a new document, the Horizon Europe Programme Guide, lists important information for applicants and thus serves a similar function. The following graphic provides an overview of these documents, which will be quoted as primary sources in the text below.

1 Please note that this article is therefore not an extensive review of the EU's open access and data management mandate but has in its focus those provisions which refer to repositories. Note also that slightly different rules might apply for projects dealing with public health emergencies (e.g. COVID) and for some mono-beneficiary grants.

2 Although Horizon 2020 expired in 2021, its provisions are still relevant, since there are many funded projects which still continue.



Graphic 1: Sources for EU information on open access and open data requirements in Horizon 2020 and Horizon Europe

2. Open Access to Scientific Publications and Research Data in Horizon 2020 (2014-2020)

On the highest (that is legislative) level, the Horizon 2020 Regulation stipulates that "to increase the circulation and exploitation of knowledge, *open access to scientific publications*[3] should be *ensured*" (own highlight) [4], thus making clear that open access to scientific publications is an obligation for Horizon 2020 grantees. The modes of implementation for this requirement can then be found in the Model Grant Agreement (MGA). As the Horizon 2020 Online Manual explains[5], the OA obligations (in article 29.2. of the MGA) primarily encompass two steps:

3 Understood primarily as scientific articles in Horizon 2020 – although open access to other publications is also strongly encouraged.

4 REGULATION (EU) No 1291/2013 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 December 2013 (2013), p. 107.

5 Horizon 2020 (n.d.)

(a) depositing publications in repositories: beneficiaries must deposit a machine-readable electronic copy of the published version or final peer-reviewed manuscript accepted for publication in a repository for scientific publications. This must be done as soon as possible and at the latest upon publication.

(b) providing open access to them: the manual clarifies that open access can be provided either through a repository of the beneficiary's choice within at most six months (12 months for publications in the social sciences and humanities) or through publication in an open access journal (or in hybrid journals). However, it is interesting to note that in the latter case the article must also be made accessible through a repository upon publication. According to the Horizon 2020 Online Manual this is "to ensure that the article is preserved in the long term"[6].

The manual also provides the following short definition of a repository:

> "Repository" for scientific publications is an online archive. Institutional, subject-based and centralised repositories are all acceptable choices. Repositories that claim rights over deposited publications and preclude access are not.[7]

To help researchers in their choice of repository the manual also refers to The Open Access Infrastructure for Research in Europe (OpenAIRE[8]) as well as the Registry of Open Access Repositories (ROAR[9]) and the Directory of Open Access Repositories (OpenDOAR[10]). Similar information is also provided in the Horizon 2020 AGA on this subject. Slightly different rules apply in public health emergencies, in which case there is a zero-embargo period; furthermore, the relevant guidance from the Commission[11] also refers to preprints in this instance.

For open research data**,** the Horizon 2020 regulation states 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".[12] As a result, the Commission launched a flexible pilot for open access to research data (ORD pilot), which was expanded to all thematic areas of the programme as of the Work Programme 2017, but with the option

6 Ibid.
7 Ibid.
8 https://www.openaire.eu/
9 http://roar.eprints.org/
10 https://v2.sherpa.ac.uk/opendoar/
11 European Commission (2020), p. 5.
12 REGULATION (EU) No 1291/2013 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 December 2013 (2013) (Own highlight)

to opt-out under the principle of "as open as possible, as closed as necessary".[13] A key requirement is the creation of a data management plan (DMP), which projects have to submit as an obligatory deliverable by month six of the project and which they should update as needed.

In the Model Grant Agreement, Article 29.3[14], further details are given, namely the requirement for the beneficiary to a) first deposit the data in a research data repository and then to make it possible for "third parties to access, mine, exploit, reproduce and disseminate – free of charge for any user – the following: the data, including associated metadata, needed to validate the results presented in scientific publications as soon as possible"; and then b) to also provide "information – via the repository – about tools and instruments at the disposal of the beneficiaries and necessary for validating the results (and – where possible – provide the tools and instruments themselves)." Over the years, stricter options were added for the health programme, in particular public health emergencies.

Additionally, the Horizon 2020 Annotated Model Grant Agreement (AGA) provides some best practice for research data repositories as follows:

> Useful listings of repositories include the Registry of Research Data Repositories (Re3data) and the Core Trust Seal certified repositories. One key entry point for accessing and depositing related data and tools is Zenodo. For further details on general and discipline-specific repositories visit the EUDAT Collaborative Data Infrastructure.[15]

Through Horizon 2020 there has been a move to see open research data in the larger context of sound data management as an essential part of research practice. In this context, the FAIR principles[16] (that is making data findable, accessible, interoperable, and re-usable) have been prominently integrated into Horizon 2020 data management guidance documents.

13 Opt outs are primarily possible for reasons related to personal data protection, IP/commercialisation, or national security.
14 European Commission (2017), p. 69ff.
15 Ibid.
16 Wilkinson, M. et al. (2016)

3. Open Access to Scientific Publications and Research Data in Horizon Europe (2021-2027)

Horizon Europe largely follows the principle of "evolution not revolution", with many provisions from Horizon 2020 being taken as the basis for the new programme, but also extended, updated and modified in line with the experience from the previous programme. Under the umbrella term "open science"[17], which is supposed to be the "modus operandi" in Horizon Europe, the regulation[18] therefore contains a number of updated requirements for open access to publications and research data.

For open access to publications the Horizon Europe regulation (articles 14 and 39) retain the wording of "ensuring" open access. The currently available pre-draft of the Annotated Model Grant Agreement lists open access provisions as part of annex 5, article 17 which deals with "communication, dissemination, open science and visibility". In a nutshell, in Horizon Europe "immediate open access is required i.e. at the same time as the first publication, through a trusted repository using specific open licences".[19] The latest version of the AGA (as of April 1,2023) makes clear that the obligation to ensure open access under the conditions set out in the Grant Agreement is considered a prior obligation, i.e. preceding any subsequent agreement with publishers.[20]

The sentence from the AGA quoted above not only summarises key changes *vis-à-vis* Horizon 2020, most notably the zero-embargo period and the open licencing requirement, but also highlights that the central importance of repositories has been retained and potentially even strengthened in Horizon Europe. The AGA provides an expanded definition of what a repository is but also what does *not* count as a repository:

> A repository is an online archive, where researchers can deposit digital research outputs and provide (open) access to them. Repositories help manage and provide access to scientific outputs and contribute to the long-term preservation of digital assets. They can be institutional, operating with the purpose to collect, disseminate and preserve digital research outputs of individual research organisations (institutional repositories, e.g. the repository of University X) or domain-specific, operating to support specific research communities and

17 Article 2 (5) of the Horizon Europe regulation defines 'open science' as an approach to the scientific process based on open cooperative work, tools and diffusing knowledge.
18 Regulation (EU) 2021/695 of the European Parliament and of the Council of 28 April 2021 (2021)
19 European Commission (2023), p. 281.
20 Ibid., p. 284.

> supported/endorsed by them (e.g. Europe PMC for life sciences including biomedicine and health or arXiv for physics, mathematics, computer science, quantitative biology, quantitative finance and statistics; Phonogrammarchiv for audiovisual recordings the CLARIN-DK-UCPH Repository for digital language data or the European Nucleotide Archive or databases of astronomical observations operated by the European Southern Observatory, among others). There are also general-purpose repositories, such as Zenodo, developed by CERN. Personal websites and databases, publisher websites, as well as cloud storage services (Dropbox, Google drive, etc) are NOT considered repositories. Academia.edu, ResearchGate and similar platforms do not allow open access under the terms required and therefore are also NOT considered repositories.[21]

Of key importance for both open access to publications and research data is the addition of the word "trusted" to repositories. Consequently, the AGA explains that the term trusted repositories can be grouped into three categories which may overlap:

- certified repositories, such as those certified by international organisations or government-authorised certification bodies (e.g. CoreTrustSeal, nestor Seal DIN31644, ISO16363)
- disciplinary or domain repositories commonly used and endorsed by the research communities, and which are recognised internationally
- general-purpose repositories, institutional repositories or any other repositories that present the essential characteristics of trusted repositories, i.e.:
    - display specific characteristics of organisational, technical and procedural quality, such as services, mechanisms and/or provisions that are intended to secure the integrity and authenticity of their contents, thus facilitating their use and re-use in the short- and long-term. Trusted repositories have specific provisions in place and offer explicit information online about their policies, which define their services (e.g. acquisition, access, security of content, long-term sustainability of service including funding, etc.)
    - provide broad, equitable and ideally open access to content free at the point of use, as appropriate, and respect applicable legal and ethical limitations. They assign persistent unique identifiers to con-

21 Ibid., p. 283.

tents (e.g. DOIs, handles, etc.), such that the contents (publications, data and other research outputs) are unequivocally referenced and thus citeable. They ensure that contents are accompanied by metadata sufficiently detailed and of sufficiently high quality to enable discovery, reuse and citation and contain information about provenance and licensing. Their metadata is machine-actionable and standardized (e.g. Dublin Core, Data Cite, etc.) preferably using common non-proprietary formats and following the standards of the respective community the repository serves, where applicable

- facilitate mid- and long-term preservation of the deposited material. They have mechanisms or provisions for expert curation and quality assurance for the accuracy and integrity of datasets and metadata, as well as procedures to liaise with depositors where issues are detected. They meet generally accepted international and national criteria for security to prevent unauthorized access and release of content and have different levels of security, depending on the sensitivity of the data being deposited, to maintain privacy and confidentiality.[22]

Based on a previous draft of these requirements from 2021, an ERC funded study recently found that while 90 % of "trusted" repositories are in line with basic open science requirements, only three repositories fulfilled all the mandatory requirements for metadata, and none met both the mandatory and the recommended metadata requirements set out in the Horizon Europe grant agreements.[23]

Additionally, the AGA also includes three additional requirements, which are mentioned here because they are provided *through* the repository:

1. Licencing requirement: as already mentioned, the Grant Agreement requires that the deposited publications *must* be licensed under the latest version of a Creative Commons Attribution International Public Licence (CC BY) or an equivalent licence. For monographs and other long-text formats the licence may exclude commercial uses and derivative works.

22 Ibid., p. 283f.

23 See https://erc.europa.eu/news-events/news/erc-study-identifies-repositories-allow-researchers-comply-eu-open-science-rules; the full study is available at https://zenodo.org/record/7728016#.ZFEUd3ZByd8

2. Validation requirements: “information must be given via the repository (or via the copy of the publication deposited in the repository) about any research output or any other tools and instruments needed to validate the conclusions of the scientific publication”[24]. Ideally, open access to these should also be provided. This requirement is very similar to Horizon 2020.
3. Metadata requirements: “Metadata should be in line with the FAIR (Findable, Accessible, Interoperable, Reusable) principles, in particular, it should be machine-actionable” and CC-0 licensed. Furthermore, "persistent identifiers (PIDs) must be provided for the Version of Record (VoR) of the publication (such as a Digital Object Identifier (DOI) or a handle), for all author(s) involved in the action (such as ORCIDs or ResearcherIDs) and, if possible, for their organizations”.[25]

For open data, article 14 of the Horizon Europe regulation[26] also uses the language of “ensuring” but with the addition of “in accordance with the principle ‘as open as possible, as closed as necessary’”. It also adds that “the responsible management of research data shall be ensured in line with the principles ‘findability’, ‘accessibility’, ‘interoperability’ and ‘reusability’ (the ‘FAIR principles’) and that “[a]ttention shall also be paid to the long-term preservation of data.”[27] Article 39 furthermore states that open access to research data

> shall be the general rule under the terms and conditions laid down in the grant agreement, ensuring the possibility of exceptions following the principle ‘as open as possible, as closed as necessary’, taking into consideration the legitimate interests of the beneficiaries including commercial exploitation and any other constraints, such as data protection rules, privacy, confidentiality, trade secrets, Union competitive interests, security rules or intellectual property rights. Furthermore, [b]eneficiaries shall manage all research data generated in an action under the Programme in line with the FAIR principles and in accordance with the grant agreement and shall establish a Data Management Plan. The work programme may provide, where justified, for additional obligations to use the EOSC for storing and giving access to research data.[28]

24 European Commission (2023), p. 285.
25 Ibid.
26 Regulation (EU) 2021/695 of the European Parliament and of the Council of 28 April 2021 (2021), p. 27.
27 Ibid.
28 Ibid., p. 39.

Already at this level, this provision strengthens the open data requirements and explicitly includes requirements for research data management, most notably a data management plan. The AGA[29] therefore contains a specific section entitled "Open science: research data management" and clarifies that the essence of the requirement is the responsible management of the digital research data generated in the action ('data') in line with the FAIR principles.[30] Beneficiaries should also ensure open access to research data via a trusted repository under the principle 'as open as possible, as closed as necessary'. More specifically, this results in the following requirements for participants:

1. Establishment (and regular updates) of a DMP
2. Deposition in a trusted repository; in some cases, it may be required that the repository takes part in the European Open Science Cloud (EOSC). Data should be kept for a substantial period of at least 5 years and preferably 10 years or longer;
3. Provision of open access "as soon as possible" to the deposited data under CC-BY, CC-0 or an equivalent licence under the "as open as possible, as closed as necessary principle"[31]
4. Provision of information via the repository about any research output or any other tools and instruments needed to re-use or validate the data.

Furthermore, metadata of deposited data must be open under a Creative Common Public Domain Dedication (CC 0) or equivalent (to the extent legitimate interests or constraints are safeguarded), in line with the FAIR principles.

Trusted (as defined above) repositories can be seen as the main go to points in order to comply with these requirements and can therefore be regarded as a central aspect of the Horizon Europe open data and data provision requirements. This impression is reinforced when looking at the Horizon Europe Programme Guide, which states:

> Horizon Europe requires information **via the repository** where publications and data have been deposited on any research output or any other tools and

29 European Commission (2023), p. 285ff.

30 It is also noted that generated data includes re-used data that have been processed or modified in a systematic or methodical way (ibid., p. 285).

31 I.e. unless this is against the beneficiary's legitimate interests, including regarding commercial exploitation; if it is contrary to any other constraints, such as data protection rules, privacy, confidentiality, trade secrets, EU competitive interests, security rules, intellectual property rights or would be against other obligations under the Grant Agreement (ibid, p. 287).

> instruments – data, software, algorithms, protocols, models, workflows, electronic notebooks and others – needed for the re-use or validation of the conclusions of scientific publications and the validation and reuse of research data[32] (own emphasis)

The Guide, furthermore, provides some information on the role of repositories in other open science practices, which Horizon Europe will encourage, most notably preregistration of the research plan in a public repository[33]; on this point the Guide also provides several example preregistration repositories[34], additionally to a more general list of repositories.[35]

4. Conclusions

So far, we have seen that Horizon Europe strengthens the open access, open data and data management provisions already present in Horizon 2020. The following table provides a summary overview of the requirements regarding repositories in Horizon 2020 and Horizon Europe respectively, as described in the main text above.

Table 1: Overview of open access and open data / data management requirements related to repositories

Horizon 2020	Horizon Europe
Basic definition of repositories	Extended definition of repositories (for publications and data) Addition and definition of "trusted" for repositories (for publications and data)
Obligation to deposit and provide open access to scientific publications after 6 to 12 months through a repository (gold OA also possible, if publication is also deposited); Creative Commons licence recommended, ensure open access to bibliographic metadata;	Obligation to deposit and provide open access to the scientific publications immediately (gold OA also possible, if publications is also deposited) as a prior obligation (i.e. surpassing subsequent agreements with publishers); Licencing, validation, and metadata requirements through the repository;

32 European Commission (2023b), p. 41.
33 Ibid, p. 42.
34 Ibid, p. 43.
35 Ibid, p. 50f.

Depositing and providing access to the data and metadata underlying the publication (if no opt out) through a repository, other data optional; Providing information on tools needed to access the data (if possible, the tools themselves).	Manage data according to the FAIR principles and deposit them in a trusted repository; Ensure open access through a CC-BY or CC-0 licence following the principle 'as open as possible as closed as necessary' through a repository; Provide information via the repository about any research output or any other tools and instruments needed to re-use or validate the data (good practice: the tools themselves); Some calls may require EOSC federated repositories.

Several implications of the strengthened mandate in Horizon Europe come to mind. Generally, the new rules succinctly state not only what is expected and required but also what is not accepted (e.g. ResearchGate not counting as an acceptable repository). While this provides more clarity, the stricter rules may, at least in the short term, also lead to a decrease in compliance by researchers until they are fully aware and informed of what is expected of them. For instance, an investigation into the use of creative commons licences Data Management Plans[36] found that only 36 % of DMPs mentioned creative commons in Horizon 2020. It will therefore take time and effort before the more stringent Horizon Europe requirements regarding the use of CC licences are implemented on the ground.

If the strengthened mandate is to have its desired effect (that is contributing to open science as the default), a number of flanking activities are therefore necessary:

- Awareness raising activities to inform researchers and engage them in the discussion: this is already being undertaken by the European Commission itself but also by other organisations, such as OpenAIRE.
- Monitoring: the actual implementation of the mandate needs to be monitored and the relevant data needs to be made publicly available so that it becomes apparent where beneficiaries are struggling (also in order to inform point Support below).
- Compliance/Sanctions: eventually, non-compliance will need to be sanctioned through a range of appropriate measures, which could also include – as the last case scenario – a reduction of the grant.

36 Spichtinger, D. (2022a), p. 1-13.

- Incentives: good data management practices should not only be mandated as an obligation but also be rewarded, e.g. through a dedicated data management prize or through extra money additionally to the EU grant.
- Support: beneficiaries reported lack of support with data management in Horizon 2020[37]; there is therefore a need to provide further assistance to them, for example through a dedicated EU Horizon Europe Data Management helpdesk.

Furthermore, there are also specific repercussions of the strengthened Horizon Europe mandate for repositories and their managers. They need to ensure that they either already conform to the new requirements (e.g. as regards licencing) or that they will upgrade their infrastructure and/or services accordingly. This may be particularly important for small thematic or institutional repositories.[38] Moreover, stakeholders like library services, grant offices and national contact points or similar organisations need to ensure that they are familiar with and can provide advice on the new rules to applicants and grantees.[39] [40] Overall, the strengthened mandate of Horizon Europe has the potential to further accelerate this transition if it is stringently implemented; in this context repositories have a key role to play.

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37 Spichtinger D. (2022b)

38 See also Hahnel, M.; Valen D. (2020), p. 192-198.

39 This is also reinforced by the statement contained in the ERC press release related to the repository study stating that it takes a high level of technical expertise to assess all requirements and corresponding features of repositories.

40 Spichtinger, D. (2023)

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