Academic Publishing as a Foundation and Area of Leverage for Research Assessment

Challenges and Fields of Action

Position Paper

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Table of contents

Executive Summary

The sector of academic publishing currently faces a number of challenges. These concern the visibility of published scholarship, unfavourable market structures and business practices, the development of new mechanisms of quality assurance and assessment, and the way in which the funding of research is linked to its assessment based on publishing metrics. In particular, the assessment of research based on bibliometrics can provide problematic incentives, thereby preventing the system of academic publication and research as a whole from developing in a way that is appropriate to its purpose.

The fundamental functions of academic publishing are to publicise, quality review and document academic findings and to attribute authorship and reputation. A publishing system that is appropriate to its purpose includes free choice of the form and venue of publication, the securing of exploitation rights by those publishing, and ensuring open access to the published material. This position paper underscores the need to support academics in meeting these requirements while at the same time enabling them to avoid succumbing to incentives that have the opposite effect. It is therefore aimed at both the academic community and public funding agencies. Together, they have a duty to ensure that research assessment is carried out responsibly and that the publication system develops in a way that is aligned with the interests of scholarship.

The preservation and promotion of such a system can only succeed if the underlying procedures for assessing research draw on a broad spectrum of academic productivity rather than reflecting a narrow focus on bibliometric indicators. Only where assessment procedures are sufficiently oriented towards the content of research is it possible to ensure that the entire spectrum of publication forms and venues is driven by research. At the same time, this entails effort and responsibility on the part of the academic community to safeguard and document the quality and value of research in its entire breadth.

The task of **the academic communities** is therefore as follows:

- *Establish, use and recognise new forms of quality review for publications*

In the digital environment with its numerous new publication options and venues, the issue of the appropriate quality review of published scholarship and publication venue must also be revisited. Authors of publications are responsible for ensuring the quality of the underlying research process and documenting this transparently. At the same time, it is up to them to choose academically and qualitatively appropriate venues for the publication of their research findings: this ensures that the fundamental procedures for high-quality, re-usable publication are adhered to and conveyed in a transparent manner. In this way, authors have the legally binding assurance that published content can be used in full in digital working environments.

- *Expand the notion of addressee orientation in academic publishing*

  Academic publishing takes place at different stages of the academic process, ranging from initial and consolidated results to final, stable outcomes. The target groups of academic publications cover a broad spectrum, from narrowly defined specialist groups to the entire academic community and indeed the public at large. For this reason, it is essential that the relevant target group is specifically addressed in each case in terms of format, text type, publication channel and readability of content. Meanwhile, aspects such as impact and reputation should not be the primary factors guiding the choice of publication venue.

- *Strengthen alternative systems of reputational attribution*

  A narrow focus in the system of attributing academic reputation – for example based on bibliometric indicators – not only has a detrimental effect on publication behaviour, it also fails to do justice to scholarship in all its diversity. Academic reputation is based not just on a broad range of publication types: it also includes contributions to the academic community and broader public interest, as well as the assumption of responsibility and taking on tasks such as coordination and management. These differing aspects should also be appropriately recognised as part of assessment procedures.

- *Ensure that scholarship has control over its own data*

  In many instances, the current publication system favours the diverse findings and results of scholarship being produced by academics but then placed in the hands of commercial providers for the purpose of publication. Here, it is important for scholarship to establish autonomous control over its own publications and the relevant use traces, making data collection more transparent or organising the process itself so as to avoid dependencies. Otherwise such dependencies are bound to be reflected in the context of assessment when the products of commercial providers are used.

  The **funding agencies and providers of finance** – including the German Research Foundation – have a responsibility to:

- *Broaden the spectrum of accepted publication formats*

  In terms of publication formats, it is crucial for a good match to be achieved between the content to be conveyed and the target group. Responsible research assessment should provide support here by explicitly accepting the entire spectrum of academic publications. At the same time, there should be no incentive for giving preference to certain publication formats or venues simply because they promise an advantage in terms of peer review or evaluation.

- *Attach greater importance to proof of achievement that is geared towards content*

  Responsible assessment of research is based on the content of academic output. It is not derived from any standardised procedure for publishing academic findings, so it should deliberately refrain from setting any incentives to align academic activity and publication types with the assessment procedure.

- *Strengthen the recipient side*

  Readers should be able to search for and find academic publications in an appropriate way and select them according to content-based criteria. However, the large-scale commercial search systems currently in use do not come close to reflecting the publication system in its entirety. For this reason, it is important to continue to support research-driven and science-led activities that seek to develop services for specialist research, make academic information available and develop the infrastructures required for this purpose.

Foreword

Academic publishing is one of the core functions of academic activity and therefore of the research system itself. As the funding body for scholarship in all its branches and as the self-governing organisation of German research, the DFG is committed to the appropriate communication of research results and the maintenance of a functioning publication system as a basic requirement of the research system. To this end, it follows the relevant trends and developments and also assesses these with regard to its own role.

From the perspective of Germany as a centre of science and scholarship, various developments in the field of publishing are currently in need of discussion: the advancing open access transformation, the further development of quality review in publishing and – a matter of great concern – the effects of bibliometrically supported incentive and assessment systems on the various publication cultures, objectionable business practices and the question of the reproducibility of published science.

The developments mentioned cannot be grasped without an appreciation of their causal link to the practices of research assessment. In addition to their communication function, academic publications have a key role to play as a basis for the evaluation of research achievements and the allocation of resources that this gives rise to. By the same token, the assessment of scholarship is a powerful incentive that impacts on the form of publication.

Current observations now suggest that publishing is moving in an unfavourable direction due to reciprocal effects with assessment structures in many areas of the research system. The logic of research and publishing that is geared towards bibliometric indicators is now also beginning to take hold in previously unaffected areas of scholarship and influences the culture in these areas. Corrective measures are required here.

This problem has been the subject of intense debate at the international level for some time, too, and has already resulted in changes being made to guidelines and assessment standards in the field of research funding in many places. There is no doubt that it is in the interests of scholarship for academic publishing to primarily serve the purpose of the dissemination, quality review and documentation of research findings. Scholarship must always be in a position to gear its publishing activity freely towards research content and towards the discourse and dialogue that it seeks with the target groups it is addressing. It should be assessed on this basis, too.

Ensuring this happens ought to be an essential goal of academic self-governance and of responsible research administration and funding. In the following, therefore, the main problems involved in this situation will be described, after which the challenges will be defined and potential courses of action proposed. As such, this analysis aims to serve as a contribution to ensuring that the publication system develops in a way that is conducive to scholarship.

1 Fundamental features of the publication system

The term academic publishing is used broadly in the chapters that follow. It covers all actors involved in the production, dissemination, reception and archiving of academic publications, including researchers, variously organised publishers, service providers for the publication process and intermediaries, platforms, libraries and archives, information facilities and providers of publication-related services.

“Publication” is to be understood here to mean “making something public”. The term “publication” essentially covers all types and formats of dissemination as well as media and text types in which scholarly ideas, reflections, findings and results are communicated.

1.1 Basic functions of academic publishing

According to Roosendaal (Roosendaal & Geurts, 1999), it is possible to distinguish four functions of academic publishing: awareness/dissemination, certification, archiving and registration of authorship. In this paper, the publication functions are differentiated according to Roosendaal’s system, whereby we use the term “quality review” as a generic term for “certification” and “content evaluation”. Furthermore, the attribution of “authorship” is supplemented by the function “attribution of reputation”, which is draw from the context of “certification”. This results in two separately considered functional complexes.

1. Dissemination, quality review and documentation of research findings

The essential function of academic publishing is to disseminate the results of research activity and make other researchers aware of them. Publication also documents and secures the research results in the long term. This enables critical discourse to take place within the research system as well as in the public sphere without any time limit: as a result, the validity of the output can be determined and verified, also allowing the innovative content of the output to be established. In this way, the foundations are laid for the research findings to be applied and for further discussion to take place.

As such, publication makes the outcome of research potentially verifiable and compatible.

2. Attribution of authorship and reputation

Another function of academic publishing is the attribution of authorship, i.e. the assignment of a particular research finding to one or more researchers (peer-oriented, social goal). This attribution also forms the basis of the reputation system, thereby serving to ensure accountability

to funders and enabling the assessment of academic performance (Merton, 1985; Luhmann, 2005).

In the practice of publishing, there are interactions between these functions. For example, the reputation conveyed by past publications has an impact on the first functional complex. On the one hand, reputation already gained can have a positive effect on the perception of what is subsequently published, thereby strengthening the impact of the publication (e.g. through easier access to reputable and widely read publication venues[1]). On the other hand, it can also convey confidence in the quality of what is subsequently published and therefore interfere with the assumed necessity and control of publication-related quality assessment (Matthew effect).

By contrast, academic publishing does not actually aim to create the basis for assessing grant and personnel financing systems. However, the fact that research assessment often starts at this point cannot help but impact on publication behaviour (see section 2.5).

What is particularly characteristic of each publication culture is whether research assessment is oriented more towards the first or the second functional complex of academic publishing.

1.2 Prevalence of publication types and practices

National and international studies indicate that the publication culture in the individual academic disciplines is highly differentiated and that there are even considerable differences within individual disciplines (Rosenbaum, 2016; Butler, 2006; Butler & Visser, 2006; Alexander von Humboldt-Stiftung (Hrsg.), 2009; Spoerhase & Hirschi, 2015, p. 3; Projekt AuROA, 2022, pp. 6–8).

At the same time, it cannot be assumed a priori that the broad spectrum of academic publishing formats used is reflected one-to-one in the CVs and proposals submitted to funding bodies for the purposes of evaluation and review. In order to gain an insight into the range of publication types available in the context of DFG reviews, a survey was conducted among the supervisors of the DFG Head Office's review boards, of which there were 48 at the time of the survey (see appendix in section 6). This revealed a differentiated pattern at the level of the four academic fields of the humanities and social sciences, life sciences, natural sciences and engineering (see Figure 1) and also at the level of individual review boards (see Figure 3). Info Box 1 provides an overview of the most common forms of publication used in the DFG procedures under consideration (see section 6.1).

The publication types indicated by the review boards in the humanities and social sciences differ considerably and are to some extent influenced by their proximity to subjects in other

[1] Such as a highly acclaimed book series, a reputable journal, proceedings of a renowned conference.

academic fields. Journal articles are mainly indicated for subject areas addressed by the "Psychology" review board, for example, where there are overlaps with the life sciences. By contrast, in the subject areas addressed by the review board "Art, Music, Theatre and Media Studies", monographs are almost exclusively referenced. Publication venues are offered in both digital formats (e.g. e-books, specific electronic journals),[2] and non-digital formats (e.g. printed books).[3] Looking at the cross-section in the humanities and social sciences, the dominant publication types are monographs, anthology volumes and journal articles, with subject-specific preferences for individual formats.

In all 25 review boards in the life sciences (n=7) and natural sciences (n=18), based on the responses given by review board supervisors, the share of specialist journals among the various publication formats indicated is either high (3) or very high (22). The average share of all other publication formats apart from the journal article is minimal to low (see Figure 1). In some subjects in the natural sciences such as mathematics, publications on preprint servers have an important role to play. Statements from the life sciences indicate that preprint servers have gained in importance in recent years and continue to do so (Chiarelli, Johnson, Pinfield, & Richens, 2019).[4]' [5] Journal articles, which prevail in the life sciences and natural sciences are significant in that "first" and "last" authorships are particularly prestigious and therefore highly coveted, for example. In some subject areas in the natural sciences, the opportunity to provide the design for the cover page of a journal is often regarded as a sign of the highest reputation and is sometimes offered at a high price at the invitation of the journal editors. Another noticeable phenomenon is publications of large-scale experimental collaborations in sub-fields of physics, in some cases involving thousands of members and who are therefore listed as authors, usually in alphabetical order.

The engineering sciences review boards also exhibit a high to very high share of publications in journals (6 out of 10 review boards). One aspect that is more widespread here than in the other three academic fields is the reporting of patents, software and code as well as data packages (see Figure 1) as evidence of academic output. In many cases, the publication types used in the engineering sciences reflect the desire to make results available for commercial implementation in industry. This proximity to business is also evident in a segment of (academic) journals that publish not only scholarly papers but also editorially or commercially motivated articles.

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[2] whereby reception is often based on parallel print publications.

[3] See also: Krey, 2020, p. 128ff.

[4] This trend was most recently accelerated by the COVID-19 pandemic (Deutsche Forschungsgemeinschaft, 2020; Fraser, et al., 2021).

[5] In recognition of the great importance of preprints, Paul Ginsparg, founder of ArXiv (https://arxiv.org/), received the Einstein Foundation's 2021 Individual Award: www.einsteinfoundation.de/en/award/booklet/individual-award-2021-paul-ginsparg/, January 5, 2022.

For most subjects, the DFG's internal survey revealed a predominance of publication in journals, with the latter's share of all publication types being reported as high to very high by 36 out of a total of 48 review boards.

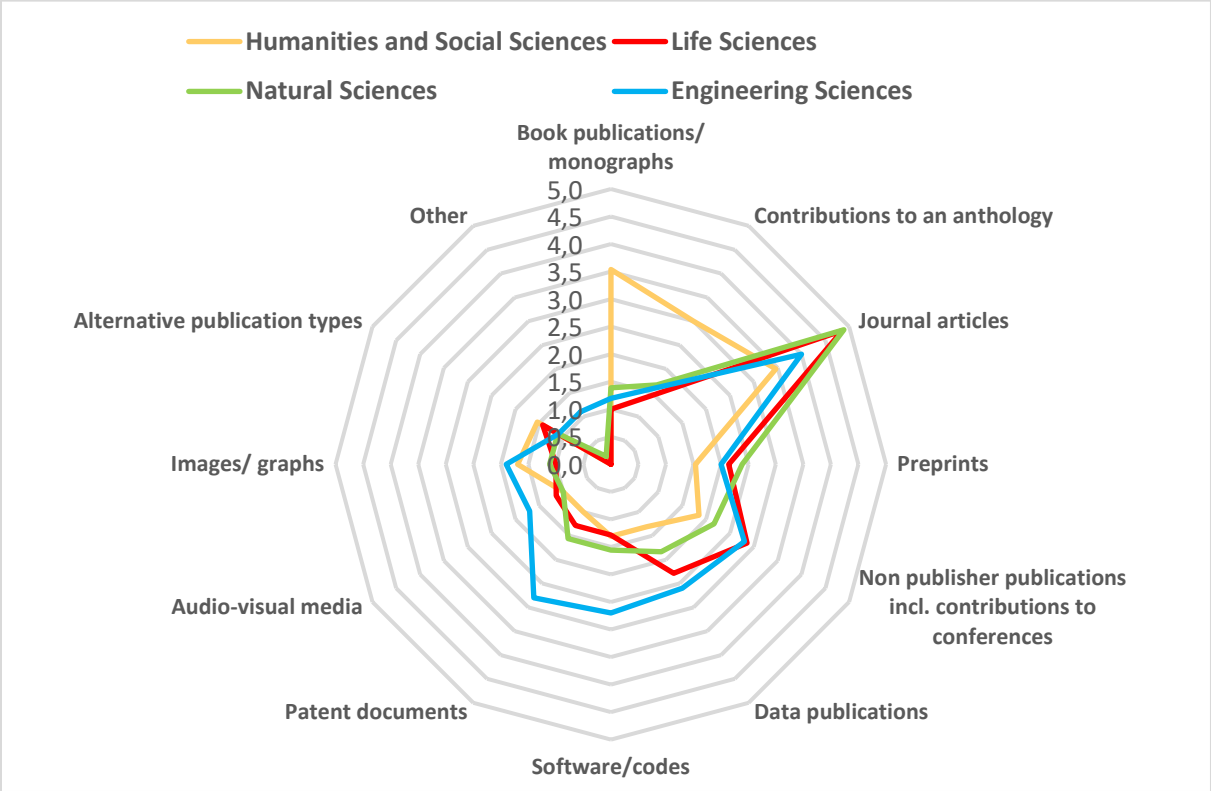

Figure 1: Share of publication types in the DFG's four academic disciplines according to a survey conducted among review board supervisors at the DFG Head Office in August 2018. Spider web diagram: 5 = very high share, 4 = high share, 3 = medium share, 2 = low share, 1 = minimum share. A detailed presentation can be found in section 6 (Appendix) on page 74, Figure 3.

Info Box 1: Widespread publication types

Publication types with a unique and persistent identifier (such as ISBN, ISSN and DOI), long-term availability and stable final version:

- Journal article
- Book publication/monograph
- Contribution to an anthology
- Presentation at an academic congress, with an abstract included in the subsequent proceedings publication
- Article on preprint server
- Data publication
- Patent document
- Some codes/software
- Some blogs

Fast publication types with hyperlink, changeable content and possibly non-permanent referencing:

- Website
- Document or media content on (openly accessible) server
- Some codes/software
- Some blogs
- Social media post

Others:

- Lecture or poster at an academic congress without further availability
- Articles in the mass media (print, radio, television)
- (Contributions to an) exhibition

and others

Info Box 2: Characteristics of widespread publication types

Journals have traditionally played a prominent role in the communication of research outcomes in many disciplines; this value remains or has even grown in the digital context and is tending to take on an orientation or filter function as the sheer volume of publications increases. Most of the currently approximately 30,000 peer-reviewed academic journals are listed in (mainly commercial) databases (Boon, 2017). Journal articles, which are short and mainly structured in the same way as monographs, can be linked and enriched with other content and metadata (data sets, patents, data on funds raised, preprint, etc.). This results in numerous cross- links within the digital reception space.

Monographs as longer, self-contained and coherent treatises on a subject (Hagner, 2015, p. 242; Kaulen, 1993)and are of great importance in the social sciences and humanities, also in terms of career development. They are subject to a comparatively longer time horizon in terms of production and reception. The majority of monographs are published without peer review prior to publication. The publication itself is a prerequisite for the usually discursively complex content to be negotiated and discussed by peers (reviews, processing by means of citation in the publications of other researchers). Monographs are frequently written in the national language and listed as individual publications in publishers' and libraries' catalogues or databases. German-language monographs are listed as standard in the *Verzeichnis lieferbarer Bücher*, the reference database of the book trade, and are archived by the German National Library.

Anthologies are used to varying degrees in the various disciplines and do not enjoy the same status in all areas. Anthologies are very divergent, ranging from well-structured edited works in which the contributions are compiled on a topic from several perspectives (so-called "working editor", authors are selected and invited, composition) to point-in-time anthologies (e.g. conference proceedings), which include cumulative contributions on a (broad) topic and usually involve a prior peer review.

In view of digitalisation, the traditional formats are losing their distinct contours (Spoerhase & Hirschi, 2015, p. 12; Breuer & Trilcke, 2021), since they are essentially being extended and can be linked as parts of larger units and enriched with audiovisual content. The German Council of Science and Humanities has recently commented on the transformation of formats and the further development of publications into digital objects (Wissenschaftsrat, 2022, pp. 40-44).

1.3 Types of access and rights situation

As in many areas, extensive digitalisation has also taken place in the scholarly book sector.[6] The legal situation in this context is more complicated than in the analogue world. Depending on the licence model, electronic books can be borrowed or downloaded at will, only per person and/or only after a waiting period of up to one year ("windowing"). Access to e-books is partly via individual licences and partly via institutional access, increasingly also in the form of e-book packages. Since the existence of print titles remains a requirement in many book-oriented academic fields (especially for reasons of better reception), duplicate acquisitions are often necessary.[7] With regard to the provision of books, there have been lengthy legal disputes in the past over the extent to which libraries are allowed to digitise books they have acquired and make them available on electronic reading stations.

For software and data from the sciences, the access and rights situation is currently heterogeneous and complex; at the same time, rapid development can be observed both in academia and among commercial platform providers. All in all, various actors are currently involved in shaping the ethical, legal, infrastructural and commercial aspects. For access to research data, appropriate subject-specific solutions are being developed by the individual consortia, particularly in the context of the National Research Data Infrastructure (NFDI)[8] . In the case of programme packages, such as simulation codes, licensing can be both commercial and free, e.g. under a General Public Licence (GPL). Git systems are often used in the academic context for access and distributed version management of source code. In addition to institutional software repositories, e.g. based on GitLab, many subjects also use GitHub, a platform belonging to Microsoft (Perkel, 2016).

Access to a large number of the articles in digital journals is regulated by the subscription model introduced for the distribution of print publications, where costs are incurred for accessing publications. For digitally available formats, institutional subscriptions or licences ensure immediate single-click access for members of the respective institution. In addition, there are other forms of paid access such as the purchase of a digital copy or access to it. In Germany, many (past) publications are accessible to members of participating institutions and to private individuals via the DFG-funded Alliance licence or national licence archives. Interlibrary loan also offers access options, but these are less convenient in the digital context, not least due to

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[6] Recently, triggered by the COVID-19 pandemic, libraries have considerably expanded their e-book offerings. In the federal state of North Rhine-Westphalia alone, the state government made an additional €40 million available for e-book licences in 2021: www.land.nrw/pressemitteilung/hochschulbibliotheken-landesregierung-stellt-40-millionen-euro-fuer-e-book-lizenzen, January 21, 2022.

[7] For intensive reading, the print version is preferred, though the digital version is valued for quotations or brief consultations. It can be assumed that this is not merely a transitional phenomenon, but that different usage scenarios have developed for printed and digital formats.

[8] www.nfdi.de/?lang=en, April 27, 2022.

legal requirements. The rights to redistribute and otherwise use journal articles are usually held by the publishers.

In addition to these forms of access, there are various forms of open access to publications: this means that the publication is available to all readers without restriction and can be re-used in a legally protected manner. The various types of OA publication have an important part to play (see Info Box 3) where the financing of publishing can take place based on Article Processing Charges (APC)[9], for instance. Numerous journals or platforms in different disciplines are often run by publicly funded institutions and/or maintained through collective funding and do not charge for publication. (Bosman, Frantsvåg, Kramer, Langlais, & Proudman, 2021) In the case of articles published in open access, only simple rights of exploitation or use are to be passed on as standard and the authors are to retain the option to redistribute their publications. Legal regulation of usage types usually takes place via standardised Creative Commons licences. In the area of Open Access, so-called mega-journals[10] and platforms have emerged that bring together a large number of different topics and journals. Open Access models and activities are still less developed and tested with books as a publication form than they are with journal articles (Hagenhoff, 2022 (in print)). In recent years, however, many publishing companies have begun to offer OA options as well (Projekt AuROA, 2022). University presses have long been active in this form of publication and offer high-quality publishing opportunities.[11] They also define formal quality criteria for OA publication (Arbeitsgemeinschaft Universitätsverlage, 2018). Open Access publication is to become the standard form of academic communication in Germany.[12] The German Council of Science and Humanities has recently made recommendations in this regard, citing in particular the golden and diamond paths of Open Access as suitable, i.e. free access at the time of publication after peer review in the official version of record in the original publication venue and under a CC-BY/CC-BY-SA licence (Wissenschaftsrat, 2022, pp. 29, S. 40ff). In its analysis, Council of Science and Humanities treats access pathways and business models separately.
In the DFG's view, other forms of Open Access, such as preprints, i.e. publications before or without peer review for the purpose of academic dialogue, are also suitable for the purpose of communication and documentation (see 1.1.) (Chiarelli, Johnson, Pinfield, & Richens, 2019,

[9] Under the APC model, the costs of publication are borne by the authors or their institutions. As of January 2022, the Directory of Open Access (OA) Journals lists a total of 17,377 quality-assured OA journals, of which 12,250 are without APC. Even though only about 30% of quality-assured OA journals charge fees, some 60% of all OA articles are published in fee-paying journals (The Budapest Open Access Initiative, 2022). APCs for "hybrid" OA journals are higher on average than those for purely "gold" OA journals.

[10] In the first decade of the 21st century, one such mega-journal, PLos ONE, saw the largest overall increase in its number of articles (Heller, 2012); it can be assumed that there has been a stagnation since then.

[11] Arbeitsgemeinschaft der Universitätsverlage, https://ag-univerlage.de, January 20, 2022.

[12] BMBF Open Access Strategy (Bundesministerium für Bildung und Forschung (BMBF), 2018, p. 6), coalition agreement between SPD, BÜNDNIS 90/DIE GRÜNEN AND FDP, p. 24., www.spd.de/fileadmin/Dokumente/Koalitionsvertrag/Koalitionsvertrag_2021-2025.pdf, January 20, 2022.

p. 16), and access via channels other than the original publication venue may also be appropriate against the background of data sovereignty (see 3.1.4.). The DFG recently signed the Action Plan for Diamond Open Access to support scholarship-driven publishing without profit interests.[13]

In other European countries, Plan S[14] for Open Access is currently being implemented. In Horizon Europe, Open Access publication is mandatory and Open Science practices are also considered to be aspects of the excellence and implementation quality of projects.[15]

[13] www.dfg.de/en/research_funding/announcements_proposals/2022/info_wissenschaft_22_26/index.html, 31.03.2022.

[14] 'Plan S' and 'cOAlition S', www.coalition-s.org, January 20, 2022.

[15] Open Science in Horizon Europe, https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/other/events/20210421/open-science_en.pptx, January 20, 2022.

Info Box 3: Established forms of Open Access

Diamond Open Access

The publication platform or journal is based at a public institution or is financed and maintained institutionally or cooperatively or by individual communities or scholarly societies. As a rule, no publication fees are charged here. Further use is clearly regulated based on the granting of licences.

Gold Open Access

The publication platform or journal exclusively offers the open access model. In some cases, fees are payable for publication. Further use is clearly regulated based on the granting of licences.

Green Open Access

Variant in which publications that appear in subscription journals are made publicly accessible retrospectively after a set period of time. Here, further utilisation is generally not legally regulated and is therefore difficult. Preprints are often attributed via this route, but they are not Green Open Access because they are first publications.

Hybrid Open Access

Under this model, authors are free to publish their articles either in open access, but with an article processing charge (APC), or according to the subscription model. Other fees are often due in addition to or instead of OA fees (submission charges, page and colour charges, etc.). The fees for hybrid open access publications are higher on average than for gold open access. Currently, parts of hybrid publishing portfolios are being transferred to OA via transformative agreements (e.g. in Germany Wiley, Springer and Cambridge University Press).

Due to the business model and the existence of transformative agreements, the DFG only supports this access route if the charging of access and publication fees is handled through the agreements. For this reason, the distinction between gold and hybrid remains relevant in terms of funding.

Bronze Open Access

This enables content to be read but not further used or exploited because transfer is not permitted, either technically or legally. This form of access is not Open Access in the true sense of the word.

The proportion of academic articles published under the Open Access model has been growing steadily for years, especially under the Gold Open Access model, with publication numbers increasing overall. In 2020 there was a surge in the share of OA that resulted primarily from the growth in hybrid and gold formats (see Figure 2). In 2021, the share of articles not published in OA was again slightly higher than in the previous year, but the share of gold and hybrid OA articles also continued to rise.

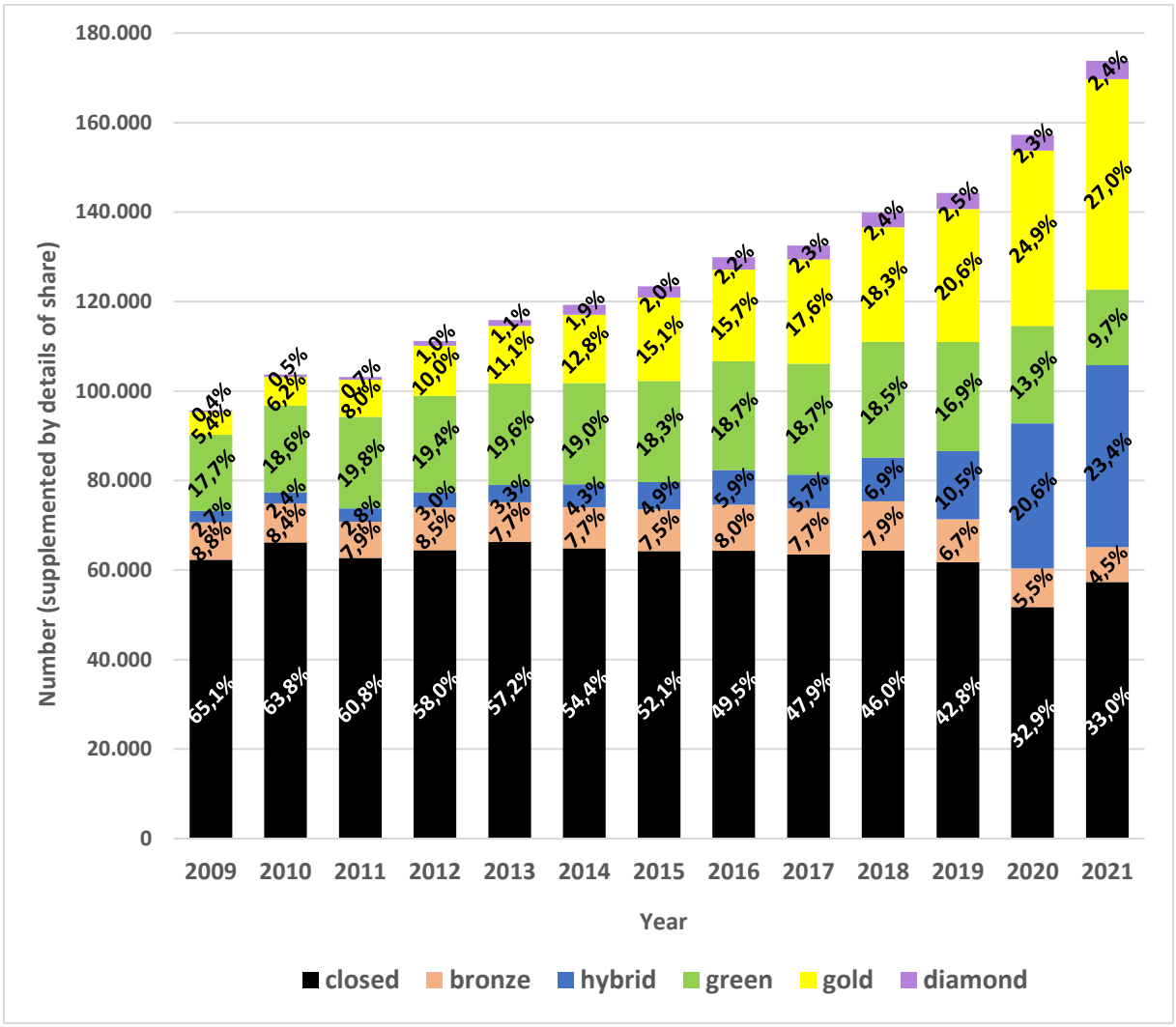

Figure 2: Absolute publication figures with share of closed access and open access in the years 2009 to 2021 for Germany. Articles were counted where at least one author had a German institutional affiliation. The "green" category includes: second publications in the form of the publisher's version or the Accepted Author Manuscript, as well as preprints that were published (and may differ in content from another version). Data basis and sources: for the number of articles: Dimensions, for the determination of open access status: Unpaywall. Data status: 11.03.2022. Developed by Forschungszentrum Jülich, presentation modified.

1.4 Variants in the quality review of publications

Depending on which forms of publication predominate, there are major differences between subjects in terms of the prevailing practices in the quality review of publications, their acceptance and their capacity (see section 2.4). At the same time, new digital forms and channels of publication consistently make it necessary to question existing mechanisms, to adapt them and to establish new ones.

Regardless of the form of publication considered in each case, the associated quality review can be represented as a combination of two partial assessments that cannot generally be clearly distinguished from each other: firstly, that of determining minimum quality in terms of the underlying research processes, compliance with standards and basic formal requirements (quality assurance), and secondly, the assessment of content (quality review), which is more selective in character. Characteristic variants of quality review can be assigned to the various text forms, publication formats and venues (see Info Box 4). The aspects of quality assurance and assessment can be combined in the same step, as in the case of journal peer review, for example, or they can be carried out separately, as in the case of monographs (review follows publication). In the digital context in particular, different variants can be observed in which quality assurance and assessment are distributed among different actors and are also carried out at different times, whether before or after publication.

Info Box 4: Common forms of quality review for publications

Journal articles are usually subject to peer review as a process of reciprocal assessment of manuscripts among colleagues prior to publication. This procedure is primarily used to examine the content of the work (quality assessment) but also includes formal aspects (quality assurance).

In the case of **book publications**, the quality of the content can be assessed both before publication, e.g. by editors or by involving a peer review board, but in particular afterwards in the form of reviews, citations and inclusion in subsequent discussion processes. Aspects of quality assurance in the form of proofreading (e.g. checking citations), on the other hand, are carried out in the run-up to publication for logical reasons.

As a rule, manuscripts posted on **preprint servers** can be cited and commented on by recipients (downstream quality check); however, they are not usually subject to a standardised quality assessment procedure beforehand, but are curated by subject experts, for example. Approximately 60-90% of preprints (depending on subject and server) are also published in a specialist journal, which in turn involves a quality review and assessment (see above, as appropriate for journal articles).

Conference contributions are selected based on both abstracts and full papers. They often pass through a peer review process.

Data packages, software, code and **patents** require other kinds of quality assurance and assessment, which, apart from patent examination, are barely covered by formalised processes. Here again, alternatives are currently being publicly discussed since peer review has proven to be less suitable for these forms of publication.

In addition to the "classic" forms mentioned above, new forms and organisational models of peer review adapted to digital communication are now well established. One example here is community peer review[16] following initial publication. Others include open peer review[17] (mainly in the case of preprints), the publication of the final reviews included in the journal peer review, the possibility of comments by non-pre-selected persons, and also the peer review consortium.[18] It is also possible to combine models of peer review in advance with the possibility of content assessment and further development of the publication after release, as practised by

[16] For example the scholarship-driven Community Peer Review in Paleontology, https://peercommunityin.org, 21.01.2022.

[17] As offered by de Gruyter, for example https://opr.degruyter.com, January 21, 2022.

[18] For example the Neuroscience Peer Review Consortium, http://nprc.incf.org, January 21, 2022.

Nova Acta Leopoldina live, for example.[19] The contributions to a publication can also be individually referenced and the academic discourse is digitally mapped.

Models involving post-publication assessment of content mean that pre-publication review by the publication medium can be limited to simply ensuring minimum methodological standards. These might include the type, scope and documentation of quality assurance applied in the research and publication process. Evaluation of the content to determine its quality or level could then take place after publication based on the participation of the community and peers (Kohle, 2015). In the case of online publications, it is possible to change publications dynamically, but this requires appropriate transparency with regard to the processes and labelling of the status of a publication. Post-publication critique and evaluation can be incorporated in a later version. Different versions of publications must be capable of being referenced as such. This approach is becoming especially noticeable in connection with preprint servers.

1.5 Reputation: Publication venue and bibliometric indicators

While conclusions can be drawn from the form of publication (e.g. journal article or book) about the preparation and in part also the type of content (see section 1.2) as well as the forms of quality review applied (see section 1.4), the choice of publication venue (e.g. journal A as compared to journal B) often involves an assumed quality of content of the articles published (Projekt AuROA, 2022, pp. 14–18). A publication venue conveys a certain reputation. For this reason, even without knowledge of the content, a monograph published by a renowned publisher will be regarded in the relevant subject-specific circles as being of higher quality than if it had been published by a publisher of lower reputation or without a publisher. The same applies to papers published in renowned journals or lectures given at renowned conferences. As such, classification of the assumed quality of a publication can take place at the level of its potential recipients prior to reception or even without reception even taking place (Hirschi, Vom Nachteil der Peer Reviews, 2018 A, p. 12). The principle can be scaled up to the level of individuals or institutions, according to the number of publications at renowned venues. This means that a bibliometric assessment is made. While monographs, for example, are less suitable for comparisons with regard to the number of publications due to the fact that they usually involve longer time periods and are less conducive to standardisation, academic papers have proven to be a particularly accessible form of publication for metric evaluation. Paper-related publication metrics allow various quantitative statements to be made regarding publishing. Publication productivity (number) and perception (citations) are especially frequently used indicators. An overview of the most common publication metrics is provided in Info Box 5.

[19] NAL-live: www.leopoldina.org/en/publications/scientific-journals/nal-live-about/, April 27, 2022.

Info Box 5: Key metrics and indicators

Bibliometrics uses various types of measurement to attempt to quantify the publication performance, influence and relevance of journals, individuals and institutions. The resulting figures are often based on citation databases of academic publications, which are operated virtually exclusively by commercial providers (e.g. Web of Science by Clarivate Analytics or Scopus by Elsevier).

Metrics for journals:

- **Journal ratings/rankings:** Often carried out by scholarly societies and partly survey-based, journal ratings/rankings provide a weighting or ranking of the journals relevant to a particular subject area according to the reputation attributed to them. An example from the field economics is the "Journal Quality List"(https://harzing.com/resources/journal-quality-list).
- **Journal impact factor:** This is an indicator of the citation frequency of articles in a journal. In order to determine the journal impact factor (JIF, also just impact factor, IF), the citations in a given year are calculated in relation to the number of publications within the two previous years (Lewandowski, Schlagwörter des Wissenschaftssystems: Journal Impact Factor, 2006). This indicator was proposed and developed by Eugene Garfield (Garfield, 1955; Garfield, 1972). The JIF is often used as an indicator of a journal's reputation, influence and relevance. The relevant analyses are offered by various providers, the best known being the Clarivate Analytics Impact Factor, which is published annually in the Journal Citation Reports (Lewandowski, 2006).

Metrics for individuals or organisational units:

- **Total number of publications:** The total number of academic publications, e.g. per time interval or in the High Impact Journal category, as a measure of the productivity of researchers and organisational units.
- **Total number of citations:** The total number of citations of all academic publications of a person or organisational unit in other works. This is often used as a way of quantifying how much influence the work of one person (or organisational unit) has on the work of other researchers.
- **h-index**: The h-index (also h-factor, Hirsch index) is a bibliometric measure proposed in 2005 by the physicist Jorge Hirsch (Hirsch, 2005) to allow quantification of the cumulative academic productivity of researchers. The h-index indicates the number *h* of publications by a researcher that have been cited at least *h* times by other papers. The h-index is therefore a weighted combination of the number and citation frequency of a person's publications.

Other:

- **Follow-up indicators:** Many other indices are follow-up indicators of either the JIF (www.ncbi.nlm.nih.gov/pmc/articles/PMC6002049/bin/pone.0199031.s001.docx) or of the h-index (www.ncbi.nlm.nih.gov/pmc/articles/PMC6002049/bin/pone.0199031.s002.docx).
- **Percentile-based indicators** such as the excellence rate take into account the problem of "skewed" distributions of citation numbers (Waltman & Schreiber, 2012).
- **"Alternative metrics":** So-called "altmetrics" attempts to include further reception channels such as social media (see for example www.altmetric.com).

Publication metrics are generally easy to understand and quickly available via a wide range of databases. The journal impact factor, for example, is recorded centrally and online and provided by publishers on their websites. Compared to the mere consideration of the reputation of publication venues, metrics are technically supported reference figures that are more differentiated and easier to quantify[20], as well as promising comparability across much larger populations. They allow quantitative statements to be made about individual works and entire journals, as well as on the publication behaviour of authors, institutions, states and even continents. As such they are proving to be a highly influential factor both in terms of the assessment scholarship and also in economic terms. At the same time, the aforementioned metrics are incomplete with regard to the impression of the impact of research that is to be conveyed: such metrics and the data sets required to create them fail to take comprehensive account of national-language and book publications or media in smaller or new subject areas and their scholarly processing, or do so to a far lesser extent. The same essentially applies to metrics as to the reputation of the publication venue: a publication with the same content at different publication venues will initially be attributed different levels of quality based on the publication venue. Clearly there is a conflict here between different basic functions of academic publishing (see section 1.1). The informative value of such secondary quality attributions for the evaluation and comparison of academic performance is limited and certain framework conditions must be observed when applying them. For example, they are not accepted or even comparable in all disciplines, or if so then only in narrowly defined areas. Bibliometric indicators, on the other hand, are easy to manipulate, which is a particular problem when they come to form the basis of allocation systems as key indicators (see sections 2.5.2 and 2.5.3).

[20] Often the basis for rankings or categorisations (e.g. classifications as “top journals”, “good journals” and “journals with a low level of recognition”)

2 Current challenges

The functions of dissemination, quality review and documentation of academic knowledge are extremely diverse today. In particular, digitalisation essentially enables immediate publication in a wide variety of formats and at different levels of quality review, while at the same time providing global reach (see section 1.2). At the same time, findings at the level of all publication functions indicate that nature and further development of the publication system as a basis for dissemination and evaluation in a way that is appropriate to scholarship are reaching their limits in many areas. Challenges here concern the visibility of published scholarship (see section 2.1), the market structures – especially in the journal segment (see section 2.2), the development of new mechanisms of quality assurance and assessment (see section 2.4), and the linking of research funding to research assessment based on published output parameters (see section 2.5).

2.1 Publication visibility

The number of academic publications appearing worldwide has doubled every 15 years since the mid-18th century (de Solla Price, 1961, pp. 161–195; Larsen & von Ins, 2010; Tenopir & King, 2014).[21] Meanwhile, the number of people working in academia is growing at a similar rate to the number of publications (Mabe, 2009, p. 4; STM: International Association of Scientific, Technical and Medical Publishers, 2018, p. 28). Yet even given increasing specialisation, each individual is confronted[22] with a continuously growing amount of information ("Supply is racing ahead of demand", (Hirschi & Spoerhase, 2015, p. 8)), which is becoming more and more comprehensive and immediately accessible thanks to digital media. This requires a high degree of individual perception management on the part of potential readers. In meeting this challenge, little insight has been available from science research. There has been no systematic build-up of knowledge about the ways in which academics perceive published findings and the effects of different perception tools (Hagenhoff, 2022 (in print)). As such, all one can do is make observations and draw conclusions. The inclusion and exclusion of certain

[21] This trend has begun to level off in the countries of the Western world, but global growth is now being driven largely by emerging countries such as India and China (STM: International Association of Scientific, Technical and Medical Publishers, 2018, p. 34). This was predicted by de Solla Price, assuming natural growth limits (de Solla Price, 1961).

[22] However, it is almost impossible to methodically define what the specifically delimited subject areas are in each individual case and to what extent their relevant output is growing (Small, 2006).

publication types, venues (reputation) and periods can be seen as an explicit or implicit narrowing-down strategy[23].

The major literature and citation databases such as Scopus, Web of Science, and PubMed offer options for filtering and sorting by keywords, citations[24] and other metadata. They are widely used as fast tools for keyword searches covering millions and millions of publications, especially journal articles. New, global and freely accessible indices are emerging to enable free search at least of abstracts.[25] Originally limited to journal articles and therefore narrow in scope, these large databases now increasingly contain other forms of publication, too, as well as related information such as clinical study protocols, patents, policy documents, data sets and details of project funding. As a result, publications in other formats that are not included in these databases often suffer from lower visibility. Search engines that deliberately include all types of publications (as is the intention of the non-commercial search engine BASE[26], for instance) offer a remedy here. In principle, it should be noted that technical search tools, whether general or specific search engines, unquestionably have an impact on the visibility of published scholarship. Like all search engines, they generate a technically mediated interpretation of the available information resources (usually publications), thereby conveying "a certain image of the information world" (Lewandowski, 2020, p. 2)which is never without bias (Friedmann & Nissenbaum, 1996; Leyrer, 2021).

Likewise, visibility is usually not available for manuscripts that have not yet successfully passed through the sometimes lengthy selection process of editorial and journal peer review.[27] One solution to this is the format of preprint archives that is now well established in some subject areas, providing transparency is established concerning the status of the publication and the process (Chiarelli, Johnson, Pinfield, & Richens, 2019, p. 17). Articles can be uploaded directly to these archives, of which around 60 now exist in various disciplines, and are therefore cited and commented on, regardless of whether they are later adopted for publication in a journal or not. Increasingly, links are emerging between the publication process of the journals and the

[23] In the natural sciences, for example, the time span during which publications are cited by the academic community is gradually decreasing (Della Briotta Parolo, et al., 2015).

[24] Filtering only the most cited articles in the databases limits the "pre-selection" without any evidence that the cited papers were read at all or that they were cited for their quality and not to point out their weaknesses, for example.

[25] https://bigthink.com/the-present/general-index-open-access, January 21, 2022

[26] Bielefeld Academic Search Engine, www.base-search.net, January 21, 2022

[27] This can take several years in some cases, as shown by the survey of DFG review board supervisors, see section 1.2.

preprint platforms,[28] be it through in-house preprint platforms[29] operated by established publishers, inclusion of preprints in the journal databases themselves or the requirement to submit a manuscript preprint before the review process begins.

At the same time, actors in the field of social media and academic social media such as Twitter, Academia.edu and ResearchGate (Buchreport, 2021) are emerging as dialogue platforms. So far they have tended to be used for secondary publications or references to users' own publications, but they are also used for primary publication. Twitter verifiably has a significant role to play, especially in the dissemination of preprints (Chiarelli, Johnson, Pinfield, & Richens, 2019, p. 22). In terms of their functionality for publishing, disseminating and searching for research findings or people, they are used for the purpose of literature search and for science communication, though there are limitations (e.g. no curation, no securing of data, limited selection of information depending on the activity of specific individuals) that should be taken into account. These networks are also volatile: in principle, they can require payment or be closed down. However, social media not only have dissemination and publicity potential, they are also of interest because of their interactive component, which is why they are used by large numbers of academics.

Publication visibility is further restricted by payment barriers (Hagenhoff, 2022 (in print)). At most institutions, single-click access should apply to a relatively large number of digital sources, especially specialist articles, based on subscription. In this way, sources become quickly visible, enabling them to be incorporated and cited. But those sources whose access is less conveniently organised for researchers on site or do not appear in the relevant indices run the risk of not being noticed to the same extent (Gargouri, et al., 2010; Archambault, Côté, Struck, & Voorons, 2016; Piwowar, et al., 2018).[30] In turn, the decision as to which digital offerings are subscribed to does not always follow purely academic criteria, but is also shaped by the pricing and contract structures of the major publishers (Deutsche Forschungsgemeinschaft, 2018 A; Shu, et al., 2018; Sample, 2012; Wellcome Trust, 2003, p. 20). The Open Access status of publications and their inclusion in navigation tools promises to remedy this situation. Various studies show that publications in Open Access have a clear visibility advantage over publications behind paywalls (Ottaviani, 2016; Piwowar, et al., 2018). This applies equally to academic papers published voluntarily or compulsorily in OA (Gargouri,

[28] To this end, authors publish their manuscripts simultaneously/shortly before submission to the journals in the form of a preprint. For example, the journal eLife offers to automatically upload submitted manuscripts to bioarxiv at the same time, https://elifesciences.org/inside-elife/e799d447/authors-can-now-submit-a-preprint-to-biorxiv-while-submitting-to-elife, 21.01.2021. The journal also offers peer review services for the preprint server: "eLife launches service to peer review preprints on bioRxiv" https://elifesciences.org/for-the-press/a5a129f2/elife-launches-service-to-peer-review-preprints-on-biorxiv, January 21, 2022.

[29] Cell Press Sneak Peak, for example, allows users to preview articles under review: www.ssrn.com/index.cfm/en/cell-press-sneak-peek, January 21, 2022.

[30] A comparable problem is likely to affect the remaining non-digital publications in academic fields with predominantly digital publications.

et al., 2010) as well as to book contributions (Projekt AuROA, 2022; Ferwerds, et al., 2018, pp. 29–30).

2.2 Market structures and business models of academic publishing

Academic publishing is highly concentrated. One study shows that even in 2013, it was possible to attribute more than 50 percent of journal articles published worldwide to the five biggest publishing groups (Larivière, Haustein, & Mongeon, 2015). Concentration tendencies can also be observed in the academic book market that is less strongly dominated by the medium of English. What is more, there is talk of a monograph crisis, (Hirschi & Spoerhase, 2015; Spoerhase & Hirschi, 2015)namely a decline in production. This may also be due to the fact that library budgets have been used less for book acquisitions in recent decades due to the rising cost of journals.[31] However, the OA transformation is now also being enabled and called for in the book sector,[32] though the specifics of this particular form of publication will need to be taken into account here (Projekt AuROA, 2022; Hagner, 2015, p. 130).

In recent years there have been indications of a substantial increase in subscription costs and profit margins among leading publishing groups (Larivière, Haustein, & Mongeon, 2015, pp. 11-12; Hagner, 2015, pp. 75–84; Yishay, 2020). Pricing policies and business models such as the clustering of journals and also e-books has made it increasingly difficult for academia to ensure affordable access to all relevant scholarly content. This led to international criticism (Buranyi, 2017), widespread cancellation of journal subscriptions on the part of large-scale consortia and even entire countries[33], and the negotiation of OA transformative agreements. In Germany, there have been DEAL negotiations with major publishers on prices and OA publishing options and these are still ongoing. In this connection, the open access transformation is not only striving for a switch from closed to open access but also for a structural change in the publication system oriented towards the possibilities offered by digitalisation. Criticism has also been raised with regard to OA transformation agreements (Brembs, et al., 2021; Eve & Anthony, 2021; Grossmann & Brembs, 2021) and it remains to be closely observed what impact these have in practice (Haucap, Moshgbar, & Schmal, 2021; Mittermaier, 2021).

[31] Science Europe: Briefing Paper on Open Access Books, 2019, p. 5.: www.scienceeurope.org/media/qk2b1cq4/se_bp_oa_books_092019.pdf, January 21, 2022.

[32] An OA transformation in the book sector seems comparatively easy to achieve given the established practice of printing subsidies that can be reallocated and the lower profit margins. It will also be very beneficial in terms of the visibility of researchers and dissemination of content.

[33] www.projekt-deal.de, January 21, 2022.

At present, there is no end in sight to the tendency towards monopolisation in the markets for academic publication, databases and software. This also makes it more difficult for well-conceived new OA bodies or platforms to become established. The tendency of research assessment systems to focus on the journal impact factor is only one difficulty here. Current market analyses indicate that the largest market participants are now moving into new business segments and, if the revenues for (open access) publications are maintained, could additionally lock in universities and research institutions by offering data analysis and research information systems (Aspesi, et al., 2019). This focus on a small number of providers (vendor lock-in) could lead to academics no longer being able to conduct their research without the services of these providers in the future, thereby increasing their dependence even further. This can have a detrimental effect on scholarship if – as is currently the case – the academic community itself has no influence on the further development of such services and the providers fail to develop them in the interests of scholars or align them with their needs (Aspesi, et al., 2019). Large corporations such as RELX are establishing services for the entire academic work process, while at the same time aggregating usage and activity data (Hagenhoff, 2017; Brembs, et al., 2020; Open Science Radio, 2020). In addition to being bound to the digital tools of a particular provider, individual academics could also be exposed to additional intrusions into their informational self-determination (Schwartmann & Benedikt, 2021; Gehring, 2021). Moreover, the control of scholarship based on data collected by commercial providers is something that should fundamentally be regarded as critical (Herb, 2018). In this way, commercialisation now extends not only to publications and services but also to the data generated when information is accessed and searched. Here, too, developments to the detriment of the academic community are to be expected.

The developments described raise pressing questions as to how science can ensure in future that it has more autonomous control over its publications in general, especially the metadata and analysis data associated with publications, and that it is aware of the algorithms on which the analyses are based. The DFG's Committee on Scientific Library Services and Information Systems addressed this challenge in a highly regarded statement (Deutsche Forschungsgemeinschaft, 2021).

2.3 Fraudulent publishing

For some years now, dubious providers have appeared on the scene with regard to two forms of events/publications, namely conferences and academic journals. Predatory publishing involves fraudulently charging fees for what is ostensibly and only at first glance serious publishing, but which does not meet the minimum requirements of an academic publication medium (no transparency with regard to the publication process, lack of quality control – despite the fact that claims are made to the contrary). Often the titles and layouts of the fraudulent formats are based on well-known and renowned conference or magazine titles (mimicry). As such, the segment of predatory publishing involves unchecked and often low-quality publications,

whereby the lack of quality control is not only not recognisable, in most cases it is even actively concealed. Predatory journals are found not only, but frequently, in the OA sector. This is an area where there are a particularly large number of providers who are still in the process of getting established. For this reason, this segment also reflects a diverse range in terms of how well-known and how respectable the publication venues are.[34] Fraudulent publishers exploit this lack of transparency. The extent to which fraudulent publishers have now been able to grow is illustrated by the example of OMICS, a publishing house that publishes more than 700 journals and over 3,000 conference formats, and that was fined US$50 million in the US in 2019 for unfair business practices.[35] It is now assumed that 3 percent of content in the Scopus database can be attributed to the area of predatory publishing (Chawla, 2021), although it is difficult to establish a clear-cut definition (Grudniewicz, et al., 2019). Various whitelists and blacklists have since appeared with the aim of distinguishing between reputable and non-reputable providers. By their very nature, these can be neither complete, up-to-date or indisputable, however. Checklists with criteria for serious publishing would seem to be more helpful here.[36, 37]

Nevertheless, it is worth taking a more differentiated look here as well. The disreputable publishers earn money from and serve a demand generated by the high level of output-oriented competitive pressure (see section 2.5) as well as a highly variable competitiveness within the global academic community, also in financial terms. For example, the sometimes very high costs of reputable OA publications are not affordable for everyone everywhere;[38] not all publications that appear in dubious media are therefore automatically bogus or necessarily lacking in quality (Allianz der Wissenschaftsorganisationen, 2018). At the same time, it is to be feared that increased use of questionable publication media will further highlight the exclusivity of reputable providers, thereby making it even more difficult for parts of the global academic community to access this more exclusive segment (Lit, 2021).

A further reflection of the high level of output-oriented competitive pressure is another segment of fraudulent publishing that pursues the opposite approach to predatory publishing – namely by placing fake contributions in the most reputable publication organs. Organised networks

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[34] This is why in Guideline 15, the GRP Code of Conduct calls on academics to verify their choice of publication venue. New open access journals can also be of excellent quality and have subject relevance.

[35] www.the-scientist.com/news-opinion/omics-international-fined-over-50-million-for-deceptive-practices-65698, January 21, 2022

[36] For criteria, see for example the declaration by three national academies of sciences on academic publications (Academie des sciences, Leopoldina, & Royal Society, 2016) and also “The European Code of Conduct for Research Integrity” (ALLEA - All European Academies, 2017)

[37] In addition to consulting a library, it is also possible to have a journal verified by Think-Check-Submit: https://think-checksubmit.org, January 21, 2022.

[38] A good alternative here would be to develop the Diamond Open Access segment – community-run publishing houses that grant free access to authors and readers alike (Bosman, Frantsvåg, Kramer, Langlais, & Proudman, 2021; Wissenschaftsrat, 2022, p. 74).

("paper mills") of academically trained ghostwriters offer to write academic papers for a fee; they are then submitted to reputable publishers under the name of the client, where they often initially pass a quality check. In many cases, these fake articles are only noticed after the fact, be it due to the lack of original data on request, or due to the duplicated illustrations used or text passages plagiarised from other publications. The fake articles produced in these paper mills are often concentrated in very specific journals and hundreds of them are then published; the share of such articles in these journals can be in the double-digit percentage range (Sabel & Seifert, 2021) which has even led to an entire special issue being dedicated to retractions, as was recently the case with the Journal of Cellular Biochemistry (Behl, 2021).

Both phenomena – giving the appearance of journal reputation and pretending to have published quantifiable academic articles – are signs of the orientation of the publishing system towards research assessment based on surrogates rather than content. Countermeasures should therefore be taken at this point (see section 2.5 and 3).

2.4 Quality review and peer involvement

Publishing offers the opportunity to verify the validity of knowledge claims generated by scholarship and research. The dissemination of knowledge content specific to particular target groups (see section 1.1) is essential here. The validity of academic publications is ensured firstly by means of formal quality assurance (guaranteeing minimum quality, also at the level of the process) and secondly by means of quality review (the evaluation of content, see section 1.4).

The idea of making research findings verifiable through the critical gaze of peers and feeding them into academic discourse corresponds directly to one of the core functions of academic publishing (see section 1.1). However, peer involvement – highly important as it is – is by no means bound to a specific form; its potential cannot be fully tapped into in every publication form and situation, and it is not the first choice for every purpose in every one of its various manifestations. There has always been a discourse in scholarship on this issue. Nevertheless, the established systems – be they reviews of monographs, edited volumes or specialist articles in the humanities or peer review of journals in the natural and life sciences – are proving slow to change (H-Soz-Kult. Kommunikation und Fachinformation für die Geschichtswissenschaften, 2021), even when well-founded criticism is raised (Hirschi, 2018 A; Spoerhase & Hirschi, 2015). Journal peer review, for example, which in its original function was a quantitatively motivated selection procedure (Riesenweber, 2014, p. 598; Hirschi, 2018 A), is now widely understood as a universal method for assessing (and also assuring) the quality of individual publications in journals. As such, journal peer review not only contributes to the choice of academic journal when it comes to publishing research findings, it also lends a seal of quality to what is published. The procedure is therefore of great importance within the academic system in two respects. At the same time, it is faced with continuously increasing

demands, whether due to the high burden on individuals caused by reviews in general or the high complexity and interdisciplinary nature of many research subjects, some of which can now only processed by consortia (Wissenschaftsrat, 2017). In view of the fact that in large sections of the research landscape, publication primarily takes the form of academic papers (section 1.2) and that the latter can easily be bibliometrically quantified as output for assessment processes, the impression quickly arises that the type of quality review used for them is the best review practice for the system as a whole. Yet a preliminary review may not be equally suitable for every research topic. In the hermeneutic disciplines of the humanities, justified doubts are raised in this regard (Kuhn & Hagenhoff, 2019; Brenner, 1997; Spoerhase & Hirschi, 2015).

One major challenge and at the same time something that is highly significant in terms of the further development of scholarly publishing is therefore the acceptance of a broad spectrum of publication formats and, along with this, the potential use of additional forms of peer participation and quality review, some of which have still to be developed. The COVID-19 pandemic is a good illustration of the benefits of flexible handling of peer participation. The enormous time pressure in publicising scientific progress in the fight against the pandemic meant that potentially suitable reviewers were faced with an increased workload. This gives rise to the idea of an alternative constellation of publication and peer participation. In this example, it was possible to publish manuscripts on preprint servers without delay. Peer engagement with these studies was then optionally carried out in different ways: commenting on the preprints directly in their archive, presenting and discussing outstanding preprints on social media, citing the preprints in follow-up papers or else by means of classic journal peer review if the preprint was subsequently published in a journal as well (Fraser, et al., 2021). This more advanced form of peer participation and quality review places high demands on reception. It should be scholarship-driven, accompanied by science research and properly communicated to the public outside academia with regard to the process followed and the validity of the findings.

2.5 Reciprocal effect of research assessment and publishing

Looking at the current shape of the publication system and the challenges it faces at the present time, one can easily gain the impression that powerful constraints and incentives stand in the way of any free choice of publication format. The starting point of these obstacles appears to be the essentially understandable effort to assess scholarship as objectively and comparatively as possible and also – based on this assessment – to provide funding for it. In view of current assessment practices, science is under pressure to deliver output that is comparable, or for such output to be regarded as comparable in principle. This pressure is reflected in the expectation of the academic publishing system to provide data suitable for the assessment of scholarship as surrogates for the assessment of the content itself. In this regard, there is clearly a reciprocal supply-and-demand relationship between the major actors in the research system – funding agencies, academia and publishers.

In many disciplines there is also an internal understanding of which publication venues are considered particularly reputable and therefore "count" (see section 1.5). In addition, the variables "number of publications" and "impact factor" are frequently established in journal-based disciplines as a measure for assessing productivity and quality (Schweizerische Akademie der Geistes- und Sozialwissenschaften, 2018). However, even if there were consensus that higher demands are generally placed on papers in the more reputable publication venues than in the less reputable ones,[39] no reliable statement can be made at the level of the individual paper without reception taking place. Studies with different metrics all show that with regard to citations of articles in highly rated journals, there is a very wide spread, i.e. as a rule there are few papers with very high reception and many with little or no reception. As such, the majority of papers benefit from the good rating of a journal, based on the significant impact of individual papers in that journal. This creates an incentive to strengthen the system, since the majority of publications benefit from the "glamour of the journal" that derives from a smaller number of publications (Osterloh & Frey, 2015 A; Osterloh & Frey, 2015 B). By the same token, high citation figures of individual papers do not automatically indicate their quality. For example, retracted papers can be cited, too; flawed or controversial papers can and indeed should be cited, precisely in order to point out their inadequacies. In the words of Caspar Hirschi:

> *"The most significant impact of quantitative performance measurement, however, is in another area. The citation indices are based on a prior assumption that shows the symbolic weight of peer review. If the number of citations that one's own papers receive in other authors' essays becomes the key indicator of a researcher's performance, then citation should fundamentally be understood as an act of affirmation. One cites, so the implication goes, what one considers to be right and important, and one does so all the more when one knows that every citation is honoured by the indices. If, on the other hand, academics were expected to critically engage with other publications in their own publications – discussing arguments, reproducing experiments and verifying methods – there would be little point in counting citations. It ought to be acknowledged that authors who cause controversy with contentious claims or meet widespread disapproval due to the use of negligent methods may do better than competitors who make a major breakthrough."* (Hirschi, 2018 B, p. 12)

In general, metrics have many weaknesses when it comes to measuring productivity in scholarship (see section 2.5.1). Hoeffel has already pointed out the weaknesses in measuring the quality of articles (Hoeffel, 1998); Eugene Garfield, one of the founders of the Journal Impact Factor, pointed out as early as 1955 in his fundamental considerations that scholars should aspire to perceive literature not only based on bibliographic indices but also through organised and comprehensive reading (Garfield, 1955). Against this background, it does not appear to

[39] And even this assumption is probably not so easy to make. See the critique of the JOURQUAL ranking in the area of business studies (Kieser, 2012).

be purposeful for metrics to dominate the assessment of scholarly performance beyond their function as an orientation aid, let alone constitute the sole basis for such an assessment.

The attempt to evaluate monographs according to a “hierarchical gradient” of publisher reputation has hardly been extensively researched, but is no less critically discussed (Spoerhase & Hirschi, 2015, p. 4). Meanwhile, other forms of publication, such as data packages, software/code or audiovisual media do not provide any standardised starting points for research assessment based on ratings, rankings or key figures.

It is true that in some areas of scholarship, procedures and instruments exist that make it easier to identify publications which may be worthy of interest. These tools are neither reliable in individual cases nor universally applicable, transferable or comparable – but they are used nonetheless. However, their use for the assessment of scholarship bears the risk of unforeseen and undesirable side effects, especially if – as can be observed in many instances – an understanding of highly rated publication practice that is in fact specific to a discipline is applied in a stereotypical manner to neighbouring fields or indeed all fields of scholarship.

It has become apparent that such evaluation systems are unable to meet the demands that are frequently made of them in terms of objectivity and fairness. Clearly, the highly extrinsic favouring of index-maximising publishing via incentives such as salary components linked to the impact factor has resulted in systemic shifts (Quan, Chen, & Shu, 2017, p. 498; Mallapaty, 2020) and is also a key factor in the emergence of predatory publishing (see section 2.3).

The disciplines mentioned in section 1.2 with a high share of journal publications are increasingly subject to competition to optimise output, while the disciplines that have so far been published primarily in other formats, where comparable quantification methods are not available, are coming under additional pressure to justify their publication behaviour (spillover) (Fecher, 2021; Spoerhase & Hirschi, 2015, p. 2). Since the monograph largely eludes bibliometric measurement simply because of its reception period, which often lasts years, while “metrics-compliant” forms of publication are much more likely to “pay off” in terms of financial resources or career advancement, the time-consuming production of monographs will obviously become unattractive. So without this being appropriate from the point of view of the subject matter, the monograph is in danger of losing importance.

In contradiction to its original endeavour to achieve objectivity and therefore also fairness, bibliometrically supported research assessment is turning into a system of performance and evaluation, described in its quantitative dimension as “publish or perish”, and in its qualitative dimension as “publish the right way”. In this way it gives rise to considerable side effects that hinder the desirable development of academic publishing.

2.5.1 Weaknesses of bibliometrics in measuring the productivity of scholarship

Thanks to digitalisation in particular, bibliometrics as a scientific method now offers far-reaching analytical possibilities and therefore significant potential for generating knowledge in the area of science research. (Bornmann & Marewski, 2019) At the same time, however, there are often exaggerated expectations of the significance, fairness and objectivity of bibliometric indicators (Archambault, Vignola-Gagné, Côté, Larivière, & Gingrasb, 2006).

Bibliometric indicators share a fundamental problem with all indicator systems: where they are used as the basis of funding allocation systems, as described in section 2.5, they run the risk of turning the measurement into the target. Powerful incentives arise to influence these key indicators so as to maximise performance measurement and therefore resource allocation: „When a measure becomes a target, it ceases to be a good measure" (Goodhart's law) (Strathern, 1997, p. 308). As such, the usefulness of indicators is quickly undermined and there is a demand for new and better indicators.

Explanatory research on the theoretical background of metrics-based research assessment, which might have provided urgently needed support here, has so far only been able to develop in a rather fragmented way (Jappe, Pithan, & Heinze, 2018), but it does suggest quite a number of specific challenges. For example, the determination and comparison of academic productivity between individuals and institutions based on metrics (e.g. number of citations or impact factors) is subject to a whole series of pitfalls. Different types of articles are cited with different frequency, for example. So-called reviews receive significantly more citations on average than original papers, for instance; this means that journals can increase their journal impact factor simply by publishing large numbers of reviews. Another phenomenon is that even the order of authors' names and their position in the alphabet influence an article's citation probability (Stevens & Duque, 2018). Studies have also shown a proportional relationship between article length and citation frequency and between journal impact factor and citation frequency (Falagas, Zarkali, Karageorgopoulos, Bardakas, & Mavros, 2013). Metrics such as the journal impact factor take on the weaknesses of their underlying indicators. But even beyond this they are prone to distortion. For example, the average impact factor of academic articles in the various disciplines varies considerably. A number of effects are responsible here. These include the average number of co-authors of the articles, which varies from subject to subject, or the varying extent to which citations are used on average at all in individual subject areas. (Althouse, West, Bergstrom, & Bergstrom, 2008)

In addition, there are subject areas in which very little is published due to the high level of complexity or specialisation. In fact, the average number of publications appearing per unit of time differs for individuals in correlation with their affiliation to one of the various academic fields, and again in correlation with their respective career stage (Deutsches Zentrum für Hochschul- und Wissenschaftsforschung, 2019). What is more, a correlation is also assumed between the impact factor and the total number of articles published in a subject area (Antonoyiannakis & Mitra, 2009). The journal impact factor itself can also differ between two

journals with essentially the same number of citations, depending on how long their articles have been publicly available on average in the “in press” state prior to actual publication[40] (Tort, Targino, & Amaral, 2012) – a practice that has since prompted Clarivate Analytics to change its calculation of the journal impact factor from 2021 onwards (Davis, 2020).

Finally, there are a number of disciplines that do not lend themselves to either intradisciplinary or interdisciplinary comparison of academic output based on metrics. These include subjects which by their very nature do not involve output via articles, including architecture, the performing arts and certain areas of computer science. In addition, there are subjects that are highly collaborative and therefore not accessible to a metric measurement of the involvement of individual authors, such as certain areas of physics and epidemiology. Finally, the number of citations is not very suitable as a quality indicator if, for example, subjects commonly involve provocative theses and intense debate of these (Hirschi, 2018 B, p. 12), as is more typically the case in the humanities and social sciences as well as in psycho-social studies, for example (Wilsdon, et al., 2015).

The above-mentioned limitations once again demonstrate that bibliometric indicators should be applied with caution when evaluating scholarship. This is even more true when less aggregated units below the level of countries, institutions or subjects are considered, or those in different subject areas/disciplines are to be compared. Here in particular, metrics should not be used in isolation, but should be supplemented with other evaluation criteria.[41] The above restrictions also apply to all corrected or weighted derivatives of prevailing metrics as well as “legacy metrics” based on the counting of alternative and broader output forms (see section 1.5).

2.5.2 Indicator-generated misguided incentives

A primarily bibliometric-oriented assessment of academic performance at the level of individuals sets incentives for behaviour contrary to the standards of good research practice as set out in the DFG Code of Conduct (Deutsche Forschungsgemeinschaft, 2019; Deutsche Gesellschaft für Psychologie, 2020). Here it is irrelevant whether the assessment is commissioned or undertaken by institutional employers, research funders or other relevant stakeholders. The effects are extremely diverse and are illustrated in the following based on various examples.

It is fundamentally in the spirit of scientific progress that research outcomes and findings are made public promptly after they have been carefully prepared (positive acceleration of the

[40] The articles often remain in this state for a period of several months and are already taken note of by the community, e.g. on Cerebral Cortex https://academic.oup.com/cercor/advance-articles, January 21, 2022.

[41] Cf. DORA: https://sfdora.org/read/, January 21, 2022

publication process). However, publishing based on key indicators rewards various strategies, some of which may seem contradictory at first glance, and which ultimately counteract precisely this goal. In some instances – for example in the case of a minimum number of publications required for the attainment of an academic degree, a career step or access to third-party funding – there is an incentive to achieve a certain number of publications within the shortest possible time. If posts or third-party funding are awarded competitively based on the number[42] of publications, this creates an incentive to publish as much as possible within a given period. Both create incentives for less careful, hastier preparation of research results and manuscripts[43] – possibly also the cause of the increasing number of retractions that are currently to be observed (Steen, Casadevall, & Fang, 2013). Incentives to produce more publications also have a negative impact on the growing problem of reception (see 2.1. below) and on the financing of publications (see 2.2. below).

In other cases, there are incentives for authors to achieve as much reputation as possible based on individual papers. This is the case, for example, if the competitive allocation of posts or third-party funding is based on the assumption that performance can be measured based on publication venues or publication media. Such incentives favour the strategy of repeatedly submitting manuscripts to journals of graded reputation (mostly based on their journal impact factor – the cascade model), for example, thereby accepting the long delays of the relevant quality review and selection systems.[44]

If both incentives are combined and the highest possible number of reputable publications is assumed – something that is not unusual in the competition for top jobs in academia – the most diverse distortions can occur.

It is also of undisputed, fundamental importance to scholarship that research results are made available and published data is reliable so that people can see which foundations can be built on and which are not trustworthy. However, high pressure to publish causes a strong bias with regard to the desired publication success and, without adequate countermeasures, bears the risk that the research question and data interpretation are implicitly or even explicitly biased with regard to the desired or anticipated results. In addition, incentives are created to exclude less marketable hypotheses, follow the mainstream, suppress dissenting opinions or omit undesirable measurement data or even invent measurement data that fits the purpose (Deutsche

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[42] This is where a further spillover can be seen from academic cultures with small-scale publications into those that publish more extensive works but less frequently and not according to bibliometrically usable criteria. If numbers are compared, the latter naturally do “worse” and come under pressure to change their publication culture – even where the existing culture has served their dissemination goals very well to date.

[43] Contrary to Guideline 7 “Cross-phase quality assurance” of the DFG Code, https://wissenschaftliche-integritaet.de/en/code-of-conduct/cross-phase-quality-assurance, April 27, 2022.

[44] Restriction as compared to Guideline 15 “Publication medium” of the DFG Code, https://wissenschaftliche-integritaet.de/en/code-of-conduct/publication-medium, April 27, 2022.

Gesellschaft für Psychologie, 2020, p. 16 f; Neufeld, 2014; Holtfreter, Reisig, Pratt, & Mays, 2020).[45] Such bias has also been linked to the so-called replication crisis in the life sciences (Ioannidis, et al., 2014). By contrast, there is usually no incentive to report negative study results (so-called publication bias) (Chan, et al., 2014)[46] – another assumed cause of the replication crisis.[47] In the spirit of good scholarship, the aspects of quality assurance and evaluation should be considered and documented in a transparent manner when publishing, and care should be taken to ensure that what is published is made available on a sufficiently long-term basis and in a reliable manner. However, publication pressure resulting from a metrics orientation can create vulnerabilities to forms of publication that are unable to provide a safeguard here (Patwardhan, et al., 2018).[48, 49]

Furthermore, in order to understand broader contexts it is often necessary for publications to describe issues in appropriate thematic breadth and over a sufficiently long period of time. This is countered by the pressure to produce as many publishable units as possible where there is an incentive to do just this. Such misguided incentives favour "iteration to the smallest publishable unit (SPU)" (slicing)[50] or, in extreme cases, even multiple publication of essentially the same findings or results. Such strategies do increase quantifiable research output, (Bornmann, Schier, Marx, & Daniel, 2012), but they also have effects of an epistemic nature, making continued research and reception more difficult, since the current state of research has to be collated more laboriously from different publications.[51]

In order to fulfil the second function of publication – namely the attribution of authorship and reputation – fair and verifiable naming of the authors of published research results and scholarly knowledge should be in accordance with their individual contributions. However, the in-

[45] Contrary to Guideline 9 "Research design" of the DFG Code, https://wissenschaftliche-integritaet.de/en/code-of-conduct/research-design, April 27, 2022.

[46] There are now formats for this, however. For example, the open access journal PLoS ONE also publishes "negative results" (see https://journals.plos.org/plosone/static/publish, January 21, 2022).

[47] Press release issued by the Federal Institute for Risk Assessment (BfR): www.bfr.bund.de/de/presseinformation/2018/27/auch_die_wissenschaft_wird_au s_fehlern_klug-205284.html, April 27, 2022.

[48] See Guideline 15 "Publication medium" of the DFG Code, https://wissenschaftliche-integritaet.de/en/code-of-conduct/publication-medium, April 27, 2022.

[49] A prescribed minimum number of publications as an entry requirement also applies in many cases in the German academic qualification system, e.g. for cumulative doctorates and post-doctoral lecturer qualifications, thereby setting problematic incentives with regard to publication.

[50] See Guidelines 13 "Providing public access to research results", https://wissenschaftliche-integritaet.de/en/code-of-conduct/providing-public-access-to-research-results, and 14 "Authorship", https://wissenschaftliche-integritaet.de/en/code-of-conduct/authorship, of the DFG Code, April 27, 2022.

[51] Although the work of compiling the state of research is of great importance to scholarship, it usually contributes little to the publication-based reputation as a working paper or review article, despite often receiving a great deal of attention and many citations.

tense pressure to publish large numbers of units creates incentives for extraneous considerations in the awarding of authorship[52], such as the unjustified inclusion of persons in the list of authors of publications based on so-called “honorary authorships”, for example, or the suppression of “legitimate” authors by “institutionally privileged” fund contributors who then occupy first or last author positions – which are particularly prestigious in areas such as the life sciences (see section 1.2) (Kiser, 2018; Neufeld, 2014).

Finally, thoughtful scholarly citation not only provides the basis for understanding one’s own published research and putting it in context, it also enables proper attribution of authorship and reputation to the research output of others.[53] This claim is also counteracted by the pressure to publish that arises based on indicator orientation. Firstly, it provides incentives for researchers to make their own work look more original by omitting citations or even to pass off other people’s ideas as their own, which even correlates with certain third-party funding sources (Krempkow, 2016, p. 49). Secondly, it encourages them to ensure their own publications are cited as frequently as possible. This in turn leads to excessive self-citation, (Van Noorden & Singh Chawla, 2019), the formation of citation networks – both at the level of individuals as well as that of entire journals and publishers – [54] and also the expectation (whether explicit or implicit) of others to cite one’s own work or the use of hierarchical power to force them to do so (Baas & Fennell, 2019; Singh Chawla, 2019).

In its statement on the reproducibility of research results (Deutsche Forschungsgemeinschaft, 2017), the DFG drew attention to the pressure of competition and acceleration as a cause of the replication problem and called for clear orientation towards the content of scholarship in assessment processes. It strongly encourages the publication of both positive and negative results, specifically in the area of biomedical studies (Deutsche Forschungsgemeinschaft, 2018 B) and more generally in the DFG Code for Safeguarding Good Research Practice, Guideline 12 (Deutsche Forschungsgemeinschaft, 2019).

2.5.3 The increase in publication pressure due to the nature of career paths in the research system

The academic sector is structurally susceptible to an incentive system geared towards “bibliometric output optimisation” (see section 2.1). Academic career paths are often characterised by a pyramid structure with a broad base of staff in the academic qualification phase, a sharply

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[52] Contrary to Guideline 14 “Authorship” of the DFG Code, https://wissenschaftliche-integritaet.de/en/code-of-conduct/authorship, of the DFG Code, April 27, 2022.

[53] See Guideline 7 “Cross-phase quality assurance” of the DFG Code, https://wissenschaftliche-integritaet.de/en/code-of-conduct/cross-phase-quality-assurance, April 27, 2022.

[54] Marie E. McVeigh: Journal self-citation in the Journal Citation Reports – Science Edition (2002): https://clarivate.com/essays/journal-self-citation-jcr, April 27, 2022.

decreasing number of positions as researchers become professionalised, and a very low number of permanent positions as compared to other employment sectors.[55] Since this situation is currently the subject of discussion at the level of science policy (Bahr, Kubon, & Eichhorn, 2021) and changes are being sought or are already being implemented, the publication-based foundations of the selection processes in the academic system and the bibliometric indicators used should be subjected to critical consideration in the relevant debates.

Whether indirectly in the procurement of third-party funding, which may also be stipulated in target agreements, or directly in appointment negotiations: individual chances of remaining in the research system frequently depend on the assessment of an individual's publication record. The use of metrics obviously has a major impact here. Universities in Germany allocate some of their basic funds under a system known as LOM ("performance-oriented allocation of funds"). The indicators here are primarily success in acquiring funding and publication performance, which is frequently reflected in bibliometric indicators.[56] Since publication performance is itself a key factor in the procurement of third-party funding, this creates a vicious circle.

The way in which global science regions compete for the best minds at national and institutional level is another factor driving the pressure to publish. A lot of effort currently goes into comparing the number of publications and their citations based on a comparison of North America – Europe – China (Tollefson, 2018).

In the conditions described, academics at the various levels of the career and responsibility pyramid find themselves competing with their respective peers for resources that are naturally limited. At each level, a dilemma can be observed with regard to metrics-oriented behaviour: even if the conviction were widespread that publishing should not be guided by the expected criteria of research assessment, it would remain largely without influence on practice. This is because academics who do not follow metrics-oriented publishing at the beginning of their careers risk having a less "advantageous" track record than others, thereby losing out in applications for tenure positions; more established academics fall behind in the competition for third-party funding and LOM funds; management personnel in turn are responsible for their organisational units slipping down in the "classic" rankings, while the early-career academics entrusted to them find themselves at a competitive disadvantage (De Herde, Björnmalm, & Susi, 2021).

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[55] This applies, for example, to the USA (Bonetta, 2011), Japan (Shusuke, 2016) and also Germany: in Germany, only 17.5 percent of university staff in the academic and artistic fields (full-time and part-time staff included) were in permanent full-time employment in 2019 (down from 23 percent in 2006) (Federal Statistical Office (Destatis, ed.), 2018, p. 32; Federal Statistical Office (Destatis, ed.), 2019) (Statistisches Bundesamt (Destatis, Hrsg.), 2018, p. 32; Statistisches Bundesamt (Destatis, Hrsg.), 2019), calculations performed by the DFG

[56] See the key figures for research performance in the resolution passed by the Standing Conference of the Ministers of Education and Cultural Affairs of the Länder (federal states) in the Federal Republic of Germany of 12.05.2011: www.kmk.org/fileadmin/veroeffentlichungen_beschluesse/2011/2011_05_12-Instrumente-Qualitaetsfeststellung.pdf, April 27, 2022.

All in all, it seems imperative that any impetus for change in terms of competitive conditions – if it cannot come via collective agreements, starting e.g. at the level of academic self-administration, the professional associations/scholarly societies and faculty associations (see section 3.1) – can only be based on new responsible assessment standards set down at the upper levels of governance in the academic system (Science Europe, 2020), firstly by the employers in academia (responsibility of the academic community, see section 3.1) and, secondly by the research funders (responsibility of the funding bodies, see section 3.2)

3 Fields of action

The challenges in publishing described in the previous chapters take differing forms and also arise in different phases within the various academic disciplines. Evaluation of published content that is strongly oriented towards the reputation of the publication medium or metrics can in certain subjects still be regarded as a desirable objectification, in others as a threat to the entire subject, its culture and content, and in still others as a now generally accepted and established rule of the game. Regardless of this, it has strong implications for the academic system as a whole. The situation in parts of the academic system certainly has analogies to institutional path dependency (Schreyögg, 2013): the actors are essentially only left with options that further consolidate the prevailing system, whether by means of even higher hurdles in accessing renowned publication venues, further refined metrics, a focus on research into topics that promise to attract attention, a focus of research assessment on a small number of frequently cited papers in the most renowned journals,[57] further expansion of the reputation, business and distribution models perpetrated by academic publishers, etc.

In order to open up the system at its "narrowed" points to allow options outside the adopted path, concerted national and international interventions are required on a system-wide basis. New incentives must be set and old ones must be re-assessed in terms of their purpose and then renewed or even abolished. The functional interrelationships in the publication system suggest that of all the factors at work within it, the link between research assessment and the allocation of resources is the most powerful (see section 2.1). Accordingly, the gatekeepers of the research system – in particular the higher education institutions, the university and non-university research organisations as funding bodies, and also public and private research funders – are primarily responsible for creating incentives, both jointly and individually, to ensure that publication practice can fulfil its primary function of communicating research findings and enabling scholarly discourse.

In the following, actor-specific fields of action will be identified and suggestions made as to how it might be possible to strengthen the appropriate incentives in the publishing sector.

3.1 Responsibility of the academic community

In the current publication system, a considerable conflict of goals is often apparent with regard to the two essential publication functions of "publicising" and "attribution" (see section 1.1): to

[57] One example is the "Rule of Five" currently being debated internationally (only the five best publications of the last five years to be included in applications). Aim: To prevent quantity (number of essays) from becoming the decision-making criterion. Foreseeable consequence: key indicators (impact factor of the papers mentioned) will become even more of a determining factor.

publicise the findings and results and ideas resulting from diligent scholarship and research in a target group-oriented and timely manner while at the same time meeting the non-content-related requirements of publication-venue-based reputation and bibliometric weight of the output formats. Undermining the publication goal of “dissemination, quality review and documentation of academic knowledge” by optimising purely quantifiable factors is by no means in the interests of knowledge-driven scholarship. Yet metrics-based incentive systems of assessment reward appropriate behaviour in large parts of academia.

Initiating a cultural change with regard to systems of research assessment is naturally most difficult in those disciplines where bibliometric metrics have a major role to play. The widespread use of bibliometrics to evaluate academic work not only benefits journal publishers (see sections 2.2 and 2.4), it also facilitates the procedures followed by funding agencies – mostly governmental – in allocating funds. The academics in the disciplines concerned, in turn, benefit from the clarity and predictability offered by an evaluation based on bibliometrics. It is precisely in their interplay that the aforementioned actors stabilise the assessment system based on bibliometrics.

However, the path being pursued threatens to cause serious and lasting damage to scholarship itself. Firstly, the negative effects of the pressure to publish can be observed in individual cases. Examples include the restrictive effect on the choice of publication channels, incentives to compromise on good research and publication practices that do not primarily serve scholarly debate. Secondly, there is also the risk of long-term, structural consequences, e.g. a failure to address research questions or formats that are disadvantaged in the competition for reputation, with an impact on the filling of vacancies, professorships and ultimately the orientation of entire research institutions.

All actors in academia should take a self-critical look at their areas of activity to see (Fecher, 2021; Ehrmann & Prinz, 2019) if and to what extent they are subject to the developments described above in order to be able to take countermeasures if necessary. This also applies, in particular, to those subject areas that are ostensibly among the privileged disciplines where resources are linked to bibliometrically optimised academic publishing; in the medium term, after all, these subjects also depend on fast and open availability of high-quality, reliable and reproducible research results – something which can also emerge from cooperation with disciplines whose publication culture is not (yet) oriented towards the metrics widely used in research assessment.

Current, subject-specific publications, e.g. the DPG position paper (Deutsche Physikalische Gesellschaft, 2021) or the survey conducted by the DGP ombudsman board on scientific in-

tegrity (Deutsche Gesellschaft für Psychologie, 2020), reflect a growing awareness of the problems outlined[58]. The AFT (association of German faculties) issued a statement on a cross-disciplinary level and voted in favour of a scholarship-driven publication culture (Allgemeiner Fakultätentag, 2018), appointments not being based solely on metrics but on a comprehensive review of an individual's accomplishments to date, and performance assessment in connection with appointments that is not based on metrics but on content (Allgemeiner Fakultätentag, Positionspapier Berufungen, 2019). As academic umbrella organisations with a sound general perspective, routines for setting standards and often experience as editors of scholarship-driven publication bodies, the scholarly societies and faculty associations have an important role to play in shaping publication and assessment cultures. However, the responsibility of academia for scholarly publishing begins at the level of individuals and should also be taken seriously at the level of academic self-governance, the universities and all other academic organisations.

3.1.1 Establish, use and recognise additional forms of quality review for publications

In the digital environment with its numerous new publication options and venues, the issue of the appropriate quality review must also be revisited. In this context, the concept of quality extends to the entire research process and to the framework conditions of the publication venue, which cannot be determined solely based on the latter's reputation (see 2.4). Both new and established publication organs and channels must be measured by whether they have implemented fundamental processes that meet the needs of scholarship in the digital age and allow for high-quality, reusable publication – both technically and in terms of content – as well as whether they offer the necessary transparency with regard to these processes. A minimum requirement here is the legally secured option to use and share published content in full in digital working environments.

It is the authors of academic publications who are responsible for ensuring the quality of the entire underlying research process. This includes ensuring the quality of intermediate steps of the research process, too, and transparently documenting any measures or precautions taken. It is also up to the authors to choose academically and qualitatively appropriate publication venues in which to publish the results of their research.[59] A systematic list of minimum standards for quality assurance of academic publications according to GRP[60] is shown in Info Box 6,

[58] Agricultural Sciences and Ecotrophology Faculty Association: *Beschluss Impactfaktoren* (resolution on impact factors), www.fakultaetentag-agrarwissenschaften-und-oekotrophologie.de/index.php/component/content/article/14-beispielbeitraege/83-beschluss-impactfaktoren, January 21, 2022.

[59] See also Guidelines 7, 12, 13 and 14 of the DFG Code (Deutsche Forschungsgemeinschaft, 2019).

[60] See Guidelines 13, 14 and 15 of the DFG Code (Deutsche Forschungsgemeinschaft, 2019).

providing a summary of best practice for established forms of publication and a guideline for new formats.

The lack of quality assurance – due to the absence of a journal peer review – in connection with COVID-19 preprints that even found their way into the tabloid press, as noted above, shows the need to make other existing forms of peer involvement and quality review visible (see section 1.4), while at the same time ensuring they are taken note of and accepted as such. At the same time, other forms of quality assurance and quality assessment in research must be established and made verifiable, for example quality assurance accompanying the research process.[61]

A gradual expansion of the mechanisms of accepted quality review and peer involvement as described here necessarily means that both publishers and recipients must take on greater responsibility (Deutsche Forschungsgemeinschaft, 2020). This will give rise to greater freedom of publication and more effective gearing of publishing towards the aspects of dissemination and visibility. It is crucial for the further development of these mechanisms that they also enjoy full recognition among sponsors, funding bodies, institutions and subject-specific communities.

This would make it possible to evaluate material for publication based on its quality and the validity of its content through broader peer participation. Upstream processes of curation might also take on a quality-related role in the digital environment. Organising or facilitating this and offering advice on it could be a new field of activity for libraries and other information infrastructures. The recognition and clear definition of different procedures would also offer new options for the assessment of scholarship.

[61] See Guideline 7 “Cross-phase quality assurance” of the DFG Code, https://wissenschaftliche-integritaet.de/en/code-of-conduct/cross-phase-quality-assurance, April 27, 2022

Info Box 6: Quality review steps for publishers and publication venues according to good research practice

The following review procedures and quality assurance measures must be ensured by the publisher or those responsible at the publication venue (e.g. a specific book publisher, journal or platform):

1. Ensure the procedural quality of the publication at the methodological level in terms of its content (e.g. correctness of citations, presentation of data production methods).

2. Identify and ensure interpretability (e.g. adherence to FAIR principles) (Wilkinson, Dumontier, Aalbersberg, & Weitere, 2016); provide the required metadata such as how the research on which the publication is based was funded (and the publication itself, where applicable); CC licensing of content, indicating the review status of a publication.

3. Adequate acknowledgement of contributions by all authors or contributors including a classification of their roles (Holcombe, 2019) according to the FAIR principles (Wilkinson, Dumontier, Aalbersberg, & Weitere, 2016) or the CASRAI role categories (CASRAI).

4. Facilitate content evaluation (e.g. expert opinions are obtained before or after publication, e.g. by means of peer review, open peer review or community peer review, or based on post-publication review, in academic discourse via blogs, further articles etc.)

Steps 1 to 3 must be ensured prior to initial publication, while Step 4 can take place after publication.

For each publication, it must be clear which stage it is at (i.e. version, indication of status with reference to the review process or type of review process, link to selected, relevant publications of similar content or underlying research data, date of initial publication, etc.).

Meanwhile, a publication venue must fulfil the minimum criteria for guaranteeing aspects 1 to 3 in terms of quality assurance as listed above so that the publications issued there can be cited in proposals, for example. In addition, it is imperative that the publication venue ensures that all processes associated with the publication are transparent and accurate. The OASPA contains the "Principles of Transparency and Best Practice in Scholarly Publishing" – a list of a journal's criteria that are to be disclosed (Redhead, 2018).

3.1.2 Expand addressee orientation in academic publishing

In order to effectively disseminate academic findings and publish discourse, it is also important to strive to ensure appropriate reception among the target groups. Academic research should be published in such a way that it is visible to addressees so that they are able to assess and review it in terms of its content and quality. This is a natural, intrinsic motivation for all publishing scholars.

Publications essentially cover the entire continuum of research – from initial and consolidated findings through to finalised, stable results, and their addressees range from narrowly defined groups of specialists to the academic community as a whole and the general public. Selecting suitable formats here is an important responsibility of the academic community. Target groups relevant to the research in question must be specifically addressed in each case based on format, text type, publication channel and comprehensibility of content. The cohesion and completeness of the respective publication should be ensured, as should its reproducibility and the verifiability of its intentions, objectives, hypotheses, measures against bias and other quality assurance methods as defined before the research began. This includes ensuring that the results and the data on which they are based are themselves verifiable (insofar as this is legally possible). Furthermore, responsibility must be assumed for the searchability and findability of what has been published, as well as for ensuring that access to publications and to the data required for their understanding and review is as unrestricted as possible (again: to the extent permitted by legal provisions), e.g. based on compatible formats, persistent identifiers, open access options etc.[62] This responsibility is not borne by academics alone, but in association with publishers, libraries and other infrastructural institutions.

3.1.3 Strengthen alternative systems of reputational attribution

If the assessment of academic output is to be based less on bibliometric aspects and more on content, the question automatically arises as to new points of reference for the attribution of reputation.

Academic reputation always results from the scholarly insights that are developed. Groundbreaking results are not bound to certain forms of publication per se. They also convey reputation directly – without having to pass through journal prestige or metric surrogates first. Examples of this include a positive community peer review, a highly regarded data publication or

[62] In accordance with Guideline 13 of the DFG Code (Deutsche Forschungsgemeinschaft, 2019).

one that is re-used in various contexts, the substantive appreciation of a high-quality contribution – regardless of the publication venue. With its ongoing diversification of publication channels and quality assurance variants, the publication system itself as described therefore offers excellent opportunities for attributing reputation – something that is undisputedly important – but without undermining the dissemination function of academic publishing.

Scholarship must face up to being assessed, but due to its great breadth and diversity, it is clearly not possible for such assessment to be based on a single, universally binding system. Nor is it conceivable that only a single publication format might be used for this purpose. In order not to encourage such a limited approach to assessment, academics should not narrow the range of output formats they use themselves in assessment processes (e.g. in connection with proposal submission) by assuming a single gold-standard publication format. It is much more important to emphasise the significance of an individual's contribution to scholarship than the number of units and the impact points of certain forms of publication. Similarly, as evidence of plausibility and multiplication capacity, it makes sense to assess to what extent the cross-process quality assurance measures and target group outreach proposed in sections 3.1.1 and 3.1.2 have been taken into account. The use of an OA publication option should be a priority here:[63] ultimately this also simplifies the evaluation of content.

In many disciplines, individual reputation could also be determined – especially as a person's career progresses – based on much broader criteria than just publication venue reputation or totalled metrics.[64] In addition to the broad spectrum of classic and new publication formats (see section 1.2), cross-disciplinary contributions may also be suitable for this in individual cases, e.g. in the form of infrastructures, guidelines, long-term studies and training structures for early-career academics, as well as the assumption of responsibilities and functions such as coordination and management tasks at the consortium level, or advisory and committee assignments. Offering a broader spectrum of research assessment in this way[65] would also take pressure off parts of the publishing sector.

3.1.4 Ensure that scholarship has control over its own data

In many instances, the current publication system favours the diverse findings and results of scholarship being produced by academics but then placed in the hands of commercial providers for the purpose of publication, who limit exploitation and usability in a variety of ways. The fact that research – which is mostly publicly funded – transforms its knowledge into a non-

[63] DFG funding guidelines, form 2.00 / 1/22, item 13.2.

[64] A situation of this kind is to be observed in the field of high-energy physics. The multi-author papers published in this field simply do not lend themselves to reputational attribution, so, alternatively, academics' reliability, skills and capabilities have a major role to play in how they are assessed (Knorr-Cetina, 2002).

[65] https://knowledge-exchange.info/event/openness-profile, February 17, 2022.

public asset in this way is often criticised. However, the effort to retain or regain control over what is published requires a structural change in the governance of publication venues, which is not least hindered by powerful incentive systems (see section 2.5).

When the commercial providers of digital tools, content and indices (Konrad, et al., 2020) or third parties cooperating with them track the use of their offerings (data tracking) in order to establish the resulting usage data as their own object of exploitation and business field, and then sell the insights gained in this way as a control instrument (predictive and prescriptive data) to decision-makers in the research system, this creates a dependency on the providers with regard to the decision-making structures in research. In view of the non-transparent way in which these data are generated and the lack of verifiability of their quality, caution is advised when using such commercial products for the purpose of research assessment and management. Here it is all the more important for scholarship to retain control over its own data and usage data or to organise data collection itself and prevent dependencies and misuse by other governmental or non-governmental actors (see section 2.2). The best way of doing this is to make use of non-profit infrastructures or infrastructures run by academic actors themselves. For this reason, open-source products and other software used for science administration might be used as research information systems, for example. The further monopolisation in the commercial market across different products, e.g. also as a result of the buy-out of library systems (Proquest, ExLibris) by index providers (Clarivate, Web of Science),[66] creates a problem for scholarship and its administration (Lauer, 2022; Siems, 2022).

For this reason, it would seem promising to consider the area of research data. Here, through the establishment of the National Research Data Infrastructure, the approach is to ensure governance and decision-making power over the infrastructures and data sovereignty is located within public institutions. This promises to prevent some of the problems that also caused the immense cost increase of accessing publications, as is currently evident in the form of vendor lock-in (greater difficulty in changing providers) and data tracking.

3.2 The responsibility of the funding bodies and providers of finance

Essentially, the academic publishing system should make it possible to disseminate academic results and findings quickly, comprehensively and openly. The materials should be appropriately quality-assured and made public via channels that are geared towards the target group. Their findability must be guaranteed, as must their free and sufficiently long-term availability (see section 1). Yet academics are often subject to a conflict of interests between orientation towards the target group on the one hand and the desire to build a reputation on the other.

[66] www.buchreport.de/news/paukenschlag-clarivate-uebernimmt-proquest, January 21, 2022.

Furthermore, contrary to what metrics-based evaluation and funding systems suggest, the relevance and quality of research papers do not have a simple causal relationship with the primarily bibliometric parameters on which they are based; metrics do not lend themselves to comparisons across different fields of academic study. The central task of funding agencies – including the German Research Foundation, of course – is therefore to ensure that the evaluation of academic achievement is based first and foremost on the content of scholarship. For this reason, the reputation of publication venues and bibliometric indicators, where they exist, should be removed from the canon of official assessment criteria and kept to a minimum in practical use.[67] The realignment of quality review, publication behaviour and reputation attribution as recommended in section 3.1 can only succeed in the long term if counterproductive incentive structures are visibly and reliably eliminated by academia and its funding bodies. It is the task of funding agencies to redesign funding mechanisms in such a way that publishing behaviour can once again take on more intrinsically motivated forms. Specifically, funding bodies must ensure that reputation, positions, resources and money are allocated to academics and their institutions in a visible, credible and comprehensive manner based primarily on content-oriented assessment of scholarship. At the same time, practices that support content-oriented assessment and a dissemination-oriented publication culture should be encouraged. Without the relevant positioning and without definitive action on the part of funding bodies, the systems of misguided incentives described here (see section 2.5) will persist unchecked below the surface, with a loss of clarity and reliability (Tregoning, 2018). Funding bodies should also influence the range and pricing of publication formats suitable for scholarship. Where, for example, publishers offer appropriate scholarship-oriented products (see also the list of criteria in section 3.2.1) and the aspects of open access, costs, exploitation of rights and data security are satisfactory, publication funding measures should be implemented; where these aspects are not satisfactory or only to a limited extent, funding should not be provided.[68]

Various advisory bodies to the academic community recently emphatically pointed out the responsibility of funders. For example, in its “Statement on Current Developments relating to Open Data and Open Access” of March 2019, the German Council for Scientific Information Infrastructures refers to the need for “academics, research funders and science policy-makers to work consistently towards changing reputation systems in order to overcome the negative excesses of the current publication system” (Rat für Informationsinfrastrukturen, 2019, p. 4). A recent publication by the German Council of Science and Humanities states: "The Council of Science and Humanities is in favour of assessing the quality of individual publications based on evaluation procedures and not relying on publication venue or indicators derived from it as

[67] According to Recommendation 4 of the San Francisco Declaration on Research Assessment (https://sfdora.org/read), January 21, 2022.

[68] Adjustments to the DFG’s actions resulting from this position paper and the signing of the San Francisco Declaration on Research Assessment, as well as from the process at European level on the Reform of Research Assessment, will be announced and documented on this website on an ongoing basis: www.dfg.de/publishing.

proof of quality." (Wissenschaftsrat, 2022, p. 54f). Internationally, a lower weighting of quantitative indicators in research assessment has been promoted for some time (see Info Box 7). For example, the "San Francisco Declaration on Research Assessment" of 2012, which was also signed by the DFG and enjoys broad support[69], advocates the assessment of research based on content. The 2019 "Hong Kong Principles of the World Conference on Research Integrity" are a step in the same direction.[70] In its "Position Statement and Recommendations on Research Assessment Processes" of July 2020, Science Europe recommends moving away from metrics and towards research content in the assessment of funding applications (Science Europe, 2020, pp. 20–21). cOAlition S – an international alliance of large, mostly national funding organisations that advocate the commitment of their funding recipients to OA publication and have been implementing this since 2021 – also regard research assessment and the focus on the publication content without regard to metrics, publication venue or publisher as a key area requiring action to be taken.[71] Examples of national initiatives are to be seen in Finland, for example, where guidelines on the responsible use of publication metrics have recently been published.[72] Meanwhile in the UK, a comprehensive analysis of the "metric tide" was presented back in 2015 with the result that, particularly in view of the increasing importance of metrics, greater emphasis should once again be placed on the responsible use of metric information in research assessment and there should be mechanisms to ensure this happens (Wilsdon, et al., 2015, p. 134).

[69] Over 2,400 (research) organisations and more than 18,000 individuals have now signed the declaration, https://sfdora.org/signers, January 21, 2022.

[70] www.wcrif.org/guidance/hong-kong-principles, January 21, 2022.

[71] "The Funders commit that when assessing research outputs during funding decisions they will value the intrinsic merit of the work and not consider the publication channel, its impact factor (or other journal metrics), or the publisher." (Principe No. 10 of Plan S, see www.coalition-s.org/plan_s_principles, January 21, 2022).

[72] Text only available in Finnish: https://avointiede.fi/sites/default/files/2020-09/Kansallinen-suositus-julkaisumetriikan-vastuullisesta-kaytosta-03092020.pdf, January 21, 2022.

Info Box 7: Selection of international statements on the reform of the assessment of performance and quality in scholarship

Declaration on Research Assessment (DORA)

Reception rather than counting & consideration of diversity: DORA recommends abandoning metrics as a basis for judgements and instead using the academic content documented in publications. It appeals to funding bodies, research institutions, academics, publishers and other organisations that create metrics and make money from them.

https://sfdora.org/read/read-the-declaration-deutsch

Science Europe Recommendations on Research Assessment Processes

Substantial and concerted changes are needed to ensure that the research assessment system will continue to function appropriately in the future: "Organisations should ensure that their assessment processes are focused on the substance and content of applications, rather than the venues or metrics that the work is associated with (…) Organisations should adapt their application and review systems to aid reviewers in conducting qualitative assessments (…) Organisations should consider broadening the spectrum of research outputs and activities that are considered during the assessment of candidates, research proposals, and/or research institutes."

www.scienceeurope.org/media/3twjxim0/se-position-statement-research-assessment-processes.pdf

Global Research Council

The pressure to perform in university league tables is a barrier to research culture: "Many university rankings use a small number of proxies of quality (e.g. a narrow set of metrics) to compare very different research performing organisations. League tables often do not measure what matters to the R&I system and they do not demonstrate excellence at a useful scale for the users of this information (for example, pockets of excellence are not captured)".

www.globalresearchcouncil.org/fileadmin/documents/GRC_Publications/GRC_RRA_Conference_Summary_Report.pdf

European Commission: "Towards a reform of the research assessment system. Scoping Report" Directorate-General for Research and Innovation, Directorate A — ERA & Innovation

Allow and recognise diversity. The report notes that 1) the research process is becoming more multidisciplinary and producing a greater variety of outcome types, and 2) quantification tools are too narrow or inappropriate for judging the quality, performance and impact of research and researchers. The report states that the current assessment system is in need of reform: "A reformed system should also be sufficiently flexible to accommodate the diversity of countries, disciplines, research cultures, research maturity levels, the specific missions of institutions, and career paths".

https://op.europa.eu/en/publication-detail/-/publication/36ebb96c-50c5-11ec-91ac-01aa75ed71a1/language-en

Research on Research Institute (RoRI) Working Paper "The changing role of funders in responsible research assessment: progress, obstacles and the way ahead"

The paper identifies and analyses four long-standing, fundamental problems in the science system:

1. Misapplication of **narrow criteria** and indicators of research quality or impact
2. Therefore the **diversity** of research missions and purposes is **reduced**
3. **Systemic biases** against those who do not meet—or choose not to prioritise – narrow criteria and indicators **have reduced** diversity, vitality and representative legitimacy of the research community
4. There has been a diversion of **policy and managerial attention towards things that can be measured, at the expense of less tangible or quantifiable qualities, impacts, assets and values** – a trend exacerbated by the rise of flawed university league tables.

www.globalresearchcouncil.org/fileadmin/documents/GRC_Publications/GRC_RRA_Conference_Summary_Report.pdf

A good overview of the now numerous international actors and activities seeking to follow the principle of "content before metrics" in the assessment of academic output is provided in RoRI Working Paper No. 3 of the Global Research Council (GRC) (Curry, et al., 2020, pp. 20, 30). The GRC also sees systemic change as the primary task of research funding bodies.[73] Knowledge Exchange has developed an *Openness Profile* , which aims in particular to better incorporate contributions in open access form into academic assessment systems.[74]

3.2.1 Broaden the spectrum of accepted publication formats

In order to return the evaluation of academic performance to content, it is first necessary to establish mechanisms that strengthen confidence in the validity of research outcomes or data – regardless of publication format or venue.

The possibility of separating quality assurance and content assessment from publication format was first discussed in section 3.1.1, However, in order for these formats to be used and for the relevant publications to be indicated and accepted in the context of academic evaluation, a new common understanding of appropriate publication formats is needed. According to section 3.1.2, the publication format must be appropriately chosen in relation to the intended form of communication. Ultimately, this might be a publication format that is well suited to bibliometric analysis. In this case, rigorous standards apply to those doing the assessment in that they must still give priority to the content. Conversely, publication formats without attributed reputation or metric evaluability (e.g. preprint, self-published anthology, dataset) must also be assessed based on the value of their content. The crucial factor is for a good match to be achieved between the content to be conveyed and the target group. For example, the posting of results in a data repository could be a suitable way of ensuring data re-use by the academic community. For the early discussion of preliminary results, on the other hand, a suitable medium might be a blog, a manuscript on a preprint server, a conference paper, or an interim or preliminary report in the run-up to the final monograph. For long-term and widespread dissemination,[75] a suitable option could be a book, book section or journal article or a newspaper article, or else publication via platforms recognised within the discipline, depending on the context.

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[73] See the working group on Responsible Research Assessment established in 2021: www.globalresearchcouncil.org/about/responsible-research-assessment-working-group/, January 21, 2022.

[74] https://knowledge-exchange.info/event/openness-profile, February 17, 2022.

[75] Various formats of science communication (print media, social media, etc.) are suitable for sharing insights with society at large. Ideally, these should be capable of conveying the stage which a research study has reached along the way to arriving at a secure state of knowledge (Wissenschaftsrat, 2021 B).

In accordance with the different purposes of publications in the broadest sense, it is difficult to recommend uniform criteria for the appropriate selection of publication format and venue. In order to be able to do this, the various criteria have to be seen as a continuum and weighted differently depending on the goal of communication. Starting from the publication of final research results with the target group of “the academic community”, a list of criteria for the selection of appropriate publication formats is proposed below. This list can be used by the academics to select publication formats and by funding bodies to evaluate publication performance. It would be possible to justify deviations in the individual criteria depending on differences in the stated target group or level of results maturity.

List of criteria: Characteristics of a scholarly publication format (best practice):

The publication format enables appropriate communication to the target group addressed; it is known and accessible to them.

The criteria for inclusion of academic contributions in the medium or publication channel are transparent and in line with good practice in the respective field.

The form of publication provides for a sufficient level of scope and detail of the contributions to allow comprehension and verifiability as well as enabling appropriate supplementary information to be appended.

The processes for content review, quality assurance and, where relevant, quality assessment are set out transparently and the status of the publication is clearly identified (e.g. peer reviewed, non-peer reviewed, before peer review, etc.).

The publication form enables published content to be made available and further disseminated as quickly as possible in the interests of academic discourse.

It offers the target group access that is as unrestricted as possible as well as subsequent use options and secure, sufficiently long-term provision of its published content.

Subsequent changes are marked as such. Versions and the final version are citable as such and are preserved. Procedures for the withdrawal of articles are clearly regulated.

The publication channel shows transparently how data generated in the course of publication and publication usage are utilised, obtains consent for utilisation and allows publishers to refuse further

collection of data and use traces by the publication format or by third parties authorised by it without restriction on access or other disadvantages.

In the case of an OA publication, the costs incurred to the authors are clearly and directly identifiable, as is any assumption of costs by the authors' research institution (e.g. in the case of OA transformative agreements, framework agreements and DEAL agreements).

Authors may retain simple exploitation or usage rights and publish their material elsewhere. CC licences are granted by the authors.

The metadata are standardised and findability is ensured via subject-related portals and databases or navigation tools.

If research data, software/code, materials or samples are made public as an independent publication or as part of or the basis for a publication, suitable repositories and databases, ideally certified, must be selected for this purpose in accordance with the good quality standards customary in the respective subject area.

The publication format ensures the assignment of persistent identifiers such as digital object identifiers (DOI) in order to guarantee the findability and citability of independently published data sets and therefore their subsequent use.

Moreover, the COVID-19 pandemic has clearly shown that the establishment of digital sovereignty in the academic sector is of enormous importance, especially with regard to fundamental, critical infrastructures and services (Wissenschaftsrat, 2021 A, pp. 43–48). This applies in particular to the publication sector. For this reason, it is all the more important for the scholarship-driven development and use of publishing output formats to be supported across the board (Wissenschaftsrat, 2022, p. 38) and freed from restrictions and counterproductive incentive systems.

3.2.2 Attach greater importance to proof of achievement that is geared towards content

Accepting a wider range of academic output formats as publications (see definition of publication in section 1) is an important step towards creating a culture of academic evaluation in which publications are regarded less as quantifiable items and more as substantive evidence of academic activity.

Through the requirements they set for the presentation of the scholarship to be assessed and their evaluation or review criteria, the funders of research are in a key position to initiate credible change. As a first step in this direction ("quality over quantity"), the DFG has already imposed a limit to the number of project-specific publications to be listed in proposals. In the day-to-day routine of evaluation, however, even such short lists still tempt people to make bibliometric comparisons such as counting publications by "top publishers". As further advancement and refinement, therefore, the primacy of the content-related evaluation of academic output is recommended when it comes to assessing scholarship. A more content-oriented evaluation is essential for the open and differentiated further development of the publication system, independent of any narrowing-down to quantitative and metric evidence of achievement. In order to expand the range of activities included in evaluation as required, the narrow definition of publication must be overcome and academic achievements beyond publishing must be incorporated to a greater extent than has been the case to date. For this purpose, reports, proposals and applications should contain additional descriptive documentation of both published and other academic achievements and qualifications, and the spectrum of such activities should be broader than is possible by simply listing published articles, books and conference contributions. In line with the suggestions in section 3.1.3, this also includes a wider range of contributions to the subject-specific community. Such an expanded spectrum also includes otherwise neglected but nevertheless valuable information such as clinical guidelines, SOPs and study protocols, codes, data sets, technology transfer, the provision of research infrastructure and training structures for early-career academics, and the assumption of coordination and management tasks. Publications referenced in this connection serve as evidence of the individual's own academic activity and provide in-depth reading. When citing academic publications in reports or proposals, bibliometric data or requirements are therefore dispensable if a qualitative approach is to be adopted. Similarly, any prescribed minimum number of publications should be called into question, whether for the award of scholarships or third-party funding or for promotion on the academic career ladder – all the more so where applicants are from non-homogeneous disciplinary backgrounds. Finally, reviewers are instructed to primarily examine the content of the research in question rather than basing their evaluation on the number and factors of certain types of publication. [76]

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[76] The "Integrated Advice of the European Commission's Open Science Policy Platform" (2018) takes a similar approach "Evaluations … should not use journal brand or impact factor as a proxy for research quality" (p. 5), see below www.dfg.de/download/pdf/foerderung/programme/lis/ospp_integrated_recommendations.pdf, 21.01.2022. A variety of outputs should be considered (p. 6).

The (Open Access) Plan S, to which some European and national funding bodies have subscribed, also provides for evaluation based on intrinsic merit in Principle No. 10 (www.coalition-s.org/principles-and-implementation), January 21, 2022.

The Swiss Science Council also proposes numerous measures to strengthen quality-oriented research assessment (Swiss Science Council SSC, Hendriks, Reinhart, & Schendzielorz, 2018). Some (European) research funders have also taken this route, see for example UKRI: Statement on the responsible use of metrics in Research Assessment (UK Research and Innovation, 2018), (Schweizerische Akademie der Geistes- und Sozialwissenschaften, 2018).

3.2.3 Strengthen the recipient side

Empowering authors by upgrading various content-oriented publication venues and modalities is an important step in counteracting misguided incentives that are detrimental to an appropriate scholarly publication culture. In order for this to succeed, however, it is also necessary to remove barriers to the recipients of academic publications: they must be able to find the content without restriction, i.e. in the form of an open access publication. This also means they have to be in a position to search and find the material in an appropriate manner right from the outset and make selections according to content-based criteria. For this, recipients need an overview of all relevant sources that is as independent and complete as possible, but which can also be geared towards individual interests based on clear rules and algorithms. Given the variety of existing publication formats, convenient access is required which – depending on subject-specific conventions – is as uniform as possible and offers transparent, comprehensible pre-selection. This can take the form of information organised on a subject-specific basis or comprehensive databases and portals.[77, , 78]

Even though their spectrum is gradually expanding just now, the major commercial search systems are still far from accounting for the entire publication system (see section 2.1). The DFG also promotes and supports the development of services for subject-specific research and the availability of academic information (specialised information services) as well as the interdisciplinary development of infrastructures (publication, research data, software) in accordance with scholarly standards. For example, since January 2021 it has been possible to submit proposals for funding of research tools under the newly focused DFG programme “Infrastructures for Scholarly Publishing”. In addition, a number of independent research tools are now available, some of which were created with DFG funding (see Info Box 8). The consortia of the National Research Data Infrastructure funded by the Federal Government and the Länder will become the first point of contact for research and subsequent use of research data.

[77] Ideas in this regard are to be found, for example, in the form of the Dimensions index (www.dimensions.ai, January 21, 2022).

[78] Another example of activities of this kind is the network database K10plus, a joint initiative being pursued by the headquarters of the Joint Library Network of the federal states of Bremen, Hamburg, Mecklenburg-Western Pomerania, Lower Saxony, Saxony-Anhalt, Schleswig-Holstein, Thuringia, the Prussian Cultural Heritage Foundation and the Library Service Centre Baden-Württemberg: www.gbv.de/news/pdf/BSZ-GBV-Mitteilung-K10plus-2019-03-27.pdf, January 21, 2022.

Info Box 8: Examples of science-driven literature search tools

1. BASE (Bielefeld Academic Search Engine) is one of the world's largest search engines for academic web documents. The index includes over 150 million documents from over 7,000 sources. The full texts of some 60 percent of the documents indexed in BASE are freely accessible (open access). The operator of the BASE search engine is Bielefeld University Library. www.base-search.net/?l=en, 27.04.2022

2. The project re3data.org (Registry of Research Data Repositories) aims to make repositories for research data accessible in a web-based directory, thereby providing guidance regarding existing data collections. www.re3data.org, 27.04.2022

3. The aim of the Specialised Information Services (FID) is to provide researchers with fast and direct access to specialised literature and information relevant to their research. http://wikis.sub.uni-hamburg.de/webis/index.php/Webis_-_Sammelschwerpunkte_an_deutschen_Bibliotheken, 21.01.2022

4. The TIB AV-Portal is a portal for academic videos in the areas of technology, architecture, chemistry, computer science, mathematics and physics. https://av.tib.eu, 21.01.2022

5. The Electronic Journals Library contains comprehensive information on open access and non-open access journals http://ezb.uni-regensburg.de/ezeit/about.phtml?bibid=AAAAA&colors=7&lang=en, 27.04.2022

6. The DATENBANK-INFOSYSTEM (DBIS) is a directory of almost 14,000 academic databases, some 6,000 of which are freely accessible online. https://dbis.ur.de//index.php?bib_id=alle&colors=3&ocolors=40&ref=about, 21.01.2022

7. Independent research tools are also to be developed or networked within the framework of the National Research Data Infrastructure (NFDI). www.nfdi.de/consortia/?lang=en, 27.04.2022

The expansion of this segment of the academic information infrastructure is something that the major funding providers and research organisations should embrace individually or jointly.

4 Conclusion

As time goes on, academic publishing with its basic functions of “dissemination, quality review and documentation of research findings” and “attribution of authorship and reputation” is subject to shifting requirements and influencing factors. From today's perspective, the essential requirements are that scholarship retains the freedom to reach its respective target groups in an appropriate manner by means of suitable forms of publication that it chooses itself, to apply quality review and evaluation of its own research even during the research process, and to safeguard this quality through the choice of publication format, securing exploitation and usage rights as well as unrestricted access to its own publications for third parties. Publication service providers and publishers must align themselves with these requirements. There are significant factors that stand in the way of these necessities, however. In many areas of the research system, the allocation of funding to support scholarship and researchers’ career paths is too systematically linked to the quantified assessment of very specific publication formats as accepted proof of academic achievement; this has a very powerful influence on publication practice and counteracts the key functions of publishing. This position paper establishes the need to support academics in meeting the stated requirements while at the same time enabling them to avoid succumbing to misguided incentives. Such regulatory activity can and must come firstly from scholarship itself in the form of its self-governing organisations, the universities and research institutions, the scholarly societies and academic umbrella organisations, and secondly from the public bodies that fund research. It is the task of these stakeholders to ensure responsible assessment of research and guarantee the appropriate development of the publication system in the future.

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6 Appendix: Survey of review board supervisors at the DFG's Head Office regarding the most common forms of publication

6.1 The DFG Review Boards

The survey was conducted in August 2018 among the researchers working on 48 DFG Review Boards, having been elected in the more than 200 subject areas represented by them according to the DFG classification system; their main task is to evaluate DFG proposals from a perspective that is as subject-specific as possible, the majority of cases having been reviewed beforehand in writing by external experts. These include, in particular, proposals submitted under funding procedures for research grants, research fellowships, the Emmy Noether and Heisenberg Programmes, as well as draft proposals submitted under the two-stage procedures for Research Units, Clinical Research Units and Research Training Groups. The composition of the DFG Review Boards is determined by the academic community itself (see www.dfg.de/dfg_profil/gremien/fachkollegien). This is done firstly based on the structural proposals submitted by scholarly societies and HEIs entitled to do so, implemented by the DFG Senate, and secondly by means of direct election of review board members by researchers working in Germany. As such, the review board structure provides a sound approximation of subject composition within the German research landscape, though with a slight delay due to the four-year mandate period.

6.2 Methodology

The staff members responsible for the 48 review boards at the DFG Head Office were asked to complete a questionnaire. The latter includes questions on the common types of publication in a subject area, the forms and use of widespread quality assurance mechanisms (e.g. peer review), and the relevance of journal and person-oriented metrics in the assessment of a research proposal in each case. With a response rate of 100 percent, responses were collected for all 48 review boards (13 review boards in the humanities and social sciences, seven review boards in the life sciences, 18 review boards in the natural sciences, ten review boards in the engineering sciences).

The following specific questions were asked:

- Which review board do you represent?
- What is the proportion of the following forms of publication in your subject area?

Response option: Very high (>90%), High (>75-90%), Medium (25-75%), Low (5-25%), Minimal (<5%), No response

- And what are the three (maximum) most important types of publication in your field? (Please rank in order of importance)
- How is quality assurance applied in the three types of publication mentioned?

Response option: Peer review, None, Other (please specify)

- For the three publication types mentioned above, please outline how a publication commonly progresses from manuscript/draft to final publication (example: Manuscript – Preprint-Server – Journal)
- In an average CV of one of your applicants, what is the approximate percentage of publications that have passed through a quality assurance process (e.g. peer review)?
- Are there particular forms of (accepted) quality assurance in your field besides peer review? (Please specify briefly)
- In which language do you usually publish in your field? (in percent)

Response option: English, German, Other (please specify)

- What is the approximate share of OA publications? (in percent)
- Are there any features that are peculiar to the publication culture in your field? (If so, please explain briefly)
- How important are metrics (h-index, number of publications, impact factor, etc.) in your field when reviewers evaluate an individual researcher?

Response option: Very Important, Important, Of Medium Importance, Not Very Important, Irrelevant

A spider web diagram (Figure 1) and a detailed heat map diagram were created from the answers to question 2. For this purpose, the responses were transferred to a 5-figure scale: 5 = Very High, 4 = High, 3 = Medium, 2 = Low, 1 = Minimal, (--) = No response.

	Book publications/ monographs	Contributions to an anthology	Journal articles	Preprints	Non publisher publications	Data publications	Software/codes	Patent documents	Audio-visual media	Images/ graphs	Alternative publication types	Other	DFG Review Board
Humanities and Social Sciences	4	4	4	1	2	1	1	1	1	5	1	--	Ancient Cultures
	5	5	5	1	2	1	1	1	1	2	2	--	History
	5	2	1	1	1	1	1	1	1	1	1	--	Fine Arts, Music, Theatre and Media Studies
	3	3	4	2	4	2	2	1	1	1	1	--	Linguistics
	3	3	3	1	1	1	1	1	1	1	1	--	Literary Studies
	4	3	3	2	2	1	1	1	2	2	2	--	Social and Cultural Anthropology, Non-European Cultures, Jewish Studies and Religious Studies
	5	4	3	1	2	1	1	1	1	2	2	--	Theology
	3	3	3	2	2	1	1	1	--	1	2	--	Philosophy
	3	4	3	1	2	2	1	1	1	1	1	--	Educational Research
	2	1	5	1	1	1	2	1	1	2	2	--	Psychology
	3	3	3	2	2	2	2	1	1	1	2	--	Social Sciences
	1	1	5	4	1	2	2	1	1	1	1	--	Economics
	5	3	3	1	2	1	1	1	1	2	2	--	Jurisprudence
Life Sciences	1	1	5	2	3	2	1	1	1	1	1	--	Basic Research in Biology and Medicine
	1	2	5	3	4	3	2	2	2	1	2	--	Plant Sciences
	1	1	5	2	2	1	1	1	1	1	1	--	Zoology
	1	2	5	3	4	4	2	2	1	1	1	--	Microbiology, Virology and Immunology
	1	1	4	1	3	1	1	1	1	1	2	--	Medicine
	1	1	5	2	2	2	1	1	1	1	1	--	Neurosciences
	1	2	5	2	2	3	1	1	1	1	2	--	Agriculture, Forestry and Veterinary Medicine
Natural Sciences	2	2	5	2	2	2	1	2	1	1	1	--	Molecular Chemistry
	2	2	5	2	2	2	1	2	1	1	1	--	Chemical Solid State and Surface Research
	1	2	5	2	1	2	1	1	1	1	1	--	Physical and Theoretical Chemistry
	1	1	5	1	2	1	1	2	1	1	1	--	Analytical Chemistry, Method Development (Chemistry)
	1	1	5	2	2	1	1	2	1	1	1	--	Biological Chemistry and Food Chemistry
	2	2	5	2	2	2	1	3	1	2	1	--	Polymer Research
	1	2	5	3	3	2	2	2	1	1	1	--	Condensed Matter Physics
	1	2	5	4	2	2	2	2	1	1	2	1	Optics, Quantum Optics and Physics of Atoms, Molecules and Plasmas
	1	1	5	5	3	3	3	2	1	1	2	--	Particles, Nuclei and Fields
	1	2	5	3	3	2	2	2	1	1	1	--	Statistical Physics, Soft Matter, Biological Physics, Nonlinear Dynamics
	1	1	5	4	2	3	2	1	1	1	1	--	Astrophysics and Astronomy
	4	2	5	5	2	2	2	1	1	2	1	1	Mathematics
	1	2	4	1	1	2	2	1	1	1	1	1	Atmospheric Science, Oceanography and Climate Research
	2	2	5	2	1	1	1	1	1	1	1	--	Geology and Palaeontology
	1	2	4	2	3	2	2	1	1	1	1	--	Geophysics and Geodesy
	1	2	5	1	3	1	1	1	1	1	1	--	Geochemistry, Mineralogy and Crystallography
	1	1	5	1	3	2	2	1	1	1	1	--	Geography
	1	1	5	1	2	1	1	1	1	1	1	--	Water Research
Engineering Sciences	1	2	4	1	2	1	1	2	1	1	2	--	Production Technology
	2	2	3	1	1	2	2	2	1	1	1	3	Mechanics and Constructive Mechanical Engineering
	1	1	5	2	4	4	4	5	2	2	1	--	Process Engineering, Technical Chemistry
	1	1	5	2	4	4	4	5	2	2	1	--	Heat Energy Technology, Thermal Machines, Fluid Mechanics
	1	2	5	2	2	2	2	3	1	1	1	--	Materials Engineering
	1	2	5	3	1	4	2	2	1	1	1	4	Materials Science
	1	1	3	1	2	2	2	2	2	2	1	--	Systems Engineering
	2	3	4	3	4	3	3	4	2	2	1	--	Electrical Engineering and Information Technology
	1	1	2	4	5	2	5	1	4	4	1	--	Computer Science
	1	1	2	4	5	2	5	1	4	4	1	--	Construction Engineering and Architecture

Figure 3: Proportion of publication types in the subjects of the 48 DFG Review Boards in August 2018 based on a survey of Review Board supervisors at the Head Office. Heat map. 5 = Very High, 4 = High, 3 = Medium, 2 = Low, 1 = Minimal, (--) = No response.

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