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## **The future development of assessment processes for research activity in the context of open science**

*Discussion paper of the Task Force for Measure 4 of the Alliance 2021-2025 Open Access Strategy as part of the Alliance Initiative "Digital Information in Science"*

### **SUMMARY**

Open science practices harbour both great potential and challenges for the future development of assessment processes for research activity. All open science activities are oriented towards a more open approach to research results and processes. This comprises digital open access to research results such as text publications, research data and software. Open science can refer to at least two aspects with respect to assessment processes: first, to the assessment process itself, the data used and the infrastructures that provide the data; second, to the subject of the assessment. Both open science functions can mutually strengthen each other.

First: Data being accessible to those involved in the process enables quality assurance and makes the process transparent. Information systems that support the documentation and assessment of research activities should therefore, in future and as a common good, be open, freely usable and science-led, as well as giving due consideration to legal and ethical restrictions and being sustainably managed.

Second: Documentation- and process-related standards that are developed in the open science context help make research reproducible and make it easier to evaluate research integrity. In this respect, such norms are also the subject of quality assessments. As open science practices differ in their forms and development across individual disciplines, the specific circumstances should be considered when including open science aspects in assessment criteria.

This discussion paper is intended as a contribution to the Alliance of Science Organisations in Germany Initiative "Digital Information in Science", which promotes the development of assessment processes for research activities in light of a profound transition linked to open science practices.<sup>1</sup> It is aimed at both the management and administrative departments of science and academic institutions, and infrastructure organisations that support research, as well as all researchers committed to an ongoing modernisation of assessment processes for research activities. The Alliance Initiative encourages discussion of this important topic, in order to more closely link both top-down and bottom-up approaches to implementing the principles outlined in this discussion paper.

### **1. Developing assessment processes for scientific activities: an important task for autonomous scientific systems**

Further developing assessment processes for scientific activities is an important task for a scientific system. It involves processes for assessing individual researchers, research projects and results, as well as infrastructures and institutions. Evaluating scientific activity concerns various aspects of research, teaching, and transfer quality. With a clear focus on quality standards inherent to science, assessment should adequately reflect changing

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<sup>1</sup> This discussion paper has been published as part of the Alliance's Open Access Strategy.

societal and scientific expectations regarding research work, projects, published results, infrastructures, and institutions.

Current changes in research practice – such as open science, multi- and transdisciplinary research, and research in large research groups (team science) – represent trends that also affect research evaluation practices. Some far-reaching proposals concerning the transformation of research assessment have already been made, which can only take effect once they have been widely implemented.<sup>2</sup> The proposals and criticism are driven, above all, by unintended consequences of assessment processes that have their origin in the reactivity of researchers, i.e. in their adaptation to the mechanisms of research assessment.<sup>3</sup> These adaptations lead to shifts in objectives, for example when the original objective – such as publishing valuable research results – evolves into the objective of maximising the value of a publication or citation indicator.<sup>4</sup> Ultimately, the predominant assessment culture in the respective scientific institutions and research/expert communities also determines possible maladjustments. Furthermore, an increasingly critical view is taken of the data used in assessment processes, as well as of the use of unsuitable processes, including journal-related indicators such as the journal impact factor to measure the research performance of individuals. Here, too, it is important that scientific organisations consciously use assessment processes to reverse or prevent undesirable developments.<sup>5</sup>

Research institutions (including infrastructure institutions) should analyse and reflect on current developments in a differentiated and suitable manner, to draw conclusions regarding their own function in assessment processes while giving due consideration to the effects on the scientific system.

Open science practices harbour both great potential and challenges for the future development of assessment processes for research activity. Before these are discussed in

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<sup>2</sup> Prominent examples are the Declaration on Research Assessment (DORA – <https://sfdora.org/about-dora/>) and the Coalition for Advancing Research Assessment (CoARA – <https://coara.eu/>). Persons involved in bibliometrics as part of assessment processes have also voiced their view: see, for example, Diana Hicks et al., 'Bibliometrics: The Leiden Manifesto for Research Metrics', *Nature* 520, no. 7548 (April 2015): 429–31, <https://doi.org/10.1038/520429a>.

<sup>3</sup> Wendy Nelson Espeland and Michael Sauder, 'Rankings and Reactivity: How Public Measures Recreate Social Worlds', *American Journal of Sociology* 113, no. 1 (July 2007): 1–40, <https://doi.org/10.1086/517897>.

<sup>4</sup> There are many examples: Barbara Kehm, 'Global University Rankings: Impacts and Applications', in *Gaming the Metrics. Misconduct and Manipulation in Academic Research*. (MIT Press, 2020), <https://direct.mit.edu/books/book/4598/chapter/211135/Global-University-Rankings-Impacts-and-Applications>. Lutz Bornmann and Hans-Dieter Daniel, 'Multiple Publication on a Single Research Study: Does It Pay? The Influence of Number of Research Articles on Total Citation Counts in Biomedicine', *Journal of the American Society for Information Science and Technology* 58, no. 8 (2007): 1100–1107, <https://doi.org/10.1002/asi.20531>. Aldo Geuna and Ben R. Martin, 'University Research Evaluation and Funding: An International Comparison', *Minerva* 41, no. 4 (1 December 2003): 277–304, <https://doi.org/10.1023/B:MINE.0000005155.70870.bd>. Sarah de Rijcke and Tereza Stöckelová, 'Predatory Publishing and the Imperative of International Productivity: Feeding Off and Feeding Up the Dominant' *Gaming the Metrics. Misconduct and Manipulation in Academic Research*, 28 January 2020, <https://doi.org/10.7551/mitpress/11087.003.0010>. Daniele Fanelli, 'Pressures to Publish: What Effects Do We See?', *Gaming the Metrics. Misconduct and Manipulation in Academic Research*, 28 January 2020, <https://doi.org/10.7551/mitpress/11087.003.0011>. Linda Butler, 'Modifying Publication Practices in Response to Funding Formulas', *Research Evaluation* 12, no. 1 (1 April 2003): 39–46, <https://doi.org/10.3152/147154403781776780>.

<sup>5</sup> Recommendations in the context of publication are available here: [DFG – German Research Foundation – DFG Position Paper on Academic Publishing as a Foundation and Area of Leverage for Research Assessment](#).

more detail in Section 3, Section 2 will briefly outline the basic principles for assessment processes.

## **2. Principles for assessment processes for research activities**

Assessment processes for research activities have various functions and both endogenous and exogenous objectives, and concern very diverse subjects.<sup>6</sup> General principles that form the basis of defined evaluation criteria should be appropriate to science and research, be based on good scientific practice, and contribute to the fair treatment of researchers. These principles are in particular:

- *Suitability*

The pluralism pertaining to the research subjects and objectives must be reflected in the pluralism of the assessment process and in the way research activity and societal relevance is determined. To ensure suitability, the development of the respective assessment methods must be based on expertise relevant to the subject. Additionally, both the assessment process itself and the evaluation criteria it uses must consider the mission of the institution being assessed. Thus, there cannot be standardised assessment processes in the form of standardised solutions. With respect to state funding, it is important that the processes in which the articulation of legitimate political requirements made of research activities for society are distinct from ensuring the epistemic quality inherent to science itself.

- *Methodically planned approach*

Research evaluation processes must comply with the principle of a carefully planned approach that gives due consideration to the current state of the method's development. "Planning" refers to the selection of persons who will ensure that the assessment is appropriate to the subject, as well as to the evaluation criteria to be used, the methods to determine research performance and relevance, the procedure itself, and the use of results. The principle excludes both ad hoc assessments using available indicators as well as deviations from the planned procedure.

- *Indispensability and priority of the qualitative assessment*

Evaluating research performance and relevance can never be based exclusively on numbers. Thus, expert qualitative considerations must be the prime foundation of the assessment. The exclusive use of quantitative indicators (number of publications, citations, patents, or references on social media, etc.) or even focusing on a single indicator contradict this principle. It is the responsibility of research/expert communities to inform themselves about the adequate and inadequate use of metrics.

- *Transparency*

The principle of transparency refers to the entire research assessment process in the context of applicable laws (for example, concerning data and personal privacy). It includes the assessment objectives, the evaluation criteria used, the planned steps of the process, the respective stages of the process that have been reached, the assessment result including its rationale, and the resulting positive or negative consequences. The robustness and legitimacy of the results depend not least on the methods and the data used.

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<sup>6</sup> See discussion paper annex.

Individual assessment criteria are rarely commensurate to the task of evaluating entities in the scientific system. Thus, as a rule, multiple criteria are required. The various criteria as well as their weighting should be clearly defined at the start of the process, so that their respective influence on the assessment result is transparent to all involved.

- *Reflective approach*

Research assessment processes can have major consequences for the individuals or institutions that are evaluated. All participants should be guided by the principle of a reflective approach in all phases of the process. This includes in particular:

- reflecting upon the ways in which individual evaluation criteria could be operationalised with the help of qualitative and quantitative methods (process planning);
- estimating the significance and limits of the assessment methods via the assessment committee (interpretation of the assessment results);
- considering the consequences of the assessment process for the person and/or scientific institution evaluated (concluding the process).

This reflective approach requires sufficient time to engage with the assessment process, which is another reason why assessments should be used sparingly and only as required. As part of human resources development, researchers should be supported in acquiring and improving assessment skills, so that the task of evaluation is not concentrated on too small a number of persons.

It is particularly important to note that assessment processes can have unintended side effects which may not be fully foreseeable.<sup>7</sup> This concerns both undesirable adaptive behaviour on the part of scientific institutions and researchers, as well as the use and expansion of assessment processes without due consideration by evaluating institutions.

### **3. The future development of assessment processes in practice: opportunities and challenges regarding open science**

With respect to the future development of assessment processes, it is necessary to consider the macro-trend of ongoing digitalisation and the current state of digitality in many scientific processes already. This applies to both the entire spectrum of features of scientific quality as well as to all the basic principles for assessment processes mentioned in *Section 2*. Open Science – which refers to a mode of scientific work that is not only practised and advocated in many different contexts but also forms the basis for intense discussions about the impacts of digitalisation on scientific quality and its evaluation – allows for the exemplary determination of the specific future development of processes.

All open science activities seek to establish more openness in research results and processes. With respect to assessment processes, it is worth defining the core element of open science as follows: It comprises the digital open access to research results such as to text publications, research data and software. The definition can be expanded to include additional aspects such as the simpler subsequent use of research results, greater

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<sup>7</sup> Examples can be found in the details in *Section 1*.

transparency concerning research processes, and the involvement of regular citizens (citizen science).<sup>8</sup>

Open science can refer to at least two aspects with respect to assessment processes. The first point can be the *assessment process* itself, the data it uses and the infrastructures that provide this data. A second point of reference can, however, also be the *subject of the assessment*. Open science then forms a criterion for the assessment process. In EU research framework programmes, for example, open science practices are part of the application and evaluation process, while this is not the case in some national scientific systems.

1) *Open science as a guiding principle for carrying out assessment processes*

The openness of data for those involved in the process (also regarding changes to the data over time) enables quality assurance and transparency of the process, including for the persons and institutions being evaluated. For this reason, the greatest possible degree of openness regarding data should be paramount for at least those involved in the process.<sup>9</sup> It is important not to confuse the call for broadly open data with making the process itself public, which can lead to confidentiality issues and thus impact the quality of the evaluation.

To the degree that the elements informing the assessment process (text publications, research data, research software, methods) are accessible and usable, they reduce the workload needed to acquire them and thus create simpler foundations for the evaluation as well as, from a systematic perspective, more efficient processes.

The qualitative assessment of research activities is also made easier in this way. Furthermore, open access and free usage allows for elements of the assessment to be shared with third parties, which is necessary for a high level of (process) transparency. Considering this, open science practices can be seen as important components for the efficient access, inclusion and thus qualitative consideration of results, and for the creation of transparency regarding assessment processes.

An analogous argument applies to the infrastructures used in the evaluation process as the basis of the responsible use of quantitative indicators. Currently, proprietary data and evaluation tools based on this data are primarily used to assess research output.<sup>10</sup> Due to their proprietary nature, neither the mechanisms to curate the data nor the algorithms for their analysis can be checked by those performing the assessment or those being assessed. Additionally, sharing the data with third parties – for example, with the individuals and institutions to be assessed, for the purpose of checks – is subject to strict limitations. These circumstances can distort the research assessment, which in turn may lead to misguided steering effects.<sup>11</sup> A

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<sup>8</sup> For more on citizen science, see the Alliance statement on participation in science [https://www.allianz-der-wissenschaftsorganisationen.de/wp-content/uploads/2022/11/2022-11-09\\_Allianz\\_Stellungnahme\\_Partizipation-1.pdf](https://www.allianz-der-wissenschaftsorganisationen.de/wp-content/uploads/2022/11/2022-11-09_Allianz_Stellungnahme_Partizipation-1.pdf).

<sup>9</sup> See the FAIR Guiding Principles for scientific data management and stewardship <https://www.go-fair.org/fair-principles/>.

<sup>10</sup> German Research Foundation, Working Group on Publications. (2022). Academic Publishing as a Foundation and Area of Leverage for Research Assessment. <https://doi.org/10.5281/ZENODO.6538163>.

DFG Committee on Scientific Library Services and Information Systems. (2021). Data Tracking in Science: Aggregation and Use or Sale of Usage Data by Scientific Publishers. An information paper from the German Research Foundation's Committee on Scientific Library Services and Information Systems. <https://doi.org/10.5281/ZENODO.5900759>

<sup>11</sup> In this context, the use of generative artificial intelligence models for assessment processes is also to be considered. According to the German Research Foundation, these practices are currently inadmissible, as such models do not comply with the principle of transparency, must be trained with

further critical point concerns the financial aspect, which makes the use of such data and/or infrastructures more difficult or indeed excludes those who have fewer financial resources at their disposal. This can lead to systematic inequalities in assessment processes and thus may also threaten their quality, if groups of people are effectively excluded as expert reviewers.

**Information systems that support the documentation and evaluation of research activities should therefore, in future and in the form of a common good, be open, freely usable, science-led, created while giving consideration to legal and ethical restrictions, and operated in a sustainable manner.**<sup>12</sup> Such information sources<sup>13</sup> make possible the further development of assessment processes particularly in relation to the transparency, reliability, and quality assurance of the analysis. Infrastructure should be developed in such a way as to make it internationally compatible and open to future development and operated in accordance with participative governance.<sup>14</sup> Open science should in this way become a standard for data sources and the data-based assessment tools in science-related assessment processes.

Digital sovereignty in science<sup>15</sup> comes at a cost. For years, science has been outsourcing key functions to non-scientific organisations. Resources are required if these functions are again to be fulfilled by scientific stakeholders. The teaching of knowledge and skills at university and in qualification phases should enable the researchers and supporting staff (e.g. in libraries and institutions related to information infrastructure, in organisations that fund research, or in the research departments of the respective institution) to, for example, use open citation databases in beneficial ways, use quantitative indicators in a reflective manner (*bibliometric literacy* in the sense of a context-sensitive understanding of quantitative indicators), and anticipate the consequences of their use in assessment processes. Information skills of this kind comprise subject-specific as well as cross-cutting elements and must be taught during initial and continuing training.<sup>16</sup>

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confidential data, and bear the risk of potentially perpetuating discriminatory patterns. See the current statement by the DFG Executive Committee on the influence of generative models for the DFG's funding activities [https://www.dfg.de/download/pdf/dfg\\_im\\_profil/geschaefsstelle/publikationen/stellungnahmen\\_papiere/2023/230921\\_stellungnahme\\_praesidium\\_ki\\_ai.pdf](https://www.dfg.de/download/pdf/dfg_im_profil/geschaefsstelle/publikationen/stellungnahmen_papiere/2023/230921_stellungnahme_praesidium_ki_ai.pdf) and also the "Proposal for a Regulation laying down harmonised rules on artificial intelligence", COM/2021/206 final, no 36, p. 41, <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021PC0206>.

<sup>12</sup> See the Barcelona Declaration on Open Research Information: <https://barcelona-declaration.org/>.

<sup>13</sup> Examples of this include CrossRef, which works in a not-for-profit way although not public-owned, Open Citation Index, and Open Alex.

<sup>14</sup> See, for example, the Principles of Open Scholarly Infrastructure. <https://openscholarlyinfrastructure.org>.

<sup>15</sup> See the German Science and Humanities Council's paper "Recommendations on Scientific Sovereignty and Security in the Digital Realm" (in German) <https://www.wissenschaftsrat.de/download/2023/1580-23.pdf?blob=publicationFile&v=11>.

<sup>16</sup> Particularly with respect to initial and continuing training in institutions relating to information infrastructure, and especially in the area of scientific/academic libraries and the administrative departments of academic institutions (research and external funding departments), it is essential to foster skills relating to methods and sources. This enables informed activity in this area, which strengthens the science-led future development of research evaluation. Information structure stakeholders can also assume the task of shaping such competencies in science. In addition to initial and continuing training, it is also essential to boost networking in this area. This includes promoting standardisation, for example in the context of the core research data set (CRDS, German: KDSF – see <https://kfid-online.de>) and the associated professionalisation of research reporting at scientific institutions. Other aspects include establishing, using, and developing information systems such as publication databases, open access repositories and/or platforms, as well as repositories for research data and research software. It is also important to consider the further development and use of

Generally speaking, openness as described above should be considered a requirement when relevant data and evaluations are used in research assessment processes. This is the only way to ensure that the principles mentioned in Section 2 are optimally implemented.

2) *Open science as a qualitative aspect in assessment processes*

Unlike in EU research framework programmes, the German science and academic system provides almost no place for open science as a criterion in research assessment. This contrasting picture is not least due to the very different tasks (missions) at the heart of the evaluation process: Researchers, teams, institutions, programmes, and research infrastructures in Germany are characterised by a combination of endogenous and exogenous objectives. An assessment process commensurate to the respective subject must consider the various tasks in the evaluation criteria used. The key assessment dimension must be the quality of research as the foundation of scientific excellence.

**Open science practices are to be considered part of good scientific practice. The standards for documenting data and processes that have been developed as part of the open science movement make research more reproducible and make it easier to assess research integrity.**

Implementing open science practices is thus a supporting measure for the responsible execution of research projects. Research whose data, processes, and results cannot, for specific reasons, be revealed, can also of course be of excellent quality. In such cases, however, there is a risk of limited transparency and reproducibility, which can negatively impact quality. To this degree, the standards that have been developed in an open science context inform quality assessment. Additionally, the use of open science criteria in research assessment can incentivise changes in behaviour that are desirable from the perspective of research integrity but are not however considered an obvious aspect when evaluating the quality of individual results. It must be borne in mind that using open science practices in assessment criteria as a form of incentive can, as with all such criteria, also lead to undesirable developments.

**As open science practices differ in their forms and development across individual disciplines, the specific circumstances should be considered when including open science aspects in assessment criteria.**

Even if the quality of scientific research does not fundamentally depend on making it publicly available, the availability of results and the openness of processes can encourage scientific quality at a systematic level by making new discoveries and results more transparent. Whether this is indeed the case, and if so how it informs the assessment process, must be judged by the participating scientific organisations, including the researchers from the respective disciplines. There is

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research information systems (RIS), which enable a comprehensive overview of the spread of research information at a scientific institution (for more information see the German Initiative for Network Information's (DINI) work on research information systems (RIS)). [https://dini.de/fis\\_U.a](https://dini.de/fis_U.a). DINI Working Group on Research Information Systems. (2022). Management of Research Information at Universities and Research Institutions. <https://doi.org/10.18452/25440>.

empirical evidence that openness has positive effects on systems,<sup>17</sup> especially if it complies with FAIR principles<sup>18</sup>.

Positive effects arise from the FAIR curating and publication of research data and software, which the assessment process should, as a rule, recognise as scientific achievement.<sup>19</sup> By “broadening the range of activities included in the assessment” they can be adequately acknowledged, so that the “narrowly defined concept of publication is overcome” and “scientific achievements beyond the publication [of texts] can receive more recognition than has thus far been the case”<sup>20</sup>.

**In assessment processes in which, alongside scientific quality, science-exogenous dimensions such as, for example, societal relevance also play a role, open research practice can be decisive in ensuring that a greater portion of the intended effects of the research is achieved. Implementing open science practices can be granted higher priority in such evaluation processes. This might apply, above all, to subjects, disciplines, research areas and institutions that are strongly characterised by societal relevance, or to research programmes where there are high expectations regarding the subsequent usefulness of research results (see Section 2 regarding the principle of suitability).**

The two functions of open science with respect to assessment processes for research activities are not fully independent of each other. Open science as a guiding principle for carrying out assessment processes is relevant to framework conditions that can foster quality in the sense of good scientific practice but not guarantee it. However, such framework conditions strengthen the tendency to consider open science in assessment processes. Open science practices can, in this way, inform assessment processes in a more thorough manner and based on transparent, curated, and standardised metadata and/or algorithms. At the same time, the increased relevance of open science in assessment processes makes it easier to develop infrastructures based on the open science principle. In other words, these two functions can mutually support each other. Good infrastructure is an incentive to practise open science. Open science can then be seen as a systematically useful practice in assessment processes and can, in the present, against a backdrop of certain evaluation objectives – above all regarding topics directly relevant to society – prove decisive with respect to research activities that are otherwise given equal importance. As a rule, however, requesting open practices in the form of standardised criteria for performance evaluations based on excellence and quality is not, in light of subject-related developments and time frames, to be recommended. In the long term, open practices should be absorbed into the canon of scientific practices as a form of good scientific practice. To this end, the further development of and

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<sup>17</sup> For more on the higher citation rate of open access publications, see research into the citation advantage (overview: Allison Langham-Putrow, Caitlin Bakker, and Amy Riegelman, ‘Is the Open Access Citation Advantage Real? A Systematic Review of the Citation of Open Access and Subscription-Based Articles’, *PLOS ONE* 16, no. 6 (23 June 2021): e0253129, <https://doi.org/10.1371/journal.pone.0253129>) as well as on the efficiency of public funding in the area of open source hardware J. M. Pearce, ‘Return on Investment for Open Source Scientific Hardware Development’, *Science & Public Policy (SPP)* 43, no. 2 (April 2016): 192–95, <https://doi.org/10.1093/scipol/scv034>.

<sup>18</sup> See the reference to FAIR in Section 1.

<sup>19</sup> See e.g. “Guideline 4: Recognition of Data and Software Work” in German Science and Humanities Council. (2020). On the Transformation in Science Due to Data-Intensive Research. Online (in German) at: <https://www.wissenschaftsrat.de/download/2020/8667-20.pdf>.

<sup>20</sup> p. 59 in German Research Foundation, Working Group on Publications. (2022). Academic Publishing as a Foundation and Area of Leverage for Research Assessment. <https://doi.org/10.5281/ZENODO.6538163>.

investment in open infrastructures, as well as development of the skills required for their use, are key as both a condition of and incentive for a future, sustainable open science.

## **ANNEX**

### ***Assessment processes for research activities – objectives, functions, subjects of evaluation***

Analysing assessment processes for research activities should be based on a systematic consideration of the possible objectives, functions, and subjects of such processes.

#### *Setting objectives for assessment processes*

The setting of objectives for assessment processes in the scientific system can be divided into endogenous objectives, which are articulated within the scientific system, and exogenous objectives, which reach the science system via other societal sub-systems. The setting of both endogenous and exogenous objectives results from negotiation processes in and among various stakeholder groups. They are subject to historical change, which reflects changes in the expectations towards research activity.

- The setting of *endogenous* objectives for research assessments refers to the definition of the (anticipated) contribution of the subject under evaluation to the (effective and efficient) fulfilment of the science system's functions. Fulfilling the standards of good scientific practice is an indispensable requirement for research activities.<sup>21</sup> This forms the basis of a broad concept of scientific quality that includes comprehensive consideration of the state of research, the originality and significance of the question posed, and the use of suitable methods. Alongside these aspects concerning the quality of research, another important factor concerns the time period and continuity with which contributions to the state of research are made. Future-oriented processes are generally more strongly focused on the documented expertise of participating researchers as well as, in the case of assessment processes relating to project funding, the degree to which a project plan can be implemented.
- The setting of *exogenous* objectives for assessment processes refers to activities that the science system provides for other societal sub-systems. As a rule, they can be classified under a general concept of societal relevance or social impact, when evaluation criteria ask, for example, how a research project helps achieve development goals that benefit society (perhaps as part of the UN Sustainable Development Goals, Grand Challenges, tackling a pandemic, and so on).

The setting of both types of objectives can be combined as long as possible conflicts between the two types are taken into consideration.

#### *Functions of assessment processes*

Scientific activity can be defined as the methodical use of intellectual and material resources for the purpose of generating, disseminating, and applying scientific insights. The recognition of research results as an individual activity takes place initially via expert

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<sup>21</sup> See the DFG's Guidelines for Safeguarding Good Research Practice <https://www.dfg.de/resource/blob/173732/4166759430af8dc2256f0fa54e009f03/kodex-gwp-data.pdf>.

review in the respective scientific community and leads to the source of the activity gaining a reputation.

Assessment processes, in turn, fulfil two central functions in the science system:

- *Evaluative function:* The aim of formal assessment processes is to provide stakeholders outside a research area with information that allows them to evaluate the research activity of individual science system entities (researchers, research groups, institutions, equipment, etc.) and situate it in the respective field.
- *Decision-related function:* Assessment processes help allocate staff and material (especially financial) resources in science systems. The assessment results inform decisions both within and outside the science system concerning future research activities, the use of staff and financial resources, and professional appointments. Stakeholders in the science system plan their activities in expectation of the use of certain evaluation processes. Additionally, these processes help improve scientific activity if the assessment results can be productively used for additional work.

#### *Subjects of assessment processes*

Assessment processes for research activities can be established at all organisational levels of the science system. Accordingly, they focus on various subjects of evaluation. In particular, these include (with examples):

- *Products* of research activities (e.g. publications, data collections, software, patents, spin-offs),
- *Individuals* (e.g. applicants for positions, tenure and permanent positions, or persons nominated for scientific and academic honours),
- *Teams* (e.g. research groups within an institute or encompassing multiple institutes),
- *Institutions* (e.g. institutes, faculties, universities, non-university research institutions),
- *Projects* (e.g. research projects that have been applied for, joint projects, and cross-cutting research groups),
- *Programmes* (e.g. funding strategies for certain research areas of external funding parties) and
- *Infrastructures* (e.g. research infrastructures such as instruments, resources and service institutions for research, as well as information infrastructures such as archives, libraries, object-focused collections, research data collections, specialist information centres, and large-scale equipment and devices).

Regarding these subjects, it should be borne in mind that various aspects and time periods may be relevant to their assessment, for example at a project's start, during the project, and at its conclusion.