Deliverable D3.1– Practices, evaluation and mapping: Methods, tools and user needs

OPENing UP new methods, indicators and tools for peer review, impact measurement and dissemination of research results

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Abbreviations

EC – European Commission

DoA – Description of Action

DoW – Description of Work

EC – European Commission

GA – Grant Agreement

OPR – Open peer review

OSF – Open Science Framework

Summary

Open access has by now become a core strategy for European research, aiming at wide knowledge circulation and fostering innovation. Embedded into a broader discourse about open science this represents a transformative approach to research, based on digital technologies and methods as well as new collaborative tools.

The growing dissatisfaction with the traditional scholarly communication process and publishing practices has triggered a proliferation of alternative dissemination and assessment methods. Considering the growing diversity of platforms and channels by which these comments and reviews are communicated, there is an urgency to assess the current status and gather best practices which can further guide developments in this field. The EU-funded OpenUP project addresses key aspects and challenges of the currently transforming research landscape and aspires to come up with a cohesive framework for the review-disseminate-assess phases of the research life cycle that is fit to support and promote open science. The primary objectives of the project are (1) to identify ground-breaking mechanisms, processes and tools for peer-review for all types of research results (e.g., publications, data, software), (2) to explore innovative dissemination mechanisms with an outreach aim towards businesses and industry, education, and society as a whole, and (3) to analyze a set of novel indicators that assess the impact of research results and correlate them to channels of dissemination. The project employs a user-centered, evidence-based approach, engaging all stakeholders (researchers, publishers, funders, institutions, industry, and the general public) in an open dialogue through a series of workshops, conferences and training, while validating all interim results in a set of seven pilots involving communities from four research disciplines: life sciences, social sciences, arts & humanities, and energy.

This report demonstrates how alternative peer review tools and methods are instrumental in further shaping the communication of scholarly results towards open science. The analysis is based on the examination of various *review methods* (peer commentary, post-publication peer review, decoupled review, portable or cascading review) and review tools and services (publishing platforms, repository-based, independent reviews). Besides the differences in operation and functionality, these new workflows and services combine common features of network-based solutions and collaborative research applications with varying degrees of openness (e.g. regarding participation, identities and/or reports). They, therefore, represent good examples of open science, in terms of transparency and networking among researchers.

1. Introduction

1.1. Goals

Peer review and its role in scientific publishing is a hot topic in the current scholarly discourse. The growing attention is primary due to the problematic state of the current scientific publishing system (A.B., 2017). Since the 17th century, research has become intertwined with the act of publishing. The perception that there is no science without being published in peer reviewed journals or monographs definitely has an impact on the discourses on both sides (Solomon, 2007).

Within academia the motivation for publishing is often summarized by the motto "publish or perish", which corresponds both to the researchers' inner demand to leave a permanent record of their research and improve their reputation, and to the institutional requirement to obtain funding. Dissemination of research results has obtained significance in research funding as well. The European Commission research framework program Horizon2020 views dissemination as an essential means of transferring research-based knowledge and maximizing the impact of research. Key stakeholders of the scholarly communication process, such as funders, identify publishing as an essential element of the research process (EC 2016).

The growing volume of publications is also the result of the commercialization of the publishing process. Robert Calasso (2015) described the trend afflicting large scientific publishers today as "the obliteration of publisher identity". By incorporating smaller publishing companies, modern publishers have often evolved into anonymous and multi-disciplinary conglomerates with a primary focus on quantity rather than on fostering quality. In view of market share, revenue growth, and profitability, publishers have set out to fill the pages of approximately 28000 active scholarly journals (Ware and Mabe, 2009).

Scientific publishing is supposed to facilitate research by carrying out four major functions (Ware and Mabe, 2009):

- *Registration*: establishing the author's precedence and ownership of an idea.
- *Dissemination*: providing access and communicating the findings.
- *Certification*: providing quality control through peer review.
- *Archival record*: setting up a permanent storage system for published works.

The primary tool of quality control is peer review. Although much criticized within the scientific communities, peer review is the widely accepted method for research validation (Solomon, 2007). Ten years ago opinions were aligned to accept peer review as a defected but necessary tool of quality control: Sieber (2006) compared peer review to democracy – "a bad system but the best one possible," while Solomon (2007) paralleled peer review with the jury system – "while flawed, it is the best we have."

However, the past decade has seen a proliferation of research in the field of scholarly communication. Since the peer review debate initiated by Nature in 2006 (Nature, 2006), where peer review was described as an under-studied topic in need for quantitative indicators and in depth qualitative analysis, abundance of reports have surfaced about its role in science, its methodology, the processes and stakeholders it involves, etc. (ALPSP/EASE Peer Review Survey, 2000; Ware and Monkman, 2008; Sense about Science, 2009; Harley et.al., 2010; Thomson Reuters report, 2011; Harley and

Acord 2011; House of Commons Science and Technology Committee, 2011; Mulligan et al., 2013; Smith, 2015; Taylor and Francis Group, 2015; Acreman et. al., 2016).

The literature on peer review draws a well-defined picture about the inherent flaws and biases it carries, its problematic position in the scholarly publishing system, and it also reviews the alternative methods and tools for quality control. However, a systematic study is needed to summarize the broken aspects of peer review, to describe how these flaws pave the way for the new solutions, and to provide an overview of the currently functioning peer review alternatives in the scholarly discourse. This report sets out to provide a landscape scan both on the literature about the problems of peer review as well as the methods and tools which wish to transform the old system.

The analysis of the new peer review methods is set in the context of open science. The main principles of open access and open science will provide a background for the discussion. The objective of the current study is not only to review the alternative peer review methods and tools, but also to define openness in case of these peer review solutions. Building upon OpenAIRE's definition of open peer review, the new peer review methods and tools will be examined in view of main attributes of openness (open identity, open report, open participation, openness in time, open platform). These attributes will help to set up categories for the methods and evaluate their practicality and sustainability within the open science discourse.

1.2. Methodology

In mapping out the processes of the transforming peer review landscape, a life cycle approach offers an effective methodology. This approach is beneficial for several reasons.

- Due to the changing publishing discourse and the continuous technological advances the peer review landscape scan is susceptible to change. Thus breaking down the process into parts helps identifying the points of intervention.
- Activities at each phase contribute to a thorough analysis process.
- The methodology guarantees a continuous check of problematic issues.
  It provides a framework for the landscape analysis starting from defining the problems, examining the root and causes, to providing recommendations to change and to implement new peer review approaches in the field.

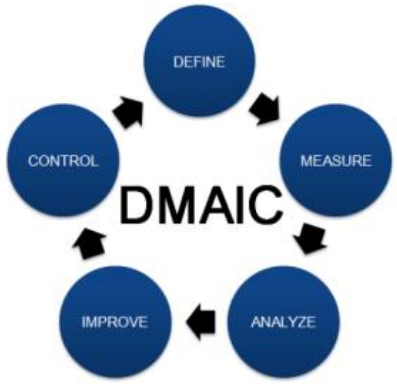

Figure 1. DMAIC Methodology.
Source: Six Sigma, Villanova University (https://www.villanovau.com/resources/six-sigma/six-sigma-methodology-dmaic/#.WOTfKfnyjcs)

The DMAIC methodology is a process-centered life cycle with the primary purpose of identifying the root causes of problems in a given process and providing solution recommendations for

improvements (Borror, 2009). This methodology serves a dual purpose here: (1) the framework of DMAIC structures the analysis process, and (2) the landscape scan is understood as a broadened process of mapping the existing peer review methods and analyzing/categorizing the emerging alternative methods/tools. This analysis informs the basis for recommending policy directions to integrate the new services into the current scholarly communication system.

Applied to the present landscape scan, the phases include:

Define phase: context of research is explained including

- the specification of the project boundaries – what are the primary goals of a landscape report, what is expected to be achieved,
- explanation of the primary concepts, which ground the current research on alternative review methods and tools, including the definition of open science, peer review and open peer review, and
- establishing ties to other projects on open science, such as FOSTER through the definition of open science and OpenAIRE through the definition of open peer review.

Measure phase: current practices are examined including

- gathering data to identify types of problems in the current publishing system, and
- collecting feedback from stakeholders (user survey).

Analyze phase: conducting gap analysis and landscape scan including

- identifying gaps through a SWOT analysis,
- setting up categories of alternative peer methods and services,
- the description of the alternative review tools based on OpenAIRE's definition of open peer review.

(Improve phase): implications of OPR and draft recommendations.

(Control phase): to manage and sustain changes over time.

This report focuses on the first three phases of the DMAIC methodology cycle. The primary objective of the study is to interpret the context of the strengthening discourse of open peer review and map out the alternative peer review methods and tools available for researchers who seek other review options than the established publishing system can offer. The *Improve* and *Control* phases are not part of this particular analysis, but they will be revisited and elaborated on during the course of the OpenUp project. One of the project's ultimate objective is to provide a set of validated practical policy and implementation recommendations and guidelines for EU, national and institutional policymakers. These recommendations will be a valuable tool in supporting decision makers to evaluate needs for and prioritisation of supportive actions for advancing a more open and gender-sensitive science system. Both the *Improve* and *Control* phases will investigate that the implementation of open science policies and the use of alternative review methods will have sufficient uptake among various research communities in order to ensure their sustainable operation in the long run.

2. Defining context

Within the *Define* phase of this analysis the context of research is explained and the principal concepts defined. The primary focus of the landscape scan is to analyze the established review system and examine the new, alternative review methods and tools. In this process the concept of peer review is redefined by pulling it apart to its components, by evaluating the underlying processes, and by building a new concept from the opportunities the alternative review methods carry within themselves. The backdrop of the analysis is provided by the fundamental principles of open science.

2.1. What is peer review?

Peer review plays a central role in scholarly publishing. It establishes a method by which research can be evaluated. It is basically a system in which research results are passed the scrutiny of qualified scientific experts (peers). If considered valid, significant and original the results are approved for publishing in the body of scholarly literature. In other words, the purpose of peer review is to check the quality of what is published.

Hackett (1997) describes 10 roles for peer review that are in tension with each other. These irresolvable values demonstrate the primary tasks of peer review, but at the same time they show the contradictions these roles carry. Thus, they unveil the problematic nature of the system.

1. **Effectiveness – efficiency**: to deliver an effective review requires time, while considering the high number of reviews efficiency requires less time spent on each review.
2. **Autonomy – accountability**: wider accountability and scrutiny by wider audiences might reduce autonomy.
3. **Originality – tradition**: refers to the tension between responsiveness to new ideas and holding on to existing knowledge.
4. **Meritocracy – fairness**: evaluation on the basis of the reputation of the author might limit the fair review of young or female researchers.
5. **Reliability – validity**: the most reliable criteria might not lead to the most valid result (Scott, 2007).

Traditional peer review includes two review formats: single-blind and double-blind review, in which the reviewer's identity is concealed in both cases, and the author's identity is either known or concealed to the reviewer, as well. The alternative review types, which are often described with the umbrella term 'open peer review' as a reference to the fact that certain aspects of the review process (identity of the reviewer, the review report, or the platform itself, etc.) is opened up to the research community or the public.

2.2. What is open science?

Open access – making research findings available free of charge for readers – has become a core strategy in Europe to improve knowledge circulation and innovation. This movement has developed into a broader discourse of open science, which represents a new approach to research based on cooperative work and new ways of diffusing knowledge by using digital technologies and new collaborative tools. Challenges addressed in open science, such as infrastructure, intellectual property rights, inter-institutional, inter-disciplinary and international collaboration among all actors, have an impact on all facets of the scholarly communication process. However, besides the challenges it raises, the concept of open science has become a primary scholarly agenda due to the widely accepted benefits for scientific research (Pontika, 2016). The Royal Society report (2012) names six key action areas for open science including urging scientists to be more open, giving recognition to the value of data gathering, standardizing sharing and the importance of re-use of data.

The changing mindset about conducting research is reflected by the EC initiatives (mandate on open access to scientific results and the Open Data Pilot (EC, 2017)) to widen the scope of openly accessible and freely re-usable research results and data. These efforts are reflected in the description of open science as "an on-going transition in the way research is performed, researchers collaborate, knowledge is shared, and science is organized. It represents a systemic change in the modus operandi of science and research. It affects the whole research cycle and its stakeholders, enhances science by facilitating more transparency, openness, networking, collaboration, and refocuses science from a

'publish or perish' perspective to a knowledge-sharing perspective" (Moedas, 2015) (EC, 2014). Open availability of publicly-funded research results and the development of infrastructures to share knowledge contribute to innovation and growth in society.

Open science is an umbrella term covering different aspects of knowledge production and dissemination. There is no unified definition of open science, but similar defining elements can be found in contesting definitions. The Wikipedia definition[1], based on Kraker et al. and openscienceASAP, defines open science within the context of six aspects:

- **Open data**: a way to publish the raw data,
- **Open access**: a way to make research results available,
- **Open source**: as a way to give access to research prototypes,
- **Open peer review**: transparent and reliable quality assurance system,
- **Open methodology**: sharing the methodological details of the study provided,
- **Open educational resources**: free access to teaching and learning materials.

Thus, open science actually includes not only the free availability of research results, tools and the underlying data, but also the accessibility of applied methodology, which bridge the pre-processed data to the final outputs and of training materials, which enables knowledge exchange.

BY the FOSTER project (2016) open science is understood and discussed as a compound notion, which has several core components: (1) *Open access* referring to free, restricted access to scholarly outputs, (2) *Open data* dealing with the free access and re-use of research data, (3) *Open source* referring to the free availability of the source code of softwares for use, creation of derivatives and distribution, and (4) *Open reproducible research* enabling the independent reproducibility of research results. Within this context, open science is defined as the practice of science in such a way that others can collaborate and contribute, where research data, lab notes and other research processes are freely available under terms that enable reuse, redistribution and reproduction of the research and its underlying data and methods. Compared to previous definitions, a more distinctive role of sharing and reusing results is given to open research and the future application of these directives through open science policies is emphasized (FOSTER, 2016).

[1] https://en.wikipedia.org/wiki/Open_science

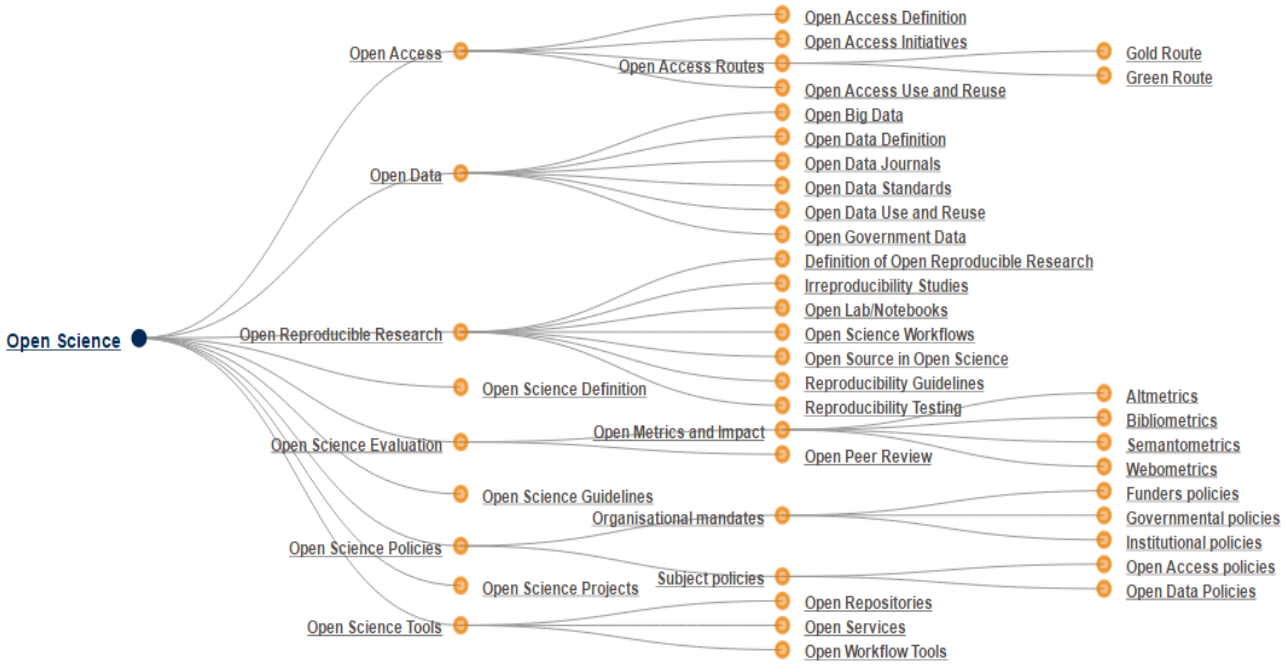

Figure 2. FOSTER`s taxonomy of open science

These definitions demonstrate that open science is a layered notion including not only access to research outputs, but also making reference to how knowledge is discovered, evaluated, shared and re-used. Within the context of our investigation, open peer review is a defining element of the open science discourse.

2.2. What is open peer review (OPR)?

Open peer review promises to offer solutions to current issues in the academic peer review system. Open peer review increases transparency through open reports and open identity of the reviewers, and offers wider involvement of the research community in the process through open platforms. As new tools, platforms and services diversify the academic publishing scene. Nature and stages of the publishing process are continuously revisited and re-evaluated in scholarly discourse. The emergence of alternative review tools and methods not only restructures the publishing system, but also redefines it.

By the increasingly common practice of using preprint servers or repositories to disseminate research results within and beyond scientific communities, the term to publish moves away from the traditional concept of publishing research articles in journals, and implies the act of sharing results publicly. Some scientists are going a step further, and using platforms such as GitHub, Zenodo and Figshare to publish each hypothesis, data collection or figure as they go along. Each file can be given a DOI to make it citable and trackable. An example is a researcher, who already publishes his papers as preprints and has been using a publishing platform to progressively write up and publish the results of a new project since January 2015. “I push ‘publish’ and it gets a DOI with no delay,” he says. “Am I really gaining that much by publishing [in a conventional journal]? Or is it better to do what is fastest and most efficient to get your research out there?” (Powell, 2016).

Considering the traditionally embedded meaning of the academic publishing system, certain cautiousness is connected to the use of the term ‘publishing’. As Dessimoz explains it: “I am saying

'made available' instead of 'published' because although preprints can be read by anybody, the general view is that the canonical publication event lies with the journal, post peer-review. Because of this, many traditional journals tolerate this practice: peer-review technically remains 'pre-publication' and the journals get to keep their gatekeeping function" (2016).

The gate-keeping function of the traditional review process is definitely being re-evaluated and redefined. In cases where the preprint version of the manuscript is published – preprint server, overlay journals, journals with community reviews, etc. (e.g. BiorXiv[2], Discrete Analysis[3], episciences[4]) – peer review loses importance as a gatekeeper in the publishing process, but still plays a role in quality check. Review might be losing its monopoly in the initial screening process, as it is often transferred into a network-based commenting or post-publication peer-review. It is still a determining factor in scientometrics and research evaluation.

The concept of "open peer review" is also controversial, because presently it is being used for several fairly different models of peer review. In most cases, open peer review refers to the review process in which the identity of the reviewers is disclosed, or the review itself is accessible for the public (Tattersall, 2016). However, there are studies which go beyond such simplified interpretations and include other attributes of the review process in the definition. Distinction has been made between *open-names peer review*, which is similar to traditional peer review except that the identity of the reviewers is shown openly, and *open-process peer review* where interested parties are invited to join the peer review process that takes place before an article is accepted for a journal or other similar venue (Sandewall, 2012). The term *community peer review* has also been used in reference to the review process accessible for the research community (Hodkinson, 2007). Paglione discusses the degree of openness involved in the peer review process. Here the various review approaches are positioned in a peer review continuum on a scale from closed to open: double blind – single blind – blind until purchased – unattributed – optionally open – fully open (Paglione, 2015).

The complexity of the review system enriched by alternative methods and tools is indicated in the definition of open peer review by a recent OpenAIRE report (Ross-Hellauer, 2016a). Here open review is defined as an umbrella term describing a variety of innovations which "open up" the traditional peer review process by modifying one or more aspects to make it more inclusive, transparent and/or accountable. Aspects are open identities, open reports and open participation (possession of one of these traits is usually sufficient to qualify a system as "Open Peer Review"), open interaction, open platforms, and time of the review.

The OPR landscape scan aims to examine the alternative review methods, tools and services, which enhance the traditional peer review system. Following the OpenAIRE definition of open peer review, the methods and tools are collected based on these attributes:

- **Open identity**: Authors and reviewers are aware of each other's identity.
- **Open report**: Review reports are published alongside the relevant article.
- **Open interaction:** Allows and encourages direct reciprocal discussion between author(s) and reviewers, as well as between reviewers.
- **Open participation**: Allows the wider community to contribute to the review process.

[2] http://biorxiv.org/
[3] http://discreteanalysisjournal.com/
[4] https://www.episciences.org/

- **Open platform**: review is de-coupled from publishing in that it is facilitated by a different organizational entity than the venue of publication.
- **Open pre-review manuscripts:** Manuscripts are made immediately available (e.g., via pre-print servers like ArXiv) in advance of any formal peer review procedures.
- **Open final-version commenting:** Review or commenting on final "version of record" publications (Ross-Hellauer, 2016b).

These attributes will provide the basis for setting up categories for collected data.

3. Measuring current practices and perceptions

3.1. User-centred survey methodology

The OpenUP survey was conducted between 20 January and 23 February 2017 with an aim to capture current perceptions and practices in peer review, dissemination of research results and impact measurement among European researchers. It was implemented via the online surveying tool SurveyGizmo (https://www.surveygizmo.eu/). The survey questionnaire consisted of four sections. The first section asked a series of questions on the respondents' scientific discipline, career stage, gender and other characteristics. The following sections asked questions on researchers' attitudes to peer review processes, their practices in disseminating research results and opinions on impact measurement/use of altmetrics. Below we describe the whole survey implementation process in detail. The target was to reach around 1,000 completed survey responses.

To obtain contact details of potential survey respondents, the OpenUP team mined contact details of the main authors of publications stored in arXiv, Pubmed and RePEc. In total, contact details were mined for around 120,000 unique researchers whose email addresses belonged to countries based in the EU-28, as well as Norway and Switzerland. This ensured that the researchers who participated in the survey had produced at least one publications as main authors, as a result of which they had at least some direct experience in the areas covered by the survey. PPMI researchers then randomly selected 20,000 emails from the original sample of 120,000 contacts. Assuming a response rate of around 5% this would have produced the desired number of around 1000 responses. It later turned out that many (i.e. around 1/3) of the 20,000 emails were not working anymore. As a result, the sample was further boosted by 10,000 emails to achieve the desired number of responses. No stratified sampling was applied, i.e. no preselection of contacts based on gender, country, career stage or any other factor was implemented.

Survey questionnaire was developed collaboratively by PPMI and OpenUP partners leading WPs 3-5. Before the full launch, partners tested and piloted the survey internally and through their partner networks. The team performed three additional rounds of piloting which involved internal teams involved in the project, as well as external experts. When piloting was finalised, the survey was fully launched on 20 January 2017. Two waves of reminders were sent to those researchers who had not completed the questionnaires sent.

The survey was closed with 1347 responses, of which 976 were completed. This implies a survey completion rate of 72.4%. For some disciplines, the response rates were lower and the survey team made efforts to further boost the survey sample for certain underrepresented areas. Overall, the results are representative of the population of the main authors in arXiv, PubMed and RePEc, resulting in satisfactory coverage of natural sciences (N=478), medical sciences (N=173), social

sciences (N=191), engineering and technology (N=125). The response rates remained relatively low in Agricultural Science (23 responses received), the Humanities (34 responses), and Math/Statistics and Computer Science (49 responses). On the other hand, the team received 380 responses from highly experienced/professor stage researchers, which can be considered a substantial value added to the existing pool of studies and surveys on the related subject areas.

The survey data and the full questionnaire can be found on Zenodo (Stančiauskas and Banelytė, 2017).

3.2. The survey sample

The 976 completed survey responses constitute the basis upon which survey results have been analysed. Based on the survey design developed by OpenUP researchers collected data on the following descriptive characteristics of researchers:

- Country of affiliation
- Scientific discipline
- Career stage
- Gender
- Organisation type and sector
- Types of outputs produced

Responses by country category

The respondents' country of affiliation was assigned to researchers based on the location of the organisation in which they were employed. The survey respondents were assigned to three country groups which were previously determined by DG RTD in their report on access to and prevention of scientific information in Europe[5]. Depending on the presence and advancement of Open Access policies, institutional strategies or subject-based Open Access initiatives at national levels, countries were assessed as having advanced, medium-level or less advanced Open Access policies (see table 1 for more details).

Table 1. Country categories by presence of Open Access policies, institutional strategies or subject-based Open Access initiatives at national levels.

Level	Country	Share of responses received (N=976)
Advanced OA systems	Denmark, Finland, France, Germany, Ireland, Lithuania, the Netherlands, Norway, Slovenia, Switzerland, the United Kingdom	52%
Medium advancement of OA systems	Austria, Belgium, Croatia, Czech Republic, Estonia, Hungary, Italy, Portugal, Romania, Slovakia, Spain, Sweden	43%
Less advanced OA systems	Bulgaria, Cyprus, Greece, Latvia, Luxembourg, Malta, Poland	6%

Source: composed by the authors from OpenUP survey data

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

Scientific discipline

Of the 976 people who completed the questionnaire, the largest share of responses, 45%, came from researchers working in Natural Sciences (n=478). Responses from researchers in Social Sciences comprised 18% (N=191), in Medical Sciences 16% (N=173), and in Engineering and Technology 12% (N=125) of the total survey participants. Mathematics, Statistics and Computer scientists, Agricultural scientists and Humanities researchers had relatively low response numbers due to the fact that the survey mostly targeted researchers from arXiv, PubMed and RePEc. Of the total responses, participations from these disciplines made up 5% (N=49), 3% (N=34) and 2% (N=23) respectively. A small fraction of participants (1%) indicated 'other' as their disciplinary category.

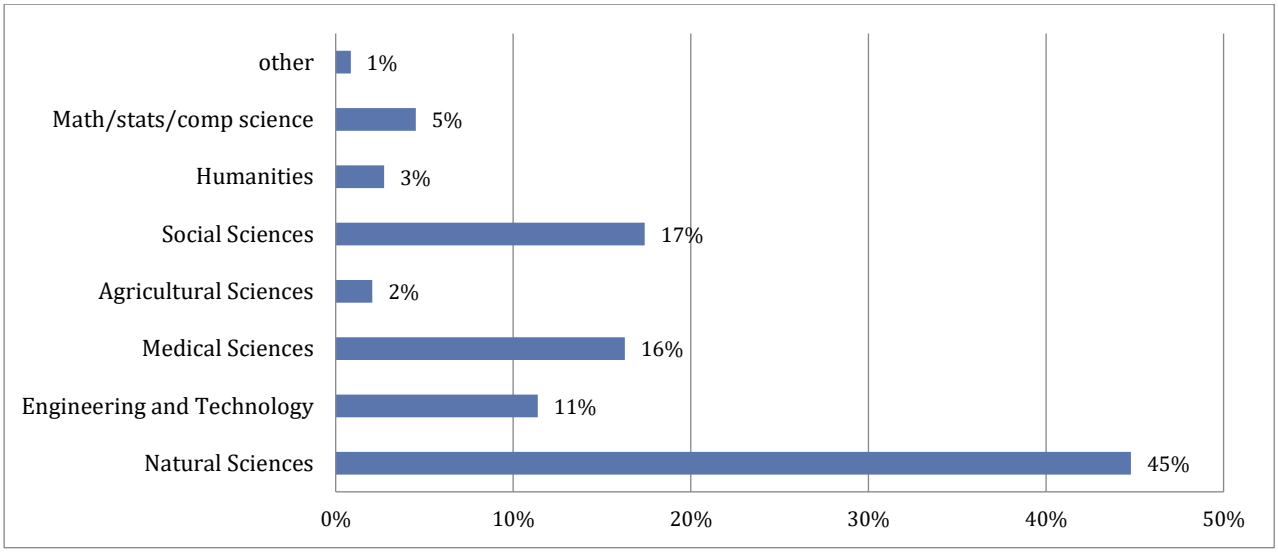

Figure 3. Distribution of response rates by scientific discipline.
N=976, in total there were 1063 responses to this question as selection of more than one option was possible.
Source: composed by the authors from OpenUP survey data

Gender, career stage and organisation

The majority of respondents to the OpenUP Survey were male (73%) (see Figure 4). Females comprised about a quarter of the total sample (26%) and categories 'prefer not to say' and 'Other' received 1% and 0% of responses. Regarding the career stage, the majority of responses were from Leading (33%) and Established (38%) researchers. Recognised researchers made up 18% of the total sample and First Stage researchers comprised 4% of the sample. The fact that a large share of respondents were the main authors of publications, came from natural sciences and engineering and technology (i.e. disciplines with very large male participation), were leading and established researchers (i.e. still frequented by male researchers) can explain the relatively low participation of female researchers.

The majority of researchers were from Universities (67%) and 28% were from Research Centres or Institutes. Respondents from Companies or Other Organisations comprised 2% and 3% respectively. Public or Government sectors dominated in the sample (90%). Answers from researchers from Private not-for-profit and private for-profit sectors made up 8% and 2% respectively.

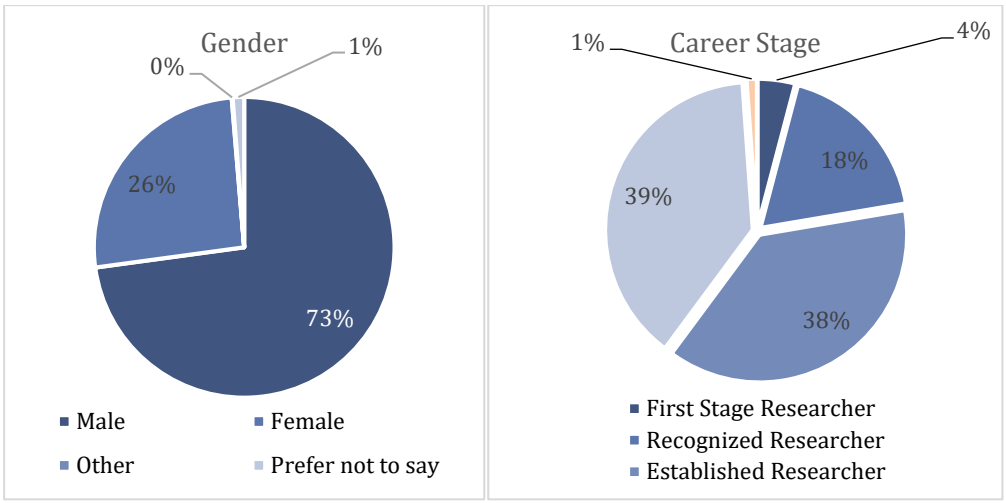

Figure 4. Share of responses by gender, career stage and type and sector of organizations.
N=976 for Gender, N=976 for career stage.
Source: composed by the authors from OpenUP survey data.

Research output

OpenUp survey respondents were also asked to enlist the most important research outputs that they produce in their work. Important outputs were described as outputs which the researchers produce most frequently or which determine researchers' success in their field. From the output list provided, the majority of researchers assigned categories 'very important' and 'somewhat important' to the traditional research outputs. This included peer-reviewed publications (99%) and book chapters and monographs (73%). The perceived importance of other outputs depended on the discipline the researchers were working in. For example, software, IT tools and applications were exceptionally valued in Engineering and Technology field. Around 73% of respondents stated that those outputs were 'very important' or 'somewhat important'. More than two thirds of Medical Scientists (70%) saw protocols, ontologies, guidelines, and methodologies for practitioners as 'very important' or 'somewhat important'. Also, a large share of Social Scientist (62%) and Medical Scientists (59.4%) allocated policy outputs to the same categories.

3.3. Results, identifying problems

Within the peer review section of the survey, questions tested researchers' attitude toward the established peer review process and their opinion on various aspects of open peer review. Researchers were asked to evaluate their experiences related to the traditional and the alternative peer review process.

Question: Satisfaction with the established peer-review process

First, researchers were asked to rate their satisfaction with the established peer review process. Majority, 72.5%, were 'very satisfied' or 'somewhat satisfied'. Particularly so in the Natural Sciences, Agricultural Sciences, and Mathematics, Statistics and Computer Sciences. The dissatisfaction with the current peer review process was rather low: around 15.8% of respondents chose 'somewhat dissatisfied' or 'very dissatisfied' categories. The largest share of 'somewhat dissatisfied' or 'very dissatisfied' researchers was among Engineers and Technology researchers (24.3%). Further analysis showed that the first stage and recognised researchers were more discontent with the established peer review than established and leading researchers (62% versus 75%). There were no large differences between male and female researchers.

Question: Reasons behind the reservations with the established peer review system

This question was asked to those respondents who chose the 'neither satisfied nor dissatisfied', 'somewhat dissatisfied' or 'very dissatisfied' answer categories in the previous question. The results presented in Table 2 indicate that the researchers were mostly concerned with the quality of peer review reports. Around 95% of the respondents stated that this reason is 'very important' or 'somewhat important' for their reservations with the established peer review system. This was the case across all countries, disciplines, organisation types, career stages and gender. Other reasons, including time/duration peer review takes, transparency issues, and the lack of scientific communication between authors and reviewers were also of considerable importance to the respondents. Approximately, 78%, 72% and 66% of researchers chose these categories as 'very important' or 'somewhat important'. Respondents across all the disciplines rated the importance of various reasons rather similarly. The exception was the respondents from Engineering and Technology Sciences. All of them (100%) rated transparency issues and 80% rated a lack of scientific communication between authors and reviewers as 'very important' or 'somewhat important'. This is higher than average and reflects the fact that, as reported in the previous question, more researchers in this field were dissatisfied with the current peer review process compared to other disciplines (see question 1.5).

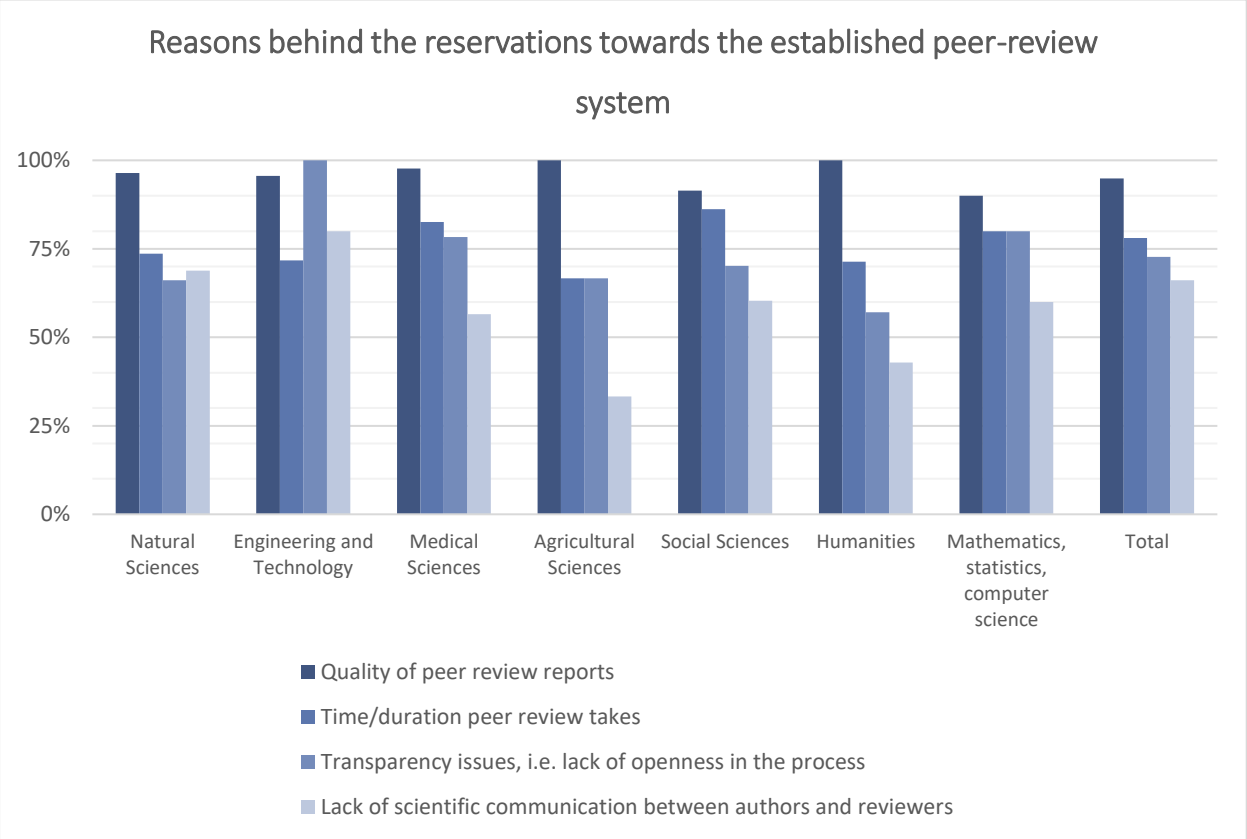

Figure 5. Reasons behind the reservations towards the established peer-review system and proportions of respondents rating then as 'very important' or 'somewhat important'.

Note: Responses to question '2.1b - How important are the below reasons behind your reservations with the established peer review system?' N=[253 – 256]. The percentages show a share of respondents who chose 'very important' and 'somewhat important' answer categories. Source: composed by the authors from OpenUP survey data.

Question: Preferred peer-review approaches

Researchers were also asked to express their opinion on different approaches of peer review. In particular, the question asked the respondents to choose which approach they would choose for their

own research outputs, either a more open peer review or the established peer review process. The answers showed that in some categories there was no unanimous preference among the researchers. For instance, 42% of the researchers preferred open participation (when a wider community of the researchers contribute to peer review) and 41% supported closed participation (only appointed peer reviewers contribute to peer review). Also, small differences were noted among the researchers who 'strongly supported' or 'supported' open report (review report is published alongside the relevant article), and closed report (no review report is published alongside the relevant article), and who assigned open pre-review (manuscripts are made available to researchers/public before formal peer review), and 'no open pre-review' (manuscripts are not made available to researchers/public before formal peer review) to the same categories (see Figure 4).

Nevertheless, the majority of researchers expressed similar opinions on some aspects of peer review. There were nearly 30% more respondents, who preferred closed identity (when neither the author's nor the reviewer's identity are disclosed) than open identity (59% versus 29%). Female researchers supported open identity over closed identity more than male researchers (i.e. 35% versus 26%). On the other hand, female scientists were much less in favour of open pre-review (33% versus 51%). More than half of the survey respondents showed strong support for open final version commenting (54% in favour of open final-version commenting versus 27% in favour of established practices) and more than two thirds supported open data review compared to no data review along with the paper (71% versus 14%).

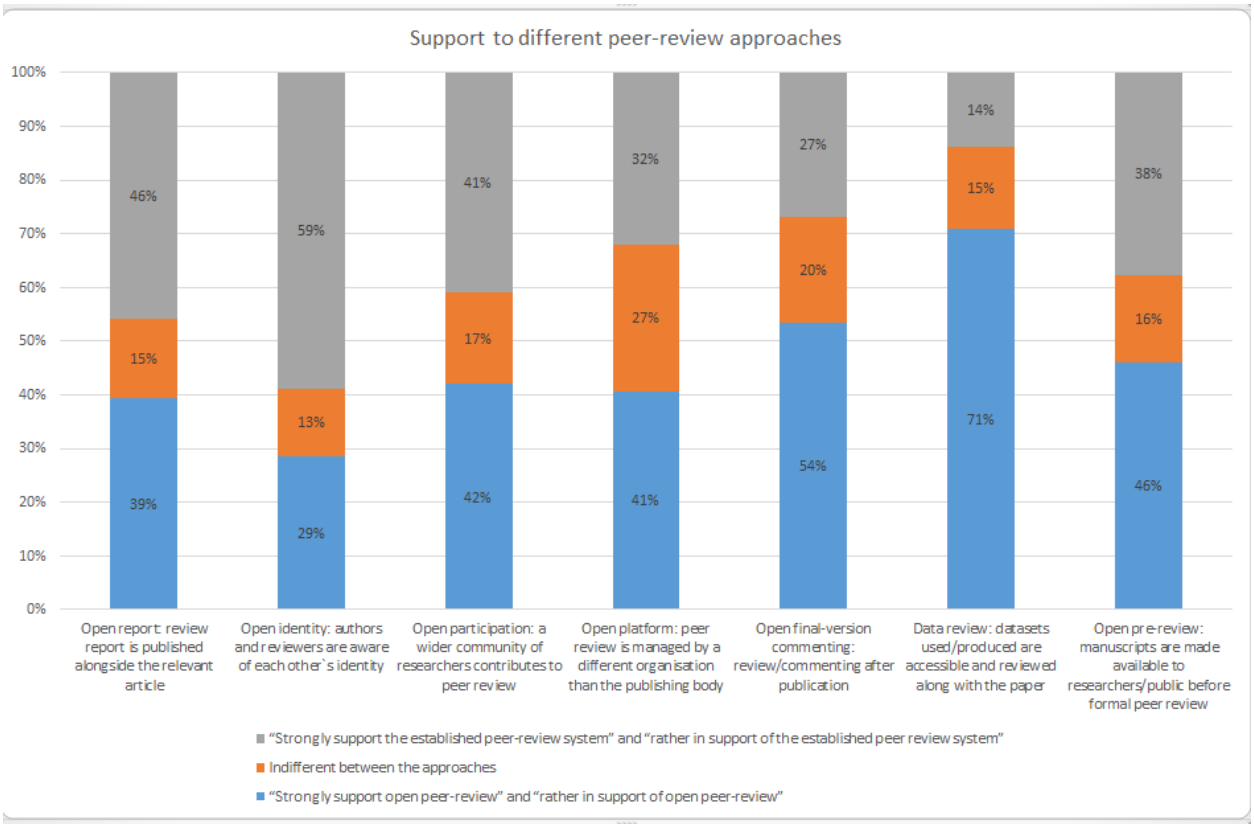

Figure 6. Proportions of respondents attributing their support to different peer-review approaches.
Note: Responses to question '2.1c - Which of the following peer review approaches would you choose to undergo for your own research outputs?' N= [855 - 915].

Question: Frequency of publishing research outputs openly accessible and free of charge to use
This question asked the survey respondents to rate how frequently they make their scientific outputs Open Access and free for others to use. Slightly more than half of the researchers, 52%, 'always, or almost always' shared their scientific publications in the Open Access platforms (see table 6). This proportion reflects the nature of the sample, as contact details of respondents were drawn from arXiv, PubMed, RePEc and other Open Access repositories.

Approximately 30% of researchers 'always' or 'almost always' openly shared their data, datasets, software, tools and applications. Open sharing of these outputs was more frequent in Natural Sciences, Engineering/Technology, and Mathematics, Statistics and Computer Science as well as among male researchers. Between 35%-40% of researchers openly shared protocols, guidelines, methodologies, and policy outputs. But the willingness to share protocols and codes was even higher among Humanities and Math, Stat. and Comp. science researchers. Further analysis of the survey results indicated, that the first stage and recognised researchers published outputs that were openly accessible and free of charge more frequently compared to the established and leading researchers.

Question: Factors that prevent sharing of research outputs openly
Overall, the survey results showed that researchers favoured Open Access practices and only 9% of the respondents stated negative personal perceptions about Open Access. The share of the first stage and recognised researchers who reported to have negative perceptions about Open Access was even lower and reached around 6%. Nevertheless, there were factors that hinder sharing of outputs openly. The main factor was the lack of financial support (52%), particularly in countries with less developed Open Access systems (46%). Also, almost two thirds of female researchers shared this opinion versus 48% of male researchers. A larger share of the first stage and recognised researchers (61.5%) tended to agree with this statement compared to a lower share of the established and leading researchers (52%). Almost a third of respondents felt that their organisation encouraged them to publish in traditional outlets/journals which have restricted access, 31% agreed to a 'very large extent' or 'to a large extent' with this statement. This was more pronounced among Social Scientists (49% agreed to those statements) and in countries with less developed Open Access systems (46%). Also, more of the first stage and recognised researchers (39%) tended to agree with this statement compared to the established and leading researchers (30%). Based on the answers, there is an emphasis drawn to the lack of financial support to openly share research results (1 in every 2 respondents), especially in the field of medical sciences (64,8%) where open access publishing do not seem to hinder career development and performance assessments (9,5%).

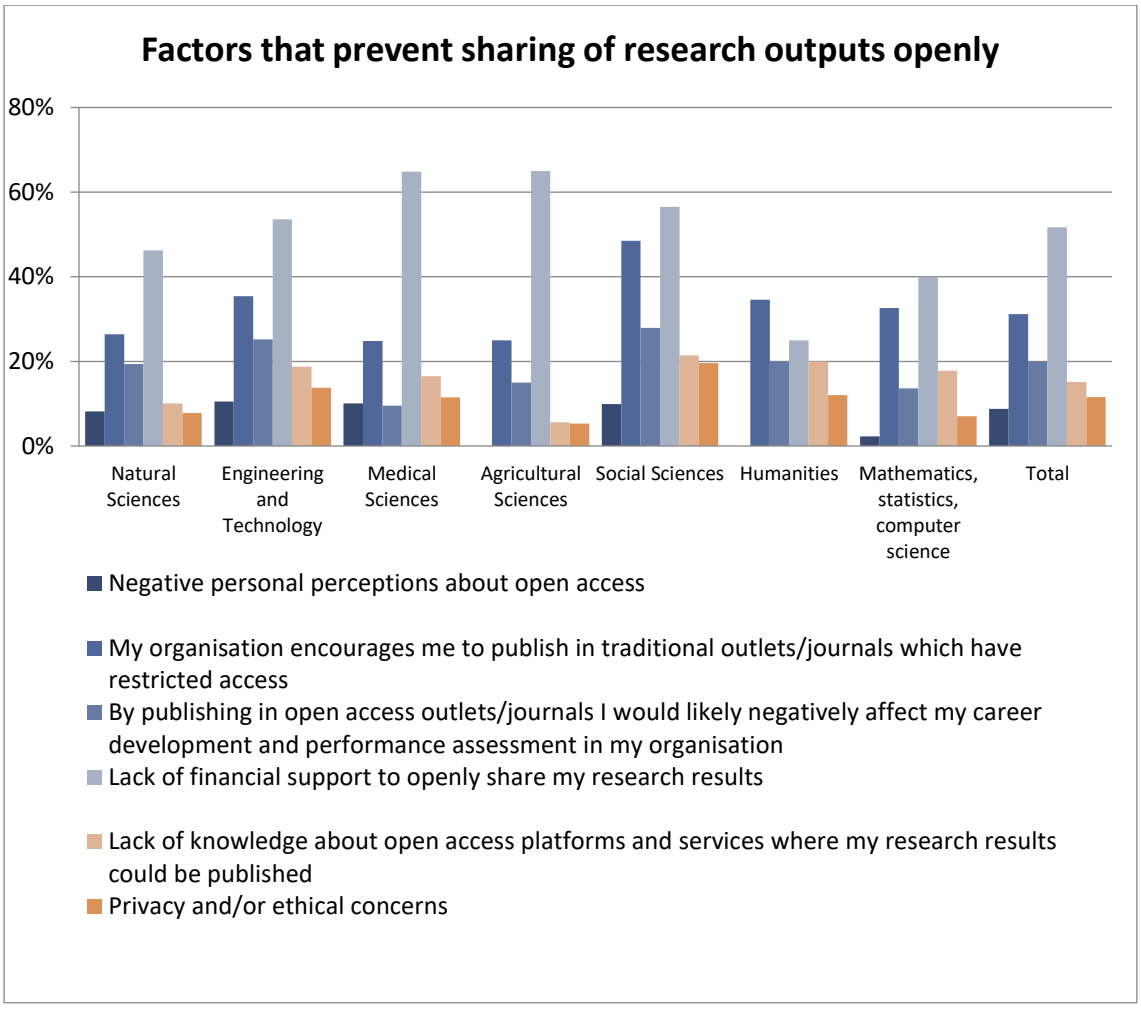

Figure 7. Proportions of respondents by discipline who agree 'to a very large extent' and 'to a large extent' with the factors listed in the table.

Note: Responses to question '2.1e - To what extent do these factors/barriers prevent you from making more of your research results openly accessible and free of charge to use?' N= [890 – 906]. The percentages show a share of respondents who chose 'To a very large extent' and 'to a large extent' answer options.

Source: composed by the authors from OpenUP survey data

Question: Reviewers' experiences under the established peer-review system

We further aimed to find out who of the OpenUp survey respondents had prior experience as a reviewer of at least one peer-reviewed publication. The majority of the participants (N=904) had previously reviewed at least one scientific article. Those respondents were asked to evaluate their experiences with the established peer-review system. The overall satisfaction with the low impact the review (process) had on their carriers and reputation. Only a fraction of reviewers felt that their review work is being explicitly acknowledged in their organisation (20%) or that it benefits their career development (33%). Interestingly, more respondents from countries with less advanced OA systems 'strongly agreed' or 'rather agreed' with these statements (39% and 51% respectively) than respondents from advanced (18% and 32% respectively) and medium-level OA systems (21% and 31% respectively).

Importantly, revealing one's identity was not viewed as an incentive that increased the willingness to work as a reviewer. Around a quarter of respondents 'strongly agreed' or 'rather agreed' with this statement. Leading and established researchers tended to be more comfortable about revealing their identity, as were male researchers. For around a half of the researchers their incentives to work as

reviewers would increase, if their work was remunerated, or if peer review process became more collaborative with authors, editors and/or publishers. First stage and established researchers tended to agree with this statement more often compared to established and leading researchers.

Table 2. Proportions of respondents by scientific discipline who 'strongly agree' or 'rather agree' with the statements concerning reviewing work.

	Natural Sciences	Engineering and Technology	Medical Sciences	Agricultural Sciences	Social Sciences	Humanities	Mathematics, statistics, computer science	Total
My work as a reviewer is being explicitly acknowledged and evaluated in my organisation	20,3%	28,7%	17,5%	20,0%	17,8%	4,0%	11,1%	20,2%
My work as a reviewer benefits my career development	32,0%	35,3%	36,9%	21,1%	30,3%	28,0%	24,4%	32,8%
My incentives to work as a reviewer would increase if my review comments were published under my name	20,6%	30,6%	31,0%	26,3%	31,3%	25,0%	18,2%	25,3%
My incentives to work as a reviewer would increase if my review work was remunerated	50,5%	47,3%	54,5%	63,2%	52,8%	60,0%	43,2%	50,7%
My incentives to work as a reviewer would increase if the peer review process became more collaborative with authors, editors and/or publishers	41,1%	61,1%	57,0%	60,0%	55,0%	52,0%	33,3%	48,7%

Note: Responses to question '2.2a - To what extent do you agree with these statements considering your experience as a reviewer under the established peer review system?' N=[870 – 900]. The percentages show a share of respondents who chose 'strongly agree' and 'rather agree' answer options.

The survey results show that the established system, although it suits the interests of the majority of the respondents, is perceived to have some weaknesses regarding the quality of review reports, duration and transparency of the review process. Responses also identify a lack of communication between the participants involved in the process, and insufficient incentive to review as deficiencies of the current system.

4. Analysis

The following section of analysis has a dual purpose: (1) it aims at identifying the gaps within the current review system through a SWOT analysis of the existing literature on scholarly peer review, and (2) it provides a landscape scan of open peer review by setting up categories of alternative peer review methods and services, and describing these alternative review tools based on OpenAIRE's definition of open peer review.

4.1. SWOT analysis of literature on peer review

The SWOT analysis provides a momentary picture about the status of the peer review system. It distinguishes between where the system is now and where it is continuously developing to. The strengths and weaknesses gathered here provide information about what studies and reports have previously defined as benefits and flaws of the current peer review system. The opportunities and threats list both issues and new factors in the review processes that have surfaced due to the transforming scholarly communication system. While the opportunities represent those situations that bring sustainability and competitiveness if seized upon, threats foreshadow problems, which should be avoided in a future effective review system. By assessing the problems and opportunities the peer review system faces, the SWOT analysis provides a background for the analysis of emerging alternative review tools. The peer review tools, services, methods, which differ from the traditional publishing review processes, will be described, categorized and evaluated on the basis of their functionality, and sustainability within the current open scientific discourse in a next step.

Strengths:
Peer review is a concept and not a method. It can be unbound from the print journal and applied to any product (Odell, 2016). It is true that peer review is very versatile: it is employed for evaluating scientific results, research data, research proposals and grants. E.g. it is used in teaching to assess portfolio information about the teaching of an instructor; in pedagogy to enhance students' critical skills; in medicine as the process by which a committee of physicians examines the work of a peer and determines whether the physician under review has met accepted standards of care. In all these cases the common theme is the scrutiny of one's work by fellow workers/peers. The primary goal is the same, but the methods for putting peer review into practice vary across journals and disciplines (Chowdhry, 2015).

Peer review is most widely known for its role in scholarly communication: it is a distinctive feature of the modern academic system. Compared to other professions, in academia value is constructed by peer judgement as opposed to market dynamics (Biagioli, 2002). Peer review ensures the quality and reliability of what gets published and promoted as scientific findings (Harley, 2010, p. 232). It is the "invisible hand," which maintains quality (Harnad, 2000). However, the value of peer review lays not so much in filtering poor manuscripts. Instead, peer review is valuable as a means of enhancing the quality of what is published (Solomon, 2017).

The system of peer review is often described as the gatekeeper in academia (Chowdhry, 2015). According to Csiszar (2016), this notion emerged in around 1900, when a movement emerged to standardize the selection and the distribution of papers, and the referees came to act as the guardians of the literature. In a recent peer review landscape report, Jubb (2016) lists the main purposes of peer review as the guardian of quality: (1) checks for soundness and validity of results, (2) assesses

originality and significance, (3) evaluates the fit between the article and the journal, and (4) helps authors improve the quality of their research.

As an essential part of the traditional scientific publishing process, academic publishers emphasize the indispensable nature of peer review: "Reviewers play a central role in scholarly publishing. Peer review helps validate research, establish a method by which it can be evaluated, and increase networking possibilities within research communities. Despite criticisms, peer review is still the only widely accepted method for research validation (Elsevier, 2017)." According to a study conducted by Taylor & Francis in 2015, there is an agreement within the research community that scholarly communication is greatly helped by peer review of published articles. Majority of the researchers believed they could have confidence in the academic rigor of published articles because of the peer review process, and also strongly agreed that peer review improved their most recently published article (in the study, improving quality is voted most important of the list of ideal benefits). It is safe to declare that peer review is highly regarded by the vast majority of researchers and considered to be essential to the communication of scholarly research. Scientists have faith that the peer reviewed research conveys quality and trustworthy results to readers.

Weaknesses:

The trust in peer review is questioned by a number of studies analyzing the flaws of the system (Mulligan, 2013). Considering the inherent contradictions the peer review system carries within itself (Hackett, 1997; Csiszar, 2016), and the added human factor of subjectivity and bias it is no surprise that the role and functions of peer review have come under scrutiny. Analyses on peer review processes cannot be directly compared to each other, as they examine review processes coming from different disciplines and different journals. Sometimes even analyses done in the same field can lead to contradictory results (Ragone, 2011). However, common themes and problems can be identified in all these peer review studies: impartiality and bias in the system, quality control of the review process, abuse of review, lack of review standards, its role on the advance of science, and inadequate incentives to review.

Bias

The system is designed to encourage objectivity and impartiality. That is why a third party (a peer) is included to evaluate the results. The impartial interpretation and application of shared standards of excellence provide the basis for this fair process and legitimizes the whole peer review process. This impartiality is questioned by the bias(es) that are prevalent in current peer review practices. Caroline Lee (2012) identifies several types of bias in her study of 2012 in this topic: bias in relation to the quality of reviewed material (reliability and reproducibility of results), the bias stemming from the author (prestige bias, nationality, language bias, gender bias), bias relating to the reviewer's characteristics (toughness or lenience induced by the field of science reviewer work in, gender by reviewer), content-based bias (bias against interdisciplinary research, negative results, conservativism). Lee's categories seemingly cover almost all problematic issues regarding the review process, but it has to be stated that these biases, in a lot of cases, cannot be separated from other problematic factors such as the quality control issues, review standards, etc..

Studies on gender bias provide an excellent example of how research in a given topic can result in inconsistent evidence. Gender bias seems to be a recurring theme not just in peer review, but in scientific discourse as well. Fiona Ingleby's case, where the reviewer suggested her to pair up with a male author in order to get her research published, might be a singular, not representative case. But

it still sheds light on apparent sexism in science (Retraction Watch, 2015). Numerous studies point out the gender imparity in scholarly communication. According to Charles Fox (2016) the lack of diversity on editorial boards might generate disparities in editorial and peer review, which contribute to gender disparities in scholarly publishing. However, Ceci argues in his research on the underrepresentation of women in science that more recent and robust empiricism fails to support assertions of discrimination in grant and manuscript reviewing, interviewing, and hiring (2011).

Grod also deals with the diversity of editorial boards and its impact on the selection process of published materials (2008). Attributes of referees such as gender and region can act as determinants of a referee's handling of manuscripts, particularly in terms of the number of manuscripts being reviewed, review time and rejection rate. However, we need to acknowledge that there are studies supporting both sides of the argument: (1) research shows that the quality of the work of male authors is rated higher if the sex of the author is known to the reviewer (Wenneras, 1997), thus the double-blind review increases female representation (Budden, 2008), and (2) there are studies which cannot confirm the
gender bias in the review process (Mutz, 2015; Webb, 2008).

Other forms of biases examined include editor's personal connection, institutional prestige (Ceci, 2011), or the advantage of English language internationally, and status bias which prevails in science (Bastian, 2015). The advance of scholarly communication and science can be interfered by publication bias. It occurs when the outcome of an experiment or research study influences the decision whether to publish or not. This phenomenon is largely due to the competition in science, which in its healthy form increases efficiency and productivity of researchers. However, it also has a downsize, namely it urges scientists to come up with tangible, positive results in order to ensure the success of the scientific paper. Fanelli claims that "papers are more likely to be published, to be cited by colleagues and to be accepted by high-profile journals if they report results that are 'positive' – term which in this paper will indicate all results that support the experimental hypothesis against an alternative or a 'null' hypothesis of no effect, using or not using tests of statistical significance" (2010). Some go as far to say that, as the system gets too suppressive and the role of publishers as a filter in selecting and curating scientific content in the review and publishing process causes more harm than good in science, the initial filtration done by publishers is not even necessary anymore (Bilder, 2016). Or even point to the direction that peer-review is not an absolute requirement of good science (Luskin, 2012).

Quality control

The quality of the review process, including both the quality control function of the review in regard to the materials passing through the system and the quality of reports prepared by the reviewers, has also become a major concern. Analyses have been conducted based on various factors, such as blinding reviewers, applying citation watch to published materials, comparing review reports, editorial review and selection process, etc. (Jefferson, 2002; Peters, 2004; Schroter, 2004; Jefferson et al., 2007; Bornmann et al., 2010; Kowalczuk, 2015). Birkou reviews research approaches dealing with the quantitative analysis of the process (2011). Experimental studies question the ability of peer review to spot important errors in research papers. In an experiment by Godlee et al. deliberate errors were included in papers already accepted by the British Medical Journal (BMJ) to be published. The report concluded that 16% of reviewers did not find any mistake, and 33% of reviewers accepted the paper despite the introduced mistakes (Godlee et al., 1998). A study done by the Centre for Studies in Higher Education in 2005 suggests that the quality of peer review seems to be tending

more toward description than analysis. Due to the overburdened editorial system, criticism has been cast on the long lag time and the sliding quality of the editorial process (Harley, 2011). The quality problems are also indicated by the increasing number of retractions by major publishers (Fang 2012, Oransky 2015, Callaway 2015). According to Fang retractions for fraud or suspected fraud as a percentage of total articles have increased nearly 10-fold since the first retractions occurred in mid 70s.

The issue of quality control has come under more scrutiny with the appearance of open access publishing. As new journals emerged in the market offering fast and wide access to scholarly results, the question has risen how they can ensure the quality of the published material. This discussion was further aggravated by the emergence of predator publishers which, in hope of financial profit from APC charges collected from authors before publishing, pushed materials through the review and publishing process, which did not meet scientific quality standards (Sorokowski, 2017). As the OpenUP survey results show (see above) quality control is a major concern for researchers. Thus this weakness of the established review system needs special attention in the development of alternative review methods.

Motivation for review

The current transformation of the publishing system and the increased scrutiny of review processes put a lot of pressure on reviewers. The increased amount of publications entering the review system does not help the balance of efficiency-effectiveness that reviewers must observe in their work. The urgency to complete reviews on time might hinder the quality or the elaborateness of the reports. Due to the work overload senior scholars or reputable field experts experience, review work is losing priority. Publishers often find it difficult to recruit motivated reviewers (Björk, 2016). The current situation in publishing definitiely leads to the erosion of referee incentive (Aarssen, 2010). Furthermore, with the advance of multidisciplinary research, it is difficult to find reviewers with the right skills and expertise needed to assess such projects and research results (House of Comm 2011).

Slow and expensive

The most recurrent criticism of the traditional peer review system is that it is slow and expensive. Many journals, even in the age of the internet, take more than a year to review and publish a paper (Smith, 2006). Although reviewers are not paid, publishers consider peer review a major financial item in the publishing process. It includes editorial costs and distribution costs. Since scientists are working pro bono right to advance science, it is often articulated that through the change of the publishing model, academics could have substantial financial gains (Smith, 2006).

Abuse

Another hindering factor in scientific developments is the abuse of the system. Major publishers, such as BioMed Central or Elsevier (Haug, 2015; Oransky, 2016; Retraction Watch, 2015) had to deal with inappropriate attempts to manipulate the peer review process triggering long investigations and ending up with article retractions. Fake reviews include different deceptive methods: asking a friend for positive review, or developing peer review circles where a group of authors agree to peer review each other's manuscripts across several journals (Patel, 2014). One of the major consequences of these manipulations of the process is that trust, on which the whole process of scientific research and publication is based, breaks. The peer review system operates on the assumption that authors, reviewers and all involved stakeholders act genuinely in a transparent manner (Callaway, 2015). However, if editors cannot take face value the author's suggestions for reviewers or assume authors

want to have their work peer reviewed and improved, publishers will introduce limitations in the process in order to protect the integrity of the system (e.g. BioMed Central disabled the option of allowing to invite author-suggested reviewers). On the other side, authors' trust within the system can fade when the submitted manuscript is leaked by a reviewer and shared on the internet without consent (Polis, 2014). Such breach of confidentiality or examples of favoritism based on friendship (Wenneras and Wold, 1997), and reviewer misconduct due to close working relations with the author (Blanes, Vidal and Leaver, 2015), can all lead up to broken trust in the research community, which hinders the development of the publishing system. It is common practice now that scientific journals and publishers follow international recommendations on conflict of interest declarations in regard to authors, reviewers, and editors (Grandjean, 2013).

Opportunities

The changes in the publishing landscape are primarily induced by the technological changes in communication, the advancement of the open access movement, and by the impact of open science principles in the scholarly discourse. The immense growth of information production and the increasing power and availability of digital technology have transferred methods and channels of communication. Digital scholarly platforms, such as e-journals, repositories, or conferences allow scholars to communicate and collaborate more effectively and efficiently than ever before (Chang, 2010). Interoperability, communication and collaboration have come to characterize modern research including network technologies, digital data capture techniques, and data mining techniques.

Due to these changes, new opportunities surface the world of 21st century publishing. According to van der Sompel (2004), the next-generation network-based communication system incorporates the following functions of scholarly communication:

- *Innovation*: more experimentation with new ways of communication.
- *Adaptability*: alternative solutions emerge as the scholarly process evolves.
- *Democratization*: the traditional vertically-integrated system transfers into an interlinked system of alternative and complementary services.

The emerging publication and review alternatives develop along these functionalities. Thus, they represent innovative solutions to the current problematic practices, they follow the main open science principles of interoperability, openness and transparency, and they foreshadow a more networked based system based on researchers' collaboration. New solutions not only require a democratic and transparent communication structure, but also redefine the roles of stakeholders in the system. Open collaboration, however, involves appropriate means of communication, thus articulating critique well, in a non-offensive way, and accepting it, as well (Bastian, 2015). Open review reports available for fellow researchers urge reviewers to provide articulate reviews, and the open platforms which provide place for author-reviewer collaboration encourage active involvements of both parties.

Transparency

It is a widely accepted fact that opening up the process and increasing transparency will improve the quality of review (Wicherts, 2016). With open review there is less likelihood of bias, the accountability of reviewers grows, therefore the reviews may become more constructive, and as the review becomes part of the published record, the reviewer can be credited with the work (Acreman, 2016).

Redefining roles in the system

The alternative review methods represent a shift from traditionally understood peer review to peer-to-peer review. In this case, papers are reviewed by working scientists, as opposed to a professional editorial staff (Harley, 2010, p. 234). Such a review approach ensures access to the systematic evaluations of manuscripts, overview of the peer review proficiency of scholars, and an accessible pool of experienced peer reviewers (Chang, 2010). Instead of the gate-keeping function of the review system, review can be viewed more as a filtering activity or a community-based process, in which groups of scholars determine for themselves the most important texts in their subfield (Fitzpatrick, 2011). New review methods also encourage the open author-directed peer review model, which requires authors to (1) solicit their own referees who should hold a PhD, (2) ask their referees to complete a standard review and sign a statement granting permission to acknowledge their endorsement for publication, and (3) submit their manuscript to the editorial team along with their referees' endorsements for publication (Aarssen, 2010).

Motivation

Discussions on the transforming review system include the wide dissatisfaction with the incentives for review. Peer review is a hard and composite work including review of the soundness of the methods, the validity of the results, the rationality of the conclusions, and references. One of the most discussed way to create incentives for greater participation and better reviews would be to allow reviewers to sign their work, and to publish the review alongside the paper itself (Bernstein, 2015). The results of our survey also confirms that the acknowledgement of the review work would definitely serve as an incentive for researchers to participate in this scholarly process (Table 2). Other incentives to reward reviewers also include waiving page or publication charges to reviewers, acknowledging them in the journal, giving reviewers feedback on the quality and outcome of their review, or even rewarding the best reviewers with appointments to the editorial board. Most academics view reviewing as part of their academic duties, and therefore reviewers generally felt uneasy with direct financial compensation for their work, but including review activities in the academic reward system would be key to improve participation (Davis, 2010).

Publishing Results

Preregistration of research could provide a solution to publication bias and the aversion to null results. According to Veer (2016) pre-registration of studies before they are conducted has recently become more feasible for researchers, and is encouraged by an increasing number of journals. The practice of pre-registration is relatively new to psychological science, and therefore, guidelines and standards of content registrations are still in a formative stage.

Threats

New solutions, besides the opportunities they offer to solve problematic situations, may carry threats and unfavorable consequences. These 'threats' need to be kept in mind when introducing new methods and tools in order to avoid the same mistakes as the development sprang from. One of the major concerns about using digital technologies in alternative scholarly processes is that relying on Web-based technologies to facilitate peer review may limit peer reviewers to scholars with high-speed Internet access (Harley, 2010, p. 55). Limitations who can participate in such network based activities definitely hurt the democratic, all-inclusive principles of open science. Platforms with a fee-to-submit system would also disclose authors who lack the means to pay (Fox, 2010).

Another major concern derives from the increasing numbers of submissions. Reviewers have less time to spend per manuscript which might lead to the decline in the quality of reviews (Aarssen, 2010). One solution might be to deal with the insufficient number of qualified reviewers who are willing to review, is the recruitment of new scholars to participate in this process. However, it seems to be a challenge to find and train the next generation of reviewers (Michaels, 2016). As an increasing load of work is put on a limited pool of experts, there seem to appear a lack of tools to identify new potential reviewers (Jones in Michaels, 2016). There are several reasons behind the shortage of reviewers. One is the lack of training: review work includes not only publications but also conference abstracts, promotion and tenure applications, funding applications, and more. Young researchers need better training, support, and recognition for their peer review contributions (Michael, 2016). Another reason behind the reluctance to review is due to the openness and transparency of the new review methods. Young scholars might also be discouraged to participate by the openness of the report or the reviewer's identity when it comes to pass criticism on a senior researcher's work (Harley, 2010).

New review methods may lead to alternative forms of bias: reviewers might not want to avoid justifying negative comments, instead they might issue a positive review, or reviewers in research networks might favor "people in their group expecting reciprocity" (Fabiato, 1994). Therefore, even alternative review services, such as Publons, employs double-blind PR has to avoid bias.

However, as opposed to a blinded peer review process, the essence of most alternative review processes is the fast dissemination of research results to keep pace with developments in the scientific field. The rapid review and fast publication might lead to a relative disregard for quality and content of these manuscripts. "Quickness and expediency of review and speed of publication should not dictate the scientific publication process at the cost of sacrificing quality of content for greater benefit to society" (Das, 2016). This issue of quality is a recurring theme in the discourse of alternative methods of dissemination and review (preprint publishing, post-publication peer review). Post publication PR is seen as an additional workload on top of 'normal' peer review. Furthermore, the proliferation of emerging publishing platforms and tools (PubMed Commons, ResearchGate, PaperHive, and PubPeer) which allow for different forms of commenting and review makes it difficult to synthesize evaluations since different comments appear on different platforms. Tennant calls the researchers' growing reluctance to contribute a "'platform fatigue' – too many competing websites trying to achieve the same thing, and fragmenting the landscape by doing so" (2017d). The problem here derives from the lack of comprehensiveness and interoperability: different platforms having different types of commentary on articles, without any standardized guidance (Tennant, 2017d)

That is why a landscape scan of the existing platforms, methods and tools will help to establish some common grounds for developing interoperable standards and channel further developments towards unified and user-friendly solutions in transforming the scholarly publishing and review environment.

4.2. Landscape scan of alternative review methods/tools

The primary aim of categorizing the OPR methods and tools is to get a better view of the functionalities and characteristics of the currently available platforms. The categories will outline the major trends to which technological developments are aligned.

4.2.1. Categories of alternative review tools and services

Although the traditional single- and double-blind peer review are still the prevalent forms of quality control in scientific publishing, emerging alternative peer review forms provide valuable options for both authors and publishers. Open peer review is introduced to scholarly communication processes in various forms. As a result of the landscape scan of alternative review methods and tools, four main categories can be defined within which the various tools carry common features, although they show differences in their realization or functionality. In this report peer review alternatives are grouped in four categories: (1) open peer review solutions offered by publishers, publishing platforms, or journals (2) independent peer review services, (3) repository related peer review solutions, (4) commentary, annotation tools.

1. **Publishers**

Publishers and publishing platforms are the two major groups which introduce alternative review methods. However, the differentiation between a publisher and a publishing platform is not that easy to make. Used mainly in the field of media, publishing platform is often referred to as a new media company model that has been perfected by the tech industry. The primary goal of these platforms was to distribute other peoples' content without much editorial oversight (Laurenson, 2015). The platform model facilitates the production and distribution of content. The same access and tools to create and publish content are provided for all users; meanwhile the relevancy of the content is decided by the readers (Baukhage, 2014). In contrast, the publisher models focuses on the creation and publication of content, which is limited to staff and editors. Due to the clear distinction publishers made between content consumers and content creators, readers do not have a say in what was published.

Academic publishers and the increased presence of publishing platforms in scholarly publishing can be told apart, but the functionalities and characteristics start to mix up. Sometimes it is hard to draw a line between these two publishing forms. While acknowledging the thin line between these two publishing methods, this report sets up the categories for alternative review methods based on the content providers' own descriptions and definition of their activities on their websites.

Publishers, such as ***Copernicus, Frontiers, BioMed Central, eLife*** have moved away from the traditional method of reviewing by shortening the publication time and making the review process partially or entirely transparent. The openness of the review process is ensured by publishing the report alongside the articles and by strongly urging, but not necessarily mandating the disclosure of the identity of the reviewers.

Another feature of open peer review is also incorporated in the operation of the majority of these publishers. The review process is turned into a collaborative effort either through the communication among editors and authors, or through initiating discussion within the research communities. They employ different degrees of collaboration: while eLife ensures the discussion of the editor and the reviewers about the submitted manuscript, Frontiers established a "Collaborative Review Forum," which unites authors, reviewers and the Associate Editor (Frontiers). Copernicus allows the widest collaboration by involving the research community in the review process, as well. Their "Interactive Peer Review" supplements the evaluation of the reviewers with the comments from the scientific community.

There are several open access **journals**, which diverge from the traditional review process and use different aspects of an open peer review at various degrees. The ***Royal Society of Open Science***[6] and ***PeerJ*** do not employ a fully open review process. They encourage referees to sign their reports, and where authors agree the editorial process is made transparent by publishing referee reports and the associated author responses alongside published articles. Since many authors and reviewers are not comfortable with disclosing their identities, these journals do not mandate open identity. However, they declare their dedication to open access and transparency by including and encouraging open identity and report in their review process. ***The BMJ***[7] goes a step further to include open and transparent review process in the publishing policy. Submitted manuscripts are posted on the journal's website and are publicly available.

ETAI (Electronic Transactions on Artificial Intelligence)[8] pioneers a new view of how scientific results may be communicated. ETAI combines open *discussion* about the article with confidential *refereeing* of the article where it is decided whether or not to accept the article to the journal. All discussions are posted alongside the articles (whether they were eventually accepted or not). ***The Semantic Web Journal***[9] also opens up the review platform to the research community. All reviews and responses from the authors are posted on the journal homepage and the reviewers and editors are acknowledged in the final printed version. However, this journal also observes the doubts reviewers might have with open identity, and although it strongly encourages reviewers to participate in the fully open and transparent review process it is still possible to submit anonymous reviews. ***Philica***[10] introduces a dynamic review process which is based on the evaluation of the reviewers' review activity. The impact of that review depends on the reviewer's own reviews: (1) *People* whose work is highly rated (and so who can be thought of as "good" researchers) carry more weight, (2) people who have proved to us that they are bona fide professional researchers are a lot more influential, (3) newer reviews carry slightly more weight than older reviews, to reflect changing opinions towards any given work. Besides the flaws of the evaluation system it operates, this review process bases its operation on the acknowledgement of the review work by rewarding the work of those who have more and quality review activity.

Publishing platforms such as F1000research, The Winnower (Authorea), scienceopen.com (research and publishing network), Scholastica, and eJournalPress, have definite features which make them a unique group of publishing and review. A common characteristic of these platforms is that they operate an easy-to-use interface making the publishing a hassle-free experience for authors. The primary aim of these publishing platforms is to increase discoverability. They allow for submitting research results in a variety of formats: original papers, negative results, case studies, reviews, slides, grants, letters, conference summaries, conference talks, blogs. Furthermore, these platforms offer services and value added features, which make these sites very user-friendly: e.g. a private collaboration tool to work on the manuscript with co-authors (scienceopen.com); configuration settings that allow to tune the software to each customer's needs and individualized customer support solutions (eJournalPress[11]); or to include file and image attachments in a PDF viewer for easy access (Scholasctica).

[6] http://rsos.royalsocietypublishing.org/about
[7] http://www.bmj.com/
[8] http://www.ida.liu.se/ext/etai/
[9] http://www.semantic-web-journal.net/
[10] http://www.philica.com/
[11] https://www.ejournalpress.com/

Discoverability is facilitated by assigning DOIs to submitted materials in most cases, thus they can be easily identified in scientific discovery processes and can be linked to other results and outputs. Another common feature is transparency. Most platforms employ post-publication peer review: after an initial and quick editorial check evaluating only the integrity of the work, the submitted materials are subjected to the review process by outside reviewers invited or suggested by the authors, or research community members. All reports, comments, evaluations are openly accessible to readers, and they are published alongside the articles.

The publishing platforms with open peer review advocate the collaborative aspect of open scientific communication turning the platforms into discussion forums on given topics and issues while providing useful commentaries to the authors on their published results.

Table 3. Publishers and publishing platforms with alternative review methods

	Platform	**Identity:** *reviewer`s identity is published*	**Report:** *reviews and comments are published (alongside the relevant article)*	**Participation:** *by invitation and/or open to wider community to able to contribute to the review process*	**Interaction:** *specified discussion between authors and reviewers, and/or public, open interaction is allowed*	**Time:** *Open pre-review manuscripts/pre-publication review/ post-publication review or commenting*[12]	**Link**
F1000Research	publishing platform	open	open	invited reviewers and open for commenting after registration	open	post-publication	https://f1000research.com/
The Winnower	publishing platform	open	open	invited reviewers and open commenting	open	open pre-review manuscripts	https://thewinnower.com/
Science Open	publishing platform	open	open	reviewer: ORCID with 5 publications, comment: ORCID with 1 publication	open	post-publication	https://www.scienceopen.com/
Scholastica	publishing platform	blindness control		invited reviewers		pre-publication	https://scholasticahq.com/
BioMed Central	publisher	On request	open	Invited reviewers	closed	pre-publication	https://www.biomedcentral.com/
Frontiers	OA publisher	open	closed	invited reviewers	discussion of authors and reviewers	pre-publication	http://home.frontiersin.org/
Copernicus Publications	OA publisher	opt in/out to sign	open	invited reviewers and research community commenting	closed	pre-publication	http://publications.copernicus.org/
PeerJ	OA journal	opt in/out to sign	authors opt in/out to publish	invited reviewers	closed	pre-publication	https://peerj.com/
eLife	OA journal	opt in/out to sign	authors opt in/out to publish decision letter	invited reviewers	discussion of editors and reviewers	pre-publication	https://elife.elifesciences.org/

[12] **Open pre-review manuscripts:** Manuscripts are made immediately available in advance of any formal peer review procedures.
Pre-publication: review takes place before the publication of the final version of the manuscript is published.
Post-publication review: Review or commenting on publicly available version of the manuscript (revisions are allowed) or on published final-version manuscript.

2. Independent peer review services

Independent peer review platforms, such as ***Peerage of Science, PubPeer, SciOR, PEER, Rubrique***, or ***Axios Review*** (no longer operational) separate the review from the publishing process. The primary aim of the review services is to provide a user-friendly and transparent review process, which benefits both the authors and the reviewers. The review service is not affiliated with a journal or publishing house, thus the evaluation is independent from standards set by publishers. The process allows different degrees of author involvement from an entirely author-directed workflow, where the author sets even the time frame for the evaluation ***(Peerage of Science***), through contacting reviewers to participate in the process (***SciOR***), or to deciding the degree of openness they are comfortable with (***PubPeer, Publons***). These platforms, in general, advocate a network-based approach where collaboration between authors, editors and reviewers is urged to improve the paper. Community interaction helps improve the quality of scientific research by enabling innovative approaches (***PubPeer***).

Quality control is incorporated into the review process on several levels. Standardized evaluation forms (***Peerage of Science*** PAQ, ***Rubriq*** Score card) are used to guide the evaluation process. Defining the questions reviewers need to report on facilitate an easier comparison of the reviews as well. Quality of the review is enhanced by the evaluation of the reviewers (Peerage of Science PEQ). Evaluation of reviewers by fellow reviewers provide a clearer picture about the participants involved allowing for the authors, editors and the publishers to make informed quality decisions. Quality assurance can also derive from a separate service, such as ***PRE Peer Review Evaluation***[13], which provides a seal of approval in the form of a badge. It ensures quality publishing in regard to both the articles being peer reviewed, and to the publishers authors can choose from.

Although these review platforms operate independently from publishers, they may be connected to a chosen set of journals. The journals the platforms are working with accept articles for publishing based on the recommendations of the review platforms. Thus, besides the primary function of managing the review process for scientific outputs, the review services evaluate the fit of the paper to a variety of journals. Papers are rigorously assessed by the editors and external reviewers to find the right journal for publication (***Axios Review***). The match between the article and the journal can also be made even if the review service is not connected to the journal of the author's preference since the services, in most cases, approach the chosen publishing with the finalized and peer reviewed research material.

Peer review platforms carry several benefits for the reviewers as well. They employ different methods to recognize and reward review work. ***Axious Review*** used to give coupons for reviewers as a kind of payment for helping their process in the form of a discount for using their services. At ***Publons*** the peer review and post publication activity factor into the reviewer's Altmetric scores (new silver line in the Altmetric donut). Futhermore, the review activitiy of the researcher is automatically exported to their ORCID ID leaving a permanent record in their research history. Rubriq goes one step further and provides besides the academic reward forms, a financial compensation for the review work (currently $100 per review), but they also offer contribution to the reviewer's organization fund or even donation to a charity in the research community. Thus, the methods and tools may vary in rewarding review work, but it is a common feature at these review services that work and time of the researchers is acknowledged.

[13] http://www.pre-val.org/

Table 4. Independent peer review services

	Platform	**Identity:** *reviewer`s identity is published*	**Report:** *reviews and comments are published (alongside the relevant article)*	**Participation:** *by invitation and/or open to wider community to able to contribute to the review process*	**Interaction:** *specified discussion between authors and reviewers, and/or public, open interaction is allowed*	**Time:** *Open pre-review manuscripts/pre-publication review/ post-publication review or commenting*	**Link**
Peerage of Science	standalone peer review platform	opt in/out to sign	opt in/out to publish review	registered, invited peers	closed	pre-publication	https://www.peerageofscience.org/
Publons	standalone peer review platform	opt in/out to sign	opt in/out to publish review	open	open	any point in the publication process	http://publons.com/
Rubriq	standalone peer review platform	double blind review	closed	closed	closed	pre-publication	https://www.rubriq.com/
SciOR	standalone review platform	open	open	open to registered authors and editors	discussions of authors and reviewers	pre-publication	https://science-open-reviewed.com/webapp/
PubPeer	standalone peer review platform/journal club	opt in/out to sign	open	open	open	post-publication	https://pubpeer.com/about
Axios Review (not operational)	peer review service	closed	closed	closed	closed	pre-publication	https://axiosreview.org/

3. Repository based publishing and review

Preprint related review platforms and tools, such as ***PaperRater, SciRate, Haldanes Sieve, Biorxiv, SelfJounal of Science, Academic Karma, episciences***, represent another group of alternative review methods and tools. Internet facilitated communication speeds up the dissemination of scientific results. With the advance of open access new alternative methods of publishing have emerged. Academic libraries have become more involved in scholarly publishing and dissemination processes. Although the potentials of institutional repositories have not yet been maximized they are definitely considered as a disseminating option. Institutional and subject repositories are usually discussed in relation to the green open access publishing, but they can also tap into the gold open access dissemination scene. They have the potential to support and connect with the institution's research community or a scholarly group/society of a given scientific field by offering to host their independent journals in their established institutional or subject repositories. "Libraries could select a subject area that is a strength at their institution and approach the groups that publish the smaller journals in that discipline about depositing both their current and older volumes in the library's repository." (Kelly, 2016)

The pioneering and successful example of arXiv, which covers preprints in the field of physics, mathematics and further quantitative disciplines (launched in August 1991) found followers in other fields, in some only 20 years later. Due to more receptive audiences, ***bioRxiv*** – an arXiv-licensed but independent preprint server provided by CSHL Press for the life sciences – launched in 2012, was soon followed by ***AgriXiv*** in agriculture and allied sciences; ***engrXiv*** for engineering; and ***SocArxiv***

in social science; and by the most recent addition of ***paleorxiv***, soon to be launched in 2017 (McGlashan 2017).

Preprints are increasingly being recognized by the publishing industry. Numerous journals and publishers exempt preprints from copyright restrictions allowing deposit of and access through repositories, institutional and/or personal websites (SHERPA/RoMEO database[14]). However, in regard to open science and the re-use of open access materials, the free availability of these manuscripts does not necessarily imply a free re-use option. "Recent data show that authors uploading their work to bioRxiv choose the most restrictive license on offer – retaining full copyright – for their work," most probably to ensure full control over their work (McGlashan, 2017b). Some publishers, like ***eLife***, even allow the deposition of manuscripts on a preprint server while they are still under review. Even DOIs are issued for preprints by Crossref from late 2016 (McGlashan, 2017a).

Funders also acknowledge the growing presence of preprint publishing in their policies: the Wellcome Trust allows researchers to cite preprints in their grant applications (Bourne, 2016), and they are cooperating with an international group of research funders to explore the value and feasibility of establishing a Central Service for Preprints, which would set out to aggregate content from multiple sources and provide new ways for researchers and machines to search, access and reuse the content of preprint servers (Wellcome Trust).

In order to facilitate a wide scientific discussion about preprint materials, a variety of forums and platforms were created, which channel communication related to the uploaded materials. This way this body of literature gets more accepted and used as evaluated scientific content. The repository-based dissemination and review forums can take a variety of forms. There are platforms, such as ***PaperRate*** or ***SciRate***, which are repository specific discussion forums, allowing for commenting on preprints in arXiv. ScienceOpen provides peer review to arXiv content by building collections where an editor or group of editors can group together articles that they find interesting, and open up all articles to post-publication peer review decoupling peer review and the communication of research from the formal publishing process (Tennant, 2017). Preprint servers facilitate communication on research results on a wider scale than traditional channels of dissemination and evaluation allowed for. Some platforms like PaperRater, SciRate or PeerJ Pre-prints have a built-in commenting or peer review function on the platform. Others allow for crowd-sourced discussion on preprints in a specific field of study (***Haldanes Sieve***), or function as a multidisciplinary repository for articles and preprints (***Self-Journals of Science***). In addition, the overlay journal format allows managing preprints as journal content (***episciences***), and there is a forum dedicated entirely to reviews on preprints (***Academic Karma***).

Repositories can also offer peer review functionalities. By turning repositories into evaluation platforms the quality control aspect of the scholarly communication process is given back to the research communities. The open-source review plug-in, the Open Peer Review Module (OPRM), developed by Open Scholar in association with OpenAIRE adds overlay peer review functionalities to repositories using the DSpace software. OPRM on an institutional or other open access repository will enable the formal review of any digital repository content, including data, software code and monographs, by an unlimited number of peers. The review process is open and transparent, thus the full text of the reviews is available and the identity of the reviewers is disclosed. The system allows all interested peers to submit a review after creating a reviewer account and providing credentials

[14] http://www.sherpa.ac.uk/romeo/index.php

certifying their qualification as peers. In addition to reviewing research objects, reviewers are also asked to evaluate previous reviews of each object they review. The OPRM includes a reviewer reputation system based on the assessment of reviews themselves where the reputation of the reviewer weighs on the importance of each review on the overall assessment of a research work. The primary objective of this system is to create reliable reputation metrics for research works, authors, reviews and reviewers. OPRM builds on the existing infrastructure offered by open access repositories. Besides providing novel metrics for the quantitative assessment of research quality, it promotes the use of relevant content that has been validated by reviewers using tags and advanced search filters. It advances an open and transparent dialogue about reliable and reviewed research material (Open Scholar, 2016).

Preprint platforms typically do not employ much editorial functions beyond a check by moderators if the content fits thematically and is scientifically sound. Additional value is added by overlay services, which enable the management of a pool of reviewers. However, they all advocate open dissemination and enable open peer review (while not necessarily on the same platform): open identity of the reviewers, open report/commentary, and open participation from all research communities and public readers as well.

Table 5. Repository based publishing and review

	Platform	**Identity:** *reviewer`s identity is published*	**Report:** *reviews and comments are published (alongside the relevant article)*	**Participation:** *by invitation and/or open to wider community to able to contribute to the review process*	**Interaction:** *specified discussion between authors and reviewers, and/or public, open interaction is allowed*	**Time:** *Open pre-review manuscripts/pre-publication review/ post-publication review or commenting*	**Link**
Self-Journals of Science	repository and evaluation system	open	open	open to authenticated scholars	open	open preprint manuscript	http://www.sjscience.org/about-sjs
episciences	overlay journal platform to preprint servers	opt in/out to sign	closed	closed	discussion of author and copy editors	open preprint manuscript	https://www.episciences.org/
Academic Karma	online peer review network	opt in/out to sign	opt in/out to publish	ORCID ID is needed to review	open	open preprint manuscript	http://academickarma.org/
Haldane`s Sieve	preprint commentary	open	open	open	open	open preprint manuscript	https://haldanessieve.org/
SciRate	scitation and commenting tool on arxiv content	open	open	open to registered users	open	open preprint manuscript	https://scirate.com/about
PaperRater	commenting tool on arxiv content	opt in/out to sign	open	open to registered users	open	open preprint manuscript	http://paperrater.org/help/getting-started.html

4. **Review applications** and commenting tools, such as or related ***to paperHIVE, The Blue Journal Club, Research Gate OPR, Epistemio, Openreview.net, Hypothes.is, ScienceOpen.com***, or PLOS Open Evaluation are not identified as peer review methods per se. However they aim to provide valuable assessment mechanisms of scientific content. They function as an application providing a

layer of customized features that can be applied to repository or journal content (***PaperHive***), or to materials disseminated through academic social networks (***ResearchGateOPR***). These tools contribute to the network-based and collaborative aspect of research by opening up the discussion on already published scientific results. In this way, they can be viewed as post publication review tools.

Some tools allow sentence-level critique (e.g. ***Hypothes.is, PaperHive***) leading to contextual in-depth analysis of the content. Their operative features are based on annotation standards for digital documents (i.e. W3C Web Annotation standards), which is a new development area in digital content management. These tools and platforms prepare for the next generation of read-write web application. ***TrueReview***[15] is an open-source tool with the motivation to provide reviews and evaluations. It organizes papers in publication venues allowing different scientific communities to set their own submission and review policies. This tool offers benefits to the reviewers by rankings that can be prominently displayed alongside papers in the various disciplines. It also provides reward to the authors of the most significant papers both via an explicit paper ranking and increased visibility in search (de Alfaro, 2016).

Table 6. Review applications

	Platform	**Identity:** *reviewer`s identity is published*	**Report:** *reviews and comments are published (alongside the relevant article)*	**Participation:** *by invitation and/or open to wider community to able to contribute to the review process*	**Interaction:** *specified discussion between authors and reviewers, and/or public, open interaction is allowed*	**Time:** *Open pre-review manuscripts/pre-publication review/ post-publication review or commenting*	**Link**
Hypothes.is	annotation/commentary tool	open	open	open	open	any point in the publication process	https://hypothes.is/
Research Gate OPR	review tool	open	open	open	open	post-publication	https://www.researchgate.net/publicliterature.OpenReviewInfo.html
Epistemio	review service for institutional research assessment	opt in/out to sign	open	open	open	post-publication	https://www.epistemio.com/
PLOS Open Evaluation	evaluation tool					post-publication	https://github.com/PLOS/open_evaluation
OpenReview	review platform/API	opt in/out to sign	open	open	open	post-publication	https://openreview.net/
PaperHIVE	interactive platform	open	open	open	open	post-publication	https://paperhive.org/

4.2.2. Alternative review methodologies

The review platforms and services discussed above employ various methods for evaluation. Some methods are characteristic for a certain category of alternative reviews, e.g. the decoupled review

[15] www.theme-junkie.com

method is employed primarily by standalone review services. Others might be used, also in combination, by several different review services and providers. In the following the alternative review methodologies, which are most regularly addressed and definitely advance the peer review discourse, will be described.

Open peer review is a manifold and frequently resurfacing concept in scholarly communication. It is often used as an umbrella term for different peer review diverging from the traditional (single/double blind) review process. According to the OpenAIRE report open peer review is most commonly defined in the literature as a review processes in which the reviewer's identity is revealed and/or the review report is published alongside the scholarly output (Ross-Hellauer, 2017b). Tony Ross-Hellauer expands this narrow description of open peer review and defines OPR as a concept including "a variety of innovations which 'open up' the traditional peer review process by modifying one or more of aspects to make it more inclusive, transparent and/or accountable. Primary aspects are: (1) Open Identities (authors and reviewers are aware of each other's identity), (2) Open Reports (review reports are published alongside the relevant article), and (3) Open Participation (the wider community to able to contribute to the review process). Possession of one of these traits is usually sufficient to qualify a system as OPR" (Ross-Hellauer, 2016).

Open peer/public commentary, one form of open participation, can be another basic feature of open peer review. In this case the review process is a collaborative process: the dissemination platform provides a forum for peer researchers or even the general public to provide evaluative commentaries to the published scholarly results. Publishing platforms such as the Winnower, journal clubs and layover journals publishing repository content employ this review method. Their primary goal is to provide fast dissemination to unpublished and unrecognized materials. This way, after an initial fast screening, results become available in a short period of time and the evaluation of the content is executed after it has been published in a network based forum.

This methodology has also been integrated into publishing, which follows traditional review-editing-publishing process of dissemination. An example is Copernicus Publishing, which includes open peer commentary with interactive public peer review in a two-stage publication process: the manuscripts are first published in the discussion forum where they undergo an interactive public discussion, during which the referees' comments (anonymous or attributed), additional short comments by other members of the scientific community (attributed), and the authors' replies are published. This stage is followed by the peer-review process after which, if the manuscripts are accepted, the final revised papers are published in the journal (Interactive Public Peer Review). The public discussion effectively contributes to both fast scientific exchange and thorough quality assurance since it speeds up the review process, fosters scientific discussion, and deters submission of sub-standard manuscripts.

Open peer commentary can be easily integrated into new and existing scientific journals as well as large scale publishing systems and repository based dissemination simply by adding an interactive discussion forum. Furthermore, "public peer review and interactive discussion can easily be adjusted to the different needs and capacities of different scientific communities by maintaining or abandoning referee anonymity, shortening or prolonging the discussion phase, adding post-peer-review commenting and rating tools for readers, making all steps/iterations of peer-review and revision transparent, adding further stages of publication for re-revised manuscripts" (Pöschl, 2010).

A recent example of such integration of open peer commentary is using comments as a preselection tool: "Something we do with more caution is use metrics and comments from preprints to help us decide whether we are interested in manuscripts that are formally submitted to us. If we are unsure about interest levels, seeing that a paper has been highly accessed on bioRxiv can support a decision to peer review" (Flintoft, 2016). This, of course, hinges on the fact that preprints are recognized as real papers in the sense of traditional publishing. This is not the case yet, but things change slowly. "Using preprint repositories can help us make the contribution real (it has a DOI, that's as real as it gets!), and then leave us with some additional time before we freeze it in a published paper" (Poisot, 2016).

Post-publication peer review (PPPR) carries relevance to the time factor of the review. A distinction of reviews can be made in regard to the time of their occurrence in the publishing process. Pre-publication review is associated with the traditional models of peer review, which occurs before publication of the scholarly output and is mediated by an editor or editorial board. The main purpose of pre-publication review is to decide what is considered to be worthy of publication (Tennant, 2017). On the other hand, post-publication peer review follows the actual dissemination stage. This method is employed by a growing number of publishers and publishing platforms, e.g. ***F1000Research, The Winnower, or ScienceOpen***. Post-publication peer review is, in most cases, intertwined with open commentary. Thus after the rapid dissemination of the scholarly results filtering and evaluation occurs subsequently to publication with the involvement of wider scientific communities and readers. Just as it was discussed in case of open peer commentary, the main benefits of post-publication review are transparency of the review process (since all commentaries and evaluations are published alongside the articles), and rapid dissemination of scientific results.

PPPR, however, seems to be a controversial concept. In case of the manuscripts being openly available before evaluation the question arises whether the reviews they receive fall into the category of post-publication review. The rise of pre-print servers contributes to alternative forms of dissemination, which short-cuts the traditional publication process and makes their manuscripts immediately available to everyone (Ross-Hellauer, 2017c). Pre-prints find their ways to be published by layover journals, publishing platforms, or open access publishers. The public availability of these manuscripts can be regarded as publishing, thus reviews and commenting on these materials can be defined as PPPR. However, the example of the interactive public review of Copernicus Publishing shows the controversy in and the use of the term 'publishing,' and in relation to that the problems with the term PPPR: The manuscripts at Copernicus Publishing are made available for evaluation and commentary just before final editing and publication in the given journal. Can we regard the manuscript to be published when it was first made publicly available for interactive review and commenting, or when the finalized, peer-reviewed, copy-edited version is made available?

Decoupled peer review offers perhaps the most drastic change to the scholarly communication process by separating the review process from the journals and publishers and offering it as an independent service to authors. The concept comes from ***Rubriq***, one of a number of companies, which offer functions usually performed by publishers. The independent peer review offered by such service providers (e.g. ***Rubriq, Peerage of Science, SciOR, Publons***) moves with the paper from one journal to another. The author is usually free to choose from publishing offers sent by subscribing journals, or to submit the peer-reviewed work to any journal where it is up to the editor of that journal to work with the independent review or not.

The primary aim of these services is to speed up the publishing process by providing a quality scholarly review, which can be used for all submissions. This way re-submissions do not necessarily involve another lengthy process of review rounds. These services hope to change peer review into a transparent, standardized, and reputable scholarly work by employing a structured review process and providing access to the evaluation reports and acknowledging review work with reputation metrics and persistent IDs.

The need to introduce quality assurance into the review process is well understood and services such as PRE, offer independent verification of the review processes: "the PRE service enables journals to showcase the integrity of their peer review practices while providing researchers with a simple, visual indicator of trust." The PRE badge basically works as a seal of approval of quality review services indicating trustworthy review at an article level.

Some of these service providers (e.g. ***Rubrique***) function independently from scholarly institutions and publishers. Thus they operate a profit-based service. The fees charged to the authors cover the costs of administrative processes and in some cases the payment of the reviewers, which of course brings back the question of bias into the review process. Many review services, though, are offered free of charge operating on a scientific network basis and providing review solutions which benefit both the authors and the publishers (e.g. ***PubPeer, Peerage of Science, SciOR***).

Portable/Cascading review: this review method has been introduced by mega-journals (Nature Publishing, BMC), which in light of reducing costs and improving efficiencies implemented services to redirect rejected manuscripts to related journals within their field (Davis, 2010). The main incentive behind this methodology is again speeding up the publishing process by avoiding sending out the same article to multiple rounds of review. The cascading involves transferring articles rejected by top-tier journals to lower-tier journals within the publisher's portfolio, or offering more suitable publication venues. Cascading peer review is definitely beneficial for low-tier journals, but might "negatively affect the reviewers' roles by replacing their gate-keeping functions with the role of controlling manuscript transfer from one publication venue to another" (Barroga, 2013).

Machine aided review is another review option, which tries to find a solution to the human biases inherent in the peer review process. A pioneering service is StatReviewer. It is a machine-aided method which looks for critical elements in submitted manuscripts. StatReviewer scans the document looking for key phrases to identify the structure according to standard IMRAD (Introduction, Methods, Results and Discussion) headings, and parses the manuscript into the relevant sections (Shanahan, 2016). The pilot study on this method includes evaluation of clinical trials submitted to four BioMed Central journals: Trials, Critical Care,. Selected articles are sent to StatReviewer without interfering with the normal peer review process for the article. This method is viewed as a supplementary evaluation system in the review process, thus provides an additional checking mechanism which is based on predetermined standards of evaluation.

Alternative review of non-textual publications

The peer review process is not only used for textual articles, but can also be used for peer reviewing non-textual publications like software, data and video. As it becomes easy to make software, data and video accessible to reviewers, this opens the possibility to also review these materials. The materials can be part of a traditional publication, e.g. published as software, data or video in a traditional

journal; as part of a specialized journal on respectively software, data or video; or made available through a (public) repository (Mayernik, 2015).

At least 87 peer reviewed journals do publish software (Hong, 2012). Authors must submit the source code along with information on how to replicate the results from the manuscript. In some cases it is also sufficient to provide videos or audio slides proving that the software is working (Shaklee, 2015). Acceptance after peer review of the article should confirm that the software runs and can be used as described. Currently there are more than 100 data journals, of which most journals use anonymous peer review and only a few open peer review (Candela, 2015). Post-publication review is, however, becoming more common (Murphy, 2015). E.g. the journal *Earth System Science Data* has interactive open access peer-review with referee reports, comments from the community, and author's responses that are publicly available prior to the editors' decision (Rasmusen, 2014).

There is a lot of confusion and disagreement on what peer review of data is (Murphy 2015, 2016). An extra problem with data is that some data are not fixed because they are dynamic or otherwise altered. The reason to review data can be to increase the trustworthiness (Mayernik, 2015) or the utility and potential use of individual datasets (Shaklee, 2015). However, some see it more as a service provided with checks and metadata necessary for reuse, in which reviewers will assess the data not in terms of significance, but addressing questions like: Is the data format a standard for the field? Can it be re-used? What is the utility to the community? etc. (Callaghan, 2014, 2015). Recommendations on peer review of data have been made by Murphy (2015) based on the workflows of 26 different platforms.

How many peer reviewed scientific video journals currently are available is not known. But it seems that the number is rapidly growing[16]. Peer review of a video depends on the way 'the video' is submitted. For example, although JOVE is famous for being a peer reviewed video journal, JOVE will only produce and publish a video after a manuscript of the video paper has been accepted by the editorial and the peer reviewers. With other video journals authors can submit a video[17], a Microsoft PowerPoint File, or a storyboard for provisional peer review before making the video itself. As with traditional journals, the video journals are not very open on the criteria they will use for peer review. Video Journal of Education and Pedagogy say they use the same form as for articles, but do not make them explicit. VJGE[18] seems to review the actual video on originality, significance, and quality of the video article. It is also interesting to see that a peer review standard (JAMA score) was attempted to bet set up to objectively evaluate the quality of videos on the subject scoliosis on YouTube. They concluded that due to lack of peer review the quality is low (Stauton, 2015). So peer review of video in some way seems necessary.

In terms of reviewing non-textual publications we can conclude that different approaches will be required, and that review can sometimes focus more on technical aspects, usability and accessibility, scientific aspects, or a combination of those (Mayernik, 2015). Publishers could improve peer review of these materials by providing recommendations (e.g. what questions should be asked), training, the

[16] JOVE jove.com and VJGE vjge.org, VideoGIE (open access) ees.elsevier.com/vgie/, Video Journal of Education and Pedagogy videoeducationjournal.springeropen.com and *The Journal of Immunology & Clinical Microbiology* jiacm.com/videojournal.html, others like *Fungal Genetics and Biology* journals.elsevier.com/fungal-genetics-and-biology/, *JBJS Essential Surgical Techniques (JBJS EST)* surgicaltechniques.jbjs.org and *Fertility and Sterility*® www.fertstert.org have a special video section.
[17] http://www.jiacm.com/videojournal.html
[18] http://vjge.org/?p=Information-Authors

right workflow for reviewing these materials, and if necessary adapting it to specific domains (Murphy, 2016).

5. Improving the review system: implications and opportunities of OPR

5.1. Changing roles

Peer review is a complex process, which includes various workflows and standards, and implies varying requirements by all stakeholders involved. Despite emerging problems peer review is considered to be an important part of the scholarly communication process by the research communities, since all stakeholders can benefit from it. E.g. peer review gives authors the opportunity to improve their manuscript. Through these manuscripts reviewers are informed about new directions and subjects of research in their field. If review activity is recognized by their institutions, reviewers may enhance their academic reputation. Editors may consider review as a support system to take informed decisions on what to publish and what not (Ali, 2016). The alternative review methods and services do not question the significance of peer review and its role in scholarly dissemination. Through their practices they attempt to re-evaluate the current system and its workflows.

5.1.1. Peer review functions

Peer review goes hand-in-hand with respectability since a publication that has been peer reviewed gains acceptance as relevant contribution to the field (Mayden, 2012). Scientific results published in acknowledged journals are associated with the journal's reputation. However, despite rigorous reviews, even the most-respected journals have been caught publishing fraudulent or seriously flawed material (Wager, 2006). Due to the increasing number of retractions of invalidated research and false scientific results by established journals (Cima, 2015) as well as documented abuse of the review system (Smith, 2006), the role and functions of peer review have come under scrutiny. Considering the disciplinary differences and the varied evaluation customs of research communities, it is not surprising that there is little agreement about the outcomes peer review should provide (Shashok, 2005).

Most stakeholders in the scholarly communication process agree on the gatekeeping function of peer review. The aim of the evaluation is to help editors to take informed decisions on what what is relevant to a field of study and should be disseminated. However, there is ongoing debate on other functions of peer review, such as legitimizing or improving science and scientific writing. It is wise to separate the reviewing practices, which evaluate the scientific content, from the editing practices, which focus on the use of language. (Shashok, 2005)

The latter function of review has become a pressing question as scientific publishing is becoming a global process, and manuscripts are received from all over the world displaying variety in language quality. Manuscripts written in poor language with spelling and grammar mistakes can frustrate the reviewer's work. However, there seems to be a common understanding among reviewers that proofreading and editing is not the primary function of the review process, and it falls under the editor's responsibility to make decision on the writing based on its language use (Academia Stack

Exchange, 2013). "Grammar is important, and errors can be pointed out; however, the main concern for the reviewer is relevancy of manuscript content." (Mayden, 2012)

A more complex question is posed by the legitimizing function of peer review. Checking validity and reproducibility of the findings is not possible without access to underlying data. Opinions greatly vary on what should be the outcome of the review process. According to publishers peer review is not designed to detect irresponsible practices, detect fraud, find plagiarism, or spot ethics and statistical problems (Oransky, 2015). This standpoint is shared by some researchers and practicing reviewers as well. There seem to be an agreement that misconducts in the form of plagiarism or duplication of figures fall into the publisher's responsibility, while reviewers should check for errors within the paper in tables, figures and methods (Neuroskeptic, 2016).

The underlying moving force in the review process is trust. Data are usually taken at face value without assuming fault play from the author's part. The traditional review process is set up to judge that the results are solid and based on data not to evaluate whether the data are fraudulent or not. The increasing number of documented retractions poses the question whether there are enough cases of fraud to justify checking the reproducibility of data (Neuroskeptic, 2016). The open post-publication peer review seems to provide one solution to this problem. A continual scrutiny of results and data is ensured by an extended access to the materials increasing the possibility that scientific mistakes get corrected (Oransky, 2015).

Thus, there are some conflicting forces driving discourse on peer review: on the one hand there is a growing demand for speeding up the review process. On the other hand there is an urgency to decrease fraud. Transparency and open peer review methods might offer solutions for these contradictory demands. Publishers and publishing platforms with alternative review methods offer relatively fast publication of results with public or post-publication peer review attached to them, ensuring open, continued and wide access to results, and in increasing cases to data as well. Transparency is further advanced by services, such as SciRev[19] where authors and reviewers can evaluate the review process they have participated in providing useful information and insights for other authors and reviewers; or by initiatives such as the PRO Initiative, which has begun January 1, 2017, where reviewers make open practices a pre-condition for more comprehensive review (Vlasits, 2017).

5.1.2. Changing role of stakeholders

The new emerging review methods and tools reevaluate not only the underlying functions and process of the established review system, but also change the primary roles of all stakeholders involved: authors, reviewers and editors.

In case of publishers and publishing platforms offering pre- and post-publication peer review, **editors** assume the responsibility of the first scan rather than deciding on the value of publishing the results at all. Even editors acknowledge that their efforts within the review process should focus on deciding where a study gets published rather than whether it gets published (Wager, 2006). With the cascading review such process is set in motion since editors in mega-journals direct papers to the appropriate level of journal based on the review reports.

[19] https://scirev.sc/

Editorial work can also be improved with the use of electronic tools. A manuscript tracking system provides information on where delays arise and where resources are being allocated. Such system can also provide feedback on the quality of their decisions in order to see the future development of rejected and accepted papers (Jennings, 2006).

In the changing publishing scene **authors** resume growing responsibility in the process. Besides the manuscript revisions dictated by reviewers and editors, authors are increasingly urged to take on the obligation of finding and suggesting reviewers, cooperating with editors and reviewers to enhance the quality of the manuscript, and providing revisions based on community comments.

Reviewers are also urged to take a more proactive role to advance change in the review system. One way to enhance the process is to make communication stronger between participants. As the reviewer-author relationship is at the heart of the review process, more effective outcomes can be achieved if a direct contact is established with the author for clarification or to resolve incompleteness (Morey, 2016). Such constructive engagement, as Morey calls it, can speed up the process and shed light onto related data or other additional information.

The PRO initiative goes one step further and gives the power to the reviewers to drive this change by requesting access to the underlying data in order to do an adequate review. The organizers urge reviewers to demand access to data from editors or directly from the authors, if this is permitted, in order "to increase the quality of the published research by creating an expectation of open research practices."

Furthermore review services such as ***Publons*** or ***PeerJ*** allow reviewers to keep track of their review activities and get recognition for them by collecting review credits. Thanks to these services, reviewers should get knowledgeable about what they are actually allowed to do with the review reports. As open access of review reports is increasingly becoming an accepted option in peer review, it is in the best interest of the reviewer to clarify the rights concerning the report with the publishers. There are proactive instances of transforming the review process. Examples provided by editors (Naik, 2017) and reviewers (Vlasits, 2017), who take up their conviction of open data, open identity and open report publicly, demonstrate that openness contributes to the improvement of this scholarly process.
The involvement of **peers** is changing within the new emerging publishing scene. The "peer" in peer review is actually obtaining a wider definition within the alternative review processes. For instance, pre- and post-publication reviews require a wider community involvement. The manuscripts are posted for public evaluation with free access to anybody or for review of a given scientific community with access through registration or invitation. In both cases the concept of "peer" actually assumes more of the original understanding of being evaluated by fellow researchers, and not necessarily by a few selected experts of the field.

5.2. Mentoring peer review

Peer review is a demanding task: the reviewer checks the soundness of the results, pays attention to mistakes in figures, tables, reasoning, and gives constructive feedback to improve the quality of the article. Despite the manifold tasks involved in peer review, the majority of the reviewers learn how to do reviews on the job. Researchers on both sides of the review process talked about the difficulties they face in either giving or receiving feedback. Some even find the process stressful and troublesome (Stevenson 2015). In order to better prepare young scholars for this academic procedure information

should be provided on the publishing cycle, decoding peer-review language, standard of etiquette, and on models of reviewing in general. According to the Taylor and Francis 2016 survey on peer review, 64% of authors in HSS and 63% in Scientific, Technical and Medical (STM) who are yet to review a paper would like formal training.
One of the primary objectives of editors is to recruit and retain good reviewers. Since they know firsthand what qualifications are needed for a good reviewer, it would seem obvious that they would like to engage in training reviewers. However, survey results refute such claim: 46% of editors in STM wanted to offer formal training or workshops but 44% said they did not want to. In the humanities and social sciences just 38% wanted to offer this option; with 56% saying they would not (Devine, 2016). It seems that the task of educating the young generation of academics about the tricks of the trade is left to practicing reviewers.

An excellent example of a review training initiative is provided by a professor at the University of Berkley, who runs a course on the theory and application of statistical models (Tennant, 2017). In a course students were given the task to statistically analyze pre-existing research to get engaged in ongoing science and reproducible research. Through this exercise the students gained confidence and expertise to critically analyze published research and started thinking about alternative models for scholarly publication, reproducibility of research results, and open science. Furthermore, by registering with ORCID and posting their analyses on GitHub, these young scholars received their first positive experience with collaborative open review.

5.3. Increasing motivation for peer review

Currently review is a voluntary academic activity. Researchers take up review tasks above their regular work. At the same time, journal editors select peer reviewers for their knowledge of a particular discipline and for being experts in their field. The journals rely on the researchers to accomplish quality review work in time, while researchers, through their review work, are associated with prestigious journals. The latter is considered an academic accomplishment (Kulkari, 2016).

However, due to the continuously growing number of publications in the global scientific environment the increasing work overload of expert reviewers interferes with keeping deadlines. At the same time editors are coming under increased tension to engage time-pressured researchers in the review process. Publishers often find it difficult to recruit motivated reviewers (Björk, 2016). The current situation in publishing definitely leads to the erosion of referee incentive (Aarssen, 2010). Furthermore, with the advance of multidisciplinary research, it is difficult to find reviewers with the right skills and expertise needed to assess particular projects and research results (House of Comm. 20). In lack of qualified reviewers editors often take chances with unknown and/or unsuitable reviewers, which may lead to the rise of article retractions and cases of peer review fraud (Johnston, 2015).
A solution would be to engage young scholars in the review process. Journal editors usually build a pool of trusted reviewers, but are reluctant to look for reviewers outside this pool and expand it with early-career scholars. According to the Taylor & Francis report (2016) authors between the age group of 20-29 believed that becoming peer reviewers would enhance their reputation and advance their career. This indicates that most researchers, particularly early career researchers, regard peer review as very rewarding and as a way of gaining global recognition (Kulkarni, 2016). Although young researchers do not necessarily have the expert knowledge of a given field that editors seek, with appropriate training their enthusiasm can be channeled to successful review work.

The primary motivating forces of the voluntary review work are (1) being a part of the research community, (2) having advanced access to the latest research, and (3) contributing to the pool of knowledge in a given field. These intrinsic motivational forces are not always able to overwrite the work overload of researchers. In this context appropriate incentives (a form of reward) can be set to increase motivation. Incentives can change motivation and also result in real behavioural change (Crotty, 2015).

Besides the intrinsic motivational forces, extrinsic motivational tools can be implemented to incentivize participation in the review process. One form is monetary compensation. Independent review services (Rubrique) charge for their services, which covers partially the fees paid to the reviewers themselves. A London-based publisher, Veruscript is also introducing a monetary reward system for reviewers: reviewers will be entitled to a slice of a paper's article processing charge (APC) and have three options. They can take a cash reward; save up credits to put towards their own publishing costs in the future; or donate these credits to help researchers who want to publish but cannot afford APCs (Matthews, 2016). Opinions vary on measuring review work on financial basis since it has the tendency of cancelling out the intrinsic, non-financial incentives for providing quality work.

Other rewarding methods include a credit system (Publons) where peer reviewers receive merits for various levels of reviewing activities. This serves both as a reward and a motivation for participating in the review process: one merit for completing a review, one more credit for being verified by an editor, one more credit if the full content of the review is published, and additional credits for giving or receiving endorsement to/from other reviewers. One major advantage of this system is that it makes review activity visible. It also enhances the transparency of the review process by urging reviewers to make their reports open access.

One step further on the motivation scale is integrating review work in the academic career system. It is very important for reviewers to receive credit for their work, so counting review work in the academic advancement system or making it a requirement in the hiring process would definitely mean acknowledgement for all voluntary scholarly contributions. However, caution should be applied for making review work "mandatory." In academia raising funds and applying for research grants has become another major aspect of the research process. Concerns have been voiced about the prioritization of the manifold tasks researcher must carry out. Some university administrations have explicitly discouraged faculty from spending their time writing peer-reviews rather than grant applications (Engler, 2010). From another perspective, if much of the academic advancement decision (at least in the sciences) is based on how much funding a researcher can bring in, "then if peer review doesn't bring in funding, it won't matter all that much" (Crotty, 2015). To counterbalance this tendency peer review should be acknowledged as academic work, should be made visible and integrated more into scholarly work plans.

6. Conclusion: potential of OPR and direction of further investigation

The alternative review tools, services and approaches discussed above offer various methods for review (e.g. open review, pre-publication or post-publication review, collaborative or decoupled review, and different degrees of openness in identity, participation and interaction among stakeholders). They might differ in their solutions, but they all carry several common features:

(1) they move away from the established publishing and review system by finding solutions to the problematic aspects of the traditional single/double blind review process (i.e. lack of transparency, potential bias, quality of review, etc.),
(2) the review process becomes more transparent either by opening up certain aspects of the process, or by providing detailed review policies,
(3) they urge a more conscious, collaborative participation by stakeholders, either through invitation and dialogue within small circles between authors, editors and reviewers, or through crowdsourcing the process and allowing the public to add comments and reviews.

These tools and services described on the basis of the seven attributes of open peer review (defined above by OpenAIRE) identify the main issues where intervention is needed in the traditional review system. The solutions they offer invigorate conversation among researchers about the functionalities of review as well as their role and responsibilities in the process. Such dialogue, which is continuously reshaped by the exchange of ideas, new perspectives (open science approach) and tools (e.g. ORCID review tracking functionality) and emerging frameworks (e.g. pre-registration of research, uploading preprints for grant application), promises a more scholar-centric approach. The peer review discourse is also advanced by a more proactive stance of the stakeholders involved. Initiatives, such as the Open Science Peer Review Oath by F1000 Research (Aleksic, 2014) or the Peer Reviewers' Openness Initiative (Morey, 2016), urge reviewers to define the terms of review and ensure that reviewed scientific results are open and reproducible, which consequently lends transparency to the peer review process and increases its impact and outreach.

As formal and informal knowledge sharing forums gain increasing significance within academic communities and their research activities, it is important to examine and discuss these alternatives to move towards a more structured and moderated dialogue about the underlying issues of research dissemination and evaluation. The alternative peer review methods discussed above contribute to a more democratic, transparent and community-based knowledge discovery and dissemination.

The OpenUp survey results show that researchers seem to be reluctant to fully embrace openness in the review process, but definitely see advantages of a transparent, collaborative review process. In order to make researchers less vulnerable to share their work and make their research open for comments, these alternative tools and services would benefit from further standardization and integration into the research cycle (Tattersall, 2016). However, the formal acknowledgement of the viability and validity of these alternatives, such as independent review services or review solutions for repositories and preprint servers, presupposes discussion on their sustainability, long-term availability, and their uptake by the researchers. These and other practical challenges need to be considered when stepping up awareness and education efforts.

Fiona Godlee (2002) cited four main reasons in support of open peer review: (1) ethical superiority – open peer review makes the reviewer and the editor more accountable for the peer review process,

(2) lack of adverse effects, (3) feasibility, and (4) recognition for peer review work. More than a decade later these benefits still seem as valid basis for the increasing presence of review alternatives. Our survey results support this view since researchers consider transparency and the recognition, alternative review services and methods offer, valuable aspects of the changing scholarly review discourse. The latest report on the future of peer review (SpotOn Report, 2017) list similar steps researchers are encouraged to take in order to successfully tackle the current problems of the scholarly publishing system. Steps, such as finding new ways of identifying, verifying and inviting peer reviewers, encouraging more diversity in the reviewer pool (including early career researchers, researchers from different regions, and women), introducing training programmes for reviewers or Identifying ways to recognize reviewers' work, clearly define the direction of developments.
Within OpenUp we are working to investigate these directions and provide support for the transformation of the review system through case studies and policy recommendations. OpenUP will set up a range of pilot studies, which offer opportunities for further exploration and evaluation. Through the engagement with research communities best practices, most fitting methodologies and settings can be identified in different research areas (arts & humanities, social sciences, energy, life sciences). The concrete results from these experiments and pilot studies will provide insights into transforming research practices as well as challenges that need further investigation.

Our ultimate goal is to broaden the discourse and ultimately accelerate the uptake of open science solutions in the scholarly communication practices across all research disciplines.

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