Background/Challenge Paper No. 2

How to use Altmetrics in the context of Open Science

May 2017

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1 Introduction

This Background/Challenge Paper on **How to use altmetrics in the context of Open Science** has been developed to help Mutual Learning Exercise (MLE) participants prepare for the 2nd Working Meeting in Helsinki on 30th of May 2017. The Modus Operandi of the MLE states the goal for this second topic as following: "Identify and discuss practical examples / best practices of how altmetrics is being used for evaluating research and rewarding researchers for engagement with Open Science. The aim is to review/assess the current reputation system and adapt researcher career reward systems to take engagement with Open Science practices into account." This 2nd Challenge/Background Paper will thus 1) present how altmetrics are being used for evaluating research and/or as part of the academic reward system (if such cases can be identified among the member states), and 2) give recommendations on how altmetrics could be used for evaluating research and/or as part of the academic reward system.

This 2nd Challenge/Background Paper starts by giving a brief overview of open science and of the academic reward system in general, moving then deeper into the connection between altmetrics and open science, followed by (possible) practical examples of how altmetrics are currently being used for research assessment and as part of the academic reward system in the member states (MS), and recommendations for how altmetrics could be used for these purposes. This document is based on a review of relevant background literature, discussions at the first Working Meeting in Brussels on 7th April 2017 and on the answers to open ended questions sent to the participants of the MLE. After the 2nd Working Meeting a Report on How to use altmetrics in the context of Open Science will be produced and it will be one of the main Deliverables of this MLE.

2 Background

2.1 Open Science

The most cited definition of open science probably comes from Nielsen (2011), who defined it as "the idea that scientific knowledge of all kinds should be openly shared as early as is practical in the discovery process." Opening up the research process and the outcomes can potentially have many benefits. According to Friesike and Schildhauer (2015) open science aims at "increasing research quality, boosting collaboration, speeding up the research process, making the assessment of research more transparent, promoting public access to scientific results, as well as introducing more people to academic research". However, while open science has been fostered and welcomed in some fields, the move towards it has been slow among research institutions and researchers in most disciplines.

Science and research can be made open in different ways. Friesike and Schildhauer (2015) summarize earlier research about open science and list five different forms or aspects of open science by interpreting the meaning of "open". First of all, open means **increased transparency** of the research process, as in opening the research data and methods for reuse and thus ensuring reproducibility of research. Second, open means **collaborative**, as in making the research process public and allowing for others to join and contribute to the research. Third, open means a **broader understanding of impact**, reflecting the "need to update standards in order to better incentivize researchers to produce quality work instead of quantity of research papers." Friesike and Schildhauer (2015) suggest that a wider range of quantitative indicators of a wider range of impact

can be incentivizing for researchers to make their research more accessible, adopting the open science ideology. Fourth form is the understanding of open as **open to the public**, thus including non-academic writing style and including the public in the research process through citizen science. Fifth form of open science is the understanding of open as **accessible to anyone**, referring to open access to research publications.

Open science means

- increased **transparency** of the research process
- increased **collaboration** that makes the research process public
- broader understanding of **impact**, that may lead to new forms of incentives
- open to the **public** by writing in non-academic writing styles and promoting citizen science
- **accessible** to anyone through open access publications

Fecher and Friesike (2014) review literature on open science research and distinguish five "Open Science Schools of Thought". The first school of thought is called the **public school**, which incorporates ideas of making the research process accessible and making the research results comprehensible to anyone (i.e. writing in a manner that is understood by anyone). The second school is called the **democratic school**, which is concerned with accessibility, i.e. open access publications and open research data. Fecher and Friesike (2014) refer to earlier research and state that open access to research publications has been earlier described as a "human right", "necessity for human development", and as a "catalyst for development." The demand and logic for open access of research publications is often motivated by arguing that research that is funded by tax-payers should also be free of charge for tax-payers. The third school of open science according to Fecher and Friesike (2014) is called the **pragmatic school**, which argues for opening of the research process and allowing for wider collaboration and sharing of information. The fourth school is called the **infrastructure school**, which sees open science as a technological challenge that can be tackled by opening software tools, applications and computing networks to facilitate more open and inclusive science. The fifth school is called the **measurement school**, which is concerned with complementing existing measures of scientific impact with measures developed from new types of data and new indicators that better reflect the modern digital age where printed scientific journals are losing their importance and information is shared more rapidly and more efficiently online than ever before. Open science movement has been slow to win ground among researchers in some disciplines, mainly because the forms or schools of thought of open science and the academic reward system do not meet. While the academic reward system can be defined as "the many ways in which an institution and field regards faculty – including, but not limited to, how it recruits, sustains, assesses, and advances faculty throughout their careers" (O'Meara et al., 2008, p. 161-162), most incentives in the academic system can be traced back to scientific publications, high-impact scientific journals and the attention the publications receive in the form of formal citations from other scientific publications. The criticism against these have, however, intensified in the recent years.

Open Science Schools of Thought

1. Public school: Making the research process accessible and the results comprehensible
2. Democratic school: Open access to scientific publications and data
3. Pragmatic school: Collaboration and sharing of information
4. Infrastructure school: Accessibility to software, applications and computing networks
5. Measurement school: Updating traditional metrics to better fit the modern digital age

2.2 Altmetrics

As scholarly communication is increasingly moving away from the traditional formats of publishing research in specific journals and as citation-based research evaluation is increasingly criticized (e.g., the San Francisco Declaration on Research Assessment, DORA, at http://am.ascb.org/dora/), some alternative or complementary sources of data about research impact or attention are being investigated under the umbrella term *altmetrics*. Although altmetrics does not yet have a widely accepted definition, the idea and potential with altmetrics is that the mentions and other indicators of visibility and awareness (e.g., number of tweets, comments, blog entries, news stories, Wikipedia references, and social bookmarks) a scientific article and other research products receive on the web in general and in social media in particular could tell something about the impact or influence of that research or of the engagement people have had with that research. Shema, Bar-Ilan & Thelwall (2014) try to capture this as they define altmetrics as "web-based metrics for the impact of scholarly material, with an emphasis on social media outlets as sources of data." We know that research has impact far beyond citations, in fact, less than 1% of the article views in the open access journals of the Public Library of Science (PLoS) result later in citations (Lin & Fenner, 2014). Thus most of the impact or influence of research articles is never captured when using citations alone as an indicator. In addition, citations can only tell something about scientific impact of research, as acknowledged by other researchers, while funders and policymakers are increasingly demanding evidence of a wider, societal impact of research (e.g., REF2014 in the UK, http://www.ref.ac.uk/).

Research in general has multiple audiences and research impact and attention received can be identified, collected and measured from a wide range of different sources on the web and in social media. For instance, earlier research suggest that Mendeley, the online reference manager used by many researchers, can reflect scientific impact (Li, Thelwall & Giustini, 2012), while attention on Facebook and Twitter probably comes from a wider audience not limited to researchers alone (Bornmann, 2014). In a similar way, mentions in policy documents could reflect the societal impact of how research is being used in policymaking. By investigating novel data sources, like those mentioned above, for mentions of research products we are able to give a more nuanced understanding of where and how research has had an impact, thus tying back to what Friesike and Schildhauer (2015) describe as the incentivizing function of broader understanding of impact and that Fecher and Friesike (2014) called the measurement school of thought of open science.

3 Academic reward system

The academic reward system is an "ever-present, ongoing system of participation, action, and consequences that influence faculty priorities and careers" (O'Meara, 2011) or simply the actions connected to "the valuing of people's professional lives" (O'Meara, 2002, p. 77). Although faculty

roles span from teaching to supervision and from research to engagement with the public, research activities and especially research outputs in the form of peer reviewed scientific articles (and citations to them) receive the highest regard as the incentives that are most motivating for individual faculty members, i.e. evaluation for promotion and tenure, pay, and recognition in the field (O'Meara, 2011). The academic reward system is, however, a complex system where multiple elements interplay, some of which are connected to demographics of the faculty members or other personal characteristics, while others are connected to the work processes or the outcomes of that work. O'Meara (2011) reviews earlier research and divides the elements of the academic reward system into elements connected to inputs, processes and outcomes. Inputs include for instance individual characteristics (e.g., gender, race, age, background) and experiences, appointment type and associated reward structures, and external influences, such as university rankings and conditions on the academic labor market. Processes include performance and productivity in teaching, research and service, and assessments and reviews of these, among other things. Outcomes include for instance promotion, tenure and contract renewal, pay, recognition by peers, organizational commitments, and opportunities for professional growth. The academic reward system thus contains elements that are beyond the control of an individual researcher and incentives that are the source of motivation for faculty members. In addition to the incentives for the individual researcher to adopt open science, the incentive structures according to Friesike and Schildhauer (2015) include institutional incentives (e.g., institutional blogs, data repositories, archiving services, open access appointees, funding options for open access publishing, and advisors that mentor and orient young researchers towards open science), disciplinary incentives (e.g., disciplinary databases for research data and scientific journals with specific policies for open research data), and systemic incentives (incentives that affect researchers regardless of their institution or discipline, such as requirements for open science in research funding). In addition to the incentives listed by Friesike and Schildhauer (2015) there are also societal incentives (such as influencing policy making, engagement with the public, public demand for open science) that can push open science at all these levels.

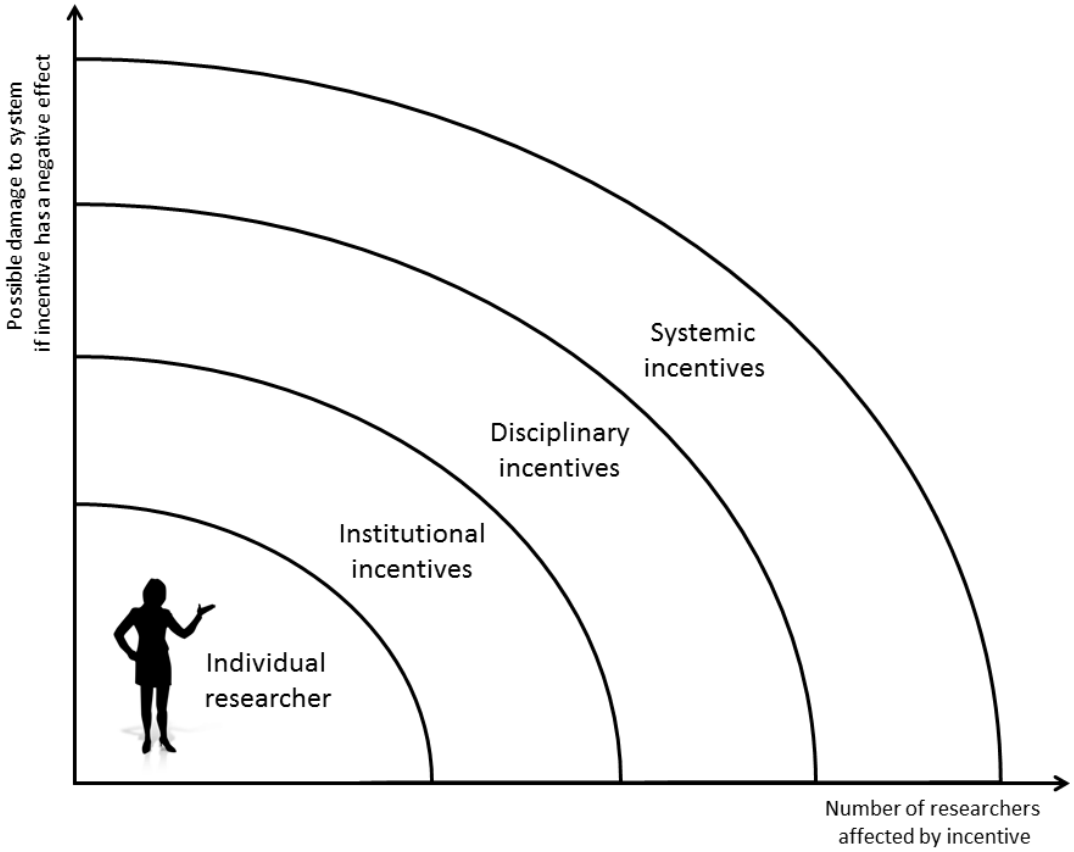

Figure 1. Forms of incentives to promote open science (adapted from Friesike and Schildhauer, 2015)

With ever-increasing competition for promotions, tenure and research funding, researchers are making increasingly strategic decisions about how to best use their time so that it helps them further their careers. Here, however, lies a contradiction between what is best for the individual researcher and what is best for science as a whole. Friesike and Schildhauer (2015) write about the social dilemma of open science: "What is in the best interest of the scientific system is not what incentivizes the individual researcher." With this the authors mean that the individual researcher is mainly incentivized by actions that best help them further their career, i.e. publish scientific articles in specific high-impact journals. It is thus not reasonable to expect that researchers would adopt the principles of open science just to improve the system at the expense of their own career development, unless the incentives to adopt open science strategies will also benefit their career development. Researchers need clear incentives that are in line with both the career ambitions of the individual researcher and that help improve the system (Leonelli et al., 2015; Levin et al., 2016). Open Access Citation Advantage (OACA) could be such a thing.

3.1 Open Access Citation Advantage

There is plenty of evidence[1] that OA articles do receive more citations compared to articles that are not openly available (Lawrence, 2001; Antelman, 2004; Harnad & Brody, 2004; Houghton & Sheehan, 2009; Kousha & Abdoli, 2010). Wang et al. (2015) discovered that open access papers in Nature Communications received more citations compared to other non-open access papers in the

[1] For a bibliography of research about open access citation advantage visit http://sparceurope.org/oaca.

same journal and that the attention the papers received (in the form of downloads) lasted much longer for the open access papers, as the number of downloads quickly fell for non-OA papers after an initial peek. The extent of the open access advantage seems, however, to vary between disciplines (Hajjem et al., 2013).

In some cases it has been argued that the OACA is a result of a self-electing process of the authors to make their best work available online which then because of that results in higher citation counts later. Gargouri et al. (2010) came to the conclusion that the OA advantage is "real, independent and causal, but skewed." The authors conclude that "the OA advantage is greater for the more citable articles, not because of a quality bias from authors self-selecting what to make OA, but because of a quality advantage, from users self-selecting what to use and cite, freed by OA from the constraints of selective accessibility to subscribers only." In other words, OA makes it possible for users to choose the articles that best suit their needs.

We cannot, however, study OACA and other aspects of open access publishing unless we have accurate data about which publications are published as open access and which are not. The data available in the major citation databases is incomplete at best on matters of open access. Some other sources for open access do, however, exist. The Directory of Open Access Journals (DOAJ, https://doaj.org) could be used to check if a specific journal is listed as open access journal. CrossRef (https://www.crossref.org) could be queried to see if the publisher has reported an open license. The Bielefeld Academic Search Engine (BASE, https://www.base-search.net) could be used to search for a green OA version of a specific article. These sources alone are, however, limited in various ways and would not be very useful when for instance analyzing developments in OA publishing at a national level. There are, however, some national efforts to collect metadata about research publications including information about open access publications, which would allow for national analysis. In Sweden metadata about research publications is stored in the SwePub portal (http://swepub.kb.se/), which allows for the metadata (including information about open access publications) to be downloaded for bibliometric analysis. A similar system, called VIRTA, is being developed in Finland to collect information about research publications from Finnish universities and research institutions. VIRTA will allow for open access to the metadata through an API. NORA (Norwegian Open Research Archives) in Norway (http://www.cristin.no/english/open-access-eng/nora/) is a service that brings together data from institutional repositories and national open access journals and makes them searchable. In Denmark the Danish National Research Database (http://www.forskningsdatabasen.dk/en/open_access/overview) uses an Open Access Indicator to monitor how the goals for open access publishing are met. On an international level the European OpenAIRE project (https://www.openaire.eu) and the platform developed in the project aims at collecting publication metadata on a European level and make it easily searchable. National and international databases such as those mentioned above, would allow for analysis of the development of OA and also for development of metrics based on OA.

3.2 Altmetrics in the academic reward system

The idea with altmetrics is closely related to the Open Science movement, partly because altmetrics are mostly derived from openly available mentions (in contrast to the major proprietary citation databases) of scientific articles and to some degree other research products. One of the ideas with altmetrics, and open science, is that open peer review could replace the current standard of double blinded peer review. With an open review process reviewers would get credit for this otherwise

hidden part of their work, while the openness of the process could lead to increased transparency. There are, nevertheless, some potential drawbacks with open peer review, as some reviewers may feel reluctant to give honest negative reviews of known senior researchers' work, thus leading to self-censorship to avoid clashes. In its perhaps most sophisticated way and most futuristic view, open review could still eventually lead to filtering and impact assessments similar to that of current web search engines, where the system simply taps into the existing online communications that form the wisdom of crowds, pointing to more valuable scientific work (Priem, 2011). As the current system of academic publishing still holds ground and forms the backbone of the academic reward system in the form of citations, it may take some time before the current system is replaced. Altmetrics, however, may be our best shot at changing the current system towards a broader understanding of research impact and openness.

The NISO Alternative Assessment Metrics Project (NISO, 2016) set out to 1) specify definitions and terminology connected to altmetrics, and to 2) "identify the main use cases for altmetrics and the stakeholder groups to which they are most relevant…" The project defines altmetrics as "the collection of multiple digital indicators related to scholarly work." These indicators are obtained from various online engagements between diverse set of stakeholders and as diverse set of scholarly outputs. The report also list three main use cases for altmetrics:

1. Showcase achievements: Indicates stakeholder interest in highlighting the positive achievements garnered by one or more scholarly outputs.
2. Research evaluation: Indicates stakeholder interest in assessing the impact or reach of research.
3. Discovery: Indicates stakeholder interest in discovering or increasing the discoverability of scholarly outputs and/or researchers.

The project also lists stakeholders of altmetrics (in no particular order):

- librarians
- research administrators
- members of hiring committee
- members of funding agency
- academics / researchers
- publishers /editors
- media officers / public information officers / journalists
- content platform providers

Finally the report of the NISO Alternative Assessment Metrics Project demand that the altmetric data providers and aggregators commit to 1) transparency by offering information about how and how often the data is generated, collected, aggregated, and how it can be accessed, 2) ensure replicability by documenting any changes in methods to collect and access the data, and 3) maximize accuracy by identifying, correcting and communicating any errors, corrections or changes in data and in access to the data.

On one hand, altmetrics could point researchers to interesting and more valuable research that have received most attention from other researchers and from the general public. With the continuous growth of scientific literature (e.g., Jensen, Saric & Bork, 2006; Larsen & von Ins, 2010; Bornmann &

Mutz, 2015) and an estimated doubling of scientific literature every nine years (Bornmann & Mutz, 2015), it is of increasing importance to develop new filtering mechanisms to help researchers find the most valuable publications for their work. On the other hand, while the open science movement still lacks the incentives for individual researchers to adopt open science, which in turn hinders the rapid assimilation of it, altmetrics could bring some of the lacking incentives by providing novel indicators for attention, visibility and impact. The same mechanisms and indicators could therefore help researchers find most valuable publications and function as an academic reward mechanism. Similarly altmetrics can inform funders, policymakers and other stakeholders of the wider impact of research and give a more nuanced understanding of the impact research has made or the attention it has received.

Another way that altmetrics could incentivize researchers to publish their research in open access journals and to share their research data openly is to showcase these achievements. Impactstory (https://impactstory.org) is an example of an online service where researchers can create professional profiles to not just showcase their publications, but also to showcase specific achievement attached to them as measured with altmetrics. Researchers are granted badges that showcase for instance how much of the work is published in open access journals, how their work has been referenced in Wikipedia, how the code they have written has been used by others, and many others that demonstrate the attention and reuse of their academic work. As online academic social networks (such as ResearchGate) are popular among some researchers, online professional profiles and badges such as those awarded at Impactstory may have some incentivizing function to adopt the open science ideology and to showcase the full set of achievements that one's academic work has achieved.

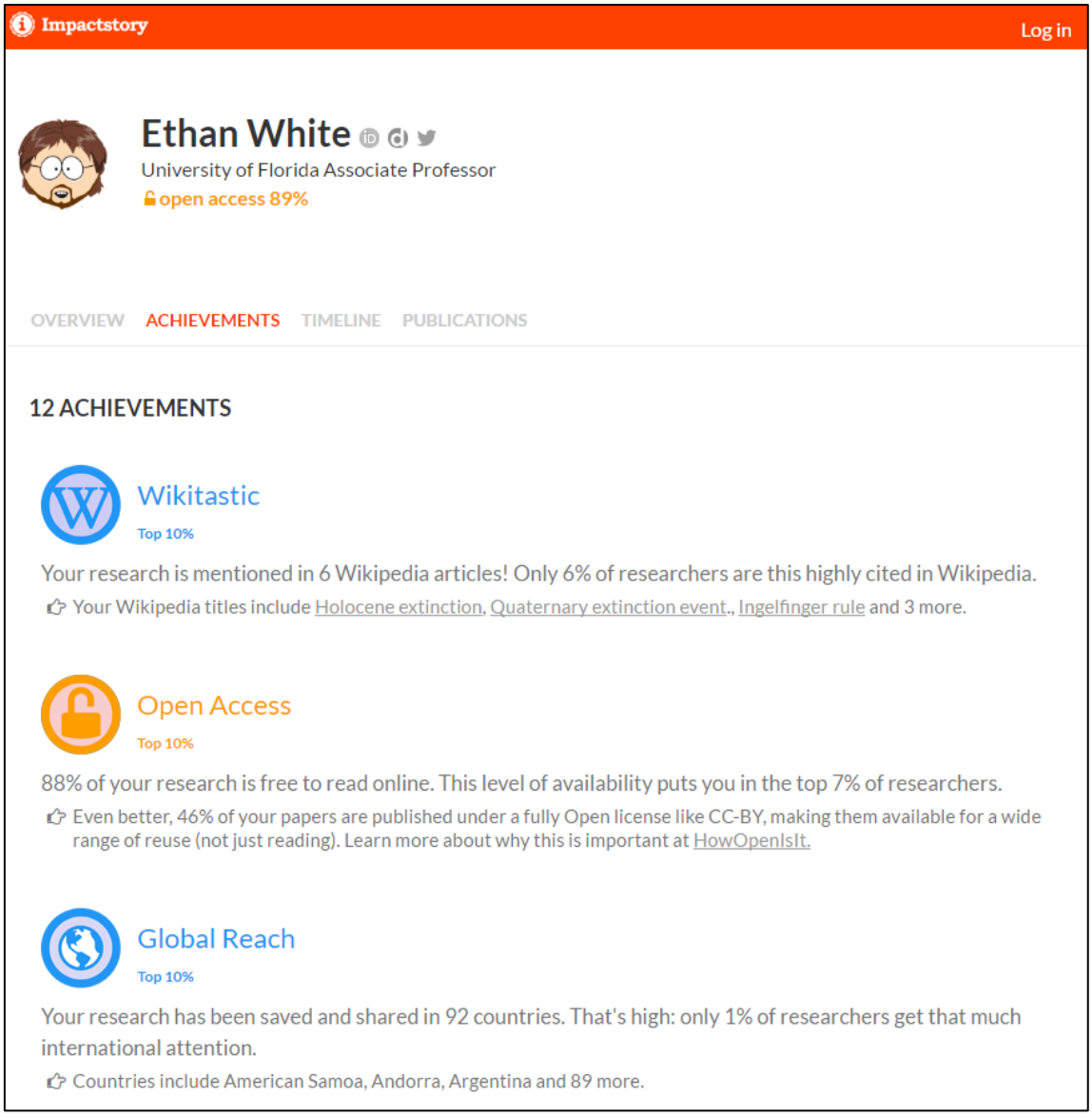

Figure 1. Example profile at Impactstory (https://impactstory.org/u/0000-0001-6728-7745)

3.3 Open Access Altmetrics Advantage

There is indeed evidence that open access publishing and sharing of the articles openly in social media can help researchers and their research to get noticed (e.g., Adie, 2014; Shema et al., 2014; Alhoori et al., 2015; Wang et al., 2015). Wang et al. (2015) found that open access articles in a specific hybrid journal received more social media attention. Alhoori et al. (2015) discovered that open access articles received higher altmetrics than non-open access articles, but that the open access advantage was clearly less significant when the authors took other factors such as journal, publication year and citation counts into account. Shema et al. (2014) discovered that articles that had been mentioned in blogs received more citations. Niyazov et al. (2016) studied articles that had been uploaded to the academic social networking site Academia.edu and compared the citation rates of them with papers published in similar journals but that were not available through Academia.edu. The results showed that articles uploaded to Academia.edu received 37% more citations after one year compared to similar articles that were not openly available online. After five years the advantage had raised to 83% more citations. The authors of this study have, however,

some competing interests, as “Academia.edu paid its employees, contractors and an external consultancy to perform this study” (Niyazov et al., 2016).

Although some studies have shown that early altmetrics are associated with later citations. It is still unclear whether the papers receive more citation later on because they were shared online more or because they were of higher quality and thus received more attention online and later citations. Still, the fact alone that OA articles receive more citations and online attention may be incentivizing for many researchers to publish their work openly online.

Another aspect of altmetrics connecting it closely to open science is the fact that altmetrics in general rely on openly available data about online mentions of research products, such as scientific articles identified by DOIs. Data for altmetrics is often being traced and collected through open APIs of various social media sites, making the data and altmetrics research more easily replicable than when using data from purely proprietary databases. In addition, some altmetrics data aggregators such as Altmetric.com and ImpactStory provide an API access to their data. This kind of openness allows for the development of what could be called *open metrics*, in contrast to metrics that are derived from (citation) data bought from commercial databases.

4 Recommendations for research evaluation and a call for open science

Both citations and publication channels are widely used in research evaluation (e.g., Garfield, 1972; Moed *et al*., 1985; Moed *et al*., 1995) and they are also fundamental parts of the academic reward system (Merton, 1968); highly cited authors are regarded as having made a significant contribution to science and publications in so called high impact journals are considered to be of higher quality because getting a manuscript published in such a journal is thought to be tougher. Thus both citations and journals (to some degree) are considered as proxies of scientific quality. Neither citations nor publication channels can, however, reflect impact that the research may have had on an audience beyond academia or measure the attention other forms of scientific outputs (e.g. datasets, code) or academic work (e.g. teaching, societal engagements) has received. A broader understanding of the impact that research has on society is needed. Both Friesike and Schildhauer (2015) and Fecher and Friesike (2014) describe how the incentivizing function of broader understanding of impact may lead to changes in the academic reward system and to an increased adoption of open science. But crucial is also to use existing metrics responsibly and transparently, something that several earlier reports have pointed out.

4.1 The Leiden Manifesto for research metrics

Research evaluations are increasingly led by data and metrics rather than peer reviews and judgement. The authors of the Leiden Manifesto call this “abuse of research metrics” and offer a list of the best practice for metrics-based research evaluation (Hicks et al., 2015). The ten principles of the Leiden Manifesto are:

1. Quantitative evaluation should support qualitative, expert assessment.
2. Measure performance against the research missions of the institution, group or researcher.
3. Protect excellence in locally relevant research.
4. Keep data collection and analytical processes open, transparent and simple.

5. Allow those evaluated to verify data and analysis.
6. Account for variation by field in publication and citation practices.
7. Base assessment of individual researchers on a qualitative judgement of their portfolio.
8. Avoid misplaced concreteness and false precision.
9. Recognize the systemic effects of assessment and indicators.
10. Scrutinize indicators regularly and update them.

The authors of the Manifesto acknowledge that research metrics can (when used appropriately and correctly) provide valuable information that would be difficult to obtain through peer review which relies on individual knowledge. The authors conclude the Manifesto by stating that "the best decisions are taken by combining robust statistics with sensitivity to the aim and nature of the research that is evaluated." Metrics alone cannot inform decisions, but when high quality data is placed in context and carefully examined against the goals of the research that is being evaluated, quantitative evidence together with qualitative evidence can help in making informed decisions.

4.2 The Metric Tide

The Metric Tide report contains the findings and recommendations of the Independent Review of the Role of Metrics in Research Assessment and Management (Wilsdon et al., 2015). While the report is specifically intended to aid in future Research Excellence Frameworks (REF) in the UK, many of the recommendations apply even in international context. Building on the concept of "responsible research and innovation", the Metric Tide report proposes the notion of **responsible metrics** that include the following dimensions:

1. Robustness: basing metrics on the best possible data in terms of accuracy and scope.
2. Humility: recognizing that quantitative evaluation should support – but not supplant – qualitative expert assessment.
3. Transparency: keeping data collection and analytical processes open and transparent, so that those being evaluated can test and verify the results.
4. Diversity: accounting for variation by field and using a variety of indicators to support diversity across the research system.
5. Reflexivity: recognizing systemic and potential effects of indicators and updating them in response.

With these the Metric Tide report highlights the importance of using the best possible data, combining quantitative and qualitative methods in research assessment, keeping data and methods open, taking diversity of science into account, and to recognize unwanted side-effects in using indicators.

4.3 The Next-generation Metrics: Responsible metrics and evaluation for open science

The report of the European Commission Expert Group on Altmetrics reviews the state of the art of altmetrics and summarizes the results of these into five findings followed by a set of recommendations (Wilsdon et al., 2017). The five headline findings of the report are:

1. An open science system should be grounded in a mix of expert judgement, quantitative and qualitative measures
2. Transparency and accuracy are crucial.

3. Make better use of existing metrics for open science.
4. Next generation metrics should be underpinned by an open, transparent and linked data infrastructure.
5. Measure what matters.

The report reiterates the recommendations from earlier high profile reports on research metrics and highlights the importance of using both quantitative and qualitative methods for research evaluation, the importance of transparency by opening up both the data and the methods used, and to take the complexity and diversity of science as a whole into account by measuring what matters in each specific case. What differs from earlier reports is the recommendation to "make better use of existing metrics for open science". This refers to the use of appropriate metrics to measure the progress of open science specifically, as in usage, collaboration and societal impact.

4.4 San Francisco Declaration on Research Assessment

The San Francisco Declaration on Research Assessment (DORA, http://www.ascb.org/dora) from 2012 is a set of recommended practices in research assessment, with a specific focus on assessing research on its own merits instead of relying on journal-based metrics, such as Journal Impact Factors, in funding and appointment considerations.

While each stakeholder group (funding agencies, institutions, publishers, organizations that supply metrics, researchers) have a set of targeted recommendations, the general recommendation states the following: "Do not use journal-based metrics, such as Journal Impact Factors, as a surrogate measure of the quality of individual research articles, to assess an individual scientist's contributions, or in hiring, promotion, or funding decisions." The declaration has been signed by over 12,000 individuals and almost 1,000 organizations that support the adoption of the given recommendations.

4.5 Amsterdam Call for Action on Open Science

The Amsterdam Call for Action on Open Science is the results of a conference on open science held in Amsterdam in April 2016. The Call formulates two pan-European goals for 2020 and the steps that need to be taken in order to reach the goals. The two overall goals for 2020 are:

1. Full open access for all research publications
2. A fundamentally new approach towards optimal reuse of research data

The two major changes or developments that need to be completed in order to meet these goals are:

1. New assessment, reward and evaluation systems
2. Alignment of policies and exchange of best practices

In line with the DORA declaration, the Amsterdam Call for Action acknowledges the problems with the current methods for research assessment that heavily emphasize quantity of scientific publications and the prestige of journals in which the research has been published (i.e. impact factors). This has severe negative side-effects as researchers make increasingly strategic decisions to meet the criteria with which they are being assessed, which again "inhibits the progress of science and innovation, and the optimal use of knowledge." The Call proposes the following steps as a solution to this problem:

- "Ensure that national and European assessment and evaluation systems encourage open science practices and timely dissemination of all research outputs in all phases of the research life cycle."
- "Create incentives for an open science environment for individual researchers as well as funding agencies and research institutes."
- "Acknowledge the different purposes of evaluation and what 'right' criteria are. Amend national and European assessment and evaluation systems in such a way that the complementary impact of scientific work on science as well as society at large is taken into account."
- "Engage researchers and other key stakeholders, including communications platforms and publishers within the full spectrum of academic disciplines. Set up assessment criteria and practices, enabling researchers to exactly understand how they will be assessed and that open practices will be rewarded."

4.6 Summary of recent recommendations and declarations

The above reviewed recommendations highlight specific aspects of responsible use of metrics in research evaluation:

- metrics should be used to support or complement qualitative expert assessment
- research assessments should take goals and missions of the evaluated entities and variation by field into account
- research assessments should be based on best available data and keep both data collection and analytical processes open and transparent
- indicators and methods should be scrutinized regularly to recognize systemic effects or false precision and they should be updated accordingly in response

Responsible and transparent use of research metrics is crucial, but that alone does not necessarily foster wider adoption of open science. According to the Next-generation Metrics report research metrics can have two roles in supporting of open science; 1) "monitoring the development of the scientific system towards openness at all levels", and 2) "measuring performance in order to reward improved ways of working at group and individual level." In addition to these, the reviewed recommendations and calls above show a clear desire to update the current research metrics so that they can better reflect a broader understanding of the impact research has had and to create incentives for adopting open science at all levels.

These aspects, together with the possible incentivizing functions of altmetrics, will be discussed during the 2nd Working Meeting in Helsinki. The outcomes of these discussions will be included in this report after the meeting.

5 MLE Topic 2: How to use altmetrics in the context of Open Science

The goal with the current topic is to 1) present how altmetrics are being used (if at all) for evaluating research and/or as part of the academic reward system, and 2) give recommendations on how altmetrics could be used for evaluating research and/or as part of the academic reward system.

5.1 Key points from the questionnaire

To map if and how altmetrics are being used by the MS for research evaluation and/or as part of the academic reward system a questionnaire was sent to the participants. The following is a summary of the respondents' answers to the questionnaire.

How is research being evaluated at governmental level in your country?

There are great differences in how research is being evaluated at governmental level among the member states (MS) and in some cases even inside a single MS. In many MS there are clear regulatory or legislative instruments in place that dictate procedures for research evaluation. In many cases the evaluations are performance-based, using mainly quantitative assessment of scientific publications and other research and teaching activities (such as collaboration with the industry and business sector, amount of competitive external funding, number of students and degrees awarded) and impact statistics as indicators of performance, international peer reviews are used too. For instance, In Austria the statutory foundations that are provided by a series of laws stipulate how to include the purpose, objectives, and procedures, as well as deadlines for evaluating the achievement of the funding objectives, and how the appropriate indicators must be defined. This statutory basis in Austria is used by nearly all research and technology programmes as they evaluate their programme planning (ex-ante evaluations), programme implementation (monitoring and interim evaluations) and programme conclusion (ex-post evaluation).

Relevant documents related to this question [please add relevant links for the final report]:

- Slovenia: http://www.mizs.gov.si/fileadmin/mizs.gov.si/pageuploads/Znanost/doc/Strategije/01.06._RISSdz_ENG.pdf
- Moldova: http://www.cnaa.md/en/
- Austria: http://www.fteval.at
- Switzerland: https://www.ressortforschung.admin.ch/html/index_de.html
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How is research being evaluated by the main research funders in your country?

In the research evaluations of research project proposals submitted to the main research funders in the member states external reviewers either in the form of international expert panels or individual reviewers are used by as good as all of the MS. The evaluation procedure is thus a more qualitative evaluation of the scientific quality of the proposal and of the merits of the researcher(s) submitting the proposal. In the evaluation of the scientific merits of the researchers publication lists and sometimes also impact factors are used. Depending on the proposed project other aspects such as cooperation with industry or potential for innovations may also be assessed.

Relevant documents related to this question [please add relevant links for the final report]:

- Slovenia: http://www.arrs.gov.si/en/progproj/
- Switzerland: http://www.snf.ch/en/theSNSF/evaluation-procedures/project-funding/
- Moldova: http://www.acd.asm.md/en

- Croatia: http://www.hrzz.hr/default.aspx?id=48
- Lithuania: http://www.lmt.lt/download/7073/2%20description%20of%20the%20procedure%20for%20the%20expert%20evaluation%202016-07-04.pdf
- Austria: https://www.fwf.ac.at/en/research-funding/decision-making-procedure/decision-making-procedure/
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Have any of the following recommendations been officially adopted in research evaluation in your country (either by the government or by the main research funders)? Are you officially committed to follow any of the recommendations?

Three member states have officially committed to the Amsterdam Call for Action on Open Science, one of the member states has officially committed to the Leiden Manifesto and one member state has officially committed to the San Francisco Declaration on Research Assessment (Table 1). None of the member states have made any official commitment to follow the principles or recommendations stated in the Metric Tide report, the Next-generation Metrics report, or the NISO Alternative Assessment Metrics Project report.

Table 1. Commitments from the member states to selected recommendations for use of research metrics [please add relevant data]

	Amsterdam Call for Action on Open Science	Leiden Manifesto	San Francisco Declaration on Research Assessment	Metric Tide report	Next-generation Metrics report
Austria	X[2]		X		
Armenia					
Belgium	X[3]	X			
Bulgaria					
Croatia					
France					
Latvia					
Lithuania[4]					
Moldova	X				
Portugal					
Slovenia[5]					
Spain					
Sweden					
Switzerland					

[2] The Austrian Science Fund (FWF) has officially adopted the San Francisco Declaration on Research Assessment

[3] The Amsterdam Call for Action has officially been signed by Belgium but its implementation has been postponed for further evaluation.

[4] The listed documents are not officially adopted. In Lithuania the main outline for the policy concerning Open Access is set up in Article 51 of the Law on Higher Education and Research according to which "the results of all research works carried out in state higher education and research institutions must be communicated to the public (in the Internet or in any other way), to the extent this kind of communication is in compliance with the legal acts regulating the protection of intellectual property, commercial or State secrets." The Resolution regarding the approval of The Guidelines on Open Access to Scientific Publications and Data adopted by Research Council of Lithuania have political provisions like "The Research Council of Lithuania supports the policy of the European Union regarding Open Access to the results of research supported by public funds, and the possibilities for the user to access such results not impeded by any financial, organisational, legal or technical barriers."

[5] National strategy of open access to scientific publications and research data in Slovenia 2015-2020 (adopted by the Government of the Republic of Slovenia in September 2015) determines that evaluation of science should encourage open access to scientific information (Chapter 4.6: "The evaluation of researchers, research organisations, research programmes and projects should encourage open accessibility of scientific information in the form of publications and research data. The criteria for the evaluation of science should also include relevant new methods for the evaluation of science.") In the draft action plan for the implementation of the strategy (to be adopted by the Government), provisions are listed for the establishment of a system for the evaluation of research data and for the analysis of science evaluation at academic institutions and at research institutes which should also contain the suggestions for changes according to the principles of open science.

If you have officially adopted or committed to follow any of the above recommendations, please describe how the recommendations have been adopted or how you're committed to follow them.

The Leiden Manifesto for instance, had been mentioned "as a good source of inspiration for the future development and potential use of performance indicators." While some of the member states had not heard about some of the given reports, others had rather clear implementation of open access/science principles at a legislative level.

"National strategy of open access to scientific publications and research data in Slovenia 2015-2020 (adopted by the Government of the Republic of Slovenia in September 2015) determines that evaluation of science should encourage open access to scientific information, as stated in chapter 4.6: "The evaluation of researchers, research organisations, research programmes and projects should encourage open accessibility of scientific information in the form of publications and research data. The criteria for the evaluation of science should also include relevant new methods for the evaluation of science.""

"In Lithuania the main outline for the policy concerning the Open Access is set up in the Article 51 of the Law on Higher Education and Research according which "the results of all research works carried out in state higher education and research institutions must be communicated to the public (in the Internet or in any other way), to the extent this kind of communication is in compliance with the legal acts regulating the protection of intellectual property, commercial or State secrets." The Resolution regarding the approval of The Guidelines on Open Access to Scientific Publications and Data adopted by Research Council of Lithuania have political provisions like "The Research Council of Lithuania supports the policy of the European Union regarding Open Access to the results of research supported by public funds, and the possibilities for the user to access such results not impeded by any financial, organisational, legal or technical barriers." (http://www.lmt.lt/lt/nuorodos/atvirosios_prieigos_dokumentai.html). "

Do you have any good or bad experiences about how to avoid the perverse incentives that all quantitative metrics risk to introduce? Please describe.

"The use of JIF is of course a hinder for the development of open access/open science. The use of citations/bibliometrics on article level is not a hinder for open access/open science and can be quite useful, for instance when looking at how researchers cooperate."

"To allow evaluators to base/complement their assessment on a diversity of performance indicators, most OA Green repositories have made the choice to make a broad set of metrics and altmetrics available through the repository."

"… leaves some freedom to the researcher to mention metrics they find interesting/advantageous to mention in their applications."

"Quantitative metrics are used in the context of informed peer review, even though there are also differences according to disciplines. Connecting indicators with peer review reduces some unintended and perverse effects to a certain degree. However, when it comes to promoting of

young researchers in some disciplines, H-Index and JIP still play a major role. There are intents to avoid perverse effects by requiring a limited list of publications in applications for faculty positions."

"At this point we have no experience with any other form of metrics other than quantitative metrics."

"It cannot be ruled out that external reviewers apply metrics in evaluating a person or proposal."

"We consider it important to not simply rely on a single measure but apply various indicators. This allows for a more nuanced picture and may help mitigating the shortcomings of individual metrics."

Please share your thoughts on what could be done to break away from the culture of "publish (and be cited) or perish"?

"The Leiden Manifesto is a very good and applicable starting point. When discussing this issue, we stress the point of using goal oriented indicators. It should be explained why a certain set of indicators is used to evaluate what kind of research practice. Indicators should always be used in a mix and the strengths and weaknesses of each indicator be reflected upon. This means that published and cited publications have to be part of research evaluation but cannot be the only one. There has to be an interdisciplinary awareness about the biases inevitable with evaluation based on publications alone. We are currently working on a shift in the assessment of researchers, away from long publication lists towards a selection of a maximum of five publications most relevant to the application."

"Abolish or at least complete the IF with other indicators among which peer review should dominate. Replace journal impact by article impact. Diminish journal power by creating OA repositories and collaborative institutional OA publishing platforms."

"Unfortunately, in our country, this is a high grade of honour to be cited and published in international journals."

"Impact may be measured in many different ways; impact on society for instance is a different aspect on research, compared to the use of citations. The organisations funding research and HEI:s are in the position of making a change in their reward-systems but also of course the governments of the MS."

"Base the assessment on the research outputs (and not only the papers) that the researchers finds the most important, and not on the quantity of items in the bibliography. Where relevant, take into consideration the engagement of the researcher in teaching activities and in "3rd mission" activities, and consider his/her realizations in a holistic perspective. Use bibliometrics as complement of the qualitative assessment of research. That being said, being productive is not a bad thing per se: for some researchers this is their best way to produce and disseminate research outputs. But we should recognize that there are different ways to disseminate research, according to the individual preferences of authors, disciplinary specificities, level of cocreation with external stakeholders, etc."

"Assess research by quality and not by quantity - CV of young scholars should be assessed based on different kind of scholarly work - Address also the societal impact of research - Alternative type of

publications should be developed and supported - Avoid using only quantitative indicators for funding decision. If using indicators, do use a broad set of them."

"Frequent publishing is one of the few methods at scholars' disposal to demonstrate academic talent. Successful publications bring attention to scholars and their institutions, which can facilitate continued funding and an individual's progress through a chosen field. The rewards for exceptional teaching rarely match the rewards for exceptional research, which encourages faculty to favour the latter. In popular academic perception, scholars who publish infrequently, or who focus on activities that do not result in publications, such as instructing undergraduates, may lose ground in competition for available tenure-track positions. On the other hand, it can also been argued that the quality of scientific work has suffered due to publication pressures. Further, the value of published work is often determined by the prestige of the academic journal it is published in. Journals can be measured by their impact factor (IF), which is the average number of citations to articles published in a particular journal. In my opinion, this is a closed circle that can be broken once the criteria for evaluating research that actually incentivise the publish or perish principle are changed."

"Publish or perish has been the rule for a very long time. The scientific system is partially based on this rule. To change this habit and build on new experiences with a new system will require time."

6 Preparation for the 2nd Working Meeting

Based on the aims of this second topic of the MLE and the responses to the questionnaire some specific objectives have been placed for the 2nd Working Meeting.

6.1 Objectives

The objectives for the 2nd Working Meeting include:

- discuss how altmetrics could contribute to the academic reward system
- discuss how altmetrics could promote wider adoption of open science

To support these aims some specific questions have been formulated below.

In order to finalize the report on this second topic, additionally two matters need to be addressed:

- complement table 1 above with possibly missing data
- include any missing relevant resources to the listings in 5.1 above

6.1.1 Specific questions to consider

Specific topics and questions that will be presented and discussed during the 2nd Working Meeting:

- What kind of open science behaviors are there (in general and specifically in the member states)?
- Is the development of the scientific system towards openness being monitored in the member states?
- Is there a consensus on what is wrong with the academic reward system?
- What needs to be done to improve/correct it? How could altmetrics contribute towards this change?

- What steps towards a wider adoption of open science needs to be taken in the member states? How could altmetrics contribute towards this goal?
- Are there any pitfalls of altmetrics (e.g. same game, new measures), that need to be considered?

7 Conclusions

[To be completed after the second working meeting in Helsinki]

8 References

Adie, Euan (2014): Attention! A study of open access vs non-open access articles. *figshare*. Retrieved on May 23, 2017, from http://dx.doi.org/10.6084/m9.figshare.1213690

Alhoori, H., Choudhury, S., Kanan, T., Fox, E., Furuta, R., & Giles, L.C. (2015). On the relationship between open access and altmetrics. In: *Proceedings of the iConference 2015*. Retrieved on May 8, 2017, from http://hdl.handle.net/2142/73451.

Antelman, K. (2004). Do Open-Access Articles Have a Greater Research Impact? *College & Research Libraries*, 65(5): 372–382. doi:10.5860/crl.65.5.372

Bornmann, L. (2014). Validity of altmetrics data for measuring societal impact: a study using data from Altmetric and F1000 Prime. *Journal of Informetrics*, 8(4): 935-950. doi:10.1016/j.joi.2014.09.007

Bornmann, L. & Mutz, R. (2015). Growth rates of modern science: a bibliometric analysis based on the number of publications and cited references. *Journal of the Association for Information Science and Technology*, 66(1): 2215-2222. doi:10.1002/asi.23329

Fecher, B. & Friesike, S. (2014). Open Science: One term, five schools of thought. In: Bartling, S. & Friesike, S. (Eds.). *Opening Science: The evolving guide on how the Internet is changing research, collaboration and scholarly publishing*. Springer, Heidelberg, p. 17-47.

Friesike, S. & Schildhauer, T. (2015). Open science: many good resolutions, very few incentives, yet. In: Welpe, I.M., Wollersheim, J., Ringelhan, S. & Osterloh, M. (Eds.). *Incentives and Performance. Governance of Research Organizations*. Springer.

Jensen, L.J., Saric, J. & Bork, P. (2006). Literature mining for the biologist: from information retrieval to biological discovery. *Nature Reviews Genetics*, 7: 119-129. doi:10.1038/nrg1768

Garfield, E. (1972). Citation analysis as a tool in journal evaluation. *Science*, 178(4060): 471–479.

Gargouri, Y., Hajjem, C., Larivière, V., Gingras, Y., Carr, L., Brody, T., & Harnad, S. (2010). Self-Selected or Mandated, Open Access Increases Citation Impact for Higher Quality Research. *PLoS ONE*, 5(10), e13636. doi:10.1371/journal.pone.0013636

Hajjem, C., Harnad, S., & Gingras, Y. (2005). Ten-Year Cross-Disciplinary Comparison of the Growth of Open Access and How it Increases Research Citation Impact. *IEEE Data Engineering Bulletin*, 28(4): 39–47. Retrieved from http://eprints.ecs.soton.ac.uk/11688/

Harnad, S., & Brody, T. (2004). Comparing the Impact of Open Access vs. Non OA Articles in the Same Journals. *D-Lib Magazine*, 10(6). Retrieved on May 23, 2017, from http://www.dlib.org/dlib/june04/harnad/06harnad.html.

Hicks, D., Wouters, P., Waltman, L., de Rijcke, S., & Rafols, I. (2015). Bibliometrics: The Leiden Manifesto for research metrics. *Nature*, 520(7548). Retrieved on May 23, 2017, from http://www.nature.com/news/bibliometrics-the-leiden-manifesto-for-research-metrics-1.17351

Houghton, J. & Sheehan, P. (2009). Estimating the potential imapcts of open access to research findings. *Economic Analysis & Policy*, 39 (1), March 2009.

Kousha, K., & Abdoli, M. (2010). The citation impact of Open Access agricultural research: A comparison between OA and non-OA publications. *Online Information Review*, 34(5): 772–785. doi:10.1108/14684521011084618

Lawrence, S. (2001). Online Or Invisible? *Nature*, 411(6837), 521. Retrieved on May 23, 2017, from http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.28.7519.

Larsen, P.O. & von Ins, M. (2010). The rate of growth in scientific publication and the decline in coverage provided by Science Citation Index. *Scientometrics*, 84 (3): 575-603. doi:10.1007/s11192-010-0202-z

Leonelli, S., Spichtinger, D. and Prainsack, B. (2015) Sticks AND Carrots: Incentives for a Meaningful Implementation of Open Science Guidelines. *Geo*, 2: 12–16. doi:10.1002/geo2.2

Levin, N., Leonelli, S., Weckowska, D., Castle, D., and Dupré, J. (2016) How Do Scientists Understand Openness? Exploring the Relationship between Open Science Policies and Research Practice. *Bulletin for Science and Technology Studies* 36(2): 128-141. http://dx.doi.org/10.1177/0270467616668760.

Li, X., Thelwall, M. & Giustini, D. (2012). Validating online reference managers for scholarly impact measurements. *Scientometrics*, 91(2): 461-471. doi:10.1007/s11192-011-0580-x

Lin, J. & Fenner, M. (2013). Altmetrics in evolution: defining and redefining the ontology of article-level metrics. *Information Standards Quarterly*, 25(2): 20-26. http://dx.doi.org/10.3789/isqv25no2.2013.04.

Merton, R.K. (1968). The Matthew effect in science. *Science*, 159(3810), 56-63.

Moed, H. F., W. J. M. Burger, J. G. Frankfort, and A. F. J. Van Raan. (1985). The Use of Bibliometric Data for the Measurement of University Research Performance, *Research Policy*, 14: 131-49.

Moed, H.F., De Bruin, R.E. & Van Leeuwen, T.N. (1995). New bibliometric tools for the assessment of national research performance – database description, overview of indicators and first applications. *Scientometrics*, 33(3): 381-422.

Nielsen, M. (2011). Definitions of Open Science? *Okfn mailing list*. Retrieved on May 23, 2017, from https://lists.okfn.org/pipermail/open-science/2011-July/000907.html.

NISO (2016). *Outputs of the NISO RP-25-2016 Alternative Assessment Metrics Project*. Retrieved on May 23, 2017, from http://www.niso.org/publications/rp/rp-25-2016/.

O´Meara, K.A. (2002). Uncovering the values in faculty evaluation of service as scholarship. *Review of Higher Education*, 26: 57-80.

O´Meara, K.A., Terosky, A.L. & Neumann, A. (2008). *Faculty careers and work lives: a professional growth perspective*. San Francisco: Jossey-Bass.

O´Mearea, K.A. (2011). Inside the panopticon: Studying academic reward systems. In: Smart, J.C. & Paulsen, M.B. (Eds.), *Higher Education: Handbook of Theory and Research*, 26. doi:10.1007/978-94-007-0702-3_5. Springer Science + Business Media B.V. 2011.

Niyazov Y, Vogel C, Price R, Lund B, Judd D, Akil A, et al. (2016) Open Access Meets Discoverability: Citations to Articles Posted to Academia.edu. *PLoS ONE* 11(2): e0148257. https://doi.org/10.1371/journal.pone.0148257

Priem, J. (2011). As scholars undertake a great migration to online publishing, altmetrics stands to provide an academic measurement of Twitter and other online activity. *Impact of Social Sciences, London School of Economics and Political Science*. Retrieved on January 16, 2015, from http://blogs.lse.ac.uk/impactofsocialsciences/2011/11/21/altmetrics-twitter/.

Shema, H., Bar-Ilan, J. & Thelwall, M. (2014). Do blog citations correlate with a higher number of future citations? Research blogs as a potential source for alternative metrics. *Journal of the Association for Information Science and Technology*, 65(5): 1018-1027.

Wang, X., Liu, C., Mao, W., & Fang, Z. (2015). The open access advantage considering citation, article usage and social media attention. *Scientometrics*, 103: 555-564. doi:10.1007/s11192-015-1547-0.

Wilsdon, J., et al. (2015). *The Metric Tide: Report of the Independent Review of the Role of Metrics in Research Assessment and Management*. doi:10.13140/RG.2.1.4929.1363

Wilsdon, J., et al. (2017). Next-generation metrics: Responsible metrics and evaluation for open science. Report of the European Commission Expert Group on Altmetrics. Retrieved on May 23, 2017, from http://ec.europa.eu/research/openscience/index.cfm?pg=altmetrics_eg