

Different types of Altmetrics

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1 Introduction

This Background/Challenge Paper on **Different Types of Altmetrics** has been developed to help Mutual Learning Exercise (MLE) participants prepare for the 1st Working Meeting in Brussels on 7th April 2017. The topic for this first Challenge/Background Paper and for the 1st Working Meeting is Different Types of Altmetrics. This first Challenge/Background Paper gives an overview of the different types of altmetrics that are currently being used and/or investigated for the purpose of research assessment and discusses the benefits and challenges with them. This document also aims at gathering experiences ('good' and 'bad') about the use of altmetrics in the member states (MS) and H2020 associated countries participating in the MLE. It is based on a review of relevant background literature, discussions at the kick-off meeting on 27th February 2017 in Brussels and on answers to open ended questions sent to the participants of the MLE. After the 1st Working Meeting a Report on 'Different Types of Altmetrics' will be produced and it will be one of the main Deliverables of this MLE.

2 Background

Both citations and publication channels have been and are widely used in research evaluation (e.g., Garfield, 1972; Moed *et al.*, 1985; Moed *et al.*, 1995). As citations indicate use of earlier research they can be argued to indicate something about the value (or quality) of the cited research, as assessed by other researchers. The assumption derived from this is that highly cited publications have made a more significant contribution to science when compared to publications with fewer citations or no citations at all. Citations are also part of the academic reward system (Merton, 1968), with highly cited authors tending to be recognized as having made a significant contribution to science. Similarly, publications in (so-called) high impact journals tend to be considered as more valuable or as being of higher quality, as it is assumed that the peer review process in these journals is tougher and that only high quality research would thus be allowed to be published in them. With that citation counts and certain journals have become a proxy for quality. However, both approaches have some severe limitations (e.g., Smith, 2012; Vanclay, 2012; Zhang, Rousseau, & Sivertsen, 2017). For example, because it can take a very long time before the results from a research are published as a scientific article and recognized and cited by other researchers, citations can only reflect past scientific impact. On the other hand, assessing research based on the impact of the journal where it was published can at best be an indication or an estimation of future impact potential and does not necessarily say anything about the content or the quality of the specific publication being assessed. Focusing on citations and journals also misses out on all the other various forms of research outputs that cannot be formally cited or published in a scientific journal (e.g., datasets, algorithms, code). In addition, both publishing and citation traditions vary greatly by discipline and they can be created for many different reasons of which some do not reflect the scientific value of the cited work, as in the case of critiques or “placeholder” citations that only mention a given work because it is the only one available on a given topic (MacRoberts & MacRoberts, 1989; Borgman & Furner, 2002). Carefully selected and responsibly used metrics can, however, complement research evaluation and support decision-making (Hicks, 2015; Wilsdon *et al.*, 2015; Wilsdon *et al.*, 2017).

Although citations and journals are still important for scholarly communication, they can no longer be considered as the sole venue for the communication and dissemination of scientific discoveries. Scholarly communication is changing as researchers increasingly use social media to discover new

research opportunities, discuss research with colleagues, and disseminate research information (Rowlands *et al.*, 2011). In addition, researchers are increasingly engaging in public conversations and professional services, such as engagement with traditional media and journalists, public lectures and collaboration with schools. Although all these activities are evidence of scholarly activities and researchers' engagement with the society, they are not taken into account with the traditional measures and methods for research assessment. As scholarly communication is breaking out from its closed ivory towers and as the open science movement is winning more and more ground and funders' mandates for open access are increasing, the public can also take part in discussions about research and disseminate the research products to their own online networks. These online activities, by researchers themselves or by a wider public audience, leave traces on the web, traces that can be identified and collected as evidence of where and how research has been used or of what kind of attention it has received and by whom. It is important to emphasize in this context that these traces do not necessarily reflect *quality* of research, but rather *reach, influence, engagement* or *impact*. Both these online traces and the research area focused on investigating the meaning and applicability of these traces are called **altmetrics**.

In 2010 Jason Priem, Dario Taraborelli, Paul Groth, and Cameron Neylon published the Altmetrics Manifesto (<http://altmetrics.org/manifesto/>), which begins by stating that *"No one can read everything. We rely on filters to make sense of the scholarly literature, but the narrow, traditional filters are being swamped. However, the growth of new, online scholarly tools allows us to make new filters; these altmetrics reflect the broad, rapid impact of scholarship in this burgeoning ecosystem. We call for more tools and research based on altmetrics."* The Altmetrics Manifesto emphasizes the potential of altmetrics in filtering more valuable research outputs for researchers, practitioners and others trying to find relevant information from the rapidly increasing amount of scholarly literature and other research outputs that are being published today. This filtering mechanism could, however, point to research with most impact (or that has received most attention). The Manifesto continues: *"Altmetrics expand our view of what impact looks like, but also of what's making the impact."* By expanding the way we understand impact altmetrics can go beyond the traditional citation-based indicators of impact and reflect the various types of impact that research has had beyond the academia. Adie and Roe (2013) write that *"altmetrics presents an alternative to the current practice of relying only on citation counts and journal impact factors for the quantitative analysis of impact by introducing new complementary approaches and sources of data."* Altmetrics are thus not thought to replace citation-based assessment, but complement them by demonstrating other aspects of the impact a research has had.

Priem (2014) defines altmetrics as *"the study and use of scholarly impact measures based on activity in online tools and environments"*, focusing thus on the activity of using the online data. Shema, Bar-Ilan, and Thelwall (2014) present a similar definition and state that altmetrics are *"web-based metrics for the impact of scholarly material, with an emphasis on social media outlets as sources of data"*, emphasizing their definition on the actual data. Thus, altmetrics, or alternative metrics, refers to both 1) the new research area that investigates the potential of new online data sources as indicators of impact or measures of attention that research has received from different audiences, and to 2) the actual data that are identified and collected from different online data providers (e.g., the number of times a research output has been mentioned on Twitter, blogs, Facebook, Reddit, news articles, Mendeley, policy documents from selected sources, Wikipedia, LinkedIn, F1000, and Pinterest) about the interactions with and mentions of various research outputs. These interactions

could be a mere mention of research articles, sharing of links to them, commenting, rating, bookmarking, saving, or in some other way indicating awareness or use of the research output. Tracking and analyzing these interactions or events can expose when, where, why, and how research has influenced people and had some type of impact, potentially pointing to research that has had more influence on a wider audience or different audiences beyond academia. For instance, scholarly blogs have been found to have an important role in disseminating research (Kjellberg, 2010) and so-called blog citations have been suggested as a measure to predict future citations (Shema et al., 2014). Earlier research has shown a connection between usage statistics on Mendeley (Mohammadi & Thelwall, 2013), Wikipedia references (Evans & Krauthammer, 2011), and tweets mentioning scientific articles (e.g., Shuai et al., 2012; Thelwall et al., 2013), and the numbers of citations those articles later receive. Social reference manager applications such as Mendeley and CiteULike or recommendation systems like Reddit and Digg have also been suggested to be fruitful data sources for altmetrics (Priem & Hemminger, 2010). Nevertheless, there is not yet a clear understanding of what the online attention some research receives actually signifies, what aspects of engagement or impact it reflects and by whom, or how and why some research receives more attention than others in social media and other online platforms.

3 What is impact?

Impact per se can be a difficult term to grasp and different stakeholders have different meanings and expectations on impact. Impact has been defined as *“an effect on, change or benefit to the economy, society, culture, public policy or services, health, the environment or quality of life, beyond academia”* (Research Excellence Framework 2014, 2011, p. 26) or it could be viewed as all the diverse ways that research-related skills benefit individuals, organizations, and nations (Economic and Social Research Council 2016). The Research Councils UK (RCUK) defines impact as *“the demonstrable contribution that excellent research makes to society and the economy”* (Research Councils UK [RCUK], 2014), meaning that a simple indication of awareness or attention is not enough to demonstrate impact, as *“demonstrable contribution”* requires evidence of how the results have been used by policymakers or practitioners, or how the results have led to improvements or changes in the society. In a similar way the National Science Foundation (NSF) in the US evaluates two aspects of research funding proposals; intellectual merit and broader impacts, where the intellectual merit refers to the potential with which the proposed research can be expected to advance specifically scientific knowledge (scientific impact) and the broader impacts *“encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes”* (National Science Foundation [NSF], 2016). As different stakeholders may have different expectations on *“specific, desired societal outcomes”*, it is important to acknowledge that measuring or evaluating different types of impact may require different types of assessment methods and/or different types of metrics, or as stated in the Leiden Manifesto: *“No single evaluation model applies to all contexts”* (Hicks et al., 2015).

Science can have impact on various aspects of the society, such as education, economy, culture, environment, and on science itself. Traditionally scientific impact of science has been identified, mapped and measured through citations, reflecting how other researchers have used earlier scientific outputs. Although this seems to be changing as funders are increasingly demanding for evidence of societal impacts, or wider impacts, of research. However, there is currently no

commonly accepted method of identifying and measuring wider societal impact of research, although some approaches have been developed and discussed (e.g., Walter, Helgeberger, Wiek & Scholz, 2007; Wolf, Lindenthal, Szerencsits, Holbrook & Heß, 2013). Projects such as ERiC (Van der Meulen, 2010), SIAMPI (SIAMPI, 2012), ASIRPA (Joly, Gaunand, Colinet, Larédo, Lemarié, & Matt, 2015), and UNICO (Holi, Wickramasinghe & van Leeuwen, 2008) have identified and evaluated a great number of both quantitative and qualitative measures that can demonstrate some aspects of research impact on different areas of the society. For instance, ERiC and ASIRPA list indicators of Dissemination of knowledge (e.g., publications, advisory activities, number of PhDs, conference presentations), Interest of stakeholders (e.g., funding, collaboration, staff exchanges, consortium partnerships), and Impact and use of results (e.g., public debates and media appearance, and patents). UNICO, on the other hand, focuses on knowledge transfer and lists indicators related to networks, continuing professional development, consultancy, collaborative research, contract research, licensing, teaching, and other measures. None of the various types of impact that go beyond academia are, however, generally considered in research assessment, nor do they contribute to the academic reward system. It is also important to acknowledge that the different meanings and expectations that different stakeholders have on impact also mean that the methods to identify and measure impact cannot be the same in every case.

In altmetrics the concept of impact may be even more difficult, as in some cases evidence of impact may not be clear or it may be difficult or even impossible to identify who has been affected by a specific research or who has become aware of it. Haustein, Bowman and Costas (2016) discuss how research impact could be viewed as a spectrum of different levels of engagement between scholarly documents or outputs and the agent (person viewing or interacting with the document), ranging from *access* to *appraisal* and finally reaching *application* (Figure 1).

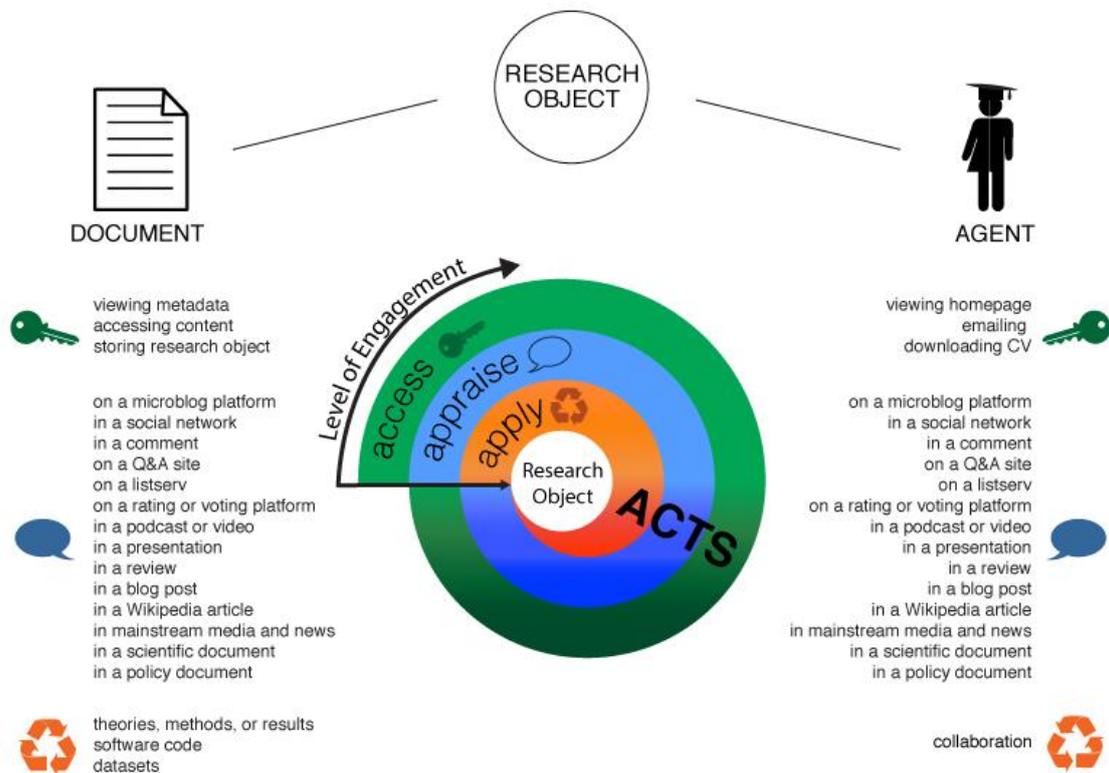


Figure 1. Framework of categories and types of acts referring to research objects (scholarly documents and agents) (Haustein, Bowman, & Costas, 2016).

Accessing a research output indicates that a person has at least become aware of the research and this activity could be captured as a page view or by download counts. *Appraising* a research output involves more engagement with it and could be evidenced by mentioning or commenting on the research in blogs, microblogs, or social networking sites, to name a few possibilities. *Applying* requires the highest level of engagement with the research output and this would occur when a person is actively using, adapting or transforming significant parts of the original research output. Applying would thus be evidenced by citations, use and adaptation of earlier code or datasets, designing presentations or lectures around the original research or even use of it for commercial purposes. While citations are assumed to always reflect use of earlier, altmetrics may be able to reflect these various levels of engagement with research outputs.

4 Different types of altmetrics

In general, we could say that altmetrics can be any identifiable (online) trace of an event where research outputs have received some form of attention or where the event reflects some level of engagement between a person and a research output. This could be a mention of a research output on Twitter or Reddit, a citation to a scientific article on a blog, Wikipedia, or a policy document, or a discussion about the research output on some discussion forum or social networking site. The term altmetrics covers in fact a wide range of different online platforms that can be mined for data about these events. Although a complete list of all potential sources of altmetrics could potentially include a vast list of different social media sites and other websites, many of the sources have a very low coverage of altmetrics and they “*may only be useful to identify the occasional exceptional or above average article rather than as universal sources of evidence*” (Thelwall et al., 2013). Altmetrics do also come in many forms and it is crucial to not think that all altmetrics are equal or that all altmetrics reflect the same level of engagement. A simple retweet on Twitter with a link to a research output may not reflect as much engagement as a lengthy review of the same research output in a blog entry or a news article can.

The vast amount of different potential sources is reflected in the multitude of sources and platforms that are being tracked and mined for altmetrics. One of the altmetrics data aggregators, Altmetric LLP¹ (<https://www.altmetric.com/>) for instance, track a vast range of different online platforms, including public policy documents, websites of mainstream media, online reference managers, post-publication and peer-review platforms, Wikipedia, Open Syllabus Project, a manually curated list of over 9,000 blogs, citations from Scopus, recommendations from F1000, social media sites including Facebook, Twitter, and Google+, and other online platforms such as YouTube, Reddit and Stack Overflow. Sometimes different altmetrics are categorized together according to the perceived activity they reflect or based on the similarity of the platforms. Another altmetrics data aggregator, Plum Analytics (<http://plumanalytics.com/>), categorizes metrics into five different categories: *Usage* (e.g., clicks, downloads, views, library holdings, video plays), *Captures* (e.g., bookmarks, code forks, favorites, readers, watchers), *Mentions* (e.g., blog posts, comments, reviews, Wikipedia links), *Social media* (e.g., likes, shares, tweets), and *Citations* (e.g., citation indexes, patent citations, clinical citations). Mega journal Public Library of Science, or PLoS (<http://alm.plos.org/>), has another

¹ In this document, the word *Altmetric* will be used to refer to the company with the same name, while the word *Altmetrics* refers to either the research area or the alternative metrics aggregated from different online sources

approach and categorize the sources used to identify the *article-level metrics* they provide for each of their articles to five categories: *Viewed* (page views and downloads), *Saved* (CiteULike and Mendeley), *Cited* (citation counts retrieved from different citation databases), *Recommended* (F1000 Prime), and *Discussed* (social media sites, including Facebook, Twitter, Reddit, Research Blogging, and Wikipedia). Another categorization is used by the Snowball Metrics (<https://www.snowballmetrics.com/>), which refers to a set of tested methodologies to assess research outputs in order to support strategic planning and benchmarking of research-focused universities and other institutions. Snowball Metrics places various platforms and data sources of altmetrics into four categories: *Scholarly Activity* (scholarly platforms such as Mendeley, CiteULike, Google Scholar Library, and ResearchGate), *Scholarly Commentary* (scholarly comments on for instance science blogs, YouTube, reviews on Publons and F1000, Wikipedia posts and citations), *Social Activity* (e.g., Facebook, Twitter, Reddit, Google+ and LinkedIn), and *Mass Media* (news websites). The different approaches taken to categorize different altmetrics speak a clear language about the uncertainty of the underlying meaning of what different altmetrics reflect and of a lack of standards that are still very problematic with altmetrics.

4.1 Benefits with altmetrics

There are some clear benefits with altmetrics over traditional citation-based research evaluation. Altmetrics are generally quickly accumulated after the publication of a research output, whereas citations can take a long time to accumulate. Especially in disciplines where accumulation of citations has traditionally been slow, altmetrics can provide timely evidence of which outputs are rapidly gaining attention online. Altmetrics can capture a much more diverse set of various types of impacts than citation-based metrics can. While citations can only reflect scientific impact, altmetrics can be able to reflect different types of societal impact, such as impact on culture, education, policy, environment, economy, and health. Altmetrics can thus help researchers, research administrators, and funders understand how their research (or the research they have funded) is being shared and mentioned in various contexts that can reflect various types of impact or engagement. Altmetrics are not limited to scientific publications and formal citations, as a wide range of different research outputs can be mentioned, shared and discussed online and the traces of these can be captured. Altmetrics data is thus highly nuanced and in best cases it can provide great detail about the context of the online event that generated the altmetrics counts. Altmetrics can thus function as a more detailed or more qualitative (in terms of being able to show context and surrounding content) complement to citations. A combination of both citation-based metrics and altmetrics (allmetrics) can thus give a more comprehensive picture of the influence or impact that research has had, including information about the audiences that the research has had an influence on. Altmetrics also has an open access advantage. A great deal of the altmetrics data is being traced and collected through open APIs of various social media sites or open RSS feeds (although some of the altmetrics data do come from proprietary sources), thus making the data (and altmetrics research) more easily replicable than when using data from purely proprietary databases. This allows for the creation and use of what could be called *open metrics*. Some studies have also shown that research published in open access journals gain more online attention (Adie, 2014).

A future potential of altmetrics is that it could be possible to track online events surrounding the research processes; however, these cannot yet be automatically identified or tracked as capturing the altmetrics events require a specific identifier (e.g., DOI, PubMed ID, arXiv ID) attached to the

online events. This does of course not mean that someone could (at small scale) manually track discussions surrounding for instance open research notebooks or conversations about research processes and map the users involved in the conversations and the influences of those conversations.

Benefits with altmetrics
<ul style="list-style-type: none">• Altmetrics are quickly accumulated after the publication of a research output• Altmetrics can capture a more diverse set of various types of impacts than citations can• Altmetrics are not limited to scientific publications and formal citations as forms of research outputs• Altmetrics can demonstrate the context in which a research has had some influence or impact on different audiences• Altmetrics use open data and are thus more easily replicable than when using data from proprietary databases

4.2 Challenges with altmetrics

There are, however, still many challenges and unknowns with altmetrics, and thus more research is needed. It is still unclear what different altmetrics are able to reflect and, in some cases, what they actually mean. More research is needed to understand what aspects of engagement, influence, or impact altmetrics reflect and by whom, or how and why some research receives more attention than others. Altmetrics are also often mistaken to mean social media metrics, however, many of the platforms that are being tracked and used as data sources of altmetrics are not what typically would be meant with social media (e.g., news websites and policy documents). Although the National Information Standards Organization (NISO) has recently completed a “recommended practice” for use of altmetrics and a Code of Conduct that aims to improve data quality, how these will be integrated and followed in the future is unclear. NISO’s (2016) Code of Conduct aims at *“increasing the transparency of data provision and aggregation as well as ensuring replicability and accuracy of online events used to generate altmetrics.”* Before this is implemented and achieved, it is not possible to compare altmetrics data from different altmetric data aggregators as they may collect different data (e.g., due to restrictions of APIs or contracts, due to use of different identifiers in the data collection, and simply differences in the platforms they chose to cover). Comparisons of altmetrics from different platforms or data providers should also be avoided, as the reasons behind the events leading to altmetrics (i.e. motivations to engage with research outputs) may vary between different platforms and their users. The reason for saving a scientific article on Mendeley for instance is most likely different from the reason the same article is shared on Twitter or Facebook. Altmetrics are time-dependent, in that altmetrics are usually generated soon after the publication of a research output. Although this can be seen as an advantage over citations, this also means that for older research outputs there may not be any altmetrics activity (with the possible exception of some sleeping beauties). On the other hand, as the use of social media is constantly increasing newer research outputs may end up having more altmetrics activity just because of a natural growth in the usage of the platforms. It is thus not advisable to compare altmetrics of older research outputs with newer outputs, but in order to know what the time-window for a reliable comparison would be, more research is needed. Altmetrics are typically identified and tracked on items that have a Digital Object Identifier (DOI). While other identifiers are also used by some data

aggregators (e.g., URN, arXiv ID, Handle, PubMed ID, URLs), DOIs remain the prominent tracking method. But as not all research outputs have DOIs and as the DOIs are not always mentioned when a research output is discussed or shared, a lot of the activity surrounding various research outputs (and research processes) is being missed. Another cause of skewness in altmetrics is that although not exclusively, a lot of altmetrics are aggregated from social media, but not everybody use social media. It is important to remember that altmetrics (that are tracked from social media) only reflect the activities and engagement of both researchers and citizens who are using social media or that are using social media to engage with research. In addition, social media data is highly dynamic, as new content is constantly created and old content may be deleted or disappear for other reasons. Whole platforms that have been used as altmetrics data sources may be discontinued, while new potential data sources are launched. Altmetrics aggregated from social media sites should thus be treated with extra caution. There is also some evidence that humorous or curious titles draw more online attention on social media and that thus altmetrics (in some cases) do not necessarily reflect *“intellectual contribution or scientific quality”* (Haustein et al., 2013).

Perhaps one of the biggest concerns with altmetrics is how easily they can be manipulated, i.e. how researchers, institutions or publishers could easily set up automated bots or fake accounts on various social media sites that would automatically engage with and share their research outputs, inflating the altmetrics (Haustein et al., 2015). Although no evidence of systematic manipulation of altmetrics has yet been detected, there are for instance on Twitter many bots that tweet links to scientific articles that contain certain keywords or that cover specific topics. These appear to have been mainly created for aggregation and dissemination purposes; however, they are still influencing altmetrics of the articles they tweet about. We can probably also assume that should altmetrics in the future be used in research assessment and in hiring and funding decisions, some researchers and/or publishers would begin to manipulate their numbers. Thus reliable procedures and systems to identify fraud and manipulation of altmetrics need to be in place before altmetrics can be considered for research assessment.

Challenges with altmetrics
<ul style="list-style-type: none">• The meaning and applicability of altmetrics generated on different platforms is still unclear• Lack of data standards leads to issues with transparency, replicability and accuracy• Altmetrics are time-dependent and thus comparing altmetrics of documents from different time periods should be avoided• Commonly known tracking issues; DOIs are most often used to identify altmetrics activity, but DOIs are not always used when engaging with a research output nor do all research outputs have DOIs attached to them• (Some) Altmetrics only reflect the actions of those that actively use social media• Altmetrics may be skewed towards humorous and curious titles• Altmetrics are easily manipulated; i.e. researchers, institutions or publishers could easily inflate the numbers, if they wanted to

4.3 Altmetrics data aggregators

With the advent of altmetrics and the increasing usage of the web in general and social media in particular in scholarly communication and in dissemination of research outputs, some start-ups have seen a business opportunity in tracking and aggregating altmetrics events and creating services and tools around the data.

4.3.1 Altmetric LLP

Altmetric LLP (<https://www.altmetric.com/>) is a company that tracks and analyses the online activity around scholarly research outputs and builds tools and services around the data they collect and analyze. Altmetric offers services for publishers, institutions, researchers and funders. Publishers can use the tools and data from Altmetric to monitor, measure, and display the attention surrounding the scientific articles they have published. Institutions can use the Explorer for Institutions to monitor attention to research outputs from a specific institution, department, research project or team, researchers or papers, which will provide them with a richer picture of the reach and influence of the research. Researchers can use the tools provided by Altmetric to monitor how and by whom their work is being discussed and to showcase the attention their work has received. Altmetrics can thus be a way for researchers to build, showcase and manage their online professional reputation and build their promotion and tenure dossiers. For funders Altmetric can provide tools to monitor how the research they have funded has been disseminated and discussed and where it has had an influence on public policy for instance. In addition, Altmetric has been an active partner in several research projects around the world investigating altmetrics, sharing their data and expertise. For instance, the Open Science Monitor², developed by RAND Europe and commissioned by the European Commission, was supported by Altmetric LLP.

4.3.2 Plum Analytics

Plum Analytics (<http://plumanalytics.com/>, acquired in 2017 by Elsevier) is another company tracking and analyzing online activity around research outputs. In March 2017 PlumX covers 52.6 million individual research outputs for which they have collected 9.4 billion individual interactions or altmetrics events. Plum Analytics' main product, the PlumX Dashboard, gives research institutions means to track the attention and impact the research has had. PlumX pulls the publication data from an institution's Current Research Information System (CRIS) and merges it with the altmetrics they collect from several online sources. Users of the PlumX Dashboard can then group the research outputs from their own organization by various organizational levels, such as faculties, departments, research groups or labs, or by subject, by journal, or any other group the user might be interested in investigating more closely. The Dashboard is thus a tool foremost for research administrators to identify the units in need of more support or the units that are doing particularly well. In addition, researchers too can use the Dashboard to monitor the attention that their various types of research outputs have received and get credit for their work.

4.3.3 Impactstory

Impactstory (<https://impactstory.org/>) is a non-profit corporation that has developed an open-source website that helps researchers monitor, track, and showcase the online attention of their research. Most of the data is supplied for by Altmetric, but other sources are used too, such as

² Open Science Monitor, <http://ec.europa.eu/research/openscience/index.cfm?pg=home§ion=monitor>

CrossRef³ for metadata of articles and Orcid⁴ for researcher identity management. Impactstory effectively promotes open science and open access publishing, by for instance showcasing the degree of open access publications a researcher has. The founders of Impactstory, Jason Priem and Heather Piwowar, are also the creators of Depsy (<http://depsy.org/>), a website that aims to “*value the software that powers science*” by showcasing how code that researchers have published on GitHub is being reused.

5 MLE Topic 1: Different Types of Altmetrics

The goal with the first topic of this MLE on 'Different types of altmetrics' is to learn from each other's experiences, both from good practices and failures. To gather background information about how altmetrics are being tested and possibly implemented and used by member states two approaches were taken; discussions about altmetrics and open science in general during the kick-off meeting, and a specifically for this topic tailored questionnaire that was distributed to representatives from the member states. The key points from both approaches are summarized below.

5.1 Key points from the kick-off meeting

From the discussions during the kick-off meeting it is clear that great diversity in the approaches and the degree of adoption of open science exist between the member states. It is also clear that although there are some ongoing discussions and a keen desire to learn more about altmetrics, none of the member states are using altmetrics for research evaluation and only few examples of other types of use were mentioned.

The aim of this MLE included learning from concrete experiences from other member states, both about their failures and successes. Some specific questions concerning impact in general were raised during the meeting: What is impact? What does impact mean for different stakeholders? How to measure impact? How can (different types of) impact be made tangible for systems of reward and measurement? How to measure impact of the research process and not just of the research output? Should we be talking about and measuring engagement instead? What role does funders have in increasing the adoption of open science and altmetrics? What kinds of cultural changes are required for wider adoption of open science? What skills and training in open science are necessary for different stakeholders?

While some of the member states had some open science initiatives in place or in planning, no organized approaches to use altmetrics were mentioned. The questionnaire thus focused more specifically on mapping the use of altmetrics in the member states.

5.2 Key points from the questionnaire

The questionnaire included five open-ended questions specifically about the use and awareness of altmetrics in the member states. The results from the questionnaire are summarized under each respective question below.

³ Crossref (<https://www.crossref.org/>) is a non-profit association of scientific publishers and a Digital Object Identifier (DOI) registration agency of the International DOI Foundation.

⁴ Orcid (<https://orcid.org/>) provides researchers' with digital identifiers to reliably and persistently distinguish researchers and their work from each other

Question 1: Are you aware of ways in which altmetrics are being used to assess research in your country? At governmental/institutional/individual level?

With the possible exception of Moldova, altmetrics are not used for research evaluation at any level in the member states. However, member states are aware of altmetrics and some examples of use of them do exist. Some institutional repositories for instance have integrated altmetrics and in Slovenia altmetrics are displayed in researchers' bibliographies and at the COBISS/SCIMET portal that aggregates data about scientific outputs in Slovenia for research assessment purposes (<http://scimet.izum.si/>). The portal aggregates data from Web of Science, Scopus, Altmetric and Plum Analytics.

Question 2: Are you aware of any other ways in which altmetrics are being used in your country? Links to relevant documents or websites will suffice.

Besides from some national journals and national or institutional repositories altmetrics are not widely used in the member states for other purposes either. In France altmetrics are being experimented in the SJS (e.g., <http://www.sjscience.org/article?id=580>), they are in production on the French national repository HAL (<https://halshs.archives-ouvertes.fr/>) and altmetrics for books will be adopted by OpenEdition Books platform (<http://books.openedition.org>, which is part of the HIRMEOS project (http://cordis.europa.eu/project/rcn/206340_en.html). In addition, there are some examples from Croatia; Rudjer Boskovic Institute use altmetrics in their CRIS (CROSBI, <http://bib.irb.hr/?lang=EN> and FULIR, <http://fulir.irb.hr/>), the repository of the Croatian Open Access journals HRČAK (<http://hrcak.srce.hr/?lang=en>) display usage statistics (views and downloads). In some of the member states researchers themselves add altmetrics to their CVs and homepages.

Question 3: What kind of change do you wish to see in your country in regard to open science and altmetrics?

The representatives from the member states wish to see following changes or initiatives in their country regarding open science and altmetrics:

- Learn about and explore use of altmetrics at a national level, as journals in national languages are rarely listed in Web of Science or Scopus other means for data about influence are needed; Learn about the potential of altmetrics to highlight research that has received more attention, for one reason or the other
- Learn about what altmetrics could do to present the impact (both scientific and societal) of locally relevant research published in a national language, even though it is apparent that researchers in a specific country are not used to use social media to share their research
- Explore possibilities to use altmetrics for research assessment in Social Sciences and Humanities
- Bigger uptake of altmetrics in general at a national level, particularly by national publishing platforms
- Clear national policies and operational action plans to realize open science principles in research and education; Approving a road map for open science at a national level
- Sustainable national support (finances and human resources) for infrastructures and platforms in field of data curation, data openness, dissemination and reuse

- Establishment and development of national CRIS as a reliable and sustainable base for evidence-based policy making; national CRIS as a source for country-relevant altmetrics; national CRIS as provider of transparent, reliable and publicly available altmetrics data
- Standardization or harmonization of altmetrics at EU level (building on NISO's work on recommended practices: http://www.niso.org/topics/tl/altmetrics_initiative/)
- Open access to research results and availability of authored open educational results as one criteria for personal promotion and academic advancement for higher education teachers and researchers, as well as research assessment in general
- A cultural change so that the academic and research communities are willing to share their publications, research data, educational material and other types of scholarly work as open access
- Development of a much broader and much more appropriate set of indicators and article level metrics (ALMs)
- Consider adoption of "open science-friendly" metrics that reflect the importance of different research outputs and activities
- National implementation of principles laid out in the San Francisco Declaration on Research Assessment (DORA) and in the Leiden Manifesto for Research Metrics (Hicks, 2015)
- Abandon all metrics unsuitable to assess the research outputs on their own merits (such as the Journal Impact Factor)

Question 4: What are your specific expectations to get out of this MLE in regards to altmetrics?

The member states expressed the following expectations for the MLE in regards to altmetrics:

- Help get a complete picture (based on current knowledge) of how altmetrics are used or could be used for different purposes in different disciplines
- Learning about what altmetrics can be used for and what they should not be used for and with that, help shape the national debate about the use of altmetrics in policy making
- Learning about the rationale behind using altmetrics (for specific purposes) in the first place and about the intended objective of employing them in such contexts instead of more traditional metrics
- Learning about the effectiveness of altmetrics in the contexts in which they are already being tested (specific questions related to this include: are they being effective; are they suited to assess the quality of research objectively; do the new metrics introduce any kind of distortion or bias to the research assessment process; are they somehow achieving the aims that justify the decision to employ them)
- Understanding how altmetrics are exercised by other countries; what are the challenges and risks in general; how can the traditional metrics and altmetrics be brought together for research assessment purposes in the context of open science
- Learning about open science policies and regulations and about the experiences from different countries (best practices and failures)
- Learning from others about good practices of creating regulatory framework to support and promote different stakeholders to adopt open science; learn about successful reward and evaluation systems; learn about good practice examples of open science training and education programs

- Learn about approaches to ensure open research data, and exchange and re-use of it
- Information about any possible EU level projects at standardization of altmetrics and/or development of any shared tools at the EU level

Question 5: Any failures or success stories regarding open science initiatives and/or (alt)metrics that you wish to share?

- **Moldova:** As an example of a failure of change the constraining conservatism of the academic community was mentioned. In the post-Soviet space there exists a strong authoritative perception of who should do science and how, often leaving young researchers in a more disadvantaged position. However, metrics and open science is seen as a way to escape from previous generations' authority and as a way to move the science more towards the people and to be able to engage more with the society.
- **France:** HIRMEOS project (http://cordis.europa.eu/project/rcn/206340_en.html), which has not been implemented yet, was mentioned as a good example of a mutualized approach to implement altmetrics within a community (SSH).
- **Belgium:** The Green open access repository of the University of Liège where the evaluation is only based on what has been submitted to the repository by the researcher him- or herself was another example.
- **Croatia:** The Rudjer Boskovic Institute has declared the first Croatian institutional self-archiving mandate which requires open access for all publications, with respect to publisher's embargo times. The Croatian Declaration on Open Access (<http://www.fer.unizg.hr/oa2012/deklaracija>) has been supported by around 20-30 institutions since 2012. However, more work is needed before it is fully accepted within the academic, research, and business communities. The National Portal of scientific journals of Croatia (Hrčak), currently providing open access to 386 Croatian scholarly journals (<http://hrcak.srce.hr>), was also mentioned as a success story, along with the Croatian scientific bibliography CRSOSBI (<https://bib.irb.hr/>) that contains more than 450.000 bibliographic records, allowing scientists to archive full-text articles in open access.
- **Slovenia:** The COBISS/SciMet (<http://scimet.izum.si/>) and the personal bibliographies of researchers on the same service were seen as positive examples. Through the service researchers can monitor the performance of their publications by using different altmetrics and more traditional metrics.
- **Portugal:** The full implementation of the Liège model by two HEIs was seen as a good example of adopting open science. With this the deposit and availability of research outputs in the Institutions' repositories is inextricably linked (conditionally) to the research assessment procedures for career progression purposes.

Additional comments from the answers to the questionnaire

- *"The combination of traditional and altmetrics tools are expected to enable us to measure the broader impact of the research and to help in assessing not only scientific, but also the societal impact of research."*
- *"Personally I'm not pushing for use of altmetrics in research evaluation because I have doubts about the relevance of all metrics in evaluation, unless used in a controlled and careful manner, which is rarely the case."*

- *“I am in favor of a cautious and complementary (to qualitative assessment and more traditional metrics) consideration for altmetrics while assessing strategic and applied research (not basic research). More generally I am in favor of a broad approach towards Open Science, not limited to the Open Access to the papers published by the Major publishers only.”*
- *“Similarly to the classic indicators and due to variety of practices and patterns of scientific publishing, the evaluations based on altmetrics are expected to be normalized within individual scientific disciplines.”*
- *“In the context of open science it would be meaningful to see how the researchers and different scientific disciplines are collaborating and working together and how this is reflected in altmetrics.”*
- *“I do not believe in the perfect indicator, and do not believe altmetrics should replace traditional bibliometrics. I think they may be complementary in some situations of evaluation (but not in all).”*

6 Preparation for the 1st Working Meeting

Based on the discussions at the kick-off meeting and the responses to the questionnaire some specific objectives have been placed for the 1st Working Meeting.

6.1 Objectives

The objectives for the 1st Working Meeting include:

1. **Discussion about what impact means for different stakeholders and how different types of impact could and should be responsibly measured.**
2. **Learn about altmetrics in general and more specifically about the possibilities and challenges with using them for research evaluation**

In addition, we will introduce and briefly discuss the topic of the next Challenge Paper on *How to use altmetrics in the context of open science*. This topic will focus on **how altmetrics could contribute to the academic reward system and function as an incentive for greater adoption of the open science movement.**

6.1.1 Specific questions to consider

Specific topics and questions that will be presented and discussed during the Working Meeting in Brussels on April 7th include:

1. Discussion about what impact means for different stakeholders and how different types of impact could and should be measured.
 - What is impact?
 - For what kind of research outputs can impact be measured? Can impact of research processes be tracked and measured?
 - Who are the different stakeholders that want to measure impact of research?
 - How are quantitative measures of research impact perceived in general?
 - How should/could impact be tracked and responsibly measured in different contexts (including different disciplines)?

- How can existing assessment mechanisms (if at all) incorporate qualitative and other alternative forms of assessment?
 - How can (different types of) impact be made tangible for systems of reward and measurement?
 - What role does funders have in increasing the adoption of open science and altmetrics?
 - What kinds of cultural changes are required for wider adoption of open science?
 - What skills and training in open science are necessary for different stakeholders?
2. Learn about altmetrics in general and more specifically about the possibilities and challenges with using them for research evaluation
- What are the best practices for using (alt)metrics?
 - Can altmetrics be used in research assessment?
 - How and for what purposes could/should altmetrics be used?
 - How reliable are the different altmetrics?
 - How to aggregate altmetrics data?
 - Which altmetrics tools could be recommended?

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