INFORMATION STANDARDS QUARTERLY
SUMMER 2013 | VOL 25 | ISSUE 2 | ISSN 1041-0031

ISQ

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NISO
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ISQ

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NISO
How the information world CONNECTS

INFORMATION STANDARDS QUARTERLY (ISQ) is a publication by the National Information Standards Organization (NISO). ISQ is NISO's print and electronic magazine for communicating standards-based technology and best practices in library, publishing, and information technology, particularly where these three areas overlap. ISQ reports on the progress of active developments and also on implementations, case studies, and best practices that show potentially replicable efforts.

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APPROVED JUNE 3, 2013

iota
small changes. big improvements.

NISO RP-21-2013 and TR-05-2013, Improving OpenURLs Through Analytics (IOTA): Recommendations for Link Resolver Providers and IOTA Working Group Summary of Activities and Outcomes

These recommendations are the result of a three-year study performed by the NISO IOTA Working Group in which millions of OpenURLs were analyzed and a Completeness Index was developed as a means of quantifying OpenURL quality. By applying this Completeness Index to their OpenURL data and following the recommendations, providers of link resolvers can monitor the quality of their OpenURLs and work with content providers to improve the provided metadata—ultimately resulting in a higher success rate for end users. The project is summarized in a technical report which was published along with the recommended practice.

ISBN: 978-1-937522-18-6, 978-1-937522-17-9

www.niso.org/workrooms/openurlquality

APPROVED MARCH 26, 2013

NISO RP-17-2013, Institutional Identification: Identifying Organizations in the Information Supply Chain

This Recommended Practice describes the work done by the NISO Institutional Identifier (I^2) Working Group to define the requirements for a standard identifier for institutional identification in the supply chain. It also provides background on the collaboration agreement between the NISO I^2 Working Group and the International Standard Name Identifier (ISNI) International Agency to use the ISNI standard (ISO 27729) and the ISNI-IA's infrastructure for institutional identification, rather than publish a separate standard for institutions. The I^2 Working Group did extensive community needs assessment with the publishing, library, and repository use sectors, and based on this input, developed a minimum set of metadata elements needed to uniquely and unambiguously identify an organization engaged in a digital information workflow. This metadata was later harmonized with that of the ISNI standard to define the final set of elements.

ISBN: 978-1-937522-11-7

www.niso.org/workrooms/i2

APPROVED MARCH 25, 2013

PIE-J
the presentation & identification of e-journals

NISO RP-16-2013, PIE-J: Presentation & Identification of E-Journals

This Recommended Practice was developed to provide guidance on the presentation of e-journals—particularly in the areas of title presentation, accurate use of ISSN, and citation practices—to publishers and platform providers, as well as to solve some long-standing concerns of serials, collections, and electronic resources librarians. In addition to the recommendations, the document includes extensive examples of good practices using screenshots from various publishers' online journals platforms; a discussion of helpful resources for obtaining title history and ISSN information; an overview of the International Standard Serial Number (ISSN) and key points for using it correctly; an explanation of the Digital Object Identifier (DOI®), the registration agency CrossRef, and tips on using DOIs for journal title management; and a review of related standards and recommended practices.

ISBN: 978-1-937522-05-6

www.niso.org/workrooms/piej/

Martin Fenner

LETTER FROM **THE GUEST CONTENT EDITOR**

ALTMETRICS HAVE COME OF AGE

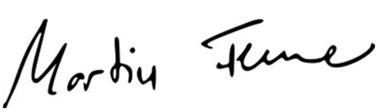
The idea of using the social web—social bookmarks, tweets, Facebook "likes", Wikipedia references, etc.—to track the post-publication discussion around journal articles and other scholarly content is of course older, but in 2010 both the term altmetrics was coined (https://twitter.com/jasonpriem/status/25844968813) and a widely-read manifesto published (altmetrics.org/manifesto/).

Since then, we have seen a flurry of activity around altmetrics, including numerous articles and blog posts, three conferences— altmetrics11 (altmetrics.org/workshop2011/), altmetrics12 (altmetrics.org/altmetrics12/), and ALM Workshop 2012 (article-level-metrics.plos.org/alm-workshop-2012/), plenty of conference presentations, a growing number of publishers displaying altmetrics with their articles, and the launch of at least three organizations dedicated to collecting and providing altmetrics. The discussion around altmetrics has shifted accordingly. We no longer need to talk about whether it is possible to reliably collect altmetrics, or whether this is valuable information that can complement citations and usage statistics.

Altmetrics have grown up, and the articles on altmetrics in this issue of *ISQ* reflect this shift in the discussion. The two feature articles look at emerging best practices and commonalities in this burgeoning field. **Scott Chamberlain** compares altmetrics data from four different altmetrics services for the same set of articles. **Robin Chin Roemer** and **Rachel Borchardt** remind us that altmetrics so far have focused on single articles or the research outputs of individual researchers and that we need to also make this information available in a format that works for institutions with their much larger sets of research outputs. Three in-practice articles review specific tools or practices that are underway. **Jennifer Lin** and I discuss how PLOS is taking altmetrics, a diverse group of metrics that basically include everything that is not a traditional citation or usage stats, and grouping them according to similarities to provide additional insights. **Mike Taylor** explains how altmetrics can help us with understanding the broader social impact of research. And **William Gunn** details how Mendeley, a social reference manager that makes the bookmarking activity of its users available via an open API, can be used for altmetrics. We also report on a new NISO initiative, with funding from the Sloan Foundation, to gather input from the community and then develop needed standards and recommended practices for altmetrics. Many of the articles in this issue discuss the areas where such standards are needed, so the launching of this project is well timed.

Coming of age sometimes means becoming dull and boring. I hope that the altmetrics articles in this issue convince you that nothing could be farther from the truth. There is a lot of interesting reading in these articles, and they all bring new and sometimes unexpected perspectives to the discussion. The same is true for the field of altmetrics itself. Growing up doesn't at all mean we should stop research and experimentation. Much more work is needed, for example, on metrics for research outputs that are not journal articles (e.g., monographs or datasets), additional altmetrics sources, and on anti-gaming strategies.

This issue of *Information Standards Quarterly* should provide much food for thought and further experiments as the field of altmetrics progresses. doi: 10.3789/isqv25no2.2013.01



Martin Fenner | *Technical Lead Article-Level Metrics for the Public Library of Science (PLOS) and Project Manager for the ORCID DataCite Interoperability Network (ODIN)*

SCOTT CHAMBERLAIN

CONSUMING ARTICLE-LEVEL METRICS:

OBSERVATIONS AND LESSONS FROM COMPARING AGGREGATOR PROVIDER DATA

The Journal Impact Factor (JIF; owned and published by Thomson Reuters)[1],[2] is a summation of the impact of all articles in a journal based on citations. Publishers have used the JIF to gain recognition, authors are evaluated by their peers based on the JIF of the journals they have published,[3] and authors often choose where to publish based on the JIF.

The JIF has significant flaws, including being subject to gaming[4] and not being reproducible.[5] In fact, the San Francisco Declaration on Research Assessment has a growing list of scientists and societies that would like to stop the use of the JIF in judging work of scientists.[6] An important critique of the JIF is that it doesn't measure the impact of individual articles—clearly not all articles in a journal are of the same caliber. Article-level metrics measure the impact of individual articles, including usage (e.g., pageviews, downloads), citations, and social metrics (or *altmetrics*, e.g., Twitter, Facebook).[7]

Article-level metrics have many advantages over the JIF, including:

Openness
Article-level metrics are largely based on data that is open to anyone (though there are some that aren't, e.g., Web of Science, Scopus). If data sources are open, conclusions based on article-level metrics can be verified by others and tools can be built on top of the article-level metrics.

Speed
Article-level metrics are nearly real-time metrics of scholarly impact.[7] Citations can take years to accrue, but mentions and discussion that can be searched on the web take hours or days.

Diversity of sources
Article-level metrics include far more than just citations and provide metrics in a variety of domains, including discussion by the media (mentions in the news), discussion by the public (Facebook likes, tweets), and importance to colleagues (citations).

There are many potential uses for article-level metrics, including:

Research
As article-level metrics rise in use and popularity, research on article-level metrics themselves will inevitably become a more common use case. Some recent papers have answered the questions: How do different article-level metrics relate to one another?[8],[9] What is the role of Twitter in the lifecycle of a paper?[10] Can tweets predict citations?[11],[12] These questions involve collecting article-level metrics in bulk from article-level metrics providers and manipulating, visualizing, and analyzing the data. This use case often requires using scripting languages (e.g., Python, Ruby, R) to consume article-level metrics. Consuming article-level metrics from this perspective is somewhat different than the use case in which a user views article-level metrics hosted elsewhere in the cloud. This use case is the target use case with which this paper is concerned.

Credit
Some scholars already put article-level metrics on their CVs, usually in the form of citations or JIFs. With the rise of article-level metrics, this will become much more common, especially with initiatives like that of the U.S. National Science Foundation (NSF) that now allows scholars to get credit for *products*, not just papers—and products like videos or presentations cannot be measured by citations or JIFs. This use case will involve scholars with a wide variety of technical skills and will be made easy with tools from ImpactStory or other providers.[13]

Filtering
Scholars cannot possibly find relevant papers efficiently given that there are now tens of thousands of scholarly journals. Individual article-level metrics components can be used to filter articles. For example, many scientists use Twitter and are more likely to view a paper that is tweeted often—in a way, leveraging article-level metrics. Article-level metrics can also be used to filter more directly. For example, article-level metrics are now presented alongside papers, which can be used to make decisions about what papers to read and not to read. Readers may be drawn, for example, to a paper with a large number of tweets or blog mentions.

In this paper I discuss article-level metrics from the perspective of developing and using scripting interfaces for article-level metrics.

From this perspective, there are a number of considerations:

1. Where can you get article-level metrics data
2. Data consistency
3. Data provenance
4. Article-level metrics in context
5. Technical barriers to use

Article-level metrics data providers

There are a number of publishers now presenting article-level metrics for peer-reviewed articles on their websites (for examples, see Wiley-Blackwell, Nature, Public Library of Science (PLOS), Frontiers, and Biomed Central). Most of these publishers do not provide public facing APIs (Application Programming Interfaces—a way for computers to talk to one another) for article-level metrics data, but instead use aggregators to provide article-level metrics data on their papers. One exception is PLOS, which collects its own article-level metrics and provides an open API to use this article-level metrics data.

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Table 1: Details on the four largest article-level metrics providers.

Variable	PLOS	ImpactStory	Altmetric	Plum Analytics
Open API?	Yes	Yes	Limited[a]	No
Data format	JSON,JSONP,XML	JSON	JSON,JSONP	JSON
Granularity[b]	D,M,Y	T	I	T
API authentication	API key	API key	API key	API key
Business type	Publisher	Article-level metrics provider	Article-level metrics provider	Article-level metrics provider
For profit	No	No	Yes	Yes
Income based on	Page charges	Publishers/Grants	Publishers	Institutions
Rate limiting	Not enforced	Not enforced[c]	1 call/sec.[a]	Unknown
Products covered	Articles	Many[d]	Many[e]	Many[f]
Software clients	R[g]	R,Javascript[h]	R,Python,Ruby,iOS[i]	Unknown

Notes: [a]Also hourly and daily limits enforced; using API key increases limits. [b]D: day; M: month; Y: year; T: total; I: incremental summaries. [c]They recommend delaying a few seconds between requests. [d]Articles, code, software, presentations, datasets. [e]Articles, datasets, books. [f]Articles, code, software, presentations, datasets, books, theses, etc. (see http://www.plumanalytics.com/metrics.html for a full list). [g]https://github.com/ropensci/alm [h]R (https://github.com/ropensci/rimpactstory), Javascript (https://github.com/highwire/opensource-js-ImpactStory). [i]R (https://github.com/ropensci/rAltmetric), Python (https://github.com/lnielsen-cern/python-altmetric), Ruby (https://github.com/ldodds/altmetric), iOS (https://github.com/shazino/SZNAltmetric).

At the time of writing, there are four major entities that aggregate and provide article-level metrics data:

1. PLOS[14]
2. ImpactStory[15]
3. Altmetric[16]
4. Plum Analytics[17]

(See Table 1 for details.)

There are a few other smaller scale article-level metrics providers, such as CitedIn[18] and ScienceCard,[19] but they are relatively small in scope and breadth. There are some similarities and differences among the four providers, which may help in deciding which service to use for a particular purpose (see also Table 3).

The four providers overlap in some sources of article-level metrics they gather, but not all (see Table 3). The fact that the sources are somewhat complementary opens up the possibility that different metrics can be combined from across the different providers to get a more complete set of article-level metrics. For those that are complementary, this should be relatively easy and we don't have to worry about data consistency. However, when they share data sources, one has to choose which data provider to use tweets from, for example, and data may not be consistent between providers for the same data source (see the *Consistency* section below).

One of the important aspects of article-level metrics is that most of the data is from article-level metrics aggregators like ImpactStory who aren't creating the data themselves, but rather are collecting the data from other sources that have their own licenses. Thus, data licenses for PLOS, ImpactStory, Altmetric, and Plum Analytics generally match those of the original data provider (e.g., some data providers do not let anyone cache their data).

Consistency

Now that there are multiple providers for article-level metrics data, data consistency is an important consideration. For example, PLOS, ImpactStory, Altmetric, and Plum Analytics collect article-level metrics from some of the same data sources. But are the numbers they present to users consistent for the same paper or are they different due to different collection dates, data sources, or methods of collection? Each of the aggregate article-level metrics providers may collect and present article-level metrics as relevant for their target audience. Thus, as article-level metrics consumers and researchers, we need to have a clear understanding of the potential pitfalls when using article-level metrics data for any purpose, especially research where data quality and consistency is essential.

For this study a set of 565 articles were used, identified using their DOIs, from PLOS journals only; this way all four providers would have data on the articles. Metrics were collected from each of the four providers for each of the 565 DOIs using as primary sources CiteULike, Scopus, PLOS-Counter (usage data: html, xml, and pdf views), PubMed Central (PMC), Facebook, Mendeley, and Twitter. (Data was excluded from Plum Analytics for CiteULike as it was not provided, but they do collect it.[20] In addition, Facebook data was excluded from Plum Analytics results because it was unclear how to equate their data with the data from the other providers.) For each DOI, the maximum difference between values (i.e., providers) was calculated and the distribution was plotted for seven article-level metrics that were shared among the providers. Figure 1 shows

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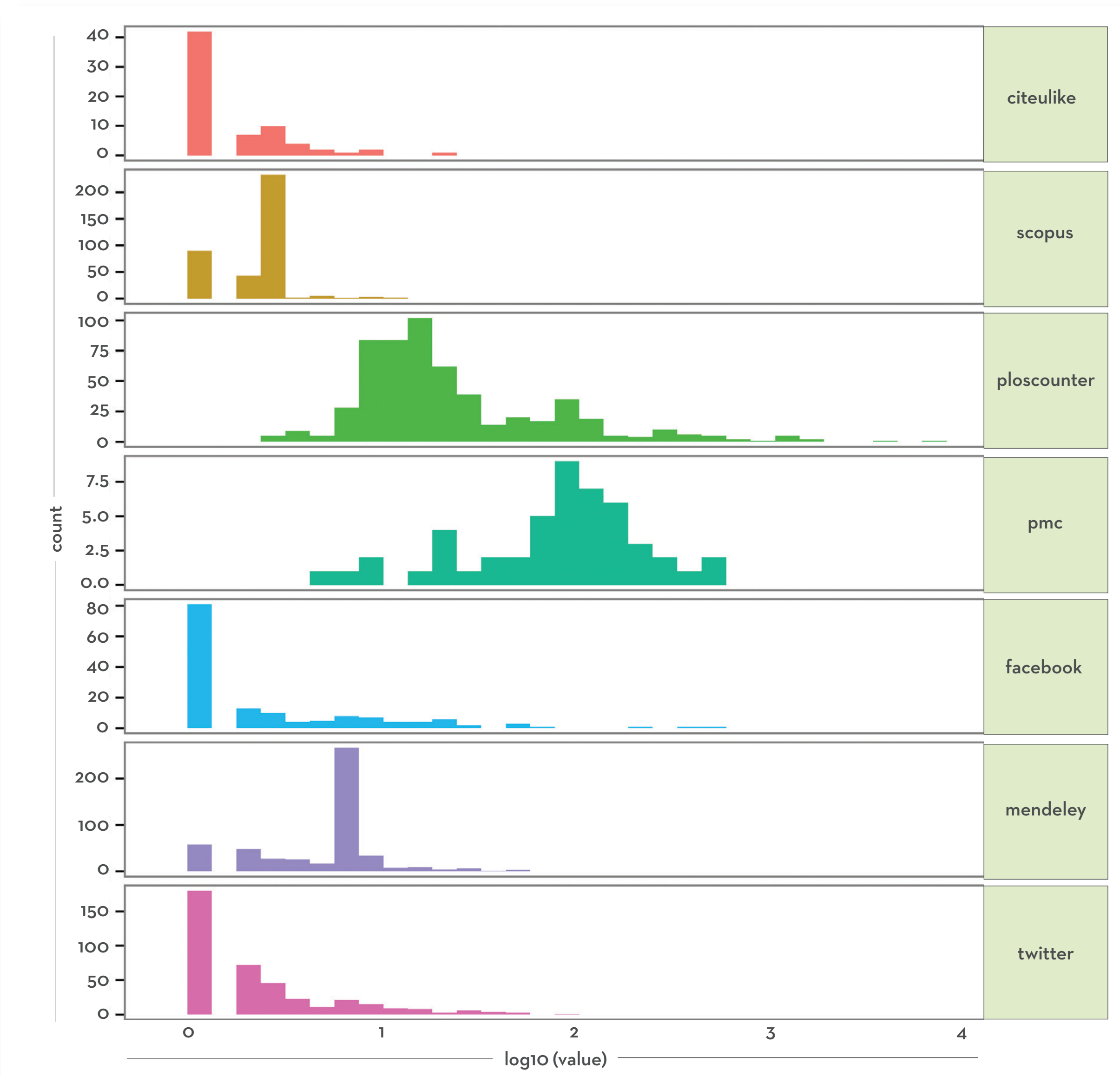


Note: Calculated on a set of 565 DOIs from Altmetric, ImpactStory, and PLOS ALM. Values were log10 transformed to improve visual comprehension. Metrics: citeulike = number of CiteULike bookmarks; scopus = number of citations; ploscounter = number of pdf views + html views; pmc = number of Pubmed Central full text + pdf views; facebook = number of Facebook shares; mendeley = number of Mendeley readers; twitter = number of tweets mentioning article.

Figure 2: Distribution of absolute differences in least and greatest value of each of seven different article-level metrics

Note: Calculated on a set of 565 DOIs from Altmetric, ImpactStory, and PLOS ALM. Values were log10 transformed to improve visual comprehension. See Figure 1 for explanation of the specific article-level metrics.

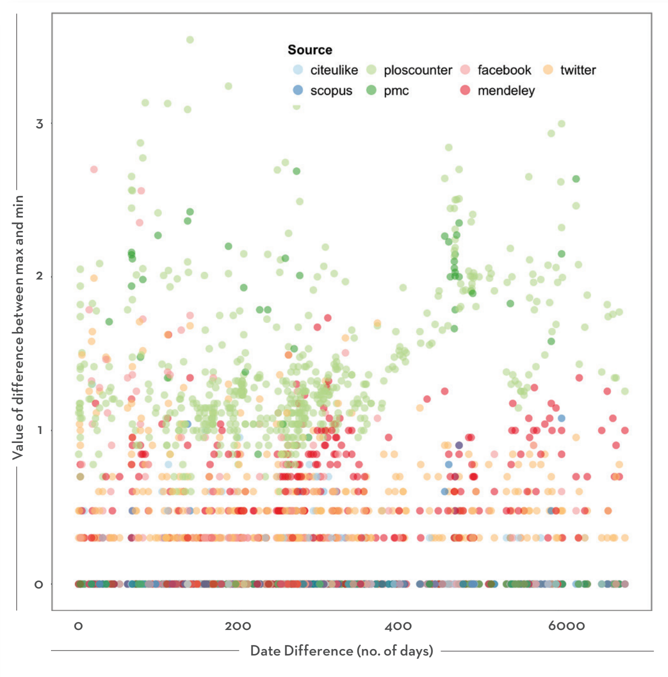
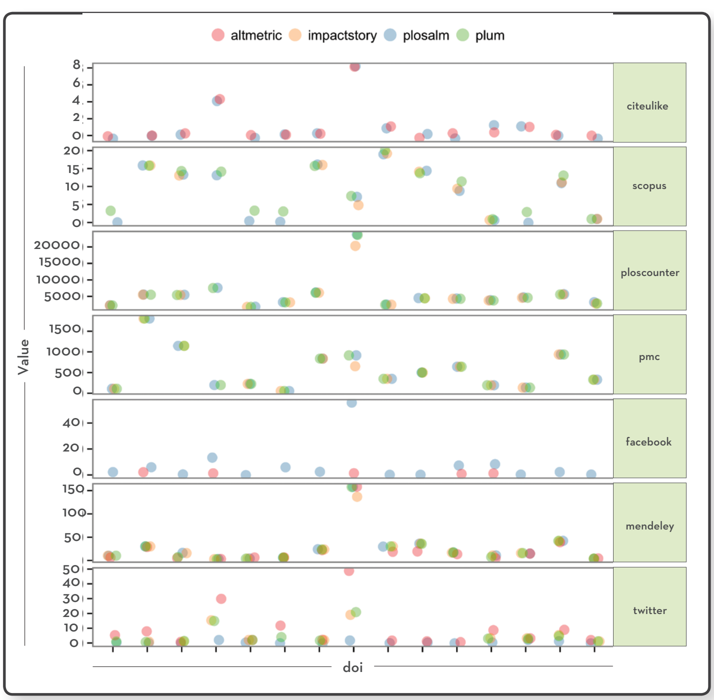


Figure 3: A comparison of seven different article-level metrics on a set of 20 DOIs from Altmetric, ImpactStory, and PLOS.

Note: This demonstrates how article-level metrics can be very similar across providers for some DOIs, but very dissimilar for others. See Figure 1 for explanation of the specific article-level metrics.



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that, at least with respect to absolute numbers, PMC citations are very different among providers, while PLOS views (html + pdf views, relevant only to PLOS ALM, ImpactStory, and Plum Analytics) are somewhat less variable among providers. The remaining metrics were not very different among providers, with most values at zero, or no difference at all.

What are some possible reasons why similar metrics differ across providers? First, data could be collected from different middlemen. For example, Twitter data is notorious for not being persistent. Thus, you either have to query the Twitter "firehose" constantly and store data, or go through a company like Topsy (which collects Twitter data and charges customers for access) to collect tweets. Whereas ImpactStory collects tweets from Topsy, PLOS collects tweets from the Twitter firehose, and Altmetric collects tweets using a combination of the Twitter search and streaming APIs. Second, data could be collected at different times, which could easily result in different data even when collected from the same source. This is especially obvious as ImpactStory collects some metrics via the PLOS ALM API, so their metrics *should* be the same as those that PLOS has. Fortunately, date is supplied in the data returned by three of the providers (PLOS ALM, ImpactStory, and Altmetric). Thus, whether or not date could explain differences in metrics from the various providers was examined. Figure 2 shows that there are definitely some large differences in values that could be due to differences in the date the data was collected, but this is not always the case (i.e., there are a lot of large difference values with very small difference in dates).

The previous analyses were a rough overview of hundreds of DOIs. To determine the differences among providers in more detail, a set of 20 DOIs from the set of 565 were used. Figure 3 shows the value of each altmetric from each of the providers for each of the 20 DOIs. Note that in some cases there is very close overlap in values for the same altmetric on the same DOI across providers, but in some cases the values are very different.

A particular example of these results may be instructive. Table 2 details the results of using the API of each of the four providers to combine data from different sources for the DOI 10.1371/journal.pbio.1001118.[22] There are many metrics that have exactly the same values among providers, but there are also differences, which could be explained by the difference in the collection date. For example, PLOS ALM gives 3860 for combined PLOS views, while ImpactStory gives 3746 views. This is undoubtedly explained by the fact that PLOS ALM data was last updated on May 31, 2013, while ImpactStory's data

PROVIDER	citeulike	scopus	ploscounter	pmc	facebook	mendeley	twitter	Date Modified
PLOS ALM	1	1	3860	192	8	11	0	2013-05-31
Altmetric	0				1	5	9	2012-07-28
ImpactStory		1	3746	192		11	3	2013-05-18
Plum Analytics		1	3746	192			3	unknown

Table 2: Example of combining results across three data providers on one DOI.

was last updated on May 18, 2013. There are some oddities, however. For example, Altmetric gives nine tweets, ImpactStory and Plum Analytics only give three tweets, while PLOS ALM gives zero. ImpactStory's data was updated more recently (May 18, 2013) than that of Altmetric (July 28, 2012), which suggests something different about the way tweets among the two providers are collected as updated date alone cannot explain the difference. In fact, ImpactStory collects tweets from Topsy, while Altmetric collects tweets with a combination of Twitter search and streaming APIs, which leads to different data. Meanwhile, PLOS ALM collects tweet data from the Twitter firehose.

The above findings on data consistency suggest that article-level metrics are inconsistent among aggregate providers of aggregate article-level metrics. Casual users, and especially those conducting article-level metrics research, should use caution when using article-level metrics data from different providers.

A crosswalk among providers

Each of the four providers, of course, has the right to collect metrics as needed for their purposes, but as article-level metrics consumers, we should be able to compare data from the same source across providers. When similar data sources are collected by article-level metrics providers, ideally, there should be a way to map data, e.g., from Twitter for PLOS, ImpactStory, Altmetric, and Plum Analytics. Table 3 provides a sample crosswalk of metrics for the same data source among providers.

Article-level metrics data provenance

Article-level metrics data comes from somewhere—tweets from Twitter, citations from Web of Science or Scopus, bookmarks from CiteULike, etc. Provenance is concerned with the origin of an object, the ability to trace where an object comes from in case there is any need to check or validate data.

Why should we care about provenance in article-level metrics? In any research field, the verifiability of research results should be a priority, and verification requires the underlying data. Second, in general, article-level metrics are based on completely digital data. This means that all use of, research on, hiring decisions based on, and conclusions drawn from article-level metrics data should theoretically be traceable back to the original production of that data. This is somewhat unusual; most research fields are based on data collected at some point that cannot be traced, but this trace should be possible in article-level metrics. A specific example will demonstrate the power of data provenance in article-level metrics. Imagine if a research paper makes controversial claims using article-level metrics data on a set of objects (e.g., scholarly papers). An independent researcher could theoretically drill down into the data collected for that paper, gain further insight, and potentially dispute or add to the paper's conclusions.

As previously discussed, data for the same article-level metrics resource could be calculated in different ways and collected at different times for the same object. The providers already provide the date the metrics were updated. However, there is little information available, via their APIs at least, regarding *how* data were collected and what, if any, calculations were done on the data. The article-level metrics community overall would benefit from transparency in how data are collected.

There are two ways to track provenance: via URLs and identifiers. ImpactStory provides a field named *provenance_url* with each metric data source. For example, for a recent paper by Piwowar et al. with DOI 10.1371/journal.pone.0000308,[23] a GET call to the ImpactStory API returns many metrics,

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one of which is 10 bookmarks on Delicious. Importantly, they also return the field *provenance_url* (in this case http://www.delicious.com/url/9df9c6e819aa21a0e81ff8c6f4a52029), which takes you directly to the human-readable page on Delicious from where the data was collected. This is important for researchers to replicate and verify any reported results. A nice feature of digital data such as article-level metrics is the ability to trace back final article-level metrics from providers such as ImpactStory to their original source.

The PLOS ALM API provides something less obvious with respect to provenance, a field called *events_url*, which for the same Piwowar et al. paper returns 82 bookmarks on CiteULike, and the human-readable link to where the data was collected (http://www.citeulike.org/doi/10.1371/journal.pone.0000308).

Plum Analytics does something interesting with respect to provenance. In addition to the canonical URL, they collect alias URLs for each object for which they collect metrics. For example, for the DOI 10.1371/journal.pone.0018657,[24] they collect many URLs that point to that paper. This makes sense as a digital product is inevitably going to end up living at more than one URL (the internet is a giant copying machine after all), so collecting URL aliases is a good step forward for article-level metrics. ImpactStory and Altmetric (except for Mendeley URLs) do this as well.

An important issue with respect to provenance is that data sources sometimes do not give URLs. For example, CrossRef and Facebook don't provide a URL associated with a metric on an object. Therefore, there is no way to go to a URL and verify the data that was given to you by the article-level metrics provider.

All four providers collect multiple identifiers, including DOI, PubMed Identifier (PMID), PubMed Central ID (PMCID), and Mendeley UUID. These identifiers are not URLs but can be used to track down an object of interest in the respective database/service where the identifier was created (e.g., a DOI can be used to search for the object using CrossRef's DOI resolver query or by appending the DOI to http://dx.doi.org/).

What is ideal with respect to data provenance? Is the link to where the original data was collected enough? Probably so, if no calculations were done on the original data before reaching users. However, some of the providers do give numbers which have been calculated. For example, ImpactStory puts some metrics into context by calculating a percentage relative to a reference set. Ideally, how this is done should be very clear and accessible.

Putting article-level metrics in context

Raw article-level metrics data can be, for example, the number of tweets or the number of html views on a publishers website. What do these numbers mean? How does one paper or dataset compare to others? ImpactStory gives context to their scores by classifying them along two dimensions: audience (scholars or public) and type of engagement (view, discuss, save, cite, recommend). Users can then determine whether a product (paper, dataset, etc.) was highly viewed, discussed, saved, cited, or recommended, and whether by scientists or by the public. This abstracts away many details; however, users can drill down to the underlying data via the API and web interface.

Altmetric uses a different approach. They provide context for only one metric, the altmetric score. This is a single aggregate metric, the calculation of which is not explained. They do provide context for the altmetric score, including how it compares to: a) all articles in the same journal, b) all articles in the same journal published within three weeks of the article, c) all articles in the Altmetric database, and d) all articles in the Altmetric database published within three weeks of the article. Altmetric gives detailed context for some article-level metrics, including Facebook, Twitter, and blogs.[25]

Plum Analytics does not combine article-level metrics into a single score as does Altmetric, but does categorize similar types of article-level metrics into captures, citations, social media, mentions, and usage (though you can dive into the individual article-level metrics).[26]

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Table 3 Notes: *These variables relate to one another across providers, but the data may be collected differently, so, for example, article-level metrics collected for Twitter may differ between PLOS, ImpactStory, Altmetric, and Plum Analytics. Where data sources are shared among at least two providers, only those fields were used that would give the same data if collected on the same date and all other things being equal. For example, PLOS ALMs field pubmed is equivalent to ImpactStory's pubmed:pmc_citations field.*

[a] *These are the exact names for each data source in the PLOS ALM API.*
[b] *You cannot request a specific source from the ImpactStory API, so these are the names of the fields in the returned JSON from a call.*
[c] *You cannot request a specific source from the Altmetric API, so these are the names of the fields in the returned JSON from a call.*
[d] *Some of these names are the exact names returned in an API call; others are not.*
[e] *Collected from the PLOS ALM API.*
[f] *PLOS ALM also provides xml_views.*
[g] *Collected from the PLOS ALM API. Other PMC data fields collected from PLOS ALM (pmc_abstract, pmc_supp-data, pmc_figure, pmc_unique-ip) and from PubMed (suppdata_views, figure_views, unique_ip_views, pdf_downloads, abstract_views, fulltext_views).*
[h] *Should be equivalent to plosalm:pubmed_central. ImpactStory also collects pubmed:pmc_citations_reviews, f1000, and pmc_citations_editorials.*
[i] *Collected from the PLOS ALM API. Scopus citations also collected from Scopus itself, in the field scopus:citations.*
[j] *ImpactStory also collects Facebook clicks, comments, and likes.*
[k] *ImpactStory also collects Mendeley readers by discipline, number of groups that have added the article, percent of readers by country, and percent of readers by career_stage.*
[l] *ImpactStory also collects the number of influential_tweets from Topsy.*

Table 3: Crosswalk between article-level metrics data collected by the four data providers.

DATA SOURCE	PLOS[a]	ImpactStory[b]	Altmetric[c]	Plum Analytics[d]
Biod	biod	No	No	No
Bloglines	bloglines	No	No	No
Nature blogs	nature	No	No	No
ResearchBlogging	researchblogging	No	No	researchblogging
Web of Science citations	webofscience	No	No	No
Dryad	No	dryad:total_downloads package_views	No	views, downloads
figshare	No	figshare:views shares downloads	No	recommendations, downloads, views
GitHub	No	github:forks stars	No	collaborators, downloads, followers, forks, watches, gists
PLOS Search	No	plossearch:mentions	No	No
SlideShare	No	slideshare:favorites views comments downloads	No	downloads, favorites, comments
Google+	No	No	cited by gplus count	No +1s
MSM (mainstream media news outlets)	No	No	cited by msm count	No
News articles	No	No	Yes	Yes
Reddit	No	No	cited by rdts count	comments, upvotes-downvotes
CiteULike	citeulike	citeulike:bookmarks	No	citeulike
CrossRef	crossref	plosalm:crossref[e]	No	No
PLOS ALM	counter (pdf_views + html_views)	plosalm (html_views, pdf_views)[f]	No	views of abstract, figures, full text, html, pdf, supporting data
PMC	pmc	plosalm: pmc_full-text + pmc_pdf[g]	No	No
PubMed	pubmed	pubmed:pmc_citations[h]	No	pubmed
ScienceSeeker	scienceseeker	scienceseeker:blog_posts	No	scienceseeker
Scopus citations	scopus	plosalm:scopus[i]	No	No
Wikipedia	wikipedia	wikipedia:mentions	No	wikipedia
Delicious	No	delicious:bookmarks	cited by delicious count	delicious
Facebook	facebook_shares	facebook:shares[j]	cited by fbwalls count	facebook clicks, comments, likes
Mendeley readers	mendeley shares	mendeley readers[k]	mendeley readers	mendeley readers, groups
Twitter	twitter	topsy:tweets[l]	cited by tweeters count	topsy tweets

One of the advantages of article-level metrics is the fact that they measure many different things, important to different stakeholders (public, scholars, funders). Thus, combining article-level metrics into a single score defeats one of the advantages of article-level metrics over the traditional journal impact factor, a single metric summarizing data on citations. The single Altmetric score is at first appealing given its apparent simplicity. However, if article-level metrics are to avoid the pitfalls of the Journal Impact Factor,[4] we should strive for meaningful article-level metrics, important to different stakeholders, that retain their context (e.g., tweets vs. citations).

A specific example highlights the importance of context. A recent paper of much interest titled *Glass shape influences consumption rate for alcoholic beverages*[27] has, at the date of this writing, an Altmetric score of 316; this score is compared relative to the same journal (PLOS One) and all journals at different points in time. Other article-level metrics are reported but are not given any context. ImpactStory reports no single score, gives raw article-level metrics data, and gives context. For example, ImpactStory reports that there are 149 tweets that mentioned the paper and this number of tweets puts the paper in the 97th-100th percentile of all Web of Science indexed articles that year (2012). This context for tweets about an article is more informative than knowing that the paper has an Altmetric score of 316—data consumers should know the context of the audience the tweets represent. The number of tweets relative to a reference set gives a bit of information on the impact of the paper relative to others. Of course not all journals are indexed by Web of Science and the important reference set for one person (e.g., papers in journals in their specific field) may be different from another person's (e.g., papers for colleagues at their university or department). PLOS recently started reporting "Relative Metrics" in the html versions of their articles, where one can compare article usage (cumulative views) to reference sets of articles in different fields.[28]

There is still work to do with respect to context. Future work should consider further dimensions of context. For example, perhaps users should be able to decide how to put their metrics into context. Instead of getting raw values and values relative to a pre-chosen reference set, users could choose what reference they want to use for their specific purpose. In addition, but much harder to achieve, is sentiment or the meaning of the mention. That is, was a tweet or citation about a paper mentioned in a negative or positive light?

Historical context

Researchers asking questions about article-level metrics could ask more questions specifically dealing with time if historical article-level metrics data were available. PLOS provides historical article-level metrics data on some of their metrics (except in the case of licensed resources, e.g., Web of Science and Scopus), while Altmetric provides publicly available historical data on their Altmetric score and historical data on other metrics to commercial users, and ImpactStory and Plum Analytics do not provide historical data. The data returned, for example, for number of tweets for an article from ImpactStory, Altmetric, or Plum Analytics is a cumulative sum of the tweets mentioning that article. What were the number of tweets mentioning the article one month ago, six months ago, one year ago? It is a great feature of PLOS ALM that you can get historical article-level metrics data. In fact, PLOS wants this data themselves for things like pattern detection and anti-gaming, so providing the data to users is probably not much additional work. However, these historical data are only available for PLOS articles.

The article-level metrics community would benefit greatly from storing and making available historical article-level metrics data. However, as more products are tracked, historical data will become expensive to store, so perhaps won't be emphasized by article-level metrics providers. In addition, a technical barrier comes in to play in that pushing a lot of data via an API call can get very time consuming and resource intensive.

Technical barriers to use

Some article-level metrics users may only require basic uses of article-level metrics, like including these metrics on their CVs to show the various impacts of their research.[13] Some users may want to go deeper and perhaps collect article-level metrics at finer time scales, or with more detailed data, than are given by article-level metrics aggregate providers. What are the barriers to getting more detailed article-level metrics data?

Diving deeper into article-level metrics means considering whether one can access data, whether the data source is machine readable, and how easy the data is to retrieve and manipulate once retrieved.

1 Data access

Many article-level metrics sources are accessible as the data providers have open, or at least partly open, APIs (e.g., PLOS). Other data sources are problematic. For example, you can only get tweets from Twitter for the past 30 days, after which you have to pay for a service that caches historical Twitter data (e.g., Topsy). Other sources are totally inaccessible (e.g., Google Scholar citations).

2 Machine readable

Ideally, article-level metrics are provided through an API. However, some metrics of interest may only be in PDFs, spreadsheets, or HTML, which cannot be easily machine-consumed and re-used or mashed up. For these metrics, the user should seek out aggregators such as those discussed in this paper to do the heavy lifting. Alternatively, technically savvy researchers could write their own code, or leverage tools such as ScraperWiki.[29]

3 Ease of use

Fortunately, many libraries or extensions exist for a number of programming languages (e.g., Python and R) relevant to scholars who deal with article-level metrics data (e.g., Figshare API libraries, Twitter API libraries; see Table 1). These libraries take care of the data collection and transform data to user friendly objects, allowing users to do the real science work of analysis and inference.

Conclusion

Article-level metrics measure the impact of scholarly articles and other products (e.g., datasets, presentations). These measures of scholarly impact are quickly gaining ground as evidenced by the four companies aggregating and providing article-level metrics (see Table 1). In any field growing pains are inevitable; article-level metrics as a field is quite young and, therefore, has some issues to work out. As shown in this paper, article-level metrics users should consider a variety of issues when using article-level metrics data, particularly consistency, provenance, and context. Article-level metrics providers collect data at different times and from different sources; combining data across providers should be done with care. Article-level metrics is special in the sense that all data is digital. Thus, there is no reason we shouldn't be able to track all article-level metrics data to their sources. This will not only provide additional insight to scholarly impact, but also provide a way to verify results and conclusions made regarding article-level metrics.

As article-level metrics grow in use and popularity, researchers will ask more questions about the data. In addition, it is hard to predict what people will want to do with article-level metrics data in the future. Since we are in the early stages of the field of article-level metrics, we have the chance to steer the article-level metrics ship in the right direction. The points covered in this paper provide fodder for article-level metrics providers and users to consider. | FE | doi: 10.3789/isqv25no2.2013.02

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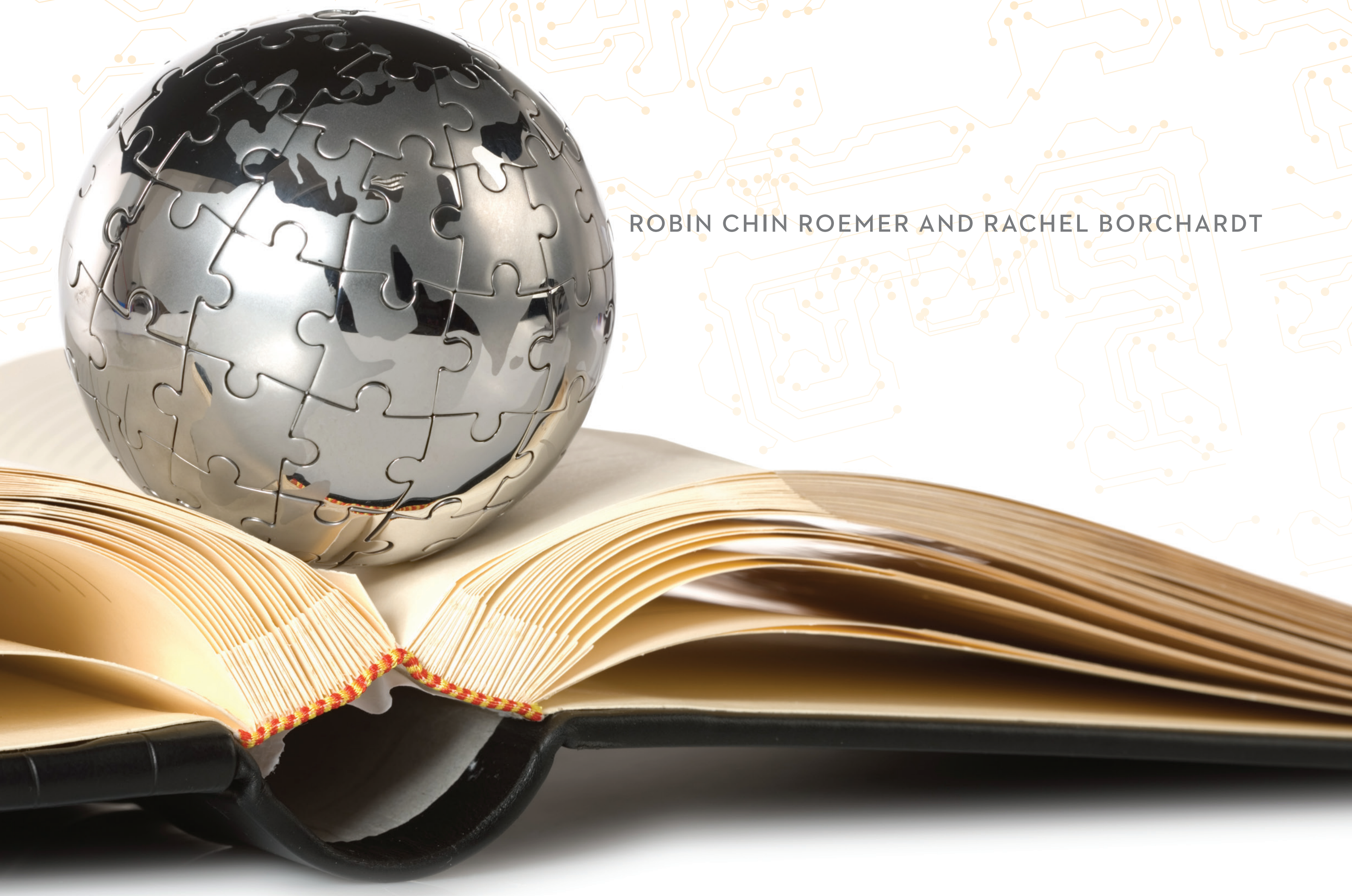
INSTITUTIONAL ALTMETRICS & ACADEMIC LIBRARIES

ROBIN CHIN ROEMER AND RACHEL BORCHARDT



"NO ONE CAN READ EVERYTHING." So begins the Altmetrics Manifesto, first published online in late 2010 by the pioneering quartet of Priem, Taraborelli, Groth, and Neylon.[1]

While the concept of altmetrics has matured considerably in the three years since the manifesto's release, the idea of the "one"—that solo he or she who turns to altmetrics to filter or analyze a collection of sources—has remained largely consistent in the movement's development. The result of this focus has been, on one hand, a positive growth in the number of altmetrics tools customized to the needs and products of individual users. On the other hand, proportionately little attention has been paid to date to the development of core altmetrics tools for scholars identified in the institutional aggregate.

From the perspective of academic librarians—a professional group that has long championed the importance of scalable scholarly filters—this contrast is part of a larger challenge that altmetrics faces in the tenure–and–administration dominated world of higher education. In this article, we take a moment to examine a few ways in which altmetrics has begun to address the needs of institutions and, more specifically, the key roles that librarians can play as partners, liaisons, and advocates in such endeavors.

A Brief Look Back: Libraries and Bibliometrics

In order to understand the current state of the relationship between academic institutions and altmetrics, it is helpful to begin with a quick look at the state of institutional bibliometrics, and the role that libraries have played in shaping it over time. As Galligan and Dyas–Correia point out in their recent altmetrics-focused guest column in *Serials Review*, librarians have traditionally served two functions in the institutional spread of scholarly metrics: the first, as "communications partner[s] with researchers," and the second, as providers of functional "learning support" through the development of metrics-enabled collections.[2]

The idea of libraries as collections-based centers of metrics support goes back to at least the 1980s, when Thomson Reuters made its Impact Factor metric[3] available to scholars through Web of Knowledge.[4] By helping broker institutional access to such proprietary tools and metrics, librarians at many universities have provided tenure–track faculty with access to electronic resources while at the same time implicitly or explicitly promoting citation–based impact paradigms.

Over the last decade, in response to faculty requests and changes in the larger field of scholarly communication, academic libraries have generally sought to diversify scholars' access to bibliometric products through subscriptions to new sets of institutional tools and networks. The 2004 launch of Scopus,[5] for example, gave research libraries with the necessary funding a new option for providing researchers with access to citation-based metrics at the article and journal levels across various disciplines. During this same period, certain enterprising libraries began to experiment with the creation of in–house solutions to the problem of scholarly visibility and impact, from the creation of library–maintained repositories to the set–up of institutionally formatted scholarly networks such as VIVO.[6] Collectively, these efforts have brought libraries closer to developer–side conversations about institutional usage statistics and "altmetrics culled from the social web."[7] However, for all this progress in the name of "learning support," little has changed at most universities in terms of the metrics expected and valued by administrators in charge of reviewing faculty for tenure and promotion. To understand this resistance, we must look at three challenges that institutions pose to the field of altmetrics and to the second major role of libraries, as partners in academic communication.

Challenges to Institutional Altmetrics and the Role of Librarians

The first and most obvious challenge that must be addressed for altmetrics to penetrate the broader realm of higher education is the development of more sophisticated tools for aggregate–level altmetrics and comparative institutional analysis. Part of the historical success of citation-based bibliometrics in academia is that they can be used to approximate the impact of scholarship across key groups of faculty, albeit in highly restricted systems of scholarship. By providing university administrators with averages and well–defined realms of intellectual transfer, faculty in various departments have been able to set precedents for what constitutes "high impact" activity for purposes of tenure and promotion.

Altmetrics tools, by contrast, have just begun to scrape the surface of aggregated and comparative institutional impact. For instance, the creators of Total–Impact—an early leader in exploring the aggregation of web-based metrics—

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Librarians, as historical performers of institutional analysis, recognize this gap and can communicate with altmetrics developers about the need to draw clearer lines of comparison and contrast between the loosely aggregated metrics of the social web and the more tightly inscribed bibliometrics of journals and databases.

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openly discussed the difficulty of normalizing altmetrics prior to the tool's rebranding in 2012 as ImpactStory.[9] While the latest version of ImpactStory now includes a report feature with some comparative data, such as percentile scores for each metric compared to an appropriate baseline, the limited design of the tool's import feature still makes it impractical for anyone beyond a small group of researchers to perform analysis on a joint collection of research, let alone the work of an entire department or institution. Librarians, as historical performers of institutional analysis, recognize this gap and can communicate with altmetrics developers about the need to draw clearer lines of comparison and contrast between the loosely aggregated metrics of the social web and the more tightly inscribed bibliometrics of journals and databases. A current example of this partnership is Plum Analytics' PlumX[10] tool, launched in 2011 by former librarian Mike Buschmen and technology entrepreneur Andrea Michalek. By uniquely allowing altmetrics tracking for large groups of users across traditional and emerging categories of metrics, PlumX demonstrates how future altmetrics offerings may yet satisfy both individual researchers and non–academic administrators seeking to benchmark their institutions against others in the field.

The second major challenge that altmetrics face in gaining traction in institutional settings is the need for tools that adequately address the full variety of scholars and types of scholarship that exist across the disciplines. Existing altmetric measures tend to bias heavily toward science, technology, engineering, and medical (STEM) disciplines, while the other disciplines (e.g., humanities, arts, and social sciences) have far fewer tools and metrics available to them.

There are several key reasons for this lack of balance, most of which go back to the larger history of bibliometrics and higher education administration. For instance, it has frequently been noted by both librarians and information scientists that researchers in STEM disciplines tend to emphasize the production and consumption of journal articles more heavily than scholars in the humanities or social sciences, for whom book–length works and monographs are also highly valued.[11] Because the field of bibliometrics was initially developed in response to the needs and practices of scientists, these non–STEM disciplines have struggled for decades to apply quantitative bibliometrics to their own scholarship, such as the tracking of citations for scholarly monographs or, more recently, select book chapters.[12],[13] Consequently, faculty in the humanities and social sciences have predominantly based their impact narratives on qualitative indicators, such as book reviews, peer comments, and publisher reputation. These qualitative measures cannot be easily summarized by metric tools, and thus represent a barrier to both traditional bibliometrics and emerging altmetrics in accurately measuring institution–level scholarly output. Nevertheless, faculty in humanities and social sciences fields are feeling increased pressure from administrators, grantmakers, and interdisciplinary collaborators to provide at least some metrics in support of their ongoing scholarly impact.

In response to these pressures, some providers of both bibliometrics and altmetrics have recently attempted to take a more structured approach to the needs of multidisciplinary users. Thomson Reuters, for instance, launched its Book Citation Index[14] in 2011 in order to better capture metrics related to monograph publications within Web of Science.[15] Touting initial coverage of more than 40,000 books—60% from the humanities and social sciences—this Index represents a substantial acknowledgement of the need for scholarly metrics across a wide range of academic departments. However, as Gorraiz et al. point out,[16] Book Citation Index is still a tool in its infancy, and therefore should not yet be used to evaluate faculty impact.

Additionally, because subscription to Book Citation Index comes at a significant financial cost to libraries, few faculty will have access to such products as part of their preparation for review and advancement.

The altmetrics community, by contrast, has addressed the problem of multidisciplinary metrics by promoting the spread of scholarly peer networks—resources that serve as both a central access point for a variety of scholarly outputs and a place to establish connections with other researchers based on similar interests. Mendeley,[17] for instance, has proven especially popular with faculty beyond the STEM disciplines, as it provides users with article and journal-level altmetrics based on reader communities that acknowledge, yet also cut across, traditional disciplinary lines. The Social Science Research Network (SSRN)[18]—an open-access repository of approximately 20 networks—has been of similar value to non–STEM researchers for almost two decades, due to its statistical tracking of per-article downloads and citations. What's more, Mendeley and SSRN are two of very few altmetrics–friendly scholarly tools that provide an option for subscription and analysis at the institutional level. However, just as the value of Book Citation Index must be tempered by the understanding of its current gaps and limits, so too must the utility of an institutional subscription to Mendeley or SSRN be balanced by an understanding of the infancy of scholarly peer networks and the stories they tell about communication across and within the disciplines. In this way, academic librarians play an essential role, once again, in convincing university administrators of the value of experimental tools and networks, while at the same time tempering faculty expectations for such tools' use alongside disciplinary impact indicators.

The third major challenge that altmetrics must address in order to gain lasting traction in the university environment is increased consistency in the education and communication between faculty, administrators, and publishers of academic content. While "ambitious scholars" have been including altmetrics data as part of their CVs for years,[19] promotion of altmetrics tools has been mostly at the individual level, taking place in online social media or at conferences, and often reliant on word–of–mouth publicity. Although developers have recently begun reaching out to librarians to help support and promote these tools, this has not yet lead to widespread adoption of altmetrics tools in most institutions, particularly for tools with a high learning curve.

There have also been promising conversations and advancements between altmetrics developers and well-established producers of bibliometrics. This has resulted in two significant developments thus far. First, a partnership between Scopus and Altmetric.com,[20] resulting in the inclusion of altmetrics data alongside traditional bibliometrics within the Scopus interface; second, the much publicized merger between Elsevier and Mendeley[21] which took place earlier this year.

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While there is already some discussion of altmetrics within librarianship, the adoption of altmetrics by a larger organizational body would likely help to unify and promote altmetrics on a wider scale.

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The integration of these latter two products is still unknown, but could lead to the folding of altmetrics information into Elsevier journals and products, similar to the former duo's blending in 2012. However, there is still a large communication gap between existing altmetrics partners and larger stakeholders in the research process—most notably the publishers of scholarly journals in non–STEM disciplines. This gap leaves faculty who produce content for these publishers with few impact measures to present outside of traditional bibliometrics.

Here again, libraries have an opportunity to take advantage of their long–standing relationships with publishers and advocate on behalf of faculty authors for increased availability of publisher–provided metrics data. By encouraging non–participating publishers to follow the lead of forward–thinking entities such as PLOS,[22] which currently provides article–level metrics to its authors, libraries have the potential to enhance communication between all the major stakeholders in the altmetrics conversation, which falls in line with their professional goal of providing information and access.

Academic libraries also clearly maintain close relationships with faculty members, who rely on librarians for training and assistance with at least some tools related to research. Indeed, there is ample evidence that librarians are already creating tools to educate not only faculty, but also administrators and library colleagues about the use and value of altmetrics tools. For example, a quick Google search for LibGuides[23]—an online product used by over 4,000 libraries worldwide to create institutional research guides—reveals more than 100 guides that mention altmetrics, and over 43,000 results for pages that mention "LibGuides" and "altmetrics" together. These numbers indicate that libraries are already incorporating altmetrics information into resources for scholarly communication, impact, and citation management. At the same time, the efficacy of these guides remains unknown, as does the bandwidth of such libraries to provide continued altmetrics support in addition to their other core services without administrative buy–in. Moving forward, libraries need not only to continue to provide accurate and appropriate altmetrics information for faculty, but also to become more mindful of the need to educate administrators in the proper use and limits of altmetric data. Additionally, it is essential for librarians to educate each other and to remain on top of altmetrics developments that affect their work as collection managers, instructors, and independent academics. This enhanced role for libraries is echoed in a recent article by Lapinski, Piwowar, and Priem,[24] which reminds us that librarians may also be active researchers, practitioners, and users of altmetrics tools.

Conclusion: Altmetric Academics

Looking forward to the future of impact and higher education, we see some exciting ways in which altmetrics can move toward more even and widespread adoption, similar to existing bibliometric measures. As academic librarians, we believe the creation of institution–friendly altmetrics tools will provide valuable information to university administrators as well as to faculty, whose research interests we represent. However, it is up to libraries and other strategically placed parties to educate stakeholders about the relative strengths and weaknesses of existing altmetrics tools and to recommend products that are a "best fit" for measuring scholarly output at both the individual and institutional levels. Likewise, it is up to entities such as libraries to educate the developers of altmetrics, as well as publishers, about the need for metrics that fairly represent the wide variety of cross–disciplinary research that takes place in academic institutions. For collections-oriented librarians, this may include advocating for the insertion of article–level altmetrics into more publications, as well as the creation of an open API system that would allow harvesting of data by current and future altmetrics tools. For embedded library liaisons, it may mean working with junior–level faculty to ensure that they can access the appropriate measures for their scholarly output and talking with senior–level faculty to ensure that these new measures are understood and accepted by larger reviewing bodies such as tenure and promotion review committees.

To advocate effectively to all of these stakeholders is a daunting task for the individual librarian. While there is already some discussion of altmetrics within librarianship, the adoption of altmetrics by a larger organizational body would likely help to unify and promote altmetrics on a wider scale. For example, SPARC[25]—an academic library–based scholarly publishing group—has had great success in spreading the word on open access issues by consolidating promotional efforts around awareness events. Similar leadership for the altmetrics movement would help solidify and support the efforts of individual librarians and libraries, particularly as they take on new levels of outreach. Finally, as researchers, librarians must recognize their ability to promote altmetrics, using them in their own impact statements and urging for the adoption of promotional guidelines that focus on the full spectrum of scholarly and professional impact within librarianship itself.

In the years to come, academic libraries may or may not continue to be the core brokers of impact metrics for faculty and administrators within higher education. However, librarians will always play a core role as advocates and partners in the scholarly process and are well positioned to take the lead in adopting, promoting, and using new types of information in academic contexts—including altmetrics. | FE |

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Jennifer Lin

Martin Fenner

Altmetrics in Evolution:

Defining and Redefining the Ontology of Article–Level Metrics

JENNIFER LIN AND MARTIN FENNER

The Public Library of Science (PLOS) first began to offer Article-Level Metrics (ALM)—including online usage, citations, and altmetrics—in 2009 to provide the research community with a view into the reach of our papers. The term altmetrics didn't exist yet, but the social bookmarks, science blog posts, and user comments collected at the time are all part of the discussion of scholarly articles on the social web or what we now call altmetrics. With ALM the emphasis is on research output in the form of an article instead of the journal that aggregates sets of articles.

Since 2009, the data sources in the PLOS suite, as well as the introduction of third party services that have joined us in aggregating altmetrics and ALMs, have experienced an upsurge. Today we have more ways to capture engagement with research outputs and more providers operating in this space than ever before. As a result, the existing landscape of ALMs and altmetrics is increasingly difficult to manage, understand, and navigate. It has become obvious that the different metrics we group together under the broader term altmetrics are indeed representing very different things. A tweet or Facebook "like" of a paper has different meaning from a user adding a paper to his/her Mendeley library or from a blog post discussing a paper. This article is borne out of such a dilemma and offers an approach aimed at alleviating what William James called the "blooming, buzzing confusion" as the scholarly community continues to develop the new technologies into a mature and formal part of the research assessment infrastructure.

Indeed, altmetrics hinges on the very prevalence of its own diversity. Its raison d'être is to provide a more expansive view of a research artifact's impact. Put differently, the circumstance that James has imparted is in fact the very condition of the existence of altmetrics (and core to their value). We are, in fact, the very baby that James describes in the quote who, in newly experiencing the world, is assailed by a whole host of sensations from discrete objects without organizational or conceptual association. To chart a future course for altmetrics, we need

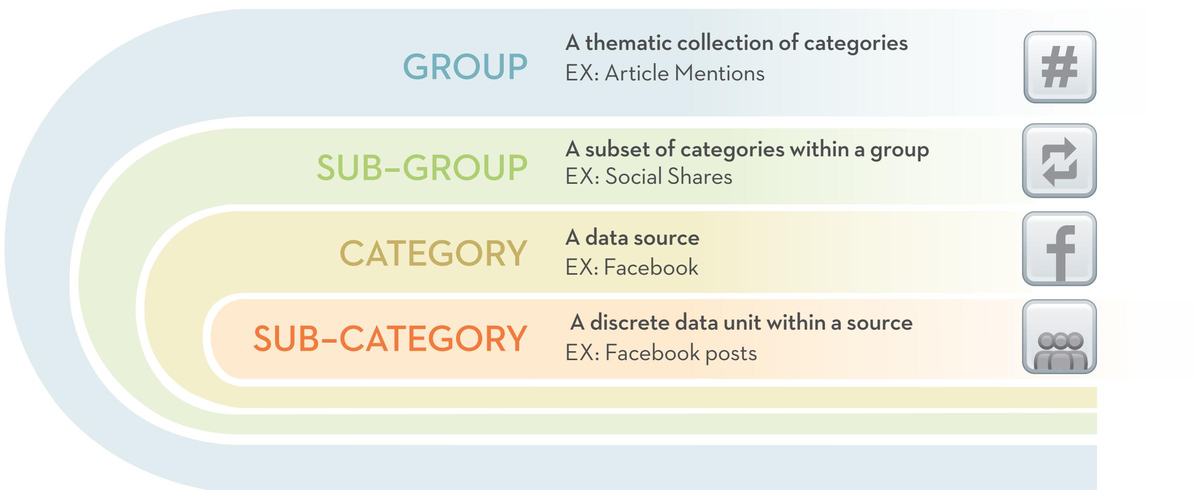

Figure 1: ALM Taxonomy

to organize the myriad metrics and make them trustworthy for all possible uses in research assessment. One important aspect of this is our ability to establish thoughtful and meaningful ways of grouping similar altmetrics together and distinguishing them from other altmetrics with different meaning. These groupings have to be used across the research ecosystem (by researchers, funders, research institutions, and publishers alike) and need to be sufficiently accommodating to endure the evolution of the assessment technology over time. We need classifications that function as infrastructure, governing how we understand and use the metrics.

We have endeavored to address this need for the purposes of PLOS's own use of its ALMs and, more broadly, to ensure that this new paradigm of assessing research takes root. The original groupings established in 2009 were no longer supporting the breadth of metrics now offered and were not in synch with those from other altmetrics providers who have since emerged. We embarked on a process of reconstructing specifications for groupings, which, broadly speaking, were made up of three overall components: evaluation, classification, and implementation. To start, we established a controlled vocabulary to reference the entities and each of their variations, as well as teasing out guiding principles for classification. Next, we evaluated the natural affinities between metrics for common groupings to arise in a manner native to the data sources. From this set of classifications we then established a framework concerning their use throughout the PLOS journals and implemented the applications of ALM data.

Evaluation

We began with a handful of metrics at the start of the program, which were made up mostly of citations, online usage, and social bookmarking data. Over time, we have expanded the number and type of ALMs—e.g., by adding social media metrics from Twitter and Facebook—and have identified more areas to continue this escalation. But we felt that we needed to take stock and formally characterize the metrics by type and subtype at a certain point. We initiated an effort to develop a standard taxonomy of terms to take into account the different dimensions of common affinities possible amongst the diverse data, as shown in Figure 1.

The taxonomic levels primarily serve a formal mechanism of delineating the different types of metrics. The generic tokens, "metric" and "ALM," can refer to any and all of them. Any confusion arising between them only further complicates our attempts to determine suitable classifications. So we established a working taxonomy not only to establish a more precise vocabulary, but also to identify fundamental differences between the minimum component (a sub-category) and all the larger entities that include it.

In addition to the distinctions made within this taxonomy of terms, ALMs can also be characterized as

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Our approach ultimately consisted of a single determinant: the purpose and nature of measurement. We moved from an emphasis on the data source itself to the underlying activity captured by the data source.

primary or secondary metrics. The former set includes the raw counts of activity captured by each source, while the latter is comprised of descriptive statistics that give context to the primary metrics (e.g., article view to PDF download ratio and average usage of similar papers). Moreover, this burgeoning set of metrics can be further distinguished based on the level of the entity measured (research paper or its component sections, e.g., figures, individual sections, etc.), type of artifact measured (article, presentation, dataset, etc.), and entity of interest (article, researcher, institution, funder, etc.). We bracketed out the latter set of distinctions to start and ascertained the broader characteristics of the very basic model.

We then established a set of general principles based on the nature of the data sources and activity captured. They emerged out of the taxonomy and the relationships between groups outlined by it.

1. The grouping should be comprehensive such that each discrete metric can be placed in one and only one group.

2. The grouping should ideally be structured at a level that accommodates new ALMs in the future (and flexibly named as such).

3. The grouping should ideally cluster ALMs together that share the following traits:
   - Temporality
   - Correlation of activity (count) to other ALMs
   - Correlation of native format (e.g., event with date, title, author) to other ALMs

4. Not all the metrics for a grouping will necessarily be represented together in every aggregate. While aggregates (roll-ups) will usually align with groupings, they do not have to include all sources within each group.

These principles not only guided the classifications process but also served to "ground" an effort that involved distilling constants in the midst of continual change from the still-evolving, ever-proliferating data sets and sources. They were also incorporated into the methodology so as to avoid bias in the determination.

Classification

We began the process by setting aside the existing groups of article usage, citations, social networks, blogs and media coverage, and PLOS readers. The categories, once responsive and informative, had become rigid and mute structures that no longer reflected deep commonalities. The internal tensions between metrics within classifications had increased as new metrics were introduced. These then amplified the overall conceptual vulnerabilities of the classification system.

Thus, the slate was cleaned and we began anew. Our approach ultimately consisted of a single determinant: the purpose and nature of measurement. We moved from an emphasis on the data source itself to the underlying activity captured by the data source. The original groups were generalizations of the counts included in a group, so that social media sources were lumped together, for example. But we returned to the basic premise of ALMs and what they offer: a view into the impact and reach of an article by measuring the degree of engagement with it. With this cornerstone, we shifted to the type of article activity as the basis of establishing classifications.

Online usage is the first step of user engagement as it captures the initial (direct) encounter with the paper. PLOS tracks HTML pageviews of fulltext articles (there are no abstract pages) as well as PDF (and XML) downloads. We combine the activity captured on our site with that of PubMed Central, a disciplinary repository, where fulltext copies of all PLOS articles are made freely available. On the other end of the user engagement spectrum are citations in the scholarly literature, which are tracked via the citation indices from CrossRef, Web of Science, Scopus, and PubMed Central.

Citations might be the most important measure of impact, but they only represent a small fraction of the user engagement with a paper, as shown in Figure 2. Only about one in 70 users who download a PDF of the paper will cite it. But many more will engage with it in other ways, and some of this activity can be captured with altmetrics.

When we examined the types of engagement captured by the data sources and grouped them together, we noticed a natural accession of increasing interest in and level of

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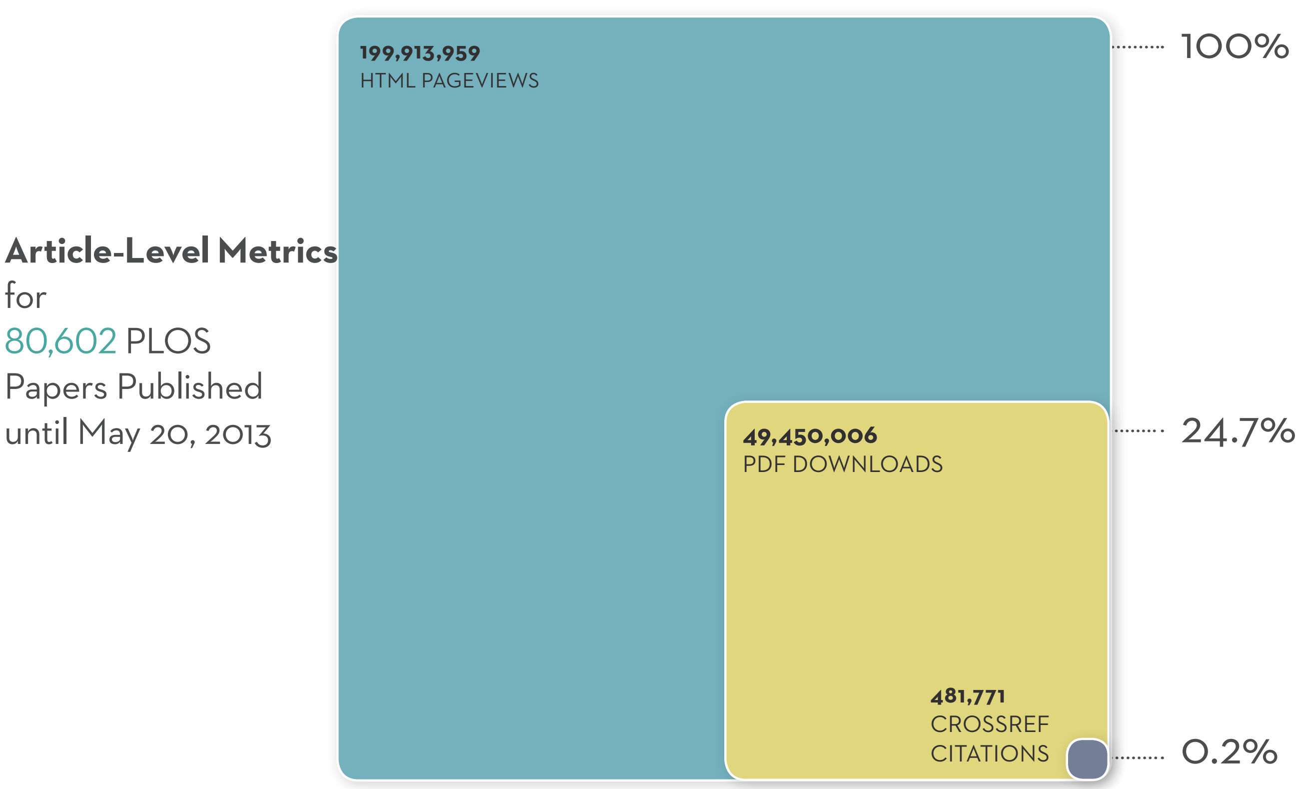
Figure 2: PLOS ALM Comparison of Usage, Downloads, and Citations



RESEARCH ARTICLE

VIEWED	SAVED	DISCUSSED	RECOMMENDED	CITED
PLOS HTML	CiteULike	NatureBlogs	F1000 Prime	CrossRef
PLOS PDF	Mendely	ScienceSeeker		PMC
PLOS XML		ResearchBlogging		Web of Science
PMC HTML		PLOS Comments		Scopus
PMC PDF		Wikipedia		
		Twitter		
		Facebook		

→ Increasing Engagement →

Figure 3: PLOS ALM Classifications

engagement with the research articles. These fall into the following groups:

1. **VIEWED**: Activity of users accessing the article online.
2. **SAVED**: Activity of saving articles in online bibliography managers, which helps researchers organize papers for themselves as well as share them with others.
3. **DISCUSSED**: Discussions of the research described in an article (ranging from a short comment shared on Twitter to more in-depth comments in a blog posting).
4. **RECOMMENDED**: Activity of a user formally endorsing the research article (via a platform such as an online recommendations channel).
5. **CITED**: Formal citation of an article in other scientific journals.

These groups, summarized in Figure 3, are meaningful not only in that they are coherent in themselves and between each other, but also inasmuch as they reflect shared correlations to other metrics. Priem, Piwowar, and Hemminger's study offers observations that agree with the recommended groupings. Furthermore, we aimed to establish a scalable ontology that will provide affordances for the continued introduction of future ALMs (e.g., database links, news media coverage, repository links, sub-article components, etc.).

We examined the classifications by other altmetrics aggregators to uncover natural affinities present between the four today. Plum Analytics organizes their suite of metrics with the categories of usage, captures, mentions, social media, and citations. These loosely correspond to our former set, but the new groups are more closely aligned with those from ImpactStory (see Figure 4), an ontology that largely influenced ours.

As is evident from Figures 3 and 4, the key difference between PLOS and ImpactStory classifications hinges upon a delineation, used by the latter, between scholar and public metrics. We gave serious consideration to this approach, but decided that while there is a great need to be able to better assess the "people behind the data" or, more specifically, the level of significance carried by the activity captured, these distinctions are not a tight fit. The metrics designated as public ones do form a superset of both scholars and non-scholars. Even within a source, we see shifts in the groups represented across time. While a paper may be viewed quite broadly between researchers and the public upon publication, researchers will represent more of the user base over the long run. We also see differences in scholarly vs. non-scholarly activity within a group, e.g., primarily scholarly online usage from PubMed Central vs. online usage by scholars and non-scholars at the PLOS website. We hope to develop more sophisticated technologies in the future, offering deeper insight into the demographics of the users whose article engagements are captured by the metrics, including scholar vs. non-scholar, but also by geography, career stage, etc. Until then, we have elected not to establish a public metric that is segregated from the purview of scholarly activity.

Implementation

Once the ALM ontology was established, the classifications were propagated for use in the PLOS journals. We sought to create overall consistency and coherence for the suite of metrics. But we continually found this effort ran up against our ability to fully deploy the metrics to support research discovery and evaluation of our content. The classifications gave us rules enabling us to systematically organize the metrics in logical groups as well as make them more convenient, portable, and easy to use. But we found there was a need to either group or name them differently at times, depending on the use case at hand. This recurring dilemma was expressed as a choice between overall consistency or maximum usability.

To address this issue, we have constructed a theoretical distinction at the heart of this tension between ALMs and the application of ALM data. From the perspective of the "consumer" of the data (i.e., the researcher, librarian, funder, et al.), there should be no difference between ALMs and their applications, but rather a seamless stream of real-time data supporting the navigation of the site as well as discovery and evaluation of content across the journal platform. For example, the numbers found related to an article should agree with the ALMs used to sort search results that pull up said article.

However, the functional implementation of ALMs in PLOS journals occasionally calls for differentiating, more broadly speaking, from ALMs and their applications. ALMs come directly from the data provider (i.e., the source) and represent the activity captured in the metric. They are directly displayed most often with their primary provenance—their respective group. Conversely, we draw from ALMs as a tool to support article search and sort, assess article engagement, and report on the most popular articles. In order to apply the data to address a wide variety of possible uses, we often need to re-present it in the context of each scenario type. Here, the data is called into dialogue with the environmental factors related to each specific use case and thereby re-appropriated so as to fulfill the express purpose of the intended use.

We take a judicious and measured approach in considering modifications to the groupings and titles dictated by the classification nomenclature. In the event it is deemed necessary to fulfill a specific application, we explicitly reference the original groupings as much as possible (i.e., retain the root word). By preserving and privileging the natural base composition of ALM data through groups, we can consistently use the metrics in a fashion true to their nature (i.e., the nature of the activity captured on the article). But we can also make the ALM data "usable" by applying them to their fullest use in their application. Here, we have greater room to manipulate the display and overall form of the data while staying true to the underlying ontology at the heart of the data ecosystem. In the act of re-appropriating the data, we may manipulate the data in a number of ways, including, but not limited to, aggregating categories to fit a specific need in a way that deviates from the base group collection (sub-group) as well as modifying the grammatical state of a group or sub-group's title.

In our implementation, sub-groups are composites that operate in each instance as an expression of the data established to perform a specific function. They are comprised of a subset of categories within a group. In the event that a subgroup is expressed as an aggregate figure, each of the constitutive subgroup elements remains commensurable to the others and springs from the same type of activity captured in the metrics. All things considered, we default to the classifications nomenclature and display any assortment of ALMs based on their member grouping.

PLOS "article signposts" illustrate the distinction discussed between ALMs and their application as well as sub-groups in action. The signposts are found at the top of every article as navigational pointers for readers to get a

	SCHOLARS	PUBLIC
RECOMMENDED	Citations by editorials, f1000	Press article
CITED	Citations, Full-text mentions	Wikipedia mentions
SAVED	CiteULike, Mendeley	Delicious
DISCUSSED	Science blogs, journal comments	Blogs, Twitter, Facebook, etc.
VIEWED	PDF Downloads	HTML Downloads

Figure 4: ImpactStory Altmetrics Classifications

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quick sense of the paper's flavor. The full selection includes citations, social media shares, bookmarks, and usage. (They only display when data exists for each article). Undoubtedly, they do expose the ALM data and are composed of it. And some of the signposts—citations and usage—easily correspond on the surface to existing groups. However, the signposts fundamentally are appropriations of ALM data. By securing and protecting this distinction, we have more latitude to aggregate, label, and display them so as to satisfy the purpose of providing signposts.

The signposts retain many characteristics of the groups, but minor modifications have been applied, including the inclusion of a sub-group, grammatical adjustments in the labels, etc. The signposts for the Viewed and Saved groups can be aggregated as each count represents unique activity across sources, but the Cited one must be treated differently. The four citation indices contain overlapping sets (i.e., articles that cite the respective PLOS article). Lacking a third-party open repository that de-duplicates all citations picked up by the services, this functionality called for the selection of a single data source, which would stand in for the entire set. Moreover, the signpost for the Discussed group is comprised of metrics too diverse to roll up their counts in a meaningful way. But Tweets and Facebook activity—both capturing social media activity—are similar by nature, and thus pulled out as a single number representing a sub-group to provide an additional flavor of article impact. Overall, the signposts were fundamentally constructed in deference to the groups, but modified in order to serve their purpose.

Harmonization Across ALM and Altmetric Providers

We see great potential for the role of ALMs in the discovery and evaluation of scholarly research. We have early demonstrations of their value with the PLOS implementation, and we continue to develop the program by expanding the suite of metrics as well as their applications. In these conditions, the need for ALMs is never greater than this moment when the volume of literature and other research outputs continues to exponentially skyrocket.

We are very encouraged to see a corresponding rise in the availability of ALMs for content from other scholarly publishers. With so many implementations of ALMs and altmetrics, the "buzzing, blooming confusion" we currently experience with the information overload of research content will become one of disparate metrics if the community at-large does not standardize the treatment of ALMs. As such, we see a concurrent need to harmonize the aggregation and treatment of the data across all journals and third-party providers of ALM and altmetrics data. While there seems to be overall agreement to see citations and usage stats as groups distinct from altmetrics, there is currently no consensus on how to group altmetrics. While, for example, ImpactStory and Plum Analytics classify altmetrics sources in similar ways as PLOS, altmetric.com provides no groupings, but instead uses a single aggregate score for all altmetrics sources. As altmetrics are still relatively new to most users, these differences across altmetrics providers can create unnecessary confusion and hinder the adoption of altmetrics as a valuable addition to other metrics for research impact assessment. We at PLOS have therefore started the discussion with other providers and aggregators of altmetrics on how to group and categorize these metrics. | IP | doi: 10.3789/isqv25no2.2013.04

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RELEVANT LINKS

Altmetric
www.altmetric.com/

CrossRef
www.crossref.org

James, William. *Principles of Psychology*. Cambridge, MA: Harvard University Press, 1983. ISBN: 0674706250

Mendeley
www.mendeley.com/

Plum Metrics: List of Current Metrics. Plum Analytics, 2013.
www.plumanalytics.com/metrics.html

Priem, Jason, Heather A. Piwowar, and Bradley M. Hemminger. *Altmetrics in the Wild: Using social media to explore scholarly impact*. arXiv.org, March 20, 2012.
arxiv.org/abs/1203.4745

Public Library of Science (PLOS)
www.plos.org

PubMed Central
www.ncbi.nlm.nih.gov/pmc/

Scopus
www.info.sciverse.com/scopus/

Web of Science
thomsonreuters.com/web-of-science/

Mike Taylor

Exploring the Boundaries:

How Altmetrics Can Expand Our Vision of Scholarly Communication and Social Impact

MIKE TAYLOR

"Out flew the web and floated wide" – Tennyson, The Lady of Shalott

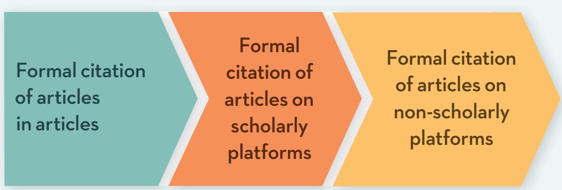
The ability to detect sharing and recommendation events that enabled the creation of the altmetrics movement also offers to enrich our understanding of how scholarly communication is used in education and governance, and how research outcomes may influence society as a whole. As the trend towards open science and open access publishing continues, it will become critical for funding agencies, publishers, and researchers to understand these communication pathways and how to accommodate and adapt to these increasingly important usage scenarios.

Introduction

In retrospect, the period during which we relied upon formal citation of article-by-article as a measurement of usage, quality, and impact will appear to have been primitive. And the following period when we attempted to enlarge our view by using formal citation of articles in online platforms will be seen to have been a small step forward (Figure 1)—but far from a revolutionary step—in how we measure, appraise, and understand scholarly impact in society.

As with any system that relies upon measurement-by-proxy, conclusions about what those measurements might mean can only be relied on when backed by significant theory and evidence. It took approximately 20 years for

Figure 1: The evolutionary stages of formal citation



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SCHOLARLY	SOCIAL	EDUCATION	LEGAL / LEGISLATIVE	ECONOMIC
» Books* » Articles » Monographs* » Conferences*	» Social Media » Mass Media* » Library Usage* » Books** » Press Releases**	» Textbooks** » Reference Books** » Course Packs** » MOOCS** » Best Practice Guidelines*	» Expert Evidence** » Written Reports** » Laws**	» Patents* » Commercial Research

NOTES:
** Indicates partial coverage in different platforms, ** Not included in any known altmetrics platform*

Table 1: Sources for detecting potential influence of scholarly research in different impact channels

bibliographic citation analysis to achieve acceptability as a measure of academic impact [Vaughan and Shaw], and it may well take another 20 years for web analytics to provide an adequate picture of how scholarly research influences society as a whole.

Just as bibliographic citation is the formal referencing of one work by another, so is much of the data in altmetrics the formal referencing of a work. In short, it is reference by hyperlink or DOI, and although some interesting work is being done by Altmetric.com to extend the reference scope, there is considerable effort needed to go beyond reliance on the formal citation link.

The current constituent elements of altmetrics' scope are varied in their type. Articles may be added to social reading lists, mentioned in the mass media, subject to scrutiny in blogs and open referee platforms, or neutrally shared on Twitter. Reference or re-use can be made of the various constituent elements—the graphics, data, computer code, and methodologies. Conference slides and videos can be repeatedly viewed for years to come. An article has life beyond the journal and these different facets provide us with the possibility of some fascinating insights into that life. Altmetrics is at the first stage of providing us with this insight.

Clearly these different elements have a common feature. They are article-centric and, equally clearly, they can convey very different meanings about how the article is being consumed, used, and re-used.

The cites not counted

Although altmetrics is making its first steps away from retrieving data that isn't formally linked to the original paper, there is a wealth of data that has yet to be added to the corpus. In part, some of this is for historical reasons. Although scholarly books are largely online and it is technically possible to mine books for citations to journals, it hasn't hitherto been the practice of the bibliographic experts to include the various book citation figures (i.e., when articles are cited by books, when books are cited by articles, and when books are cited by other sources). This isn't to say that altmetricians couldn't add this information to their data sources; although book citations are less well structured than journal references, there is considerable expertise and technology available for automatically identifying and resolving citations.

However, scholarly books are only the start of where this expansion might take us. There are numerous locations where research articles are cited beyond other research articles: government reports, professional institutions' guidelines for best practice, and press releases, to mention a few (see Table 1). While these cites might convey radically different appraisals of what is meant, they are, at the moment, outside the sphere of either formal bibliometrics or altmetrics, while certainly being—from a technical and access point of view—readily analyzable.

Furthermore, there are many scholarly documents that might reference articles, including massive online open courses (MOOCs), coursepacks, and reading lists. Although it is important to stress that there is no assumption that a citation in a MOOC has an equivalence to a citation in an article, there is clearly room for analytics and interpretation in understanding the role of primary research in education at all levels.

However, not all activity is online—and not all online activity can be accessed. Clearly it is impossible to measure directly the extent of this activity, although we can borrow techniques from e-commerce marketing and we can develop research projects that will shed light on off-line usage.

Encouraging and enabling people to share online content using tools that yield usage data forms a large part of what e-commerce and e-marketing practitioners have been doing for over a decade. Any search on "tracking viral communications" or "encouraging marketing share" will yield millions of search results. And essentially, this is transferrable to the field of scholarly communications. Some may find the metaphor to be distasteful, but if output may be equated to a product, producers and publishers might seek conversion to a similar interim point (pageviews both for scholarly content and e-commerce) and then measure outcomes in definitive terms, albeit in terms of citation (whether formal or informal) rather than sales.

Much of this marketing advice would be to make articles easy to share—and indeed many scholarly platforms have added links and buttons to make citation easier, particularly when it comes to adding documents to specialized platforms such as Mendeley, Zotero, or CiteULike. However, we have a great deal to learn from how e-commerce platforms encourage user engagement, and it is no surprise to see the emergence of consultants who aim to improve social reach and impact.

Additionally, when publishers and researchers are involved in promoting scholarly work that promises to have a high uptake, we should actively encourage formal referencing, particularly in press releases. A generic scholarly system for sharing DOI-based links—perhaps allied with ORCID and CrossMark® for identity and versioning management, respectively—would not only enable tracking and usage statistics, but would hugely enhance the articles, e-mails, or bookmarks in which they were used.

Discovering the differences: how do disciplines differ in influence and reach?

The extent to which disciplines' formal citation practices vary is well known, and it is assumed that different disciplines will have different social citation patterns. However, different disciplines have different socio-economic and legal environments and these have very different levels of transparency and public discussion and will vary over time as shown in Figure 2.

For example, the connections between research and medical best practice are well linked in the UK, with legal organizations that publish best practice guidelines citing primary research. This provides clear evidence of the social impact of this research; through its use in the guidelines, it may influence many thousand practitioners and millions of patients. (Unfortunately, these guidelines are usually identified by ISBNs—at least in the UK—and are, therefore, usually not included in formal journal citation counts.) In contrast, economists—who may occasionally make statements to the mass media and advise politicians, occasionally in public—wield enormous influence but with very little legal authority and limited governance. There is, of course, a great deal of difficulty in distinguishing the role of published advice. Often recommendations are made

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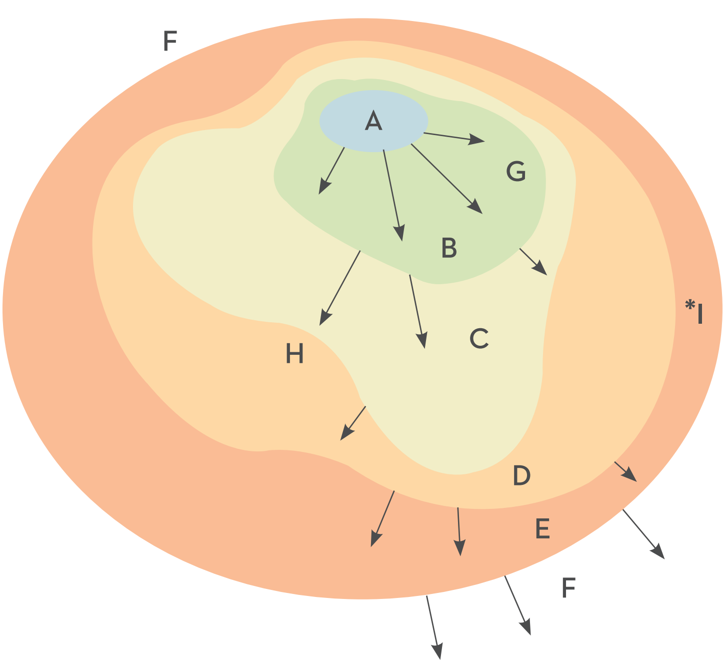
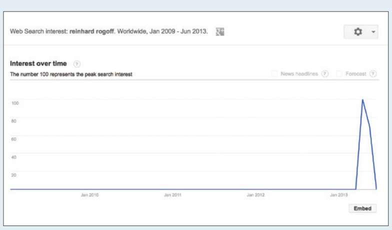
Figure 2: The changing face of scholarly impact



KEY

- **A** As the scope of altmetrics expands from its ancestry in formal citation metrics...
- **B** to new types of citation in new platforms...
- **C** with further recognition of citation in previous channels...
- **D** and technology improvements to make citation easier to detect...
- **E** so the overall picture of scholarly impact will become closer to the complete universe...
- **F** even as it expands.
- **G** But variations in use and technological development may create misleading features...
- **H** and miss others...
- **I** while scholarly citation may prove to have been an accurate indicator of social impact in some fields.

An interesting example of when primary research *does* come to general attention and an illustration of the disproportionate nature of social mentions and impact can be seen in the 2013 criticism of Reinhart and Rogoff's 2010 paper *Growth in a Time of Debt*. The paper is described as a 'foundational text' (Linkins) of austerity programs and according to ImpactStory received fewer than 100 social mentions. The methodological critique that discovered Excel errors and other problems with the research received over 500 social citations [Herndon, et al.]. The Google search history for "reinhart rogoff" in the figure below dramatically shows the peak interest in the authors at the time of the criticism.



Google search history showing more interest at time of article critique than at any time since publication

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and ignored, or "taken under advisement" into other areas of policy; and there may be little to distinguish the status of these documents on government websites.

That said, the power of primary research to influence society is enormous, particularly in medical areas, which have large numbers of practitioners treating whole populations with quasi-legal governance.

Likewise, the degree to which research can achieve influence though education is unknown. The formulation and use of research citations in textbooks is uncertain whereas with monographs and serials, citation is much more journal-like. There is certainly a need for some significant research on how people use these different forms of publication.

For example, some research questions addressed to medical practitioners might be:

- Are revised guidelines circulated throughout the team and executed precisely?
- Are revised guidelines discussed and mediated before execution?
- What role does additional research, team experience, and finance play in the mediation of guidelines?

However, while publications are placed online in reasonably well-known locations, with reasonable provenance, and with citation forms that are predictable (and are therefore readable by computers), it is inevitable (and correct) that the altmetrics platforms will discover them and that these references will start showing up as part of altmetrics.

Altmetrics – an advantage in a competitive world?

Research has an unusual set of dynamics. It is not only collaborative—researchers are expected to use, refer, test, and improve on others' work—but it is also competitive, with researchers competing for attention, publication, and research grants. Additionally, granting agencies may feel a competitive tension between themselves, and journals, publishers, and editors certainly compete for both authors and readership. Clearly the growing movement towards open science and open access publishing will address some of the balance in these competitive relationships.

Under the circumstances of a changing environment with competitive relationships, it seems likely that new elements will be brought into play to gain an advantage. Altmetrics is obviously an important element in these relationships. With all parties having an interest in impact (both scholarly and social) and reach (again, both scholarly and social), the promise of altmetrics is, at the very minimum, to provide some description of the reach of scholarly impact.

	MEDICINE	NURSING	ECONOMICS	PURE MATHEMATICS
Number of papers published in 2011	123,771	5,759	23,727	14,379
Number of practitioners in the UK	c. 250,000[1]	c. 700,000[2]	Thousands (100s in government)	3,000 (globally)
Professional goverance	Medical Research Council, Geneal Medical Council[3]	Nursing and Midwifery Council, Royal College of Nursing[3]	None	None
Scholarly impact (5FWRI 2011[4])	0.91	0.73	0.74	0.81
Number of UK Acts of Legislation relating to the practice of this profession[5]	78 UK Acts of Legislation relating to "General Medical Council" with more than 200 of wider relevance	152 UK Acts specifically related to "nursing", with more than 200 of wider relevance	3 UK Acts for "economists"	30 UK Acts for "mathematics" (all education) and 3 Acts for "mathematician"
Social impact	High	High	High	Low

NOTES:

1 General Medical Council, "The state of medical education and practice in the UK: 2012." (http://data.gmc-uk.org)

2 According to the Nursing and Midwifery Council (http://www.nmc-uk.org/About-us/Annual-reports-and-statutory-accounts), there are 671, 668 nurses and midwives who are legally allowed to practice in the UK. Approxmately 350,000 are employed by the NHS. (http://www.nhsconfed.org/priorities/political-engagement/Pages/NHS-statistics.aspx)

3 NICE (National Institute for Health Care and Excellence). (http://www.nice.org.uk/)

4 Five-year field-weighted relative impact

5 Determined by full text searches on April 24, 2013 (http://www.legislation.gov.uk)

Table 2: The socio-legal structure and potential for social impact of four research disciplines in the UK. *Source: Research Trends, Issue 33, June 2013 [Used with permission.]*

In fact, this description, although only a part of what altmetrics hopes to achieve, is an exciting prospect for all people involved in scholarly work. Hitherto, we have had the most crude figures for knowing whether research is being read or used. The increasing strength of altmetrics—particularly as the platforms compete over their relative efficiencies in different areas (e.g., mass media, non-English language platforms, and governmental publications)—will be to increase the detail and scope of the description of research in society. Not only will formal links, recommendations, and re-uses get counted, but linguistic and pattern matching technologies can be leveraged to discover softer citations.

However, the description is only one element of the work of altmetrics, and it is likely to be the simpler of the two parts of the movement.

The pathway from published research to social impact is multi-factorial and complex. As well as the socio-economic and legalistic frameworks in which research achieves its impact, there is cultural variation. For example, humanities research can become politically weighted when nations undergo a period of change [Tongshik] and linguistics and the management of lexical change can achieve quasi-governmental status [Académie française].

At the very least, these observations suggest that in order to begin the task of comprehending social reach in an objective way, it will be necessary to develop a methodology that can accommodate all these variations and to understand the interplay between the different elements that make up altmetrics data, coupled with their influence on the formal citation count.

Fortunately, machine learning can provide us with these tools, but this work must be coupled with on-the-ground research to discover how people use, adapt, and translate research. It is possible that, over time, this human-scale work will migrate online and become part of the overall description—but we cannot wait for this to happen. A greater insight into how people work with research and how research reaches its impact at a human level is more within the scope of the humanities than computer

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science; but without this work—and without the mutual engagement of the humanities and altmetrics—the analytical part of altmetrics will only ever be a limited proxy for social impact.

The background to bibliometrics and the science and business of evaluation and comparison has set the scene for the advent of altmetrics. It is inevitable—given the competitive and dynamic environment—that one of the first ambitions of researchers in this area is to attempt to enhance existing figures in an evolutionary direction. However, the ability to detect sharing, recommendation, and influence is technologically mediated—continuing to grow, both qualitatively and quantitatively—and is the challenge for all fields of research. The potential for what we currently call altmetrics is nothing short of a complete map of scholarly activity and influence, one that is as complicated and multi-disciplinary as any field of study that exists at present. Altmetrics will grow to include *all* impact—including bibliometric citation—becoming a genuine revolution in scholarly communication. | IP |

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The potential for what we currently call altmetrics is nothing short of a complete map of scholarly activity and influence, one that is as complicated and multi-disciplinary as any field of study that exists at present.

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Zotero [website]
www.zotero.org/

RELEVANT LINKS

William Gunn

Social Signals Reflect Academic Impact:

What It Means When a Scholar Adds a Paper to Mendeley

WILLIAM GUNN

MENDELEY RESEARCH NETWORKS

"The notion that the impact factor can encapsulate the value of everything a scholar produces is a bit simplistic." Todd Carpenter, Executive Director, National Information Standards Organization[1]

The academic social network Mendeley[2] has emerged as one of the most interesting sources of altmetrics. With a community of 2.4 million academics who have uploaded over 420 million documents across every discipline from life science to math to the arts and humanities, Mendeley is making it possible for academics, institutions, and funding organizations to really see the true picture of the impact of their research, not just on their field, but on all the stakeholders in research.

Altmetrics

Altmetrics, or "alternative metrics," are so called to distinguish them from bibliometrics, the traditional, decades-old system of counting citations and academic journal publications and also from webometrics, the measurement of webpage rank or influence by analyzing links between pages on the web.[3] There are a number of new kinds of data that are being collected about scholarly works, such as article pageviews, document saves or bookmarks, PDF downloads, tags, likes or shares on social networks, saves to reference managers, forks and patches of experimental code, and comments or posts on blogs, each reflecting a different dimension of influence.[4] These various metrics, collectively called altmetrics,[5] have been the subject of extensive study over the past few years[6] and show modest correlation to traditional citation-based metrics, but also reveal new types of impact: impact on the non-publishing consumers of research and also impact of non-journal forms of academic output such as code, datasets, or simply individual bits of data or figures too small for a traditional publication.

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Social signals

Examining item usage to determine impact is a very old practice.[7] Libraries and publishers have been collecting and using usage-based metrics for a long time in the form of COUNTER reports,[8] ILL requests, and similar indicators, so altmetrics aren't novel in the application of usage metrics to the assessment of academic impact, but rather seek to add new types of usage, new objects of use, and to do this at web scale, rather than locally to one institution.[9] One of the more interesting forms of usage is what's reflected in scholars' use of social networks to discover and share academic material. This usage comes in many forms, some heavy and content-rich, such as blog posts or Wikipedia links, some plentiful yet content-poor. On the plentiful side, Twitter has emerged as an important source of scholarly signals.[10],[11] While this is convenient—because many scholars use Twitter, tweets are public, and they can easily be gathered and analyzed—the limited context available with a tweet provides an indication that the article cited may have been read, but little more. On the other hand, blog posts and Wikipedia references provide a very strong signal that a work is useful to scholars, but the relative amount of the literature which appears in a blog post is fairly small, limiting its systematic use. The happy middle ground is occupied by social bookmarking tools and academic reference managers. These tools have broad enough adoption by scholars to have reasonably good coverage of the literature, and the presence of a document in a reference manager is a much clearer signal that the article is influencing research. Mendeley is one of those tools and it provides plenty of context via metadata capture and user profiles, opening up the possibility of filtering the social signals according to the needs of the entity examining its impact. It is important to note that differences in how the various communities use the available tools modify how impact is reflected by the tool and, in addition, the newness of many of these tools biases them to more recent literature. This article will discuss Mendeley as a source of altmetrics and what types of impact are reflected in the data available from the platform.

What data does Mendeley collect?

Mendeley is a reference management tool for researchers to organize, share, and discover research. It has broad adoption across disciplines with the largest numbers of researchers currently in life sciences, chemistry, math, and computer science, but also with representation from the social sciences and non-journal based humanities disciplines as well. Accordingly, the research catalog has the best coverage in the sciences, often having greater than 90% of recent issues of many journals. The greater representation of the sciences in Mendeley is thought to be primarily a reflection of its PDF-centric workflow and the journal article-centric communication in the sciences.

Researchers use Mendeley to store research papers and other publications along with the metadata about those publications, to share those papers or collections of papers with colleagues, and to discover new material based on what others are reading. The activity on Mendeley, therefore, provides many signals that reflect different types of impact, and there have been numerous studies comparing how many people have an item in their Mendeley library with citations, Impact Factor,[10] F1000,[13] article downloads, and social bookmarking.

Mendeley can return quite a lot of aggregated, anonymous, data about the usage of a publication found in its catalog. Figure 1 shows an example of the data returned from a document details call to Mendeley. Note that some documents which have only been uploaded by one researcher may not be available via the API due to the content quality filter that suppresses results for these documents. Using Scopus[14] data as a "ground truth" dataset to enrich the consensus metadata provided by researchers using Mendeley, we will be able to tune our content quality filters more finely and will be able to remove the requirement for a document to have been uploaded more than once in order to have a canonical representation, catalog page, and API availability.

Discussion of a few of the items returned by such a details call and what they, individually and in the aggregate, can tell us about scholarly activity is in order.

Keywords

Keywords are user-generated content that provides an indication of what the author thinks are significant concepts or relationships in the paper. Mendeley currently only returns the author-supplied keywords in response to a request for the public details for a paper. Any tags that an individual user has added can only be retrieved by permission of the user through a separate user-specific call for the document details.

Identifiers

Identifiers are the other names by which the document is known. These may be a PubMed ID (PMID), an arXiv ID, a DOI, an ISBN, or an ISSN. Included elsewhere in the document details data is a UUID (universally unique identifier) for the document, an article page URL, and the "page slug", which is the bit of the URL that uniquely identifies the catalog page for the document. These

Figure 1: Example of the data returned from a document details call to Mendeley


```
{"abstract":"Diabetic complication is comprised of [truncated]",
"keywords":[
          Interleukin 18",
          "diabetic nephropathy",
          "high sensitive CRP",
          "proinflammatory cytokine",
          "oxidative stress",
          "adipokine"],
"website":"http:\/\/www.ncbi.nlm.nih.gov\/pubmed\/20186552",
"identifiers":{
          "pmid":"20186552",
          "issn":"14325233",
          "doi":"10.1007\/s00592-010-0178-4"},
"stats":{
          "readers":7,
          "discipline":[
                    {"id":3,"name":"Biological Sciences","value":71},
                    {"id":19,"name":"Medicine","value":29}],
          "country":[
                    {"name":"United States","value":29},
                    {"name":"Brazil","value":29},
                    {"name":"United Kingdom","value":14}],
          "status":[
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                    {"name":"Student (Master)","value":14},
                    {"name":"Post Doc","value":14}]},
"issue":"2",
"pages":"111-7",
"publication_outlet":"Acta Diabetologica",
"type":"Journal Article",
"url":"interleukin-18-contributes-more-closely-progression-diabetic-nephropathy-other-diabetic-
complication",
"uuid":"8af2c880-cd0d-11df-922b-0024e8453de6",
"authors":[
          {"forename":"Takayuki","surname":"Fujita"},
          {"forename":"Norikazu","surname":"Ogihara"},
          {"forename":"Yumi","surname":"Kamura"},
          {"forename":"Atsushi","surname":"Satomura"},
          {"forename":"Yoshinobu","surname":"Fuke"},
          {"forename":"Chie","surname":"Shimizu"},
          {"forename":"Yuki","surname":"Wada"},
          {"forename":"Koichi","surname":"Matsumoto"}
],
"title":"Interleukin-18 contributes more closely to the progression of diabetic nephropathy
than other diabetic complications.",
"volume":"49",
"year":2010,
"categories":[338,43],
"oa_journal":false,
"mendeley_url":"http:\/\/api.mendeley.com\/research\/interleukin-18-contributes-more-closely-
progression-diabetic-nephropathy-other-diabetic-complication\/"}
```


identifiers are useful for querying other databases about documents found at Mendeley to find out what data the other database may have, or as a shorthand way of making subsequent calls to the Mendeley API for a given document. Mendeley can also return a PMC (PubMed Central) ID (which is different from a PubMed ID) and an OAI (Open Archives Initiative) ID, if available (not shown above).

Stats

The Stats array contains several data structures which contain descriptive information about the document.

1 Readers

This is the number of Mendeley users who have a given document in their library. This number includes all copies of

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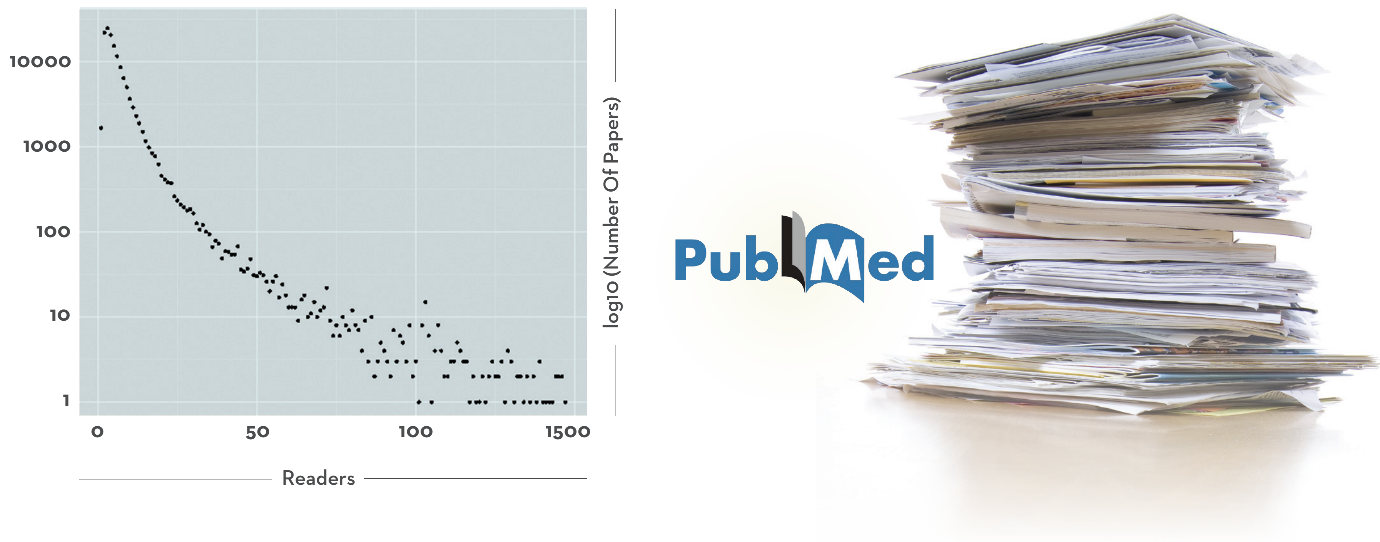

Figure 2: Distribution of document readership in Mendeley among a sample of 140K non-review papers published in 2012 and indexed by PubMed

a document, including citation-only entries, and is updated approximately daily. This value is perhaps one of the most interesting from an altmetrics point of view; more details about how this number is derived can be found in the section below on *Mendeley Readership*.

2 Discipline

This is the breakdown of the disciplines of the readers, given as whole number percents of the total readership. The discipline name, ID, and percentage are given for the top three disciplines. This information can give a picture of the relative impact of a document on a specific field. For example, in the data in Figure 1, five of the readers come from Biological Sciences and two come from Medicine. Because the numbers add up to 100%, there are no other disciplines reading this document. At the moment, a reader may have only one discipline, which s/he selects at signup, and all reading of the user is attributed to that discipline. Mendeley plans to transition to a flexible tag-based system for discipline assignment in the future.

3 Country

This is a reporting of data about the geographic dispersal of readers, reported as percents. This data can be used to plot the impact of a work or set of works on a map at the country level. More granular readership information is coming, but due to privacy issues there are no current plans to report city-level data.

4 Status

This is similar to the reporting of data on the readership by academic discipline. Status is also selected by users at signup. One way to use this data is to determine if research is having more of an impact on early-stage researchers relative to senior investigators, but there are classifications for non-research professions as well, which allows practitioner vs. researcher analyses.

Categories

Categories are given as numerical IDs and map onto the disciplines and sub-disciplines that Mendeley users assign themselves.

URL and UUID

These give the value of the unique identifier of the document in Mendeley, as well as the page slug for the article. So if you had a PMID and wanted to find the page on Mendeley for the article, you would first do a details call using the PMID, then append the value of the page slug to "http://www.mendeley.com/catalog/" to get the article page URL. The API also returns a slash-encoded version of the URL for the catalog page in the mendeley_url field, to allow developers to choose the mechanism for constructing links that works best for them.

Groups

If a document is present in a group on Mendeley, the information about what public groups it belongs to will also be returned. Only public groups will be shown in a request for document details using the public group method. If you want information about documents in private groups, you have to request permission via OAuth to access a user's private group information. Information about which groups

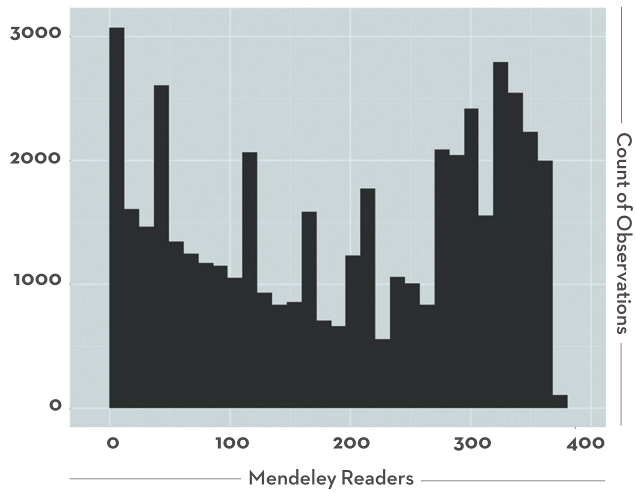

Figure 3: F1000-reviewed papers often have higher readership

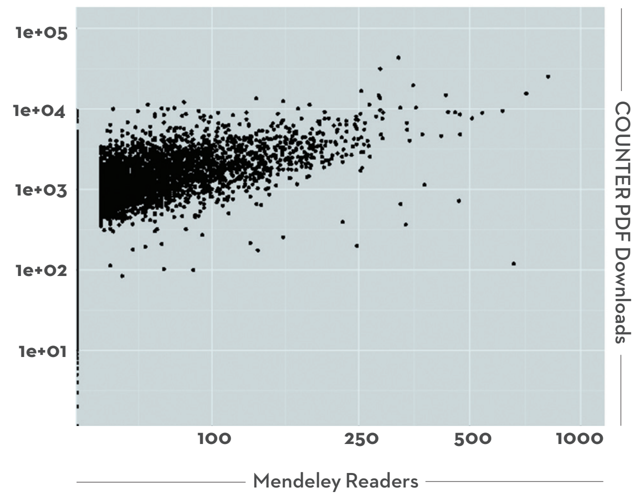

Figure 4: Correlation of Mendeley readership and PLOS-published COUNTER-compliant PDF download data

a document is in serves a similar function as do tags, so group memberships can be considered publicly available tags for a document. In addition, tags added to papers in public groups are available through a request for the details of documents in the group. Another way in which public groups can be used for altmetrics is by crawling publicly available groups and the membership of those groups to look at researcher-level altmetrics. For example, a researcher may be a member of a large number of groups, an administrator of a group with a large number of members, or listed as an author on a paper widely shared among a clinical practice or nursing group. This sharing among practitioner groups is another way to pick up impact of a paper on the non-citing readership.

Mendeley readership

The number of readers of a document on Mendeley is one of the potentially most interesting numbers from an altmetrics point of view. This number reflects the number of Mendeley users who have the document in their library. On a lower level, this number is the size of a document cluster. The Mendeley catalog is generated by a clustering algorithm, which runs approximately daily across the entirety of the Mendeley catalog (currently 420 million documents, increasing about a half a million a day), and clusters duplicates of the same document into one canonical representation. The size of this cluster is the readership of the document it contains. Occasionally, when the catalog is regenerated, multiple clusters will be generated for the same document. This happens primarily with documents that have been uploaded hundreds of times in various forms and with various modifications made to the metadata by users. If there is duplication, the number of clusters is usually around three to five, with readers distributed randomly among them. This cluster instability is the reason that numbers for a given document sometimes seem to go down; the remedy is to track and combine the various duplicates of the document until they all collapse into one. Once Mendeley builds a "ground truth" set of metadata into the catalog via Scopus, documents will be assigned to a permanent cluster, anchored to the canonical metadata, where available. This will eliminate the issue of cluster instability.

Mendeley readership compared to other metrics

The distribution of readers of a document in Mendeley is distributed in a similar manner to citations (Figure 2). A small fraction of 2012 papers in PubMed have the majority of the citations, and so also with Mendeley readership (though not necessarily the same papers). There is a relationship between Mendeley readers and other altmetrics as well. Mendeley readership and F1000 scores are roughly correlated (Figure 3), as are Mendeley readers and COUNTER-compliant downloads of papers published by PLOS[15] (Figure 4).

There are a few things to keep in mind when considering the meaning of Mendeley readership or any other altmetric. The first thing to remember is that Twitter has only been around since 2006 and Mendeley since 2008, so given that

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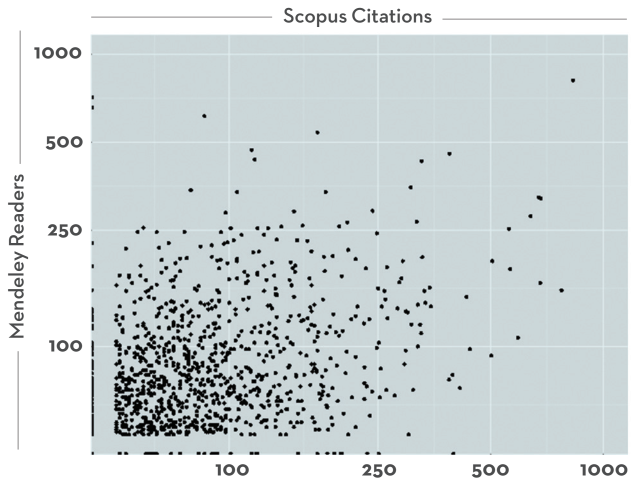

Figure 5: Correlation between readers and citations within the same discipline

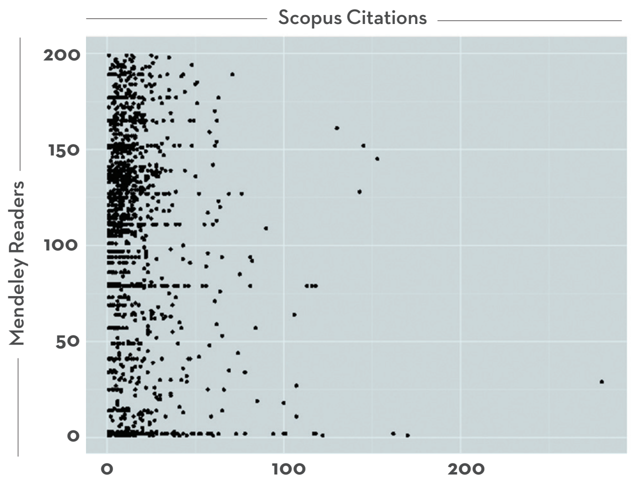

Figure 6: Correlation between readers and citations across multiple disciplines

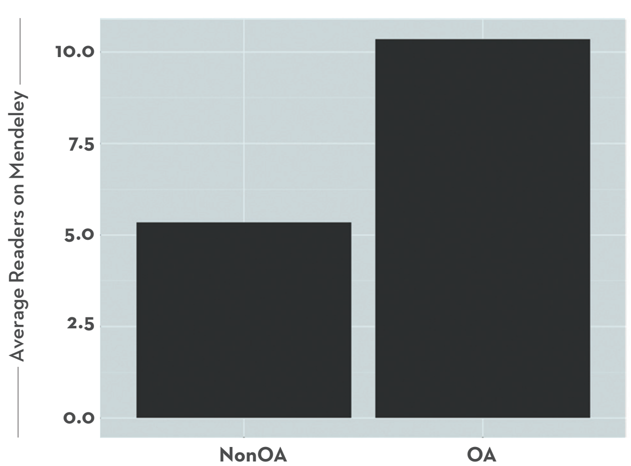

Figure 7: Mendeley readership of open access vs. non-OA articles

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papers accrue most of their citations in the first two to five years after publication,[16],[17] it's reasonable to expect altmetrics to favor recent papers as well. Several ways to address this bias have been previously reported.[18],[19] It's also important to keep the different citation practices of various fields in mind when comparing quantitative metrics to citations. There's a within-field correlation between readers and citations of papers published by PLOS (Figure 5), but when looking at multidisciplinary non-open access publications such as *Cell*, *Nature*, and *Science*, the relationship appears much weaker (Figure 6). In addition, open access (OA) papers enjoy a significant readership advantage relative to non-OA papers (Figure 7).

Where do we go from here with altmetrics?

There's a growing interest in altmetrics from funders, institutions, researchers, and publishers. There are several commercial and non-profit companies that are operating in this space (ImpactStory,[20] Altmetric.com,[21] Plum Analytics,[22] PLOS,[23] and Mendeley's Institutional Edition[24]). In addition, many publishers such as Nature and Springer are beginning to report their own altmetrics. Clearly, now is the time to capitalize on the interest and attention to finally bring assessment of research out of the systems belonging to the print era and into a more modern, multifaceted system that takes advantage of the flexibility and scale of the web. Future extensions to altmetrics are expected to include more semantics about the inter-document links. For example, not just how many people cited a paper on Twitter, but who they were, or not just how many readers a paper has, but whether or not those reading a paper are highly read themselves. This discussion has focused on the journal article, but altmetrics providers such as ImpactStory are already tracking the impact of datasets and code along with more traditional academic outputs. The overall goal is to be able to relate this impact data to actual outcomes such as changed clinical practice, economic impacts, and policy implementations.

| IP | 10.3789/isqv25no2.2013.06

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Note: Data and code from this article are available upon request.

Future extensions to altmetrics are expected to include more semantics about the inter-document links. For example, not just how many people cited a paper on Twitter, but who they were, or not just how many readers a paper has, but whether or not those reading a paper are highly read themselves.

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NR [NISO REPORTS]

NISO Awarded Sloan Foundation Grant to Develop Standards and Recommended Practices for Altmetrics

The National Information Standards Organization (NISO) is undertaking a new two-phase project to study, propose, and develop community-based standards and recommended practices in the field of alternative metrics. Assessment of scholarship is a critical component of the research process, impacting everything from which projects get funded to who gains promotion and tenure to which publications gain prominence. Since Eugene Garfield's pioneering work in the 1960s, much of the work on research assessment has been based upon citations, a valuable measure but one that has failed to keep pace with online reader behavior, network interactions with content, social media, and online content management. Exemplified by innovative new platforms and products, a new movement is growing to develop more robust alternative metrics—called *altmetrics*—that complement traditional citation metrics. The project is funded through a $207,500 grant from the Alfred P. Sloan Foundation. NISO will first hold several in-person and virtual meetings within the community to identify the critical areas where altmetrics standards or recommended practices are needed. This will be followed by a second phase of convening a working group to develop the consensus standards and/or recommended practices prioritized in the community meetings.

Citation analysis lacks ways to measure the newer and more prevalent ways that articles generate impact such as through social networking tools like Twitter, Facebook, or blogs. Additionally, new forms of scholarly outputs, such as datasets, software tools, algorithms, or molecular structures are now commonplace, but they are not easily—or if at all—assessed by traditional citation metrics. These are among two of the many concerns the growing movement around altmetrics is trying to address.

For altmetrics to move out of its current pilot and proof-of-concept phase, the community must begin coalescing around a suite of commonly understood definitions, calculations, and data sharing practices. Organizations and researchers wanting to apply these metrics need to adequately understand them, ensure their consistent application and meaning across the community, and have methods for auditing their accuracy. Agreement is needed on what gets measured, what the criteria are for assessing the quality of the measures, at what granularity these metrics are compiled and analyzed, how long a period the altmetrics should cover, the role of social media in altmetrics, the technical infrastructure necessary to exchange this data, and which new altmetrics will prove most valuable. The creation of altmetrics standards and best practices will facilitate the community trust in altmetrics, which will be a requirement for any broad-based acceptance, and will ensure that these altmetrics can be accurately compared and exchanged across publishers and platforms.

The first phase of the project will gather two groups of invited experts in altmetrics research, traditional publishing, bibliometrics, and faculty assessment for in-person discussions with the goal of identifying key altmetrics issues and those that can best be addressed through standards or recommended practices. This input will form the basis of two virtual meetings, open to the public, to further refine and prioritize the issues. Additional community input will be sought through an array of electronic and social mechanisms and events coordinated with major community conferences. A report summarizing this input will identify the specific areas where NISO should develop standards or recommended practices, which will be undertaken by a working group convened in phase two. The complete project from initial meetings to publication of standards is expected to take two years. Information about the meetings and other methods for participation will be announced on the NISO website (www.niso.org/topics/tl/altmetrics_initiative/) and in the monthly Newsline e-newsletter.

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Nettie Lagace

NISO Publishes Recommended Practice and Technical Report on Improving OpenURLs Through Analytics

NISO has published a new recommended practice, *Improving OpenURLs Through Analytics (IOTA): Recommendations for Link Resolver Providers* (NISO RP-21-2013). These recommendations are the result of a three-year study performed by the NISO IOTA Working Group in which millions of OpenURLs were analyzed and a Completeness Index was developed as a means of quantifying OpenURL quality. By applying this Completeness Index to their OpenURL data and following the recommendations, providers of link resolvers can monitor the quality of their OpenURLs and work with content providers to improve the provided metadata—ultimately resulting in a higher success rate for end users. The project is summarized in a technical report, *IOTA Working Group Summary of Activities and Outcomes* (NISO TR-05-2013), which was published along with the recommended practice.

OpenURLs are context-sensitive URLs widely used by publishers and libraries to allow end users to connect to the full-text of e-resources discovered during a search. To ensure that the user accesses the most appropriate copy of a resource (one that is preferably free to the user due to a subscription through the user's library), the OpenURL link connects to a link resolver knowledgebase. The metadata embedded within the OpenURL is compared through the link resolver with what is held in or licensed through the library and the end user is then presented with the available full-text access options. At a typical academic library, thousands of OpenURL requests are initiated by patrons each week. The problem is that too often these links do not work as expected because the metadata in the OpenURL is incorrect or incomplete, leaving users unable to access the resources they need.

Through its analysis, the IOTA Working Group, chaired by Adam Chandler, Electronic Resources User Experience Librarian at Cornell University Library, found that there was a pattern to the failures in OpenURLs. The Completeness Index was developed as a method of predicting the success of OpenURLs from a given provider by examining the data elements that provider includes in the OpenURLs from its site. This metric can serve as a tool to help determine which content providers are more likely to cause linking problems due to missing data elements in their OpenURLs and can identify exactly what the problems are. The Recommended Practice explains how to implement the measures so that problems can be clearly identified and steps taken with the content providers to improve the quality of the metadata.

The IOTA Recommended Practice is a perfect complement to the NISO/UKSG KBART Recommended Practice (NISO RP-9-2010). While KBART recommends how to improve the data within the link resolver knowledgebase, IOTA is focused on the metadata passed in the OpenURL itself. Together, these recommendations can ensure that OpenURLs will consistently provide the results that libraries, publishers, and end users have come to expect from this technology.

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The IOTA Recommended Practice and Technical Report are both available for free download from the IOTA Working Group's page on the NISO website at: www.niso.org/workrooms/openurlquality.

The problem is that too often these links do not work as expected because the metadata in the Open URL is incorrect or incomplete, leaving users unable to access the resources they need.

NW [NOTEWORTHY]

ISO Publishes New Standard on Thesaurus Interoperability

ISO 25964-2:2013, Information and documentation – Thesauri and interoperability with other vocabularies – Part 2: Interoperability with other vocabularies

In March 2013, the second part of the ISO standard on *Thesauri and interoperability with other vocabularies* was published. Focusing on the interoperability aspect—particularly mapping between vocabularies—the new part expands and complements Part 1, which was published in 2011 and covered the development and maintenance of thesauri both monolingual and multilingual, including formats and protocols for data. The ISO 25964 standard is under the oversight of the ISO TC46/SC9 committee (Information and documentation/Information and description), for which NISO is the Secretariat.

Semantic interoperability between vocabulary systems, also referred to as knowledge organization systems (KOS)—is critical in today's electronic and semantic web environments where a multitude of vocabularies are in use. Even within a single organization, it is common to find several different such vocabularies, such as the records management system, the library catalog, the organization's intranet, and different subject-specific disciplines for the research lab. With so many vocabularies in use in different organizations across disciplines and countries, a user would have to craft many different search queries and run the appropriate one against these different repositories to effectively retrieve all the relevant information. Automated support based on mapping between these different vocabularies is both needed and technologically possible, following the mapping guidelines in ISO 15964-2.

The standard begins with the principles and practicalities of interoperability, especially mapping, that apply to most vocabularies and especially thesauri. The vocabularies with which a thesaurus may need to operate and that are addressed in the standard are classification schemes (including those used for records management), taxonomies, subject heading schemes, name authority lists, and—although used for different purposes—terminologies, ontologies, and synonym rings. The standard provides a brief description of each of these vocabulary's key characteristics, contrasting its semantic components with those of a thesaurus, and then provides specific guidelines for mapping between a thesaurus and the specific vocabulary.

To further support implementation of the standard, the working group prepared an informational website, hosted by NISO. Included on the website are tables of content for each part of the standard, a correspondence table between ISO 25964 and the W3C Recommendations for SKOS (Simple Knowledge Organization System) and SKOS-XL extension, an XML schema for exchange of thesaurus data conforming to ISO 25964-1, and links to information sources for further reading and related resources. The working group has also updated the Wikipedia articles on *ISO 25964* and *Thesaurus (information retrieval).*

Following publication of the standard, the Ministry of Culture and Communication (France) developed the GINCO (Gestion Informatisée de Nomenclatures Collaboratives et Ouvertes) software dedicated to the management of vocabularies and implementing the principles defined in ISO 25964-1. The software was released publicly and is available under a CeCiLL v2 license, a French free software license, compatible with the GNU GPL.

Both parts of the standard are available for purchase from ISO and various national standards bodies. ■

ISO 25964 website: www.niso.org/schemas/iso25964

Wikipedia article on ISO 25964: en.wikipedia.org/wiki/ISO_25964

GINCO software: https://github.com/culturecommunication/ginco

The Amsterdam Manifesto on Data Citation Principles

During the *Beyond the PDF 2 Conference* in Amsterdam on March 20, 2013, Mercè Crosas, Todd Carpenter, David Shotton, and Christine Borgman developed and issued for comment and endorsement the following manifesto on data citation.

Preface:
We wish to promote best practices in data citation to facilitate access to data sets and to enable attribution and reward for those who publish data. Through formal data citation, the contributions to science by those that share their data will be recognized and potentially rewarded. To that end, we propose that:

1. Data should be considered citable products of research.
2. Such data should be held in persistent public repositories.
3. If a publication is based on data not included with the article, those data should be cited in the publication.
4. A data citation in a publication should resemble a bibliographic citation and be located in the publication's reference list.
5. Such a data citation should include a unique persistent identifier (a DataCite DOI recommended, or other persistent identifiers already in use within the community).
6. The identifier should resolve to a page that either provides direct access to the data or information concerning its accessibility. Ideally, that landing page should be machine-actionable to promote interoperability of the data.
7. If the data are available in different versions, the identifier should provide a method to access the previous or related versions.
8. Data citation should facilitate attribution of credit to all contributors ■

Comments and an electronic endorsement mechanism are available at: www.force11.org/AmsterdamManifesto

SPARC Issues Primer on Article-Level Metrics

SPARC has released a new community resource, *Article-Level Metrics – A SPARC Primer*, discussing the emerging hot topic in scholarly publishing of Article-Level Metrics (ALMs).

While traditional metrics about journal article usage are typically based on citations, ALMs, as stated in the primer's Executive Summary:

» Offer a new and effective way to disaggregate an individual article's impact from the publication in which it appears;

» Aggregate a variety of data points that collectively quantify not only the impact of an article, but also the extent to which it has been socialized and its immediacy;

» Pull from two distinct data streams: scholarly visibility and social visibility;

» Are both more granular and more immediate than traditional benchmarks;

» Have the potential to complement existing metrics and add critical nuance to the tenure and promotion process;

» Are not owned or controlled by any single company.

The primer differentiates ALMs and altmetrics in that ALMs use both traditional measures and altmetrics to focus specifically on measuring impact *at the article level*. Alternative metrics can be used at both journal and article levels and for other types of resources, including measures across a particular scholar's works.

In addition to describing article-level metrics in more detail, the primer also explains their relationship to open access, provides real-life examples of publishers and publishing platforms using ALMs, and discusses their potential use in the tenure and promotion process, their limitations, and future opportunities.

"ALMs that are free to use, modify, and distribute contribute to a world in which information is more easily shared and in which the pace of research and development is accelerated as a consequence." ■

ALM Primer: www.sparc.arl.org/sites/default/files/sparc-alm-primer.pdf

BISG Offers Free Field Guide to Fixed Layout for E-Books

The Content Structure Committee of the Book Industry Study Group (BISG) has developed a free *Field Guide to Fixed Layout for E-books*. Most e-content is made "flowable" to allow it to re-format automatically for the particular device being used. However, some content is not readable or user-friendly when a device reformats and flows it, particularly content that is heavily designed, including such items as illustrated children's books, textbooks, cookbooks, and art books. To ensure the fidelity of this content is retained, publishers may prefer to create a non-flowable fixed layout, even though this may limit some of the distribution channels and reading devices.

The guide is directed to publishers who want or need to create fixed-layout e-books and covers:

- When to use (and not use) fixed layout
- How to create a fixed layout e-book
- Accessibility issues for print-disabled readers
- Synching text and audio
- Interactivity and JavaScript
- Retailer standards (Amazon, Apple, Google, Barnes & Noble ■

The Field Guide is available at: www.bisg.org/publications/product.php?p=28&c=437

W3C Launches New Digital Publishing Activity

The World Wide Web Consortium (W3C) launched in June 2013 a new Digital Publishing Activity to make the Web a platform for the digital publishing industry, and to build the necessary bridges between the developers of the Open Web Platform and the publishing industry.

Today's eBook readers and tablets for electronic books, magazines, journals, and educational resources use W3C technologies such as (X)HTML, CSS, SVG, SMIL, MathML, or various Web APIs. Commercial publishers also rely on W3C technologies in their back-end processing all the way from authoring through to delivering the printed or electronic product and beyond. The publishing industry is one of the largest consumers of W3C technology.

Work in this activity primarily takes place in the Digital Publishing Interest Group. That Interest Group is a forum for experts in the digital publishing ecosystem of electronic journals, magazines, news, or book publishing (authors, creators, publishers, news organizations, booksellers, accessibility and internationalization specialists, etc.) for technical discussions, gathering use cases and requirements to align the existing formats and technologies (e.g., for electronic books) with those used by the Open Web Platform.

The launch of this Activity follows two W3C Workshops this year so far: Great Expectations for Web Standards (February) and Richer Internationalization for eBooks (June). W3C is also holding a Workshop on publishing workflow in September in Paris. [Source: W3C news release] ■

W3C Digital Publishing Activity: www.w3.org/dpub/

Digital Publishing Interest Group: www.w3.org/dpub/IG/

Great Expectations for Web Standards workshop: www.w3.org/2012/08/electronic-books/

Richer Internationalization for eBooks workshop: www.w3.org/2013/06/ebooks/

Workshop on publishing workflow: www.w3.org/2012/12/global-publisher/

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Today's eBook readers and tablets for electronic books, magazines, journals, and educational resources use W3C technologies such as (X)HTML, CSS, SVG, SMIL, MathML, or various Web APIs.

SD [STANDARDS IN DEVELOPMENT: *June 15, 2013*]

Listed below are the NISO working groups that are currently developing new or revised standards, recommended practices, or reports. Refer to the NISO website (www.niso.org/workrooms/) and the *Newsline* quarterly supplements, *Working Group Connection* (www.niso.org/publications/newsline/), for updates on the working group activities.

Note: DSFTU stands for Draft Standard for Trial Use.

WORKING GROUP	STATUS
Demand Driven Acquisition of Monographs Co-chairs: Michael Levine-Clark, Barbara Kawecki	Recommended Practice (NISO RP-20-201x,) in development.
Digital Bookmarking and Annotation Sharing Co-chairs: Ken Haase, Dan Whaley	Standard (NISO Z39.97-201x) in development.
Journal Article Versions (JAV) Addendum Chair: Michael Dellert	Revised Recommended Practice (NISO RP-9-201x) in development.
Knowledge Base and Related Tools (KBART) Phase II *Joint project with UKSG*. Co-chairs: Magaly Bascones, Chad Hutchens	Phase II Recommended Practice (NISO RP-17-201x) in development.
Open Access Metadata and Indicators Co-chairs: Cameron Neylon, Ed Pentz, Greg Tananbaum	Recommended Practice (NISO RP-22-201x) in development.
Open Discovery Initiative Co-chairs: Marshall Breeding, Jenny Walker	Recommended Practice (NISO RP-19-201x) in development.
Protocol for Exchanging Serial Content (PESC) Co-chairs: TBD	Working Group being formed to develop recommended practice.
Resource Synchronization Co-chairs: Herbert Van de Sompel, Todd Carpenter	Standard (NISO Z39.99-201x) in development.
Standard Interchange Protocol (SIP) Co-chairs: John Bodfish, Ted Koppel	Standard (NISO Z39.100-201x) in development.
SUSHI Server Working Group Chair: Oliver Pesch	**NISO RP-13-201x, *Providing a Test Mode for SUSHI Servers*** Finalizing for publication following a draft for trial use.

| SD | doi: 10.3789/isqv25no2.2013.10