

# PASTEUR40A Briefing Paper: Research Impact Measurement in Higher Education

Working Together to Promote Open Access  
Policy Alignment in Europe

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**Research impact is the demonstrable contribution that research makes to society and the economy.**

One way of indicating research impact is through measuring the interest in, and use of, scholarly journal articles. The quantitative study of "*the application of mathematical and statistical analysis to bibliography; the statistical analysis of books, articles, or other publications*" is known as bibliometrics<sup>1</sup>. Bibliometric measures are useful to many interested parties including researchers, institution, funders and the commercial sector.

This paper explores the current bibliometric measures in practice, it discusses whether they are fit for purpose and considers future directions for research impact measurement.

## Introducing Research Impact

In 2010 the world's total nominal research and development spending was approximately one trillion dollars, with many countries spending over 2% of GDP PPP (Purchasing power parity)<sup>2</sup>.

<sup>1</sup> Bibliometrics: Oxford English Dictionary Online:

<http://www.oed.com/view/Entry/241665?redirectedFrom=bibliometrics-eid>

<sup>2</sup> Wikipedia: List of countries by research and development spending:

[https://en.wikipedia.org/wiki/List\\_of\\_countries\\_by\\_research\\_and\\_development\\_spending](https://en.wikipedia.org/wiki/List_of_countries_by_research_and_development_spending)

Research is funded in a variety of different ways with funding models for Higher Education continually evolving. For example, in the UK research is funded by a combination of endowments (for wealthy universities), student fees and a significant contribution from the public purse. Source of funding aside, research remains firmly in the public interest though there is a continual need to justify spending.

At universities, stakeholders are interested in how research supports academic progression and in the positive influence it has on society as a whole and the economy. The effect research has is widely known as 'research impact' and tends to be more highly regarded when demonstrable and supported by evidence. Demonstrable research impact is very important to universities and research institutions, as it is routinely used to place them in international league tables and often used to support decision-making by funders in future funding rounds. The European Commission supports this need to assess and measure research. The Commission's Communication *Delivering on the modernisation agenda for universities: Education, research and innovation of 2006* noted that: "*Universities should be funded more for what they do than for what they are, by*

*focusing funding on relevant outputs rather than inputs.”<sup>3</sup>*

Research impact is also of importance to individual researchers, playing a role on CVs and in funding applications.

Despite the recognised importance of research impact, however, there is still a lack of understanding of how research quality and research impact are measured. The approaches used often lack transparency leading many to ask: can we measure better?

### Research Impact Measurement: An overview

Research bibliometrics continue to be a divisive issue in research communities. While most involved recognise the need for accountability and assessment of research impact, many question whether bibliometrics serve the objectives they are supposed to, with some expressing general hostility to measurement and its implications.

While bibliometrics are depicted as an objective measure that use quantitative methods, there is debate over interpretation and adoption of different approaches. It is important to recognise that no one method is the definitive approach and that most researchers and institutions will use a combination of techniques. As EU Research Commissioner Janez Potočnik wrote in the opening to the 2010 report on *Assessing Europe’s University-Based Research* “coexistence of different models to assess university-based research is not only inevitable, but healthy.”<sup>4</sup>

<sup>3</sup> EC Communication Delivering on the modernisation agenda for universities: Education, research and innovation: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2006:0208:FIN:en:PDF>

<sup>4</sup> Assessing Europe’s University-Based Research: Expert Group on Assessment of University-Based Research: [http://ec.europa.eu/research/science-society/document\\_library/pdf\\_06/assessing-europe-university-based-research\\_en.pdf](http://ec.europa.eu/research/science-society/document_library/pdf_06/assessing-europe-university-based-research_en.pdf)



*Levels of measurement*

One way to classify research bibliometrics is by considering at what level they measure impact.

They can measure the impact of:

- People or groups: at an individual level, department level, research group level or institutional level
- Papers: at an article level, journal level or book level

Some of the most popular bibliometric methods (listed in the following table) may be more appropriate for one particular level of measurement than another.

Type	Individual	Departmental	Research Group	Institutional	Journal
Citation Count	Y	Y	Y		
Article Download Count	Y				
H-index	Y				
Group H-index		Y	Y		

Journal H-index					Y
G-Index	Y				
Altmetrics	Y				Y
Publication count	Y	Y	Y	Y	
Academic ranking reports				Y	
Journal Impact Factor					Y
Eigenfactor Score					Y
Impact Per Publication					Y

A full list of scholar indices and their related formulas is available on Wikipedia<sup>5</sup>. Some of the most popular are:

- **Citation count** - the number of citations of a given paper or set of papers
- **H-Index** - based on the set of the scientist's most cited papers and the number of citations that they have received in other publications. The h index is where the number of papers equals the number of citations (beginning with the paper with the highest number of citations).
- **G-Index** – a variation of the h-index which takes into account the citation evolution of the most cited papers over time.
- **Publication count** - the number of publications produced by an individual or institution
- **The Journal Impact factor (JIF)** - a measure indicating the average number of times articles from the journal published in the past

2 years have been cited that particular year. A 5-year JIF is also available.

So, for example, the JIF is not appropriate for measuring individual impact and was developed first and foremost as a tool for journal editors to assess how their own journal is performing. The JIF came under criticism in the recent HEFCE report: The Metric Tide: Report of the Independent Review of the Role of Metrics in Research Assessment and Management<sup>6</sup>. The well-supported San Francisco Declaration on Research Assessment intends to halt the practice of correlating the journal impact factor to the merits of a specific scientist's contributions. Using measurement tools in the wrong context can be confusing and even damaging to reputations, so an awareness of appropriateness is imperative.

### Research Evaluation and Impact: Limitations

While research impact measurement is extremely useful it is clear that there are significant limitations to many of the approaches. The main limitations include:

- **Journal prestige:** Impact can be raised by association with a prestigious journal.
- **Journal policies and editor bias:** Journals are able to adopt policies that boost their impact factor. For example by publishing a higher number of review articles, which tend to be cited more than research papers; or by releasing special issues, which tend to garner higher levels of citation. Editors have been known to encourage or insist on authors citing journal articles from their own publication. Policy decisions that support impact factor are easier to make in a larger more commercially

<sup>5</sup> Wikipedia: Scholar Indices and Impact:  
[https://en.wikipedia.org/wiki/Scholar\\_Indices\\_and\\_Impact](https://en.wikipedia.org/wiki/Scholar_Indices_and_Impact)

<sup>6</sup> The Metric Tide: Report of the Independent Review of the Role of Metrics in Research Assessment and Management:  
<http://www.hefce.ac.uk/pubs/rereports/Year/2015/metrictide/>

successful journal than in a small specialist publication.

- **Discipline issues:** Citation-based research metrics were developed primarily for the science disciplines. They do not necessarily translate across research disciplines, or even research fields, due to different publishing patterns and coverage of publication types. This applies most strongly in the Humanities and Social Sciences where indicators are not well established.
- **Non-publication outputs:** Impact techniques are less well developed for new types of outputs such as data sets, websites, and digitised collections.
- **Notoriety:** Publications or journals are not necessarily cited for good reasons or an endorsement of quality. They may be mentioned because of failings.
- **Naming issues:** Ambiguity of names can be an issue for individual researchers
- **Self-citation:** Researchers tend to cite themselves. The more prolific a researcher the more he or she is cited by his or herself.
- **Timeliness:** Bibliometric and citation data is backward looking, it offers little insight in current work and can ignore new and emerging disciplines, growing institutions and young researchers. It is not a good measure of potential.

### Research Evaluation and Impact: Developments

One new approach to measuring impact is through article level metrics or altmetrics<sup>7</sup> (a portmanteau for 'alternative metrics'): non-traditional metrics, which move beyond citation counts and track online conversations around research. Collating altmetrics involves monitoring social media sites, newspapers, government policy documents and other sources for

mentions of scholarly articles. Other approaches include looking at page views and downloads of papers. The Open Access publisher PLOS provides article level metrics for all of its journals including downloads, citations, and altmetrics. SPARC has published a primer on altmetrics<sup>8</sup>, which describes this topic further.

But any metric or metric system has pros and cons: altmetrics are a different way of measuring from bibliometrics and inevitably have their own set of advantages and limitations

#### Benefits:

- They can measure articles with high impact but relatively few citations.
- A picture of impact can be built very quickly. Citations take months or years to accumulate.
- On the whole they are transparent. The algorithms behind altmetrics tend to be open and people can follow the related data trail. This is not always the case with traditional metrics.
- They allow researchers to understand better how their research is being discussed and used by other scholars and the public.
- They can be adjusted more easily than bibliometrics and inappropriate metrics removed e.g. data can be compared by discipline or field.
- They can be used to reach and understand a non-academic audience and capture the influence that research has outside of academia.

#### Limitations:

- They can easily be misinterpreted and misused and at times they can lack context and meaning. (However this can also apply to traditional bibliometrics.)

<sup>7</sup> Altmetrics: <http://www.altmetric.com/>

<sup>8</sup> SPARC primer on altmetrics: <http://www.sparc.arl.org/initiatives/article-level-metrics>

- They are not always reproducible and can be transient because altmetrics refer to a heterogeneous family of diverse metrics.
- The tools used to produce altmetrics can disappear if not supported. While there is a diverse range of (often open source) tools developed for altmetrics many rely on open business models rather than commercial backing.

Other complementary qualitative methods include impact stories, information on cultural applications and measures of esteem, peer review information, funding received, grants received etc.

Among some research communities thinking on metrics has also begun to move from a supply-side model, in which metrics are created from the data available, to a demand-side model, in which the purpose of the measurement is anticipated and metrics are created that most closely match need<sup>9</sup>. One example of this is snowball metrics<sup>10</sup>, a bottom-up initiative owned by international research-intensive universities to ensure that metrics are of practical use to them, and are not imposed by organisations with specific agendas. They are working towards metric methodologies which can enable institutional benchmarking on a global scale. These take the form of a series of free "recipes" available for anyone to use.

Another area of interest is that has warranted significant investigation is the effect of making an article and/or its underlying data available via Open Access. One article looking at Impact Factor gains of journals after their conversion to Open Access found "a significant rise – a doubling and more" of impact factor after transferring to an Open Access

model<sup>11</sup>. Evidence shows that such approaches result in higher citation rates due to increased exposure. A comprehensive list of journal articles considering this area is available from SPARC Europe<sup>12</sup>.

### Research Evaluation and Impact: Peer Review

While scientific publishing has been around for over 350 years formal peer review of submitted articles by external academics is relatively new. The peer review system involves an editor sending an article out to a number of experts in the field who can comment on the work. The identity of these experts is not normally indicated, though conversely the author details for the article are available to the reviewer. 'Blind peer review' as it is often known, has a number of issues:

- Reviewers may be biased for or against and author (peers are often competitors)
- Some have noted 'inherent conservatism' by peer reviewers and "perceived bias towards conservative judgements" or a lack of risk-taking
- Blind peer review has been shown to not be gender-neutral
- Not sharing reviews makes it difficult to gather evidence on the authenticity of the peer review conducted.

The apparent solution to this is 'double-blind review' where the author's name is also hidden however authors are still often identifiable. Once the review has taken place the comments are only shared with the editor and the author. For an

<sup>9</sup> Demand side metrics were discussed at the Impact of Science Conference 2014: <https://scienceworks.nl/the-impact-of-science-2014/>

<sup>10</sup> Snowball initiative: <http://www.snowballmetrics.com/>

<sup>11</sup> The Impact Factor of journals converting from subscription to open access: <http://blogs.biomedcentral.com/bmcblog/2014/11/06/the-impact-factor-of-journals-converting-from-subscription-to-open-access/>

<sup>12</sup> The Open Access Citation Advantage: <http://sparceurope.org/oaca/>

explanation of open peer review see the F1000 research information sheet<sup>13</sup>.

### So can we measure research impact?

Comprehending research evaluation and impact requires that we ask ourselves some fundamental questions about academic research. What exactly is research impact? And why do we feel the need to measure it? Does our current measurement system effectively assess the impact and value of research to society more broadly (e.g. contributions to medicine, green energy, technology, democracy, more equal societies, etc.)? Does it enable equality among institutions involved in research, both nationally and internationally? A recent article written by Laura Czerniewicz, Associate Professor at the University of Cape Town, pointed out that the current systems retain the status quo and continue to favour the Northern hemisphere and persecute the global south<sup>14</sup>.

In her aptly titled paper on research impact measurement 'not everything that can be counted counts, and not everything that counts can be counted'<sup>15</sup> Jane Grimson compares current practice with what is happening in the health sector. Health sector Key Performance Indicators must be:

- **Valid** - indicators should measure what they are supposed to measure
- **Reliable** - they should give the same answer if measured by different people
- **Sensitive** - they should be able to measure small changes

<sup>13</sup> F1000 research information sheet:

<http://blog.f1000research.com/2014/05/21/what-is-open-peer-review/>

<sup>14</sup> It's time to redraw the world's very unequal knowledge map:

<https://theconversation.com/its-time-to-redraw-the-worlds-very-unequal-knowledge-map-44206>

<sup>15</sup> Measuring research impact: not everything that can be counted counts, and not everything that counts can be counted:

<http://www.portlandpress.com/pp/books/online/wg87/087/0029/0870029.pdf>

- **Specific** - they should measure actual changes
- **Evidence-based** - and they should be underpinned by research

Grimson points out that "*health care indicators are simply a proxy indication of quality, and that in order to truly understand whether the care being provided is safe and of good quality, it is necessary to consider many other, generally qualitative, issues*". She argues that the issue faced by research impact measurement is that it is traditional bibliometrics that define what constitutes research quality rather than providing objective measures of research quality. Within health care they are more aware of the risk of data-driven, as opposed to evidence-driven, indicators.

### Future Trends and Conclusions

Whilst an understanding of research impact measurement is imperative for those connected with research within universities it is important to retain a critical eye. Not only can measurements be gamed but we need to ensure that we are measuring the right things and are mitigating unwanted effects.

Recommendations from 2010 EU Assessing Europe's University-Based Research report still stand today<sup>16</sup>. They suggest that we should:

- Combine indicator-based quantitative data with qualitative information
- Recognise important differences across different research disciplines
- Include assessment of impact and benefits
- Integrate self-evaluation

<sup>16</sup> Assessing Europe's University-Based Research: Expert Group on Assessment of University-Based Research:

[http://ec.europa.eu/research/science-society/document\\_library/pdf\\_06/assessing-europe-university-based-research\\_en.pdf](http://ec.europa.eu/research/science-society/document_library/pdf_06/assessing-europe-university-based-research_en.pdf)

The recent HEFCE report on the Metric Tide mentioned earlier talks of ‘responsible metrics’. Responsible metrics are described in terms of the following dimensions:

- **Robustness:** basing metrics on the best possible data in terms of accuracy and scope
- **Humility:** recognising that quantitative evaluation should support – but not supplant – qualitative, expert assessment
- **Transparency:** keeping data collection and analytical processes open and transparent, so that those being evaluated can test and verify the results
- **Diversity:** accounting for variation by field, and using a range of indicators to reflect and support a plurality of research and researcher career paths across the system
- **Reflexivity:** recognising and anticipating the systemic and potential effects of indicators, and updating them in

response.

The report points out that it is the duty of Higher Education Institutions to take responsibility and ownership for these metrics rather than passively accepting the use of opaque quantitative indicators, such as those used in the creation of league tables. The review identified 20 recommendations for further work including action in the following areas: supporting the effective leadership, governance and management of research cultures; improving the data infrastructure that supports research information management; increasing the usefulness of existing data and information sources.

Research impact measurement, whilst incredibly useful for those working in research, should always be treated with a critical eye.

## Further Information

### Bibliometric tools

Web of Science:  
<http://login.webofknowledge.com/>

Scopus:  
<http://www.scopus.com/>

Publish or Perish:  
<http://www.harzing.com/pop.htm>

Google Scholar:  
<https://scholar.google.co.uk/>

PLOS Article Level metrics:  
<http://article-level-metrics.plos.org/>

Scopus:  
<http://www.scopus.com/>

Eigenfactor:  
<http://www.eigenfactor.org/>

SCImago:  
<http://www.scimagojr.com/>

### Altmetrics

Impact Story:  
<https://impactstory.org/>

PlumX:  
<https://plu.mx/>

Readermeter:  
<http://readermeter.org/>

PLOS Impact explorer:  
<http://www.altmetric.com/demos/plos.html>

Papercritic:  
<http://www.papercritic.com/>

### EU Documents

European Commission report Enhancing Europe's Research Base, DG Research, Brussels. Report by the Forum on University based Research.  
[http://ec.europa.eu/research/conferences/2004/univ/pdf/enhancing\\_europeresearchbase\\_en.pdf](http://ec.europa.eu/research/conferences/2004/univ/pdf/enhancing_europeresearchbase_en.pdf)

Commission Communication on the modernisation of universities report asks "How to create a new and more coherent methodology to assess the research produced by European universities?"  
<http://bookshop.europa.eu/en/assessing-europe-s-university-based-research-pbKINA24187/>

EC Communication report 'Delivering on the modernisation agenda for universities: Education, research and innovation'.  
<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2006:0208:FIN:en:PDF>

EC on resolution on 'Modernising Universities for Europe's Competitiveness in a Global Knowledge Economy'  
[http://www.consilium.europa.eu/uedocs/cms\\_Data/docs/pressdata/en/intrm/97237.pdf](http://www.consilium.europa.eu/uedocs/cms_Data/docs/pressdata/en/intrm/97237.pdf)

European standard for social impact measurement announced.  
[http://ec.europa.eu/internal\\_market/social\\_business/docs/expert-group/social\\_impact/140605-sub-group-report\\_en.pdf](http://ec.europa.eu/internal_market/social_business/docs/expert-group/social_impact/140605-sub-group-report_en.pdf)

### Timeline of Research Impact and Peer Review

Open Access Working Group blog:  
<http://access.okfn.org/2015/06/10/research-impact-measurement-timeline/>

F1000 Peer review:  
<http://blog.f1000research.com/2014/05/21/what-is-open-peer-review/>

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## European Research Impact Measurement Timeline

