Research Intelligence

Metrics Selection Across the Research Lifecycle

Holly J. Falk-Krzesinski, PhD
Vice President, Global Academic Relations, Elsevier and Senior Adjunct Instructor, School of Professional Studies, Northwestern University

Andrea Michalek, MS
Vice President of Research Metrics, Product Management and Managing Director of Plum Analytics, Elsevier

9th Annual NORDP Research Development Conference ~ Broomfield, CO
May 10, 2017
Research Metrics Can Be Used to…

- Analyze the strengths of research at the institution
- Determine where research is a good potential investment
- Demonstrate ROI (Return On Investment) of research money
- Identify rising stars amongst the early career researchers
- Tell a better narrative about everything that is happening with research
Different Researchers Have Different Needs for Metrics
Research Metrics Throughout the Research Process

Input Metrics: Enabling Research
- Recruit and evaluate researchers
- Secure and manage funding
- Establish partnerships

Process Metrics: Doing Research
- Search, discover, read, review, experiment, analyze

Output and Outcome Metrics: Sharing Research
- Manage Data
- Publish & Disseminate
- Partner with businesses
- Esteem (authority and reputation amongst peers)
- Impact (benefit to society)

Societal-economic impact

Get published
Get viewed
Get cited
# Diverse Needs for Metrics

<table>
<thead>
<tr>
<th>Theme</th>
<th>Sub-theme</th>
<th>Metrics in areas of</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Funding</td>
<td><strong>Awards</strong></td>
<td>Number, monetary value and duration of awards</td>
</tr>
<tr>
<td></td>
<td>Can I support my research?</td>
<td></td>
</tr>
<tr>
<td>B. Outputs</td>
<td><strong>Productivity of research outputs</strong></td>
<td>Number, types and growth of outputs (e.g. articles, books, research data, works of art)</td>
</tr>
<tr>
<td></td>
<td>How productive am I?</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Visibility of communication channels</strong></td>
<td>Impact of communications channels published in (e.g. citation impact of journals, visibility of data repositories and blogs, prestige of conferences, status of books publisher, accessibility of channel)</td>
</tr>
<tr>
<td></td>
<td>What is the impact of the channels that my outputs are published in?</td>
<td></td>
</tr>
<tr>
<td>C. Research Impact</td>
<td><strong>Research influence</strong></td>
<td>Views (usage) impact, citation impact</td>
</tr>
<tr>
<td></td>
<td>How are my outputs used in academia?</td>
<td>Research reputation: awards, prizes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Altmetrics: scholarly activity and scholarly discussion</td>
</tr>
<tr>
<td></td>
<td><strong>Knowledge transfer</strong></td>
<td>Commercial use (e.g. number of patents, licenses, and spin outs; extent of consultancy work), translational research</td>
</tr>
<tr>
<td></td>
<td>How are my outputs used in industry?</td>
<td></td>
</tr>
<tr>
<td>D. Engagement</td>
<td><strong>Academic network</strong></td>
<td>Collaboration: geographical, cross-sector, cross-disciplinary</td>
</tr>
<tr>
<td></td>
<td>How good is my collaboration network within academia?</td>
<td>Network: number of collaborators, centrality, connectedness, geographical extent</td>
</tr>
<tr>
<td></td>
<td><strong>Non-academic network</strong></td>
<td>Crowd-sourcing: collect and analyze data, raise funding (through academic and wider networks)</td>
</tr>
<tr>
<td></td>
<td>How good is my collaboration network outside academia?</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Expertise transfer</strong></td>
<td>Who supervised me, and who have I supervised? Where are alumni working? Editorships and peer review (frequency and quality for journals, books and funders). Teaching metrics</td>
</tr>
<tr>
<td></td>
<td>How do I transmit knowledge to others within academia?</td>
<td></td>
</tr>
<tr>
<td>E. Societal Impact</td>
<td><strong>Societal Impact</strong></td>
<td>Direct and indirect impact on general public’s well being and understanding of research (e.g. influence on policy, improvements in health care and outcomes of medical interventions, altmetrics: social impact and media mentions)</td>
</tr>
<tr>
<td></td>
<td>What is my wider impact?</td>
<td></td>
</tr>
</tbody>
</table>
### Diverse Needs for Metrics…and Diverse Entities

<table>
<thead>
<tr>
<th>Metric theme</th>
<th>Metric sub-theme</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Funding</td>
<td>Awards</td>
</tr>
<tr>
<td>B. Outputs</td>
<td>Productivity of research outputs</td>
</tr>
<tr>
<td></td>
<td>Visibility of communication</td>
</tr>
<tr>
<td></td>
<td>channels</td>
</tr>
<tr>
<td>C. Research Impact</td>
<td>Research influence</td>
</tr>
<tr>
<td></td>
<td>Knowledge transfer</td>
</tr>
<tr>
<td>D. Engagement</td>
<td>Academic network</td>
</tr>
<tr>
<td></td>
<td>Non-academic network</td>
</tr>
<tr>
<td></td>
<td>Expertise transfer</td>
</tr>
<tr>
<td>E. Societal Impact</td>
<td>Societal Impact</td>
</tr>
<tr>
<td></td>
<td>Policy</td>
</tr>
</tbody>
</table>

**Outputs**
- e.g. article, research data, blog, monograph

**Custom set of outputs**
- e.g. funders’ output, articles I’ve reviewed

**Researcher or group**

**Institution or group**

**Subject Area**
- Serial
  - e.g. journal, proceedings

**Portfolio**
- e.g. publisher’s title list

**Country or group**
Examples of Metrics

**Researcher Level**
- Document Count
- $h$-Index

**Article Level**
- Citation Count
- Citations per paper
- Field-Weighted Citation Impact (FWCI)
- Outputs in top quartile
- Citations in policy and medical guidelines
- Usage
- Captures, e.g. bookmarking
- Mentions
- Social media

**Journal Level**
- CiteScore
- Journal Impact Factor
- Scimago Journal Rank (SJR)
- Source Normalized Impact Per Paper (SNIP)
SciVal Metrics

Slice and dice your data from multiple angles to identify your core strengths and weaknesses

**Productivity metrics**
- Scholarly Output
- Outputs in Top Percentiles
- Publications in Top Journal Percentiles

**Citation Impact metrics**
- Citation Count
- Citations per Publication
- Cited Publications
- Number of Citing Countries
- $h$-indices ($h$, $g$, $m$)
- Field-Weighted Citation Impact
- Citing-Patent Count
- Patent-Cited Scholarly Output
- Patent-Citations Count
- Patent-Citations per Scholarly Output

**Collaboration metrics**
- Collaboration (geographical)
- Collaboration Impact (geographical)
- Academic-Corporate Collaboration
- Academic-Corporate Collaboration Impact

**Disciplinarity metrics**
- Journal count
- Journal category count

**Usage metrics (Trends module)**
- Views Count
- Views per Publication
- Field-Weighted Views Impact
Users in Different Countries Select Different Metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>World</th>
<th>Australia</th>
<th>Canada</th>
<th>China</th>
<th>Germany</th>
<th>Japan</th>
<th>United Kingdom</th>
<th>United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field-Weighted Citation Impact</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Outputs in Top Percentiles</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Publications in Top Journal Percentiles</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Collaboration</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Citations per Publication</td>
<td>5</td>
<td>3</td>
<td>7</td>
<td>6</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Citation Count</td>
<td>6</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>8</td>
<td>6</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>h-indices</td>
<td>7</td>
<td>7</td>
<td>4</td>
<td>8</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>4</td>
</tr>
</tbody>
</table>

Usage of metrics available in SciVal’s Benchmarking module from 11 March 2014 to 28 June 2015. A partial list of the metrics available at that time is shown, focusing on the most frequently-used. Scholarly Output is excluded since this is the default. Note that recently added metrics based on e.g. media mentions and awards data were not available at this time and so are not represented in this analysis.
Types of Research Output

What is Research Output?

There are 67 ARTIFACT TYPES

Research output is more than articles.

Measure it ALL

PlumX Customers' Research by Type

<table>
<thead>
<tr>
<th>Type</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Article</td>
<td>56.5%</td>
</tr>
<tr>
<td>Thesis/Dissertation</td>
<td>10.6%</td>
</tr>
<tr>
<td>Book</td>
<td>5.4%</td>
</tr>
<tr>
<td>Conference Paper</td>
<td>4.4%</td>
</tr>
<tr>
<td>Report</td>
<td>3.5%</td>
</tr>
<tr>
<td>Review</td>
<td>2.4%</td>
</tr>
<tr>
<td>Book Chapter</td>
<td>2.4%</td>
</tr>
<tr>
<td>Government Document</td>
<td>1.8%</td>
</tr>
<tr>
<td>Video</td>
<td>1.4%</td>
</tr>
<tr>
<td>All Others</td>
<td>11.6%</td>
</tr>
</tbody>
</table>
Metrics that update in real time provide a Feedback Loop

Feedback loops help change behavior.
**Metrics timeline: From Idea to Impact**

**Old Paradigm**

- Idea
- Blog Post
- Grant
- Conference
- Publication
- Video

It can take at least 2 - 5 years from idea to a published peer-reviewed journal article.

**New Paradigm**

- Idea
- Blog Post

Due to the pace of scholarly publishing, it takes another 3 - 5 years from the time the work is published to get to critical mass of citation counts.

From idea to measurable citation counts can take 5 - 10 years.

**Metrics available immediately**

- Presentation view
- PDF download
- Bookmark
- Save reference
- Share
- Citation counts
- Tweet
- Video play
- Dataset download

**From Idea to Impact**

- It can take at least 2 - 5 years from idea to a published peer-reviewed journal article.
Sources of Metrics

ACI
Amazon
Airiti
bepress
bit.ly
CABI
CrossRef
Delicious
Dryad
dSpace
DynaMed Plus
EBSCO
ePrints
Facebook
figshare
Github
Goodreads
Google+
Mendeley
NICE (UK)
OJS Journals
PLOS
PubMed
PubMed Central
Reddit
RePEc
SciElo
Scopus
SlideShare
SourceForge
SSRN
Stack Exchange
Twitter
USPTO
Vimeo
Wikipedia
Worldcat (OCLC)
YouTube
Identifying Research

- DOI
- URL
- OCLC ID
- ISBN
- SSRN
- Scopus Author ID
- ORCID iD
- VIVO Author ID
- VIMEO Video ID
- YouTube Video ID
- Slideshare Slideshow ID
- RSS Link
Categorizing Metrics for Analysis

**USAGE**
(clicks, downloads, views, library holdings, video plays)

**CAPTURES**
(bookmarks, code forks, favorites, readers, watchers)

**Mentions**
(blog posts, comments, reviews, Wikipedia links)

**SOCIAL MEDIA**
(+1s, likes, shares, tweets)

**CITATIONS**
(citation indexes, patents, clinical, policy)
How Do You Measure Research Output

**Usage**
- Most important metric after citation
- 17.3M
  - Number of PlumX artifacts with usage

**Captures**
- Leading indicator of citations
- 457.9M
  - Total number of Capture interactions across PlumX

**Mentions**
- Where the stories of research are found
- 17.6M
  - Total number of Wikipedia Mentions across PlumX

**Social Media**
- Indicates how research is promoted
- 4.7%
  - Percentage of PlumX artifacts on Social Media

**Citations**
- Traditional measure of impact
- 6.9X
  - Number of times articles are cited more than books

Captures are a way for a researcher to save work for later.

Captures can be a leading indicator for citations.

- Following
- Bookmarking
- Favoriting
- Putting in reference management software

21.7%
- Percentage of artifacts with Campus
PlumX is Comprehensive

- **52.6 Million**: Total number of artifacts in PlumX
- **9.4 Billion**: Total number of interactions with research in PlumX
- **83.2%**: Percentage of customer artifacts that have at least one metric
The Plum Print

• Visualizes scholarly engagement
• Includes 5 categories of metrics
• Designed to communicate engagement without a score
PlumX Metrics Integration

PlumX Metrics will integrate with Elsevier products

- Scopus
- SciVal
- Pure
- Mendeley
- ScienceDirect
- Journal Pages
Golden Rules for Using Research Metrics

Use both *qualitative* and *quantitative* input into your decisions

- This is about benefitting from the strengths of both approaches, not about replacing one with the other
- Combining both approaches will get you closer to the whole story
- Valuable intelligence is available from the points where these approaches differ in their message

Use *more than one* research metric as the quantitative input

- A research metric’s strengths can complement the weaknesses of others
- There are lots of different ways of being excellent
- Using multiple metrics drives desirable changes in behaviour
Responsible Metrics

- **Robustness**: basing metrics on the *best possible data* in terms of accuracy and scope
- **Humility**: recognizing 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 variety of indicators to support diversity across the research system
- **Reflexivity**: recognizing *systemic* and potential effects of indicators and updating them in response

http://www.hefce.ac.uk/pubs/rereports/year/2015/metrichtide/
Mechanisms for Gathering Metrics is Important

From the NISO Code of Conduct for altmetrics

- Describe all known limitations of the data.
- Detail how often data are updated.
- Describe how data are aggregated.
- Provide a clear definition of each metric.
Summary

- Diverse and evolving set of metrics for different needs, themes, entities and outputs
- Select metrics based on goals and timeliness to create a feedback loop for researchers
- Categorize metrics for analysis, compare like with like
- Use more than one metric when making decisions and determinations
- Both qualitative and quantitative metrics are needed to fully describe research performance
A Final Note: Global University Rankings

• Key performance indicators that showcase distinctive strengths of research institutions
• Help students select their university of choice, faculty to make career decisions, and university leaders to discuss strategic priorities
• Accuracy and integrity are crucial
• Must deploy a range of techniques – both qualitative and quantitative
Thank you

Email  H.Falk-Krzesinski@Elsevier.com
Mobile  +1 847-848-2953
Twitter  @hfalk14
LinkedIn  http://www.linkedin.com/in/hollyfk
ORCID  0000-0001-8112-2445