Citation Impact: what is it and how to measure it?

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Session Summary

1. Citation impact
   • Definitions and Limitations
   • Citation indicators: how are citations measured?

2. Tools that capture citations
   • Web of Science, Scopus and Google Scholar
   • How citations are used in League Tables

3. Actions
   • Tips to make sure your publications are captured in citation databases
   • Tips to enhance citations

DISCLAIMER: the indicators and databases presented in this session are not exhaustive
Key points

1. Citations are not a measure of quality and must be used in the right context

2. Citation metrics vary across databases

3. Research quality and open research practices are the best ways to enhance citations
1. What is citation impact?

Citation Impact is a measure of the frequency with which an academic paper is cited in other publications.

- Credit to someone’s work
- Indicator of intellectual contribution to one’s field
- Used to assess research performance
- It informs funding decisions
Limitations

Not all citations are good → Lack of context!!

• Inaccurate attribution: giving wrong credit

• Incorrect citations (typos or wrong article mentioned)

• Citations do not reflect the impact or influence of a work beyond academic circles
Citation features

• Gender difference (?)
• Document type-sensitive
• Time-sensitive (2-3 years are needed to cumulate citations)
• Field-sensitive
Citations: Field difference

<table>
<thead>
<tr>
<th>Neuroscience</th>
<th>Life Sciences</th>
<th>Pharmacology</th>
<th>Chemistry</th>
<th>Physics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Sciences</td>
<td>Health Sciences</td>
<td>Earth Sciences</td>
<td>Biological Sciences</td>
<td>Social Sciences</td>
</tr>
<tr>
<td>Materials Science</td>
<td>Computer Sciences</td>
<td>Arts and Humanities</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.1 Publication Cultures by Comparison: NSE (Natural Sciences, Engineering) and SSH (Social Sciences, Humanities)

<table>
<thead>
<tr>
<th></th>
<th>NSE</th>
<th>SSH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Citation behaviour</td>
<td>Constructive citation (rung ladder principle)</td>
<td>Citation as differentiation/rebuttal</td>
</tr>
<tr>
<td>Thematic orientation</td>
<td>International</td>
<td>Regional and national</td>
</tr>
<tr>
<td>Publication language</td>
<td>English</td>
<td>Often language of the country</td>
</tr>
<tr>
<td>Place of publication</td>
<td>International</td>
<td>Regional and national</td>
</tr>
<tr>
<td>Kind of publication</td>
<td>Journal papers dominate</td>
<td>Monographs and collected volumes dominate; also journal papers</td>
</tr>
<tr>
<td>Target group</td>
<td>International specialist audience</td>
<td>Specialist academia and audience</td>
</tr>
<tr>
<td>Individual vs. coauthorship</td>
<td>Coauthorship</td>
<td>Often individual authors</td>
</tr>
</tbody>
</table>

1. How do we measure citations?

Not normalised indexes
• Citation count
• Mean citation count
• H- Index

Limitations:
Don’t provide context!!!
Don’t consider field/time/document type differences.

Normalised indexes
• Journal Normalised Citation Impact (JNCI)
• Category normalised citation impact (CNCI)
• Percentile in Subject Area
H-Index

h-index of value=\( h \) indicates that \( h \) number of publications that have been cited at least \( h \) times (Jorge Hirsch 2005)

LIMITATIONS:
- It does not take into account highly cited papers
- H index can only increase over the years
- H index favours senior academics

Never use H-index to directly compare researchers
# H-Index: example

<table>
<thead>
<tr>
<th></th>
<th>Researcher A</th>
<th>Researcher B</th>
<th>Researcher C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>H-Index</strong></td>
<td>4</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Paper 1</td>
<td>4</td>
<td>25</td>
<td>6</td>
</tr>
<tr>
<td>Paper 2</td>
<td>6</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>Paper 3</td>
<td>5</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Paper 4</td>
<td>5</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Paper 5</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Paper 6</td>
<td>0</td>
<td>0</td>
<td>/</td>
</tr>
<tr>
<td>Paper 7</td>
<td>0</td>
<td>/</td>
<td>/</td>
</tr>
<tr>
<td>Paper 8</td>
<td>0</td>
<td>/</td>
<td>/</td>
</tr>
</tbody>
</table>
Normalised citation indexes: CNCI and JNCI

Normalised citation score = \( \frac{\text{Article citations}}{\text{Expected citations}} \)

- Expected citations = average number of citations to articles of:
  - the same field, year and document type
  - same year, journal and document type
Normalised indexes in Incites: CNCI and JNCI

<table>
<thead>
<tr>
<th>Article Title</th>
<th>Publication Date</th>
<th>Times Cited</th>
<th>Journal Expected Citations</th>
<th>Category Expected Citations</th>
<th>Journal Normalized Citation Impact</th>
<th>Category Normalized Citation Impact</th>
<th>Percentile in Subject Area</th>
<th>Journal Impact Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antibiotics from Deep-Sea Microorganisms: Current Discoveries and Perspectives</td>
<td>2018</td>
<td>62</td>
<td>38.22</td>
<td>20.49</td>
<td>1.62</td>
<td>2.34</td>
<td>89.18</td>
<td>6.085</td>
</tr>
<tr>
<td>Enantiospecific Allosteric Modulation of Cannabinoid 1 Receptor</td>
<td>2017</td>
<td>58</td>
<td>20.24</td>
<td>13.99</td>
<td>2.47</td>
<td>4.15</td>
<td>97.96</td>
<td>5.780</td>
</tr>
</tbody>
</table>

\[
\frac{62}{38.22} = 1.62 \quad \frac{62}{26.49} = 2.34
\]
Normalised citation indexes: CNCI

CNCI (Incite) similar to FWCI (SciVal): often used to benchmark institutions.

For a group of papers, the CNCI value is the average of the values for each of the papers.

\[
CNCI_i = \frac{\sum_{i} CNCI_{\text{each paper}}}{p_i}
\]

- \( p \) = number of papers
- \( i \) = entity being evaluated

http://help.prod-incites.com/inCites2Live/indicatorsGroup/aboutHandbook/usingCitationIndicatorsWisely/normalizedCitationImpact.html
Normalised citation indexes: CNCI and JNCI

LIMITATION

• Extremes, highly and poorly cited papers, are very influential on the final score
  → not indicated to evaluate small sets of publications
Normalised citation indexes: Percentile

How does it work?

1. Define a reference set (papers published in the same year, same field, same document type)
2. Rank the publications according to the citation counts
3. Divide publications in percentiles

<table>
<thead>
<tr>
<th>Paper rank</th>
<th>Citation count</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>250</td>
</tr>
<tr>
<td>2</td>
<td>199</td>
</tr>
<tr>
<td>3</td>
<td>180</td>
</tr>
<tr>
<td>4</td>
<td>111</td>
</tr>
<tr>
<td>5</td>
<td>110</td>
</tr>
<tr>
<td>6</td>
<td>90</td>
</tr>
<tr>
<td>7</td>
<td>83</td>
</tr>
<tr>
<td>8</td>
<td>80</td>
</tr>
<tr>
<td>9</td>
<td>79</td>
</tr>
<tr>
<td>10</td>
<td>60</td>
</tr>
<tr>
<td>...</td>
<td>59</td>
</tr>
<tr>
<td>1000</td>
<td>2</td>
</tr>
</tbody>
</table>

TOP 1%
Normalised citation indexes: Percentile

**PROS**
- Provide context
- Not influenced by extremes

**CONS**

What to do with:

- papers with equal citations?
  - Use the average rank → e.g. both are given 3.5
  - Or use the same rank → there are two 3 and there will be no 4

- article with multiple subject categories?
  - the article is ranked in all categories
  - WoS provide the score of the highest percentile
Misuses of citation metrics

• Often confused as a measure of quality

• Goal displacement

• Self-citations

• Cite what you know; citation of works by friends, colleagues, groups, and networks.
The case of the Journal Impact Factor

• It is one of the most misused metrics
• It is a journal metric, not an article metric!! → it must not be used to evaluate the quality of an article.

\[
\text{JIF (2022)} = \frac{\text{Total citations received in all published items (2022)}}{\text{Citations received in citable items (2020–2021)}}
\]

Citable items= Original Research (research papers, proceeding papers, reviews)
Not citable items= Editorial materials (commentary, perspectives, letters...)

Citable items= Original Research (research papers, proceeding papers, reviews)
Not citable items= Editorial materials (commentary, perspectives, letters...)
The case of the Journal Impact Factor

Manipulation of JIF:

• Journals publish more editorial materials
• Editorial malpractice → suggesting citations during peer-review
• Citation cartels → mutual agreements between journals to cite each other

Citation Cartels: The Mafia of Scientific Publishing

Visualizing Citation Cartels

Toward the Discovery of Citation Cartels in Citation Networks
DORA (2012)

General recommendation:

Do not use journal-based metrics such as Journal Impact Factors, as a surrogate measure of the quality of individual research articles, to assess an individual scientist’s contribution or in hiring, promotion and funding decision.

https://sfdora.org/read/
Key points

1. Citations are not a measure of quality and must be used in the right context.
2. Citation metrics vary across databases.
3. Research quality and open research practices are the best ways to enhance citations.
2. Tools and systems that capture citations

• Citation services provide citation numbers but only for the publications in their own database.
• Citation counts will vary across providers.

- Scopus
- Google Scholar
- Web of Science™
- InCites
- Altmetric
- Dimensions
Tools and systems that capture citations

The coverage of databases is different:

<table>
<thead>
<tr>
<th></th>
<th>WoS (core collection)</th>
<th>Scopus</th>
<th>Google Scholar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Journals</td>
<td>21 858 Journals</td>
<td>26 228 Journals</td>
<td></td>
</tr>
<tr>
<td>Coverage</td>
<td>85 million records</td>
<td>87 million records</td>
<td></td>
</tr>
<tr>
<td></td>
<td>134000 books</td>
<td>335000 books</td>
<td></td>
</tr>
<tr>
<td></td>
<td>300000 conferences</td>
<td>100000 conferences</td>
<td></td>
</tr>
<tr>
<td>Time coverage</td>
<td>Since 1900</td>
<td>Since 1970</td>
<td></td>
</tr>
</tbody>
</table>
Tools and systems that capture citations

Web of Science and Scopus rely on a set of source selection criteria to decide which journals, conference proceedings, and books the database should index.

Google Scholar follows an inclusive and automated approach.

Sensitive to bias in the selection criteria

Limited coverage of texts written in languages other than English

Limited coverage in Social Sciences and Humanities

It is not fully transparent about how articles and citations are included.

It offers less reliable data and fewer bibliometric tools.

It presents errors such as duplicate entries, incomplete bibliographic information and inclusion of non-scholarly materials.
Individual citations across multiple platforms

Google Scholar

Scopus

WoS

Metrics
Profile summary
- Total documents: 51
- Web of Science Core Collection publications: 51
- Preprint: 0

Web of Science Core Collection metrics
- H-Index: 1939
- Total Publications: 1,421

View citation report
Author Impact Beamplot Summary

Citation Percentile
- Author's publication percentile range
- Overall citation percentile median

Percentile range displays for authors from 2080 to 2021. View all publications in full beamplot.
Key points

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Citations and the League Tables

- League tables: University rankings based on certain metrics
  - **Research Indicators**
    - **Citations**, publications in indexed journals, highly cited researchers, international co-authors, research reputation, % of most cited publications, Nobel prizes, Research Grants
  - **Teaching Indicators**
    - Staff/Student ratio, university income, international student/staff, reputation, Doctorate to Batchelor student ratio, academic staff with Doctoral degree
  - **Industry & Innovation**
    - Industry article citation impact, average citations by patents, number of patents filed, % articles with industry co-authors, % patents cited, Income from Industry, ratio of patent applications to grants

Bibliometric measures in League Tables

Boosting research can help improve ranking
Research is an important indicator for many ranking systems

Weight or “dose” of bibliometric research indicators (Non-Exhaustive & Exemplary)

Academic Ranking of World Universities

THE World University Ranking

U.S. News Global University Ranking

QS World University Ranking

On average bibliometric research indicators constitute ~50% “dose” of the above ranking systems

Research bibliometric indicators can be boosted and monitored directly by universities

<table>
<thead>
<tr>
<th>League Table</th>
<th>Citation Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Times Higher Education: World University Ranking (&amp;subject)</td>
<td>Scopus (Elsevier)</td>
</tr>
<tr>
<td>Times Higher Education: Impact Rankings</td>
<td>Scopus (Elsevier)</td>
</tr>
<tr>
<td>QS World University Rankings (&amp;Subject)</td>
<td>Scopus (Elsevier)</td>
</tr>
<tr>
<td>QS Graduate Employment Rankings</td>
<td>Scopus (Elsevier)</td>
</tr>
<tr>
<td>CWTS Leiden Rankings</td>
<td>Web of Science (Clarivate)</td>
</tr>
<tr>
<td>Shanghai Academic Ranking</td>
<td>Web of Science (Clarivate)</td>
</tr>
<tr>
<td>US News &amp; World Report</td>
<td>Web of Science (Clarivate)</td>
</tr>
<tr>
<td>Round University Ranking</td>
<td>Web of Science (Clarivate)</td>
</tr>
<tr>
<td>Centre for World University Rankings</td>
<td>Web of Science (Clarivate)</td>
</tr>
</tbody>
</table>
Increase journal coverage and citation capture

How to increase capture by Web of Science and Scopus:

1. Fix your Researcher Profiles and link them to your ORCID

   - WoS: Introduction to your Researcher Profile (clarivate.com)
   - Scopus: Author profiles - Scopus | Elsevier solutions

2. Encourage your publishers to submit journals, books and conference proceedings to Web of Science

   - To submit journals for evaluation, use the Web of Science Publisher Portal.
   - To submit a book, email: clarivateeditorialbookrequests@clarivate.com
   - To submit conference proceedings, email: tr.pubrelations-proceedings@clarivate.com
3. How to increase citations

• Produce a piece of well-written, top-quality, original research
• Follow open research practices!

1. **Use Preprint servers:** preprints archives are a popular way to get your results out early, allowing you to receive feedback from your peers and your work to be visible before the final publication.
How to increase citations

2. Make your manuscripts open access where possible

• Make your manuscript easily accessible. Upload your accepted manuscript or preprints to Pure so that it is recorded in the University repository.
  Check SHERPA RoMEO [https://v2.sherpa.ac.uk/romeo/] or email openresearch@abdn.ac.uk to discover your open access options.

• Make use of University read and publish deals;
  Corresponding affiliated authors can publish original and review articles as gold open access at no cost in selected journals.

Publisher agreements | Library | The University of Aberdeen (abdn.ac.uk)
3. Make your data, software, and code open where possible

- Papers with supporting data freely available in a repository are associated with on average 25% increase in citations!


- Figshare, Dryad, SlideShare etc. can all be used to share your research data and you can add a catalogue record to Pure to keep a record of everything in one place.

How to make your data open | Library | The University of Aberdeen (abdn.ac.uk)
How to increase citations

• Collaborate with one or more co-authors; co-authors provide additional opportunities for promoting the research and citing the work. A high profile co-author can generate early interest in the work and international collaborations can generate wider audiences.

• Use social media (e.g., Facebook, Twitter, Academia.edu, ResearchGate, Mendeley). Make sure that links to papers on social media are working. Check the settings on your University profile page to make sure that your Pure data is visible.

• Make use of conference opportunities, invited talks, and public engagement events to make your research more visible. Use blogs and websites to promote your work and talk to other researchers about your paper. Consider writing up your research as a non-academic piece in a magazine or newspaper for a wider, public audience.
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Questions?

**ExplORe**

Open Research Essentials

A training series with a focus on Open Research practices

- **24th of January** – Open Research: who are we and what do we do?
- **31st of January** – Citation Impact: what is it and how to measure it?
- **21st of February** – Making Data Open: What you need to know
- **28th of February** – Guide to Open Access Research Publications
- **14th of March** – Open Licences for Publications and Data

**Online from 9.15 to 10.00 am**

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