CWTS
Meaningful metrics

Applying bibliometrics in research assessment and management … It's complicated !

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Presentation at the NARMA Meeting, 14th April 2015

Universiteit Leiden

Outline

- *CWTS and Bibliometrics*
- *Detail and accuracy in bibliometric applications*
- *Normalization in bibliometrics*
- *Coverage in bibliometric studies*
- *Infamous bibliometric indicators – What to avoid*
- *CWTS methodology – basic indicators*
- *Advantages and disadvantages in bibliometric analysis*

CWTS and Bibliometrics

What is bibliometrics ?

- Quantitative analysis of science & technology, and the study of cognitive and organizational structures in science and technology.
- Scientific communication between scientists through (mainly) journal publications.
- Key concepts are **output** and **impact**, as measured through publications and citations.
- Important starting point in bibliometrics: scientists express, through citations in their scientific publications, a certain degree of influence of others on their own work.
- By large scale quantification, citations indicate (inter)national influence or (inter)national visibility of scientific activity, but should not be interpreted as synonym for ‘quality’.

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CWTS data system

- CWTS has a full bibliometric license from Thomson Reuters to conduct evaluation studies using the Web of Science.

- Our database covers the period 1981-2014/5.
- Some characteristics:
  - Over 41.000.000 publications.
  - Over 600.000.000 citation relations between source papers.
  - Author disambiguation tools are applied, linked with acquired experience
  - Continuous address cleaning tools being developed, related to the ***Leiden Ranking***.
  - Contains reference sets for journal and field citation data.

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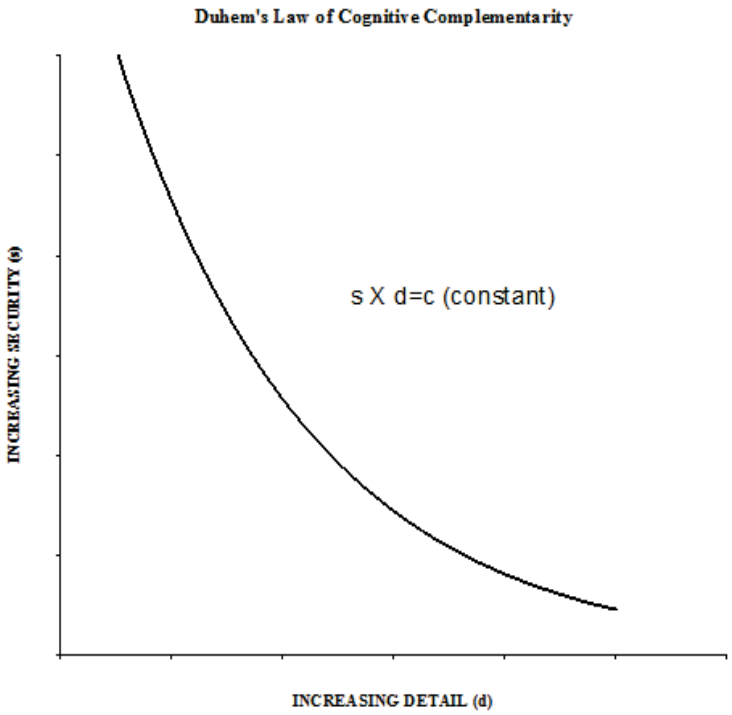
Detail and accuracy in bibliometric applications

Tension between detail and accuracy:
Duhem's *'Law of Cognitive Complementarity'* *



- An inverse relationship exists between the precision of our information, and its' substantiation
- Detail and security / accuracy stand in a competing relationship !

* '*Epistemetrics*' by Nicolas Rescher (2006)

- We estimate the size of the tree at *around* 8 mtr.
- We are *quite sure* that the tree is between 6-12 mtr. high.
- We are *virtually certain* that ist height is between 3-18 mtr.
- But we can be *completely and absolutely sure* that its height is between 1 mtr and 56 mtr.

Levels of aggregation in bibliometric analysis

- We distinguish various levels of analysis:
  - ***Macro-level***, e.g. country and region comparison for the EU, Dutch Observatory of S&T.
  - ***Meso-level***, e.g. research organizations, universities, institutes.
  - ***Micro-level***, e.g. analysis of programs, groups, or even, increasingly, individual researchers.

Bibliometrics can be applied on all three levels of analysis, however, **every level brings it's own requirements !!!**

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Data collection in bibliometric analysis

- Roughly, we can distinguish three methods for the collection of a set of publications:
  - Based on a **list of names** of researchers
    (verification through a website creates a valid dataset)
  - Based on a **list of publications** of a unit
    (the supplied lists form the authorized/verified dataset)
  - Based on the **address** of an institute or unit
    (this approach does not allow lower level insights and conclusions)

We work with various methods, macro-level studies usually exclude the first two methods.

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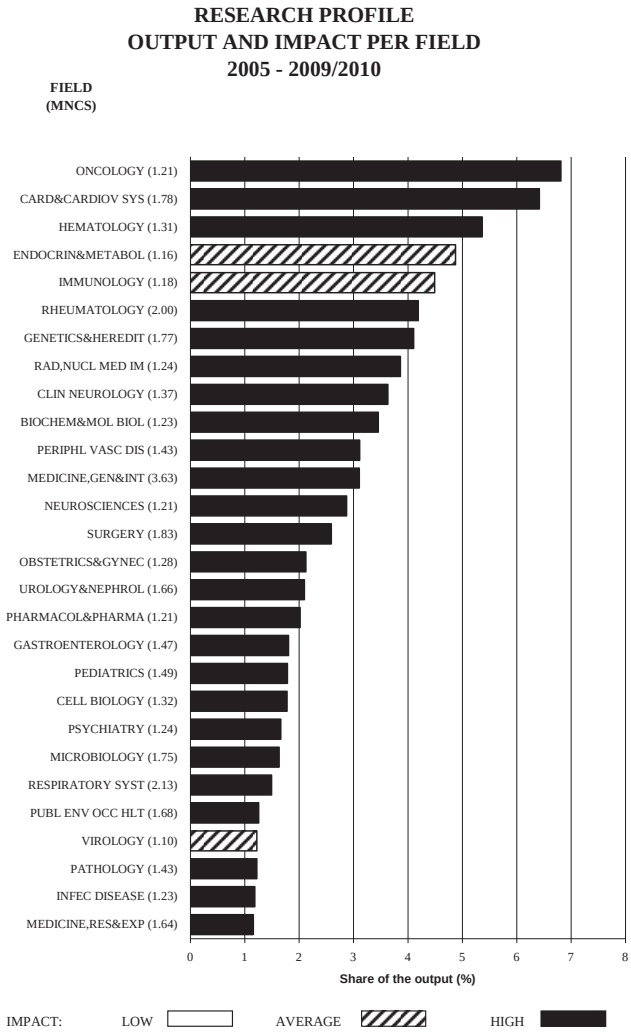
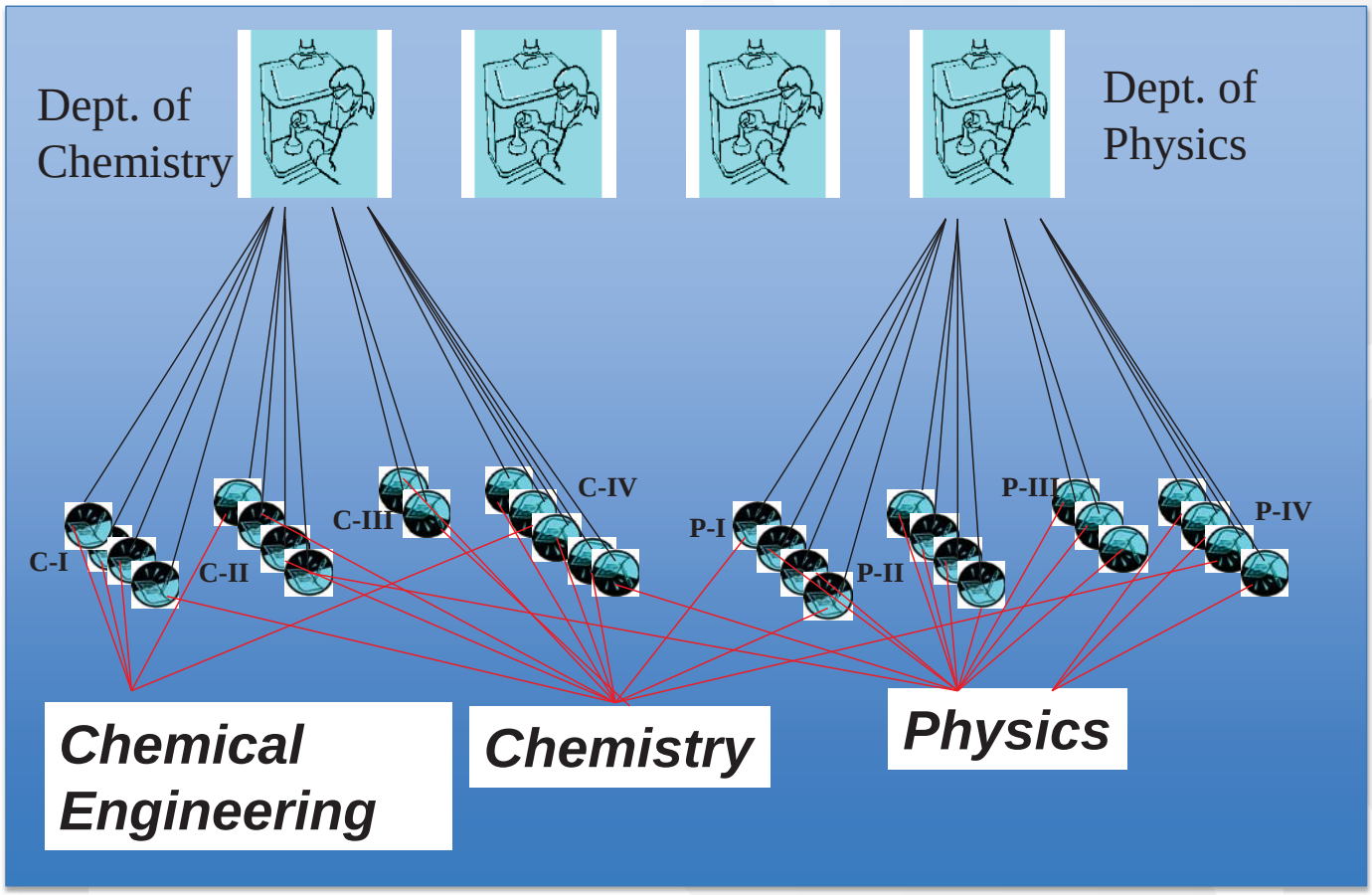


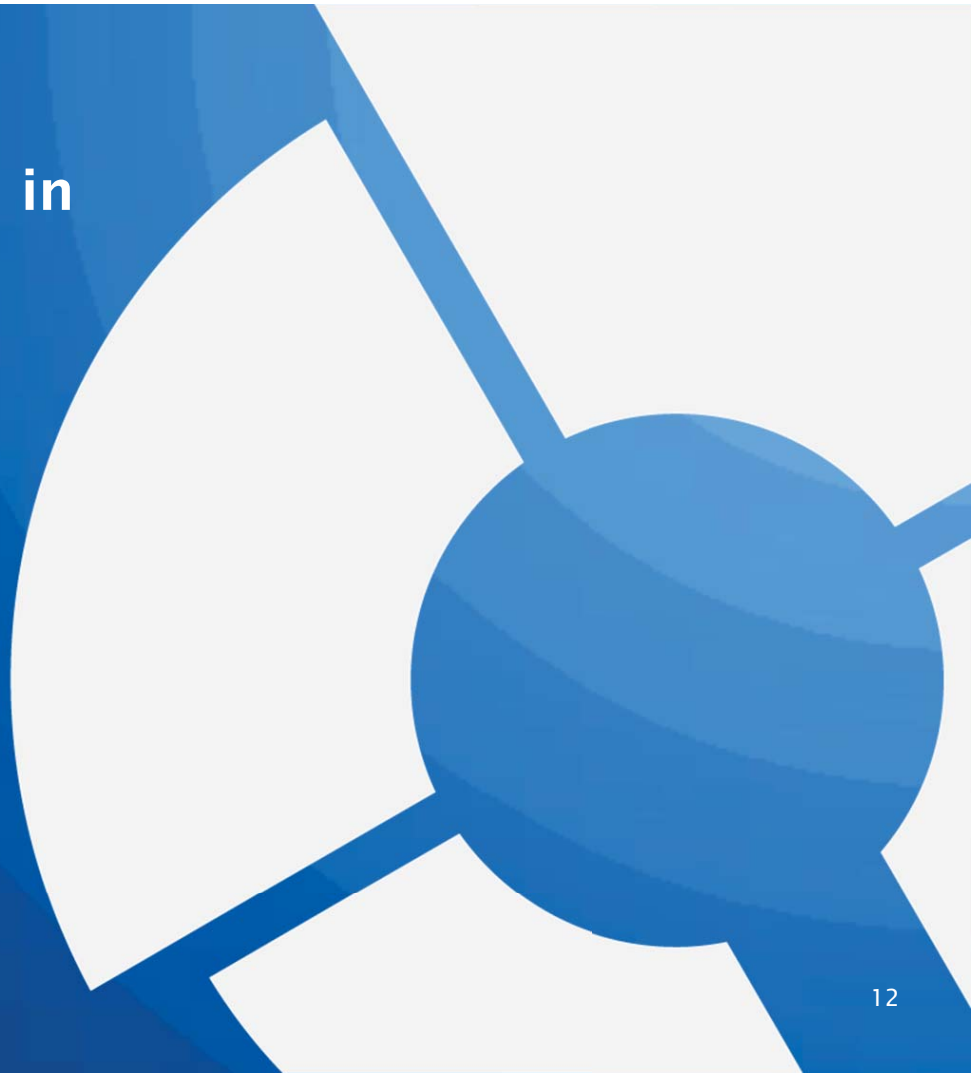
Example of a so-called *Research Profile*

- Profile of Leiden University Medical Center
- In *Immunology* they're not as strong as in other medical disciplines.
- However, this does not automatically mean that the Dept. of Immunology is performing at that level !

Disconnect between organizational units & fields



Normalization in bibliometrics



On normalization in bibliometric analysis

- The use of normalization is ***conditio sine qua non*** in applying bibliometric techniques.
- The most used system is that Journal Subject Categories, which fits the multidisciplinary nature of the Web of Science.
- However, the most applied system, that of Journal Subject Categories, has serious drawbacks *

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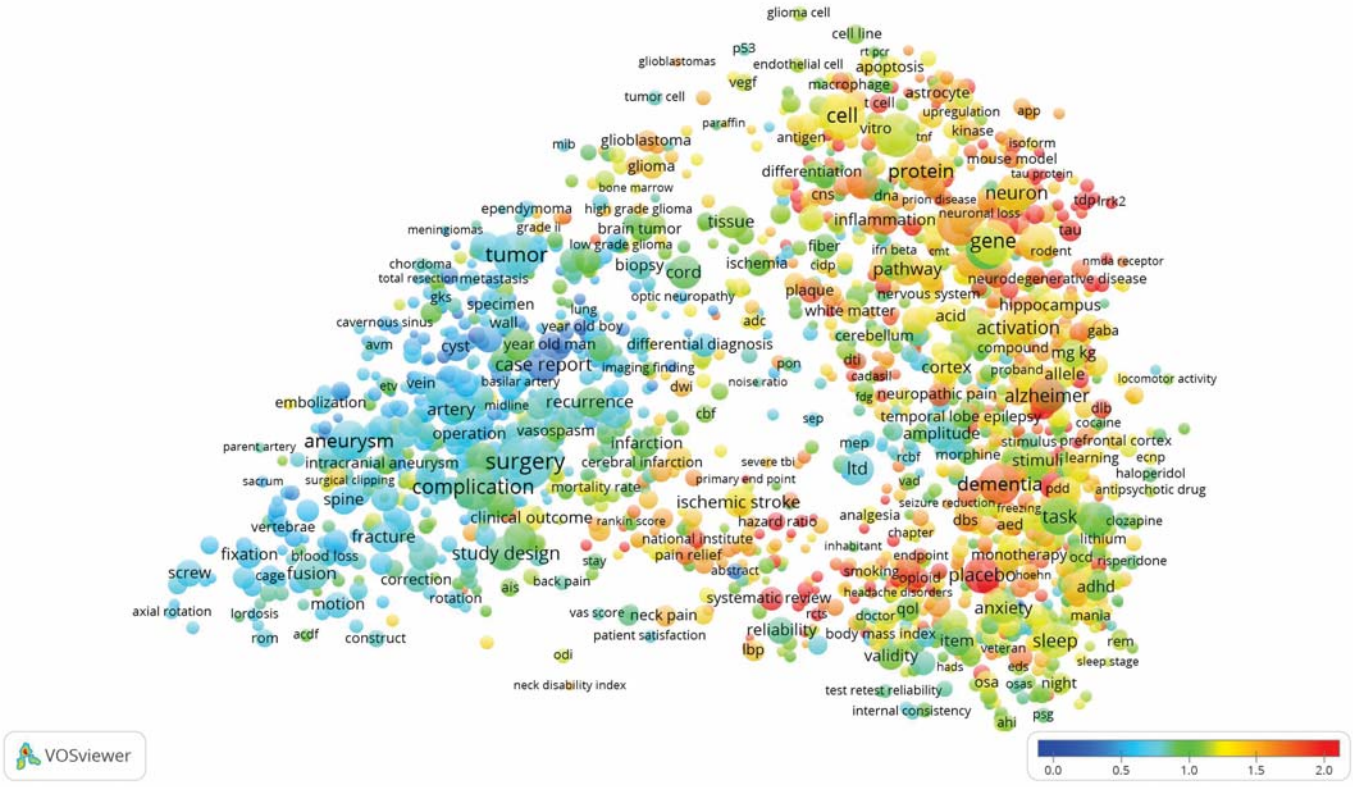
* Van Eck, N.J., et al (2013). Citation analysis may severely underestimate the impact of clinical research as compared to basic research. PLoS ONE, 8(4), e62395. arXiv:1210.0442

Journal Subject Category *"Clinical Neurology"*



Some conclusions on normalization

- Therefore, CWTS has developed methods to normalize in a different way, avoiding these problems.
- However, normalization and level of aggregation remain in a complex relationship.
- We have to remain aware of the other meaning of the word normalization, and avoid that this becomes a straight jacket.

Coverage in bibliometric studies

Introduction

- The use of evaluative bibliometrics can only become meaningful when used in a the right context.
- Publication culture of the unit(s) under assessment are shaping that context.
- As such, any bibliometric study should start with an assessment of the adequacy of metrics in that particular context.
- Therefore, CWTS has developed methods to assess that fit of metrics in a certain context.

How to define adequate coverage ?

- In order to determine whether metrics applied in an assessment context are meaningful, one needs to know what is represented through the metrics.

- We distinguish two types of coverage:
  - ***Internal*** (from inside the perspective of the WoS)
  - ***External*** (from the perspective of a total output set)

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Assessing the adequacy of WoS for bibliometrics: The *Internal* coverage method

- Look at publications in WoS across fields,
- Use the references given by the authors of the publications,
- Analyze the communication channels referred to,
- Usage of WoS journals as share of the total number of references is an indication of the relevance for the authors involved,
- Thereby constituting a basis for the usage of bibliometrics as evaluation tool !

Assessing the adequacy of WoS for bibliometrics: The *External* coverage method

- Use the list of publications of an organization, subject of a bibliometric analysis.
- Match the submitted list with the WoS.
- Degrees of covered scientific outlets indicate the relevance of WoS journals.
- Thereby constituting a basis for the usage of bibliometrics as an evaluation tool !

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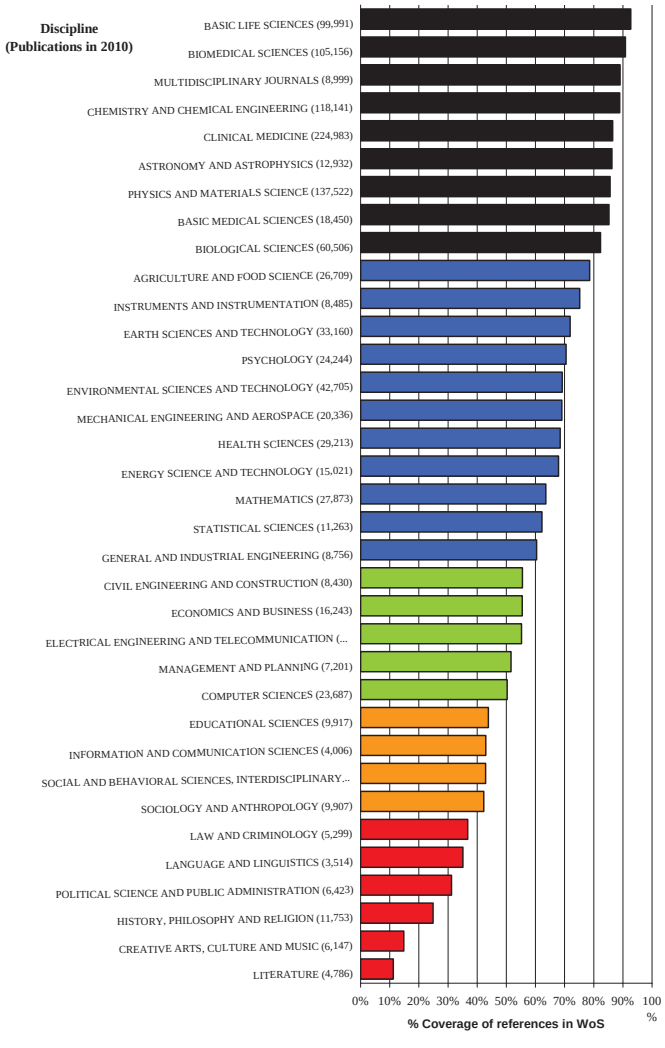
Internal coverage in bibliometric studies

AU	Moed, HF; Garfield, E.	in WOS
TI	In basic science the percentage of 'authoritative' references decreases as bibliographies become shorter	
SO	SCIENTOMETRICS 60 (3): 295-303, 2004	Y
RF	ABT HA, J AM SOC INF SCI T, v 53, p 1106, 2004	Y
	GAR TION INDEXING, 1979 (BOOK!)	N
	GA S INFORMATION S, v 8, p 403, 1985	N
	GILBERT GN, SOC STUDIES SCI, v 7, p 113, 1977	Y
	MERTON	Y
	RO	Y
	ZUC	Y

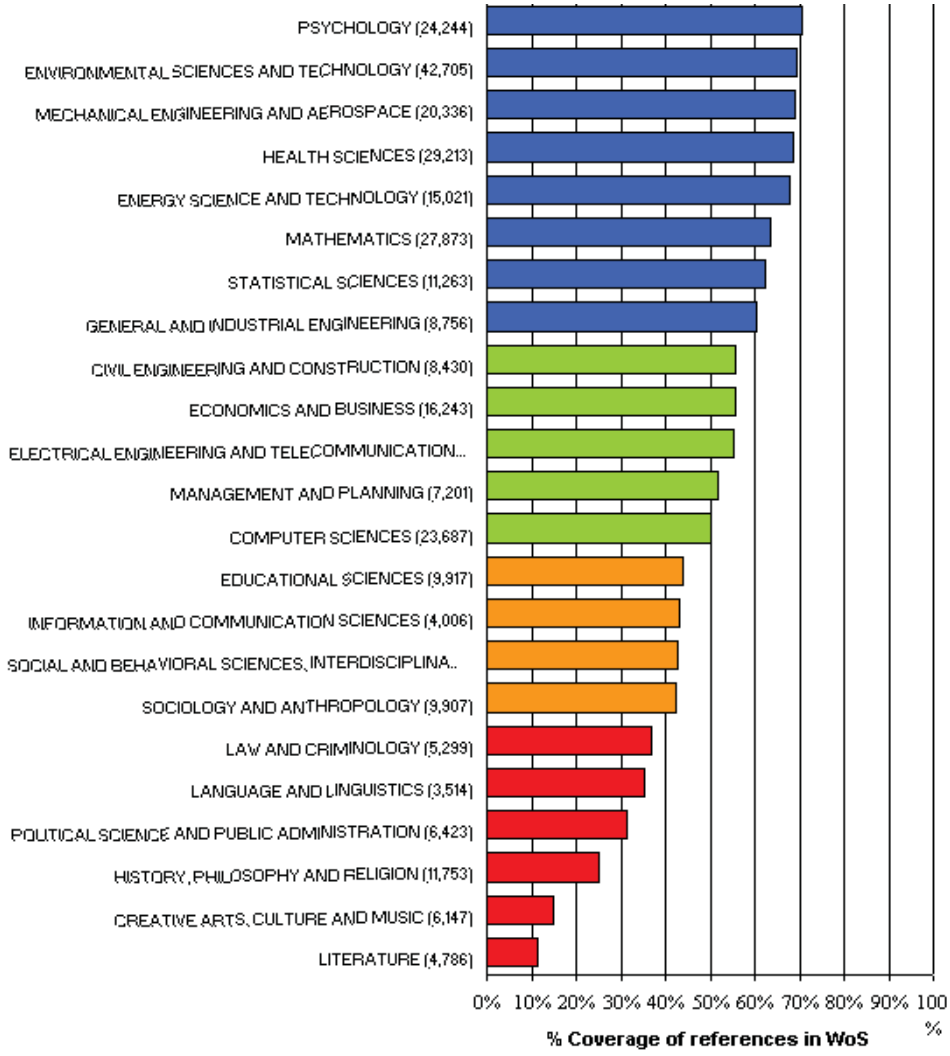
Not in WoS

WoS Coverage
= 5/7 = 71%



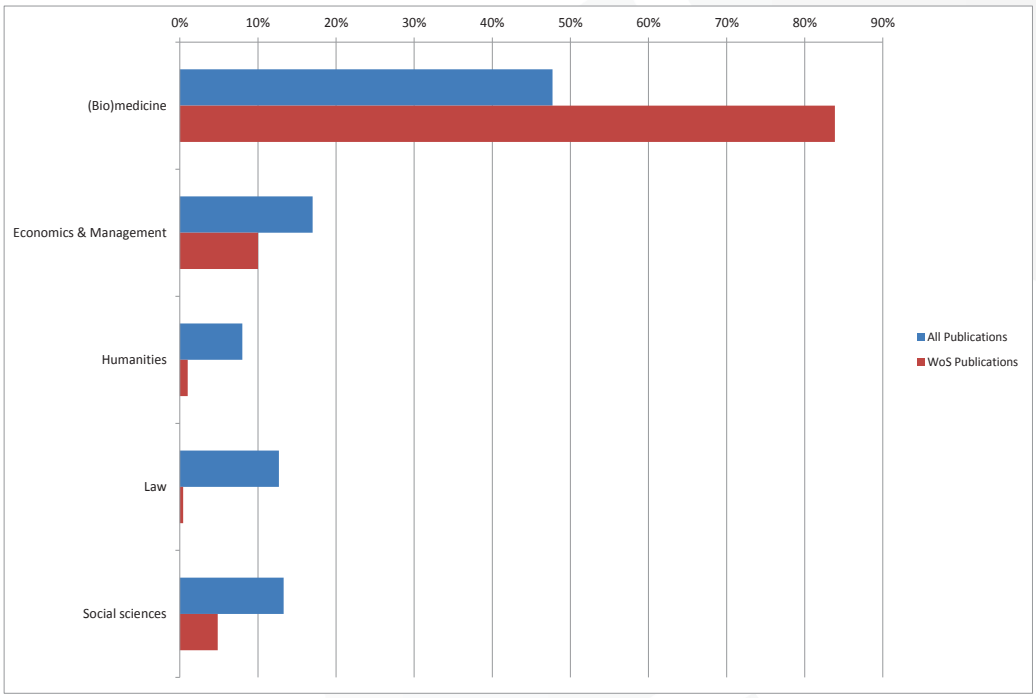
WoS Coverage in 2010 across disciplines

- **Black=Excellent coverage** (>80%)
- **Blue= Good coverage** (between 60-80%)
- **Green= Moderate coverage** (but above 50%)
- **Orange= Moderate coverage** (below 50%, but above 40%)
- **Red= Poor coverage** (highly problematic, below 40%)



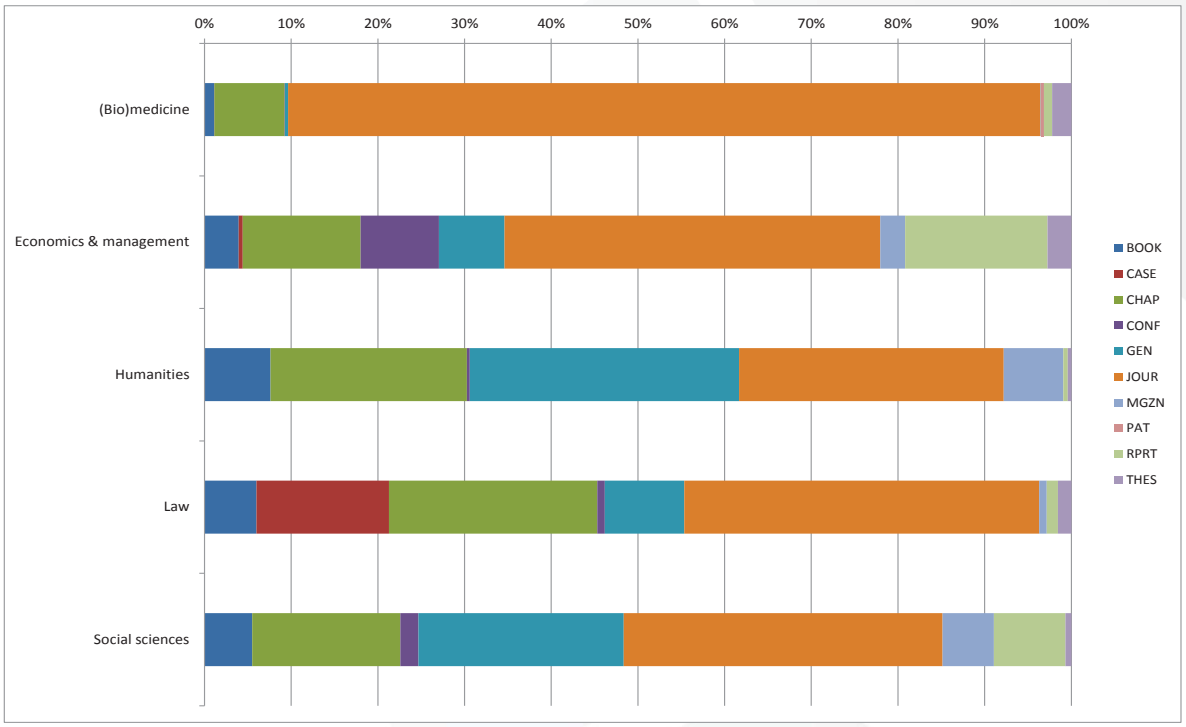
External coverage in bibliometric studies

External coverage & journal literature (i)



- Production is spread across disciplines.
- In Web of Science, Biomedicine is dominant !

External coverage & journal literature (ii)



- We observe a variety of types of output.
- Journal publishing is important in all disciplines !

Infamous bibliometric indicators: JIF & H-index

Definitions of Journal Impact Factor & Hirsch Index

- **Definition of JIF:**
  - The mean citation score of a journal, determined by dividing all citations in year T by all citable documents in years T-1 and T-2.

- **Definition of h-index:**
  - The 'impact' of a researcher, determined by the number of received citations of an oeuvre, sorted by descending order, where the number of received citations on that single paper equals the rank position.

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Problems with JIF

- **Methodological issues**
  - Was/is calculated erroneously (Moed & van Leeuwen, 1996)
  - Not field normalized
  - Not document type normalized
  - Underlying citation distributions are highly skewed (Seglen, 1994)
- **Conceptual/general issues**
  - Inflation (van Leeuwen & Moed, 2002)
  - Availability promotes journal publishing
  - Is based on expected values only
  - Stimulates one-indicator thinking
  - Ignores other scholarly virtues

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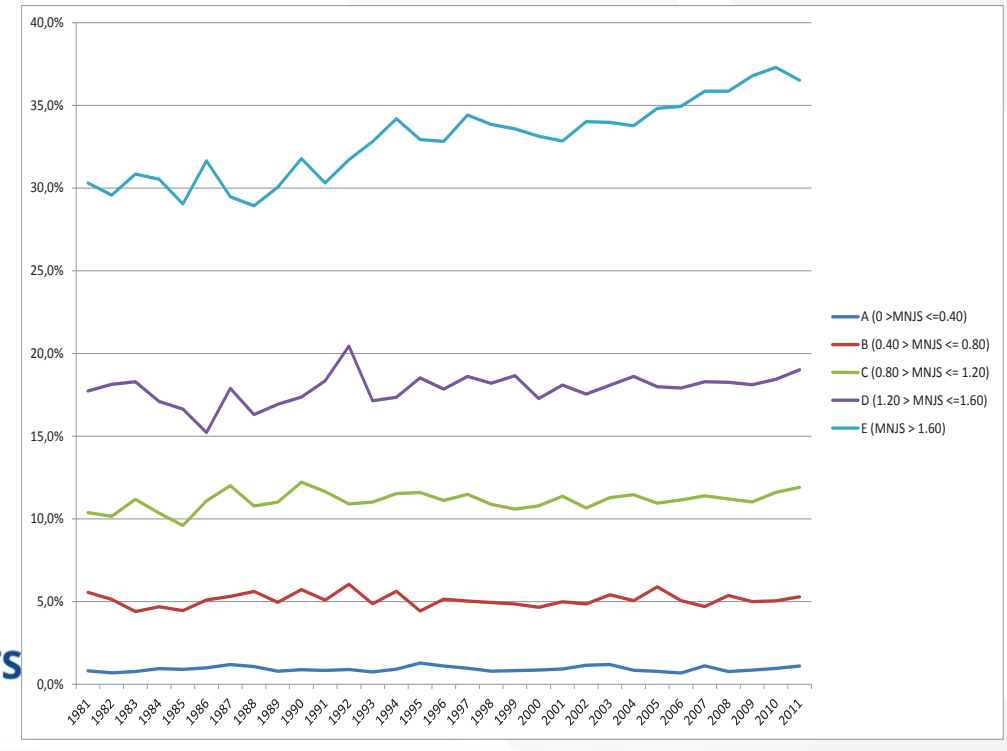
Deconstructing the myth of the JIF…

- Take the Dutch output
- Similar journal impact classes
- Focus on publications that belong to the top 10% of their field



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Problems with H-index

- **Bibliometric-mathematical issues**
  - mathematically inconsistent (Waltman & van Eck, 2012)
  - conservative
  - Not field normalized (van Leeuwen, 2008)
- **Bibliometric-methodological issues**
  - How to define an author?
  - In which bibliographic/metric environment?
- **Conceptual/general issues**
  - Favors age, experience, and high productivity (Costas & Bordons, 2006)
  - No relationship with research quality
  - Ignores other elements of scholarly activity
  - Promotes one-indicator thinking

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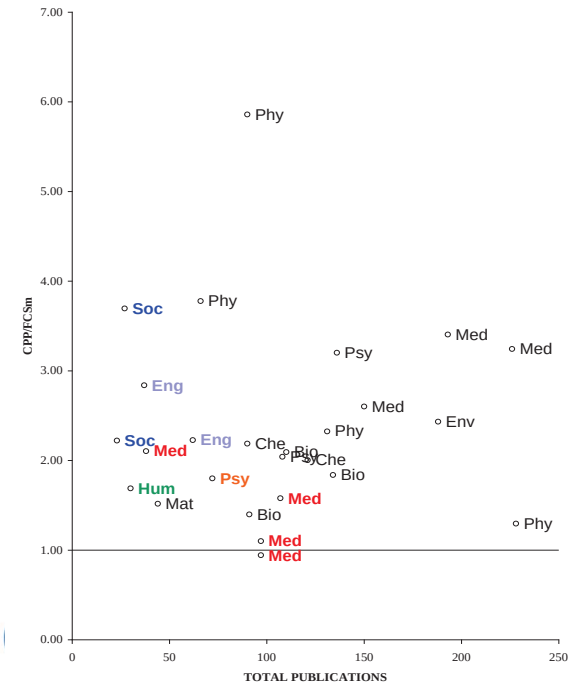
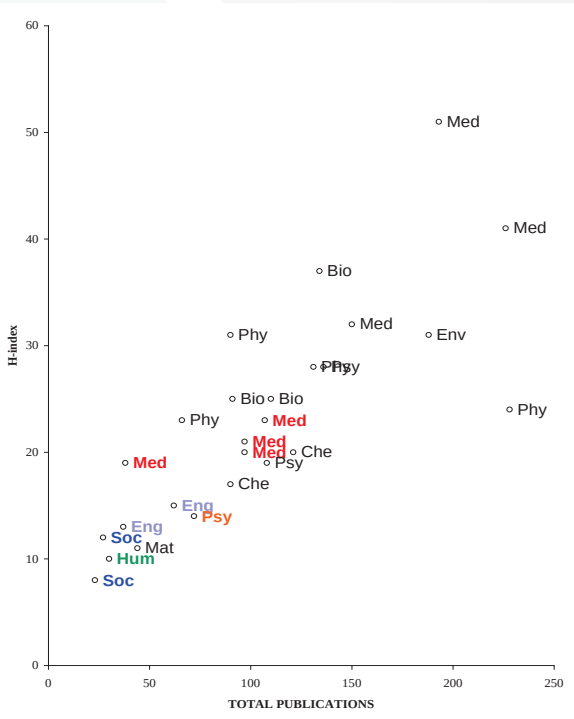
The problem of fields and h-index …

- Spinoza candidates, across all domains …
- Use output, normalized impact, and h-index





In what database context … ?

Selected my own publications in WoS and Scopus, Google Scholar has a pre-set profile.

Database	H-index	Based upon …
Web of Science	14	Articles in journals
Scopus	25	Articles, book (chapters), and conference proceedings papers
Google Scholar	33	All types, incl. Reports

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CWTS methodology: basic indicators

Indicators suitable for assessment (1)

p: the number of publications of a unit, in a certain period.

tcs: The total number of citations received in a certain period.

mcs: the mean citation score of the oeuvre of a unit.

% not cited: the share of that oeuvre that is not cited.

% self citations: the share of citations given by the (co-)authors.

Indicators suitable for assessment (2)

mncs: the comparison of the actual impact with expected field average impact scores.

mnjs: comparison of the journals in which the unit published, with the field average impact in which the output was published.

internal coverage: indicates relevance of the bibliometric analysis, based on reference behavior of units themselves.

Top 10%: The share of the output that belongs to the top 10% most highly cited in the fields the unit is active in.

Various additional types of analysis focus on …

- ***Research profiles***: a break down of the output over various fields of science.
- ***Scientific cooperation analysis:*** a break down of the output over various types of scientific collaboration.
- ***Knowledge user analysis:*** a break down of the 'responding' output into citing fields, countries or institutions.
- ***Network analysis:*** how is the network of partners composed, based on scientific cooperation?

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Advantages and disadvantages of bibliometric analysis

Some disadvantages of applying bibliometrics …

- Steers away from more qualitative considerations.
- Metrics shape as much as measure scientific activity.
- People tend to forget we are talking about ***'indicators'***.
- Tends to stimulate one-dimensional thinking.
- It requires skills to calculate and interpret results.
- ….

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Some advantages of applying bibliometrics …

- It offers insights into underlying structures and patterns.
- It is a strong complementary tool to peer review.
- It is relatively stable in time.
- ….

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We have not dealt with …

- The historical-social sciences perspective on the origins of the rise of bibliometrics in the nowadays science system.
- University rankings and all their problems.
- Bibliometric mapping and network methodologies.
- *'Address'* and *'Author'* issues when collecting data.
- Open Access and the 'issues' in relation to evaluation
- …

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Some conclusions …

- Bibliometrics should always be combined with peer review,
- … and preferably conducted by skilled experts !
- Always contextualize the bibliometric scores !
- One better avoids the '***Quick & Dirty***' indicators !
- Advanced bibliometrics can be very helpful in research management, at various levels.

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Thank you for your attention!

Any questions?
Ask me now, or mail me
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