Institute for Research Information and Quality Assurance

# Bibliometrics between ambition and responsibility

Nordic Workshop on Bibliometrics and Research Policy
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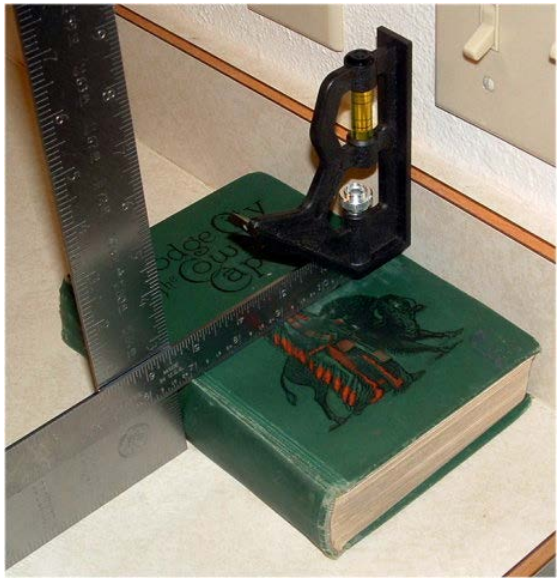
# Structure of the presentation

- What is bibliometrics / scientometrics?
- Why bibliometrics / scientometrics?
- Institutionalization
- Application and use
- Towards guiding principles

# What is bibliometrics / scientometrics?

- First attempts to measure science date back to as early as 18th century but, systematic developmemt of quantitative and evaluative analysis of science since mid 20th century
- Present-day bibliometrics are based on different scientific fields with own concepts that were more or less combined to an interdisciplinary understanding:
  - History of science (D. de Sola Price)
  - Philosophy (V.V. Nalimov)
  - Information science (E. Garfield)
  - Sociology of science (R.K. Merton)
  - Mathematics (S.D. Haitun, A.I. Yablonsky)



Based on Hornbostel / Glänzel, esss 2014, Vienna

# What is bibliometrics / scientometrics?

Robert K. Merton represents the sociologists' view of scientometrics. Among his most famous ideas related to science and its measurement, the *Matthew effect* and his notion of citation as a reward system (currency of science) should be mentioned.

According to the sociologists' view communication in science is not merely linked to cognitive processes (cf. information science), but also characterized by the position scientists hold in the community.

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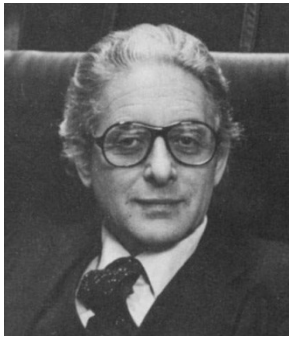
# What is bibliometrics / scientometrics?

In his book entitled “Little Science – Big Science” (1963), Derek J. de Solla Price analyzed the recent system of science communication and, thus, presented the first systematic approach to the structure of modern science applied to science as a whole.



His pioneering work also laid the foundation of modern research evaluation techniques.

His ideas were also timely since the development of science reached a stage where traditional information, retrieval, evaluation, and funding mechanisms became more and more difficult and expensive.

Based on Hornbostel / Glänzel, esss 2014, Vienna

# What is bibliometrics / scientometrics?

Addressed questions:

- Why should we not turn the tools of science on science itself?
- Why should we not measure and generalize, make hypotheses, and derive conclusions?

He paved the way for scientometric research by

- showing how to get away from methods and models adopted from other fields towards the development of a scientometric-specific methodology;
- proposing the growth model and studying scientometric transactions, e.g. the network of citations between scientific papers;
- finding that a paper that is frequently cited will probably get more citations than one cited less often and creating a model for this phenomenon;
- conducting scientometric studies for policy implications and research evaluation, thus opening the door for the present-day evaluative bibliometrics.

Based on Hornbostel / Glänzel, esss 2014, Vienna

# What is bibliometrics / scientometrics?

Eugene Garfield, founder and chairman of the *Institute for Scientific Information* (now part of Thomson Reuters) developed the *Science Citation Index* (SCI) in the early 1960s for the advanced Information retrieval and for science-information services, which has become an important source for scientometric studies.

*"The SCI was not originally created either to conduct quantitative studies,*

*calculate impact factors, nor to facilitate the study of history of science".*

(Garfield, *From information retrieval to scientometrics – is the dog still wagging its tail?* 2009)

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# What is bibliometrics / scientometrics?

**Examples**

- The *Journal Impact Factor* (JIF) was first used as a measure for comparing journals independently of “size” and to help to select journals for the SCI.
  (Garfield & Sher, *American Documentation*, 1963)
- The co-citation based *Atlas of Science* developed and issued by the Institute for Scientific Information (ISI) was considered a new kind of “review literature” which is also suited to help students in choice of careers in science.
  (Garfield, *Current Comments*, 1975)

Only later Garfield recognized the power of the JIF for journal evaluation and considered it also a journal performance indicator.

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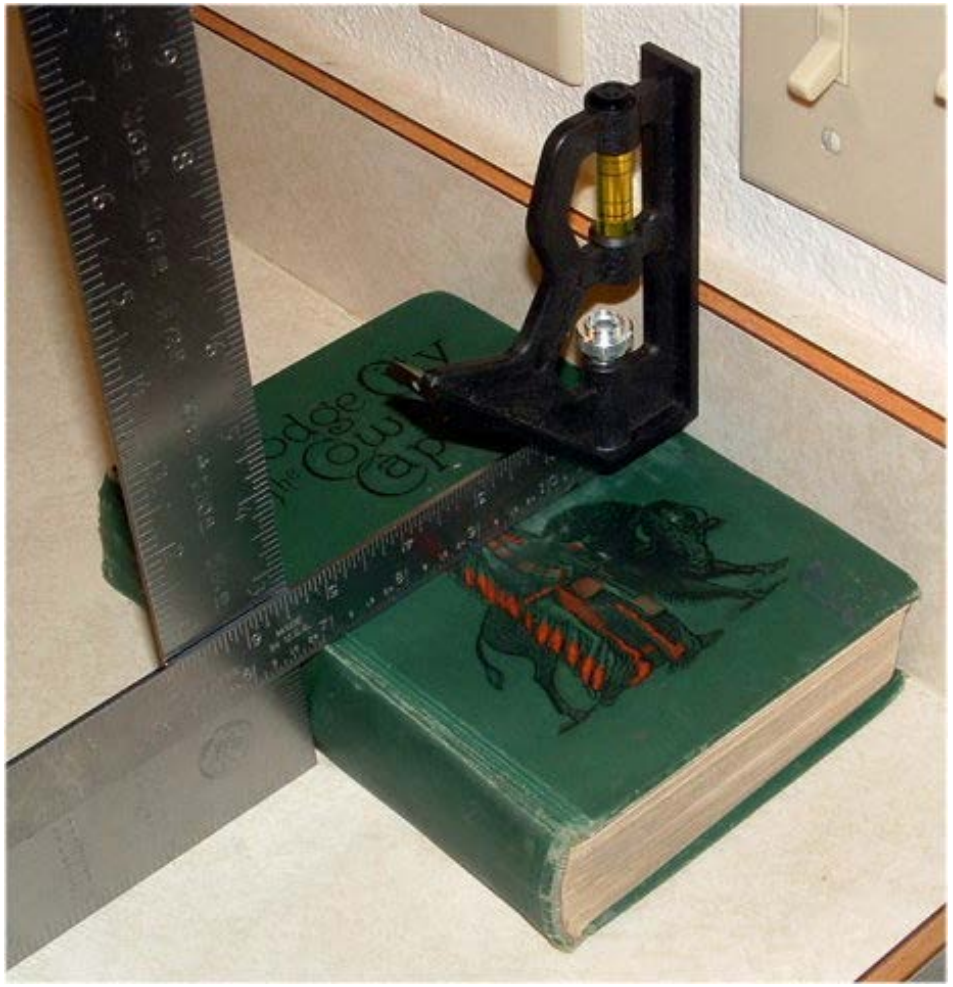
# What is bibliometrics / scientometrics?

- Pritchard (1969) explained the term *bibliometrics* as “the application of mathematical and statistical methods to books and other media of communication”.
- Nalimov and Mulchenko (1969) defined *scientometrics* as “the application of those quantitative methods which are dealing with the analysis of science viewed as an information process”.
- Otto Nacke (1979) defined *Informetrics*, “Informetrie: Ein neuer Name für eine neue Disziplin”, Nachrichten für Dokumentation 30, n. 6 (1979): 219-26



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# Why bibliometrics / scientometrics?

**Its early goals**

- Monitoring, describing, and modelling the production, dissemination, and use of knowledge, including information seeking, library circulation, and scholarly communication
- Optimizing library access and circulation, improving bibliographic databases, and extending information services

Based on Hornbostel / Glänzel, esss 2014, Vienna

# Why bibliometrics / scientometrics?

Necessities of ‘metrics’ for scientific research:

- Growth of scientific literature
- Challenges of “big science”
- Economic and societal use of science
- Internationalization of scientific community

Bibliometrics / scientometrics represented a statistical approach

- to master the growing flood of scientific information and
- to analyze and understand the underlying cognitive processes of communication in science
- by measuring quantitative aspects of these processes and
- by providing the results to scientists and users outside the scientific community.

Based on Hornbostel / Glänzel, esss 2014, Vienna

# Why bibliometrics / scientometrics?

- ‘Science indicators movement’ in the US with the discussion about the possible use of bibliometrics in science policy in the 1970s marked the begin of a new era in bibliometrics.
- Research evaluation using quantitative methods
- Distribution of funding on the basis of performance indicators

Comes also with consequences for bibliometrics:

- Re-interpretation of prior bibliometric concepts
- New fields of applications and challenges opened to bibliometrics; but many tools were still designed for use in scientific information, information retrieval; and libraries; they became used in a context for which they were not designed.

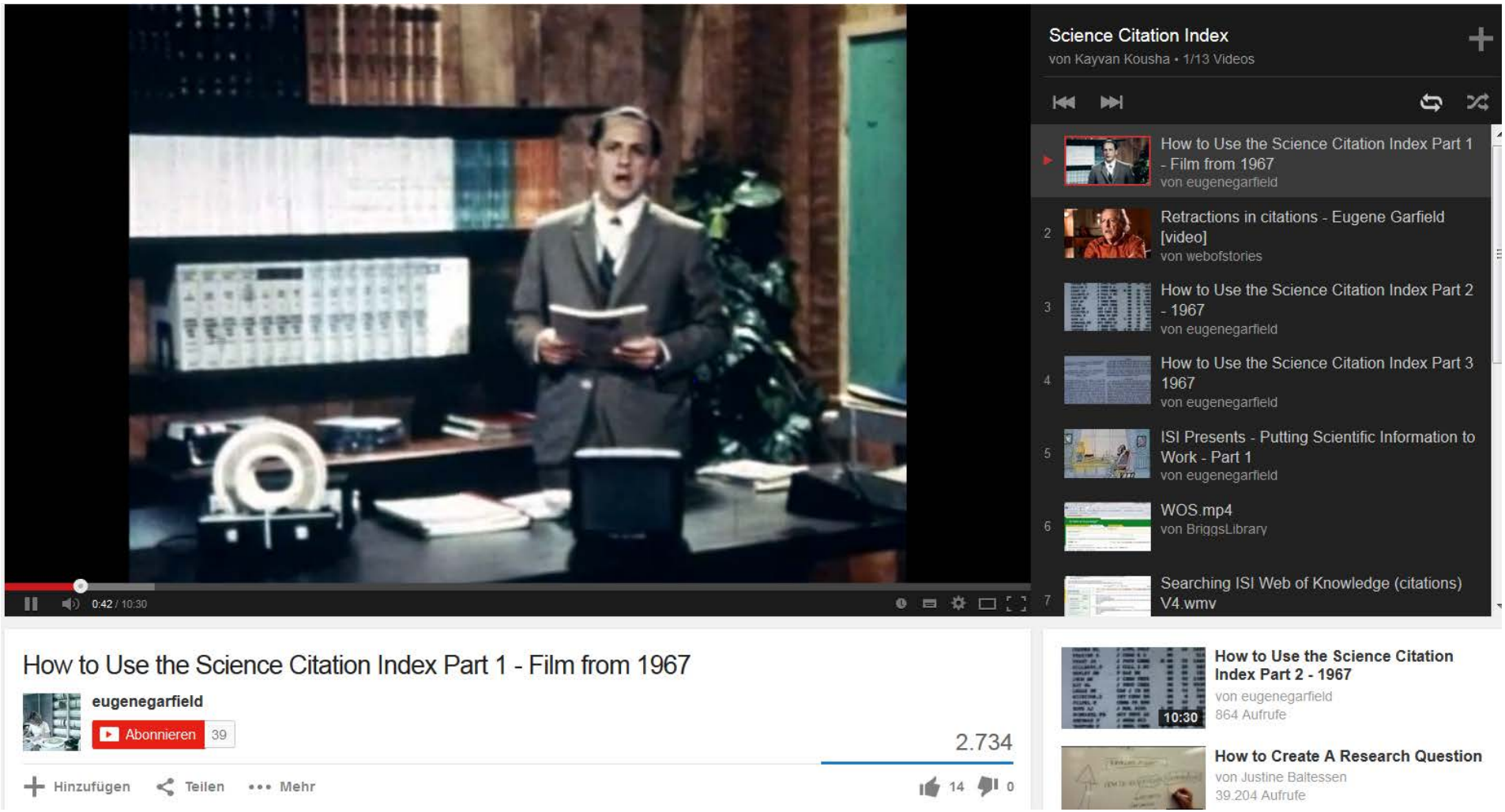
Based on Hornbostel / Glänzel, esss 2014, Vienna

# Institutionalization

The institutionalization process, started in the 1970s with a major momentum in the 1980s.

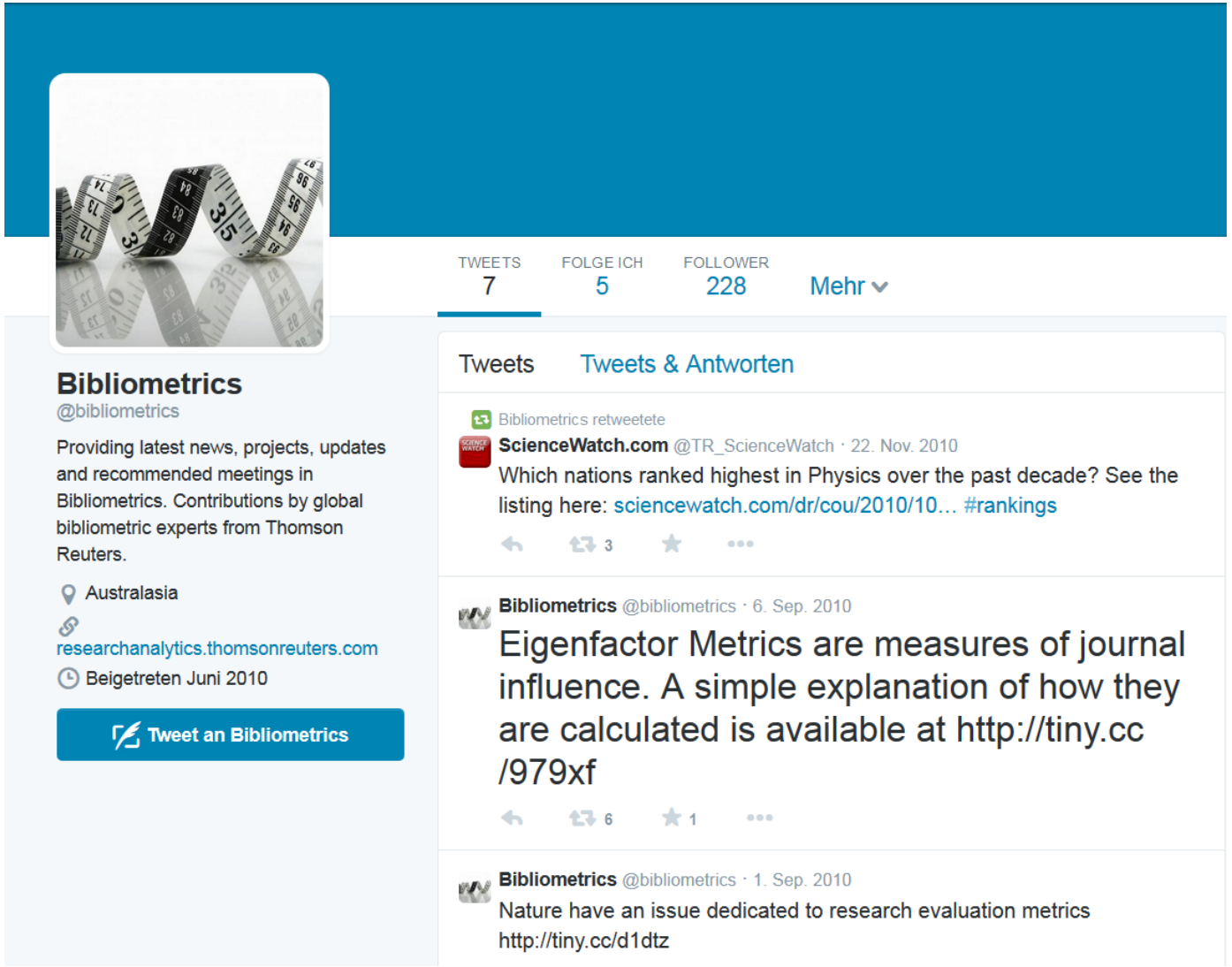
- Structured scientific research, service activities, higher education
  - Germany: Institut für Dokumentation und Information über Sozialmedizin und öffentliches Gesundheitswesen; Center für Science Studies (later IWT) Univ. Bielefeld
  - Hungary: ISSRU
  - Netherlands: CWTS (2014: 25th anniversary); Univ. Amsterdam Dept. Science Dynamics
  - France: Ecole de Mines, OST
  - Spain: CINDOC (now IEDCYT)
  - ...
- Documented scholarly communication
  - Scientometrics (1978); Research Evaluation (1991); Journal of Informetrics (2007)
  - Relevant books e.g. Handbook of Quantitative Science and Technology Research (first 1988, 2004)
  - ...
- Public perception and visibility
  - Conference series: ISSI (1987), STI (1988), Nordic Workshop (1996), CollNet (1998), et al.
  - International Societies / Organizations: ISSI (1993); ENID (2008)
- Training
  - Mainly Library and Information Science
  - Tailored courses (CWTS, esss)

# Institutionalization




Source: https://www.youtube.com/watch?v=abNZ66ZLbjU&list=PLFD2DCD0C1F06B795

# Institutionalization

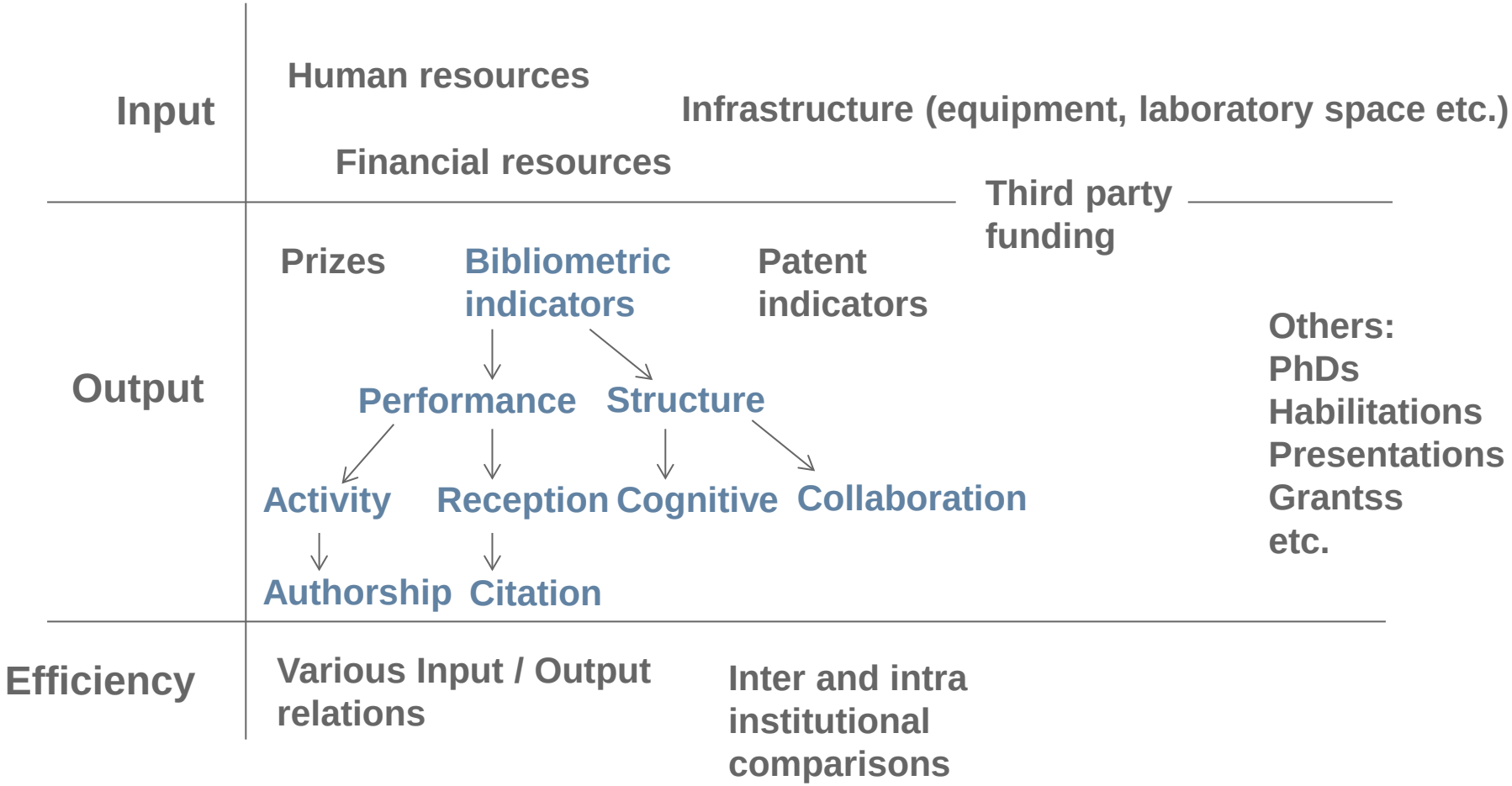



Source: https://twitter.com/bibliometrics

# Measuring science

- Indicators = Proxies
  - represent a highly complex reality
  - empirically ascertainable variables and factors, that are used to reflect aspects that cannot be directly measured
  - terms are rather vaguely defined – quality, performance, progress, usefulness, importance…
- Accommodate the need for “objective“ data but, also the interest to better understand developmental processes and contexts of science itself
  - indicators used as analytical tools e.g. to better understand the complicated system of knowledge production and knowledge exchange itself but, also as to inform science policy decisions

# Measuring science

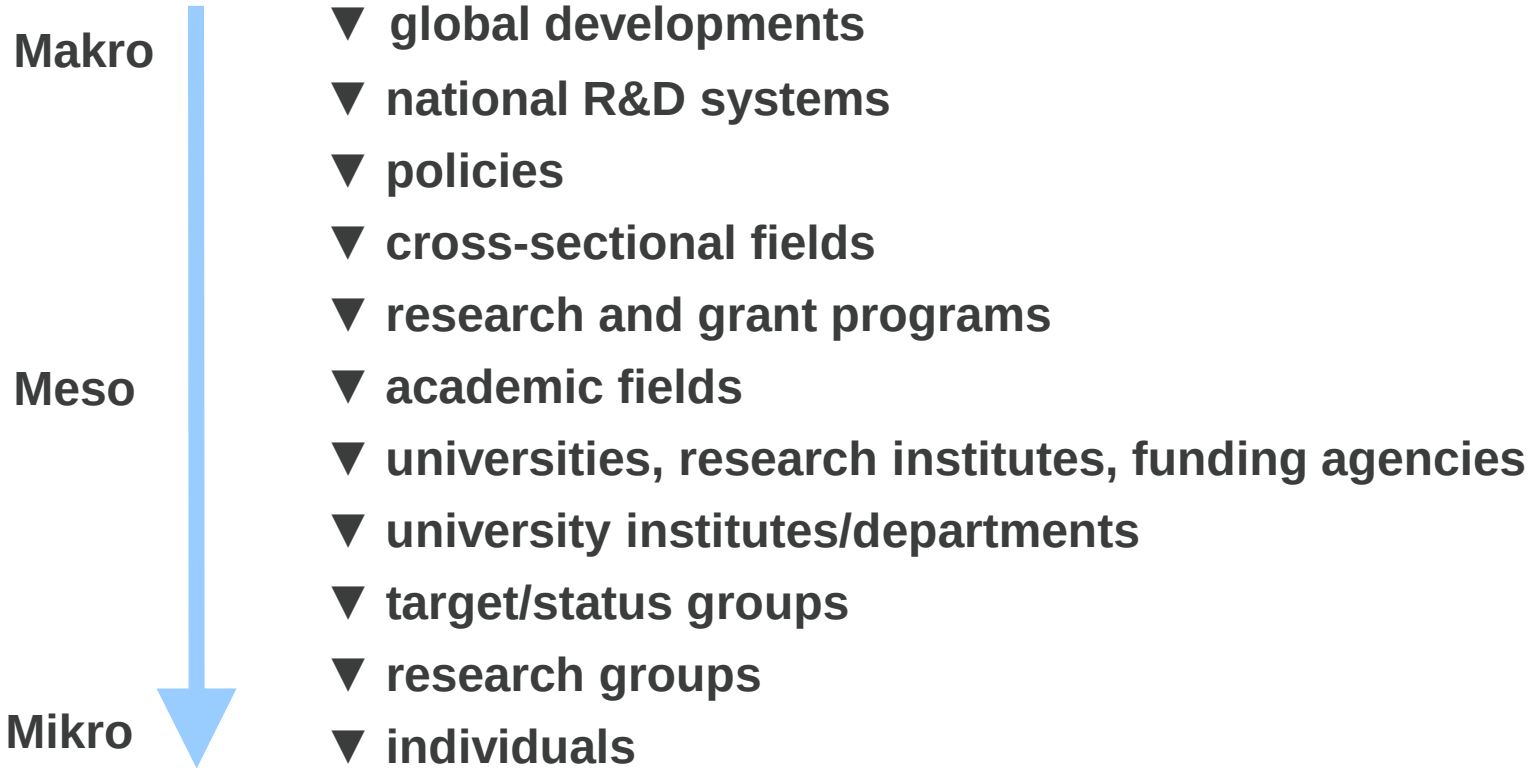



Based upon Hornbostel 1999, p. 59

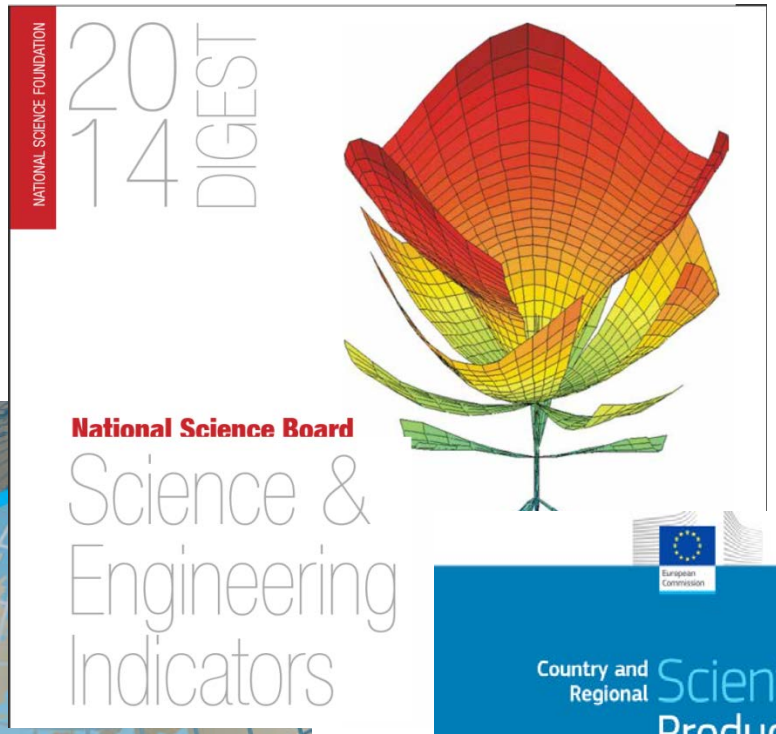
# Application and use

- Assessment and evaluation
- Formula-based funding systems
- Foresight processes
- Monitoring of public funding
- Strategic decision making processes

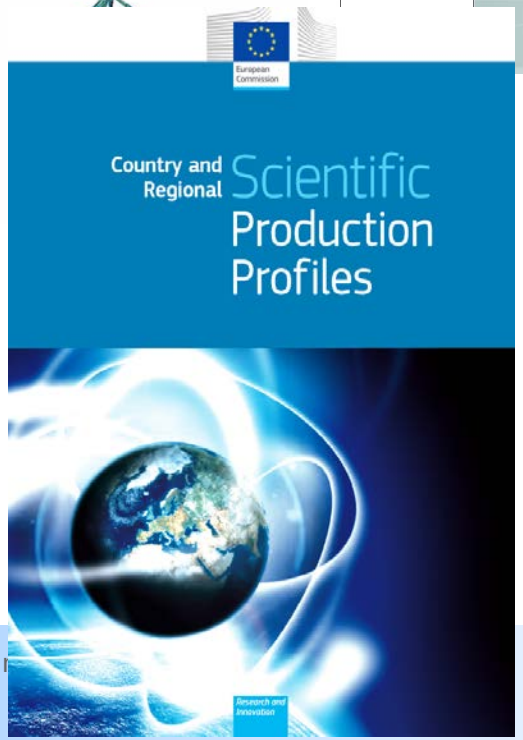
# Application and use



# Application and use: Reporting





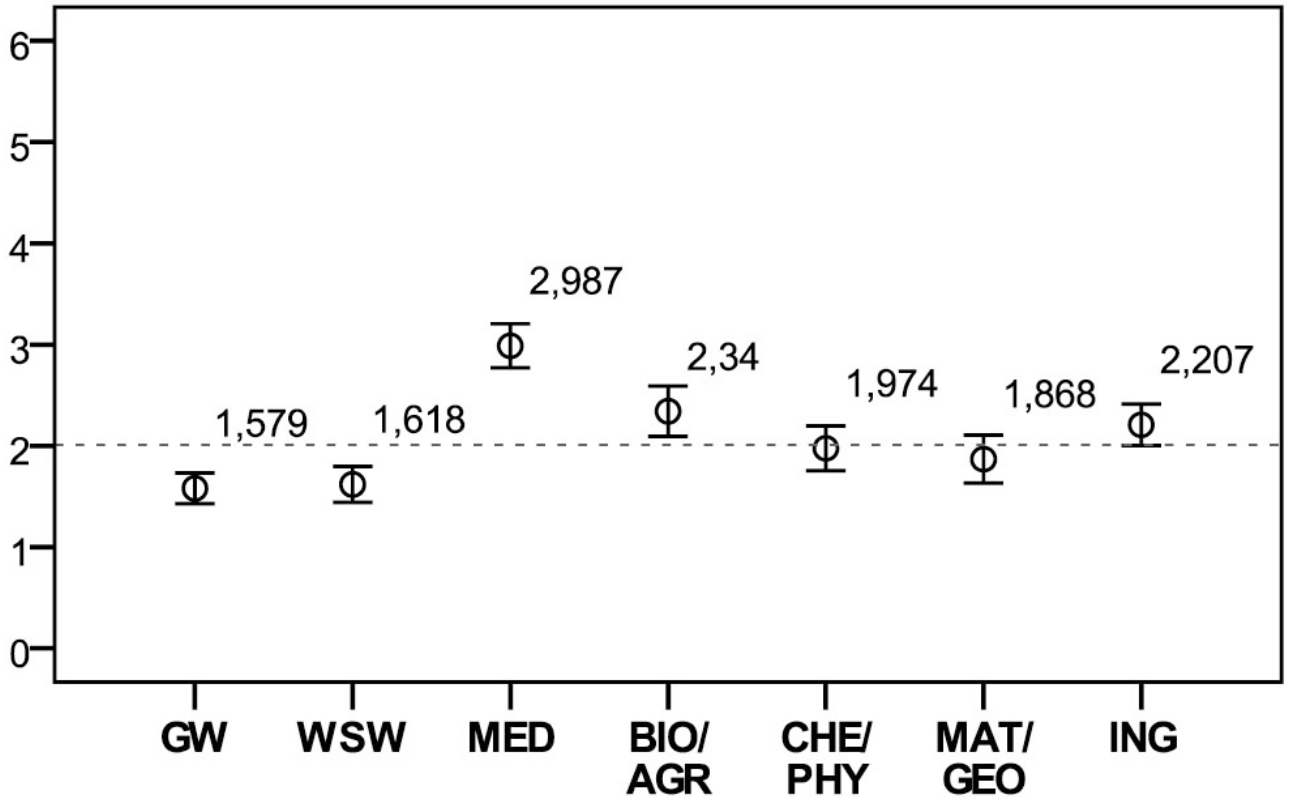




# Application and use: performance based funding

Examples PBF with bibliometric component:

- Funding of Flemish universities via *Bijzonder Onderzoeksfonds* (BOF) with part of the allocation key being based on publication and citation data (Debackere & Glänzel, *Scientometrics*, 2004)
- Distribution of basic research funding in the Norwegian HE as well as Denmark, Finland, Czech Republic, New Zealand, partly in Germany et al. (OECD 2010)
- Australia, bibliometric data used for ERA but not used to distribute basic funding to HEI

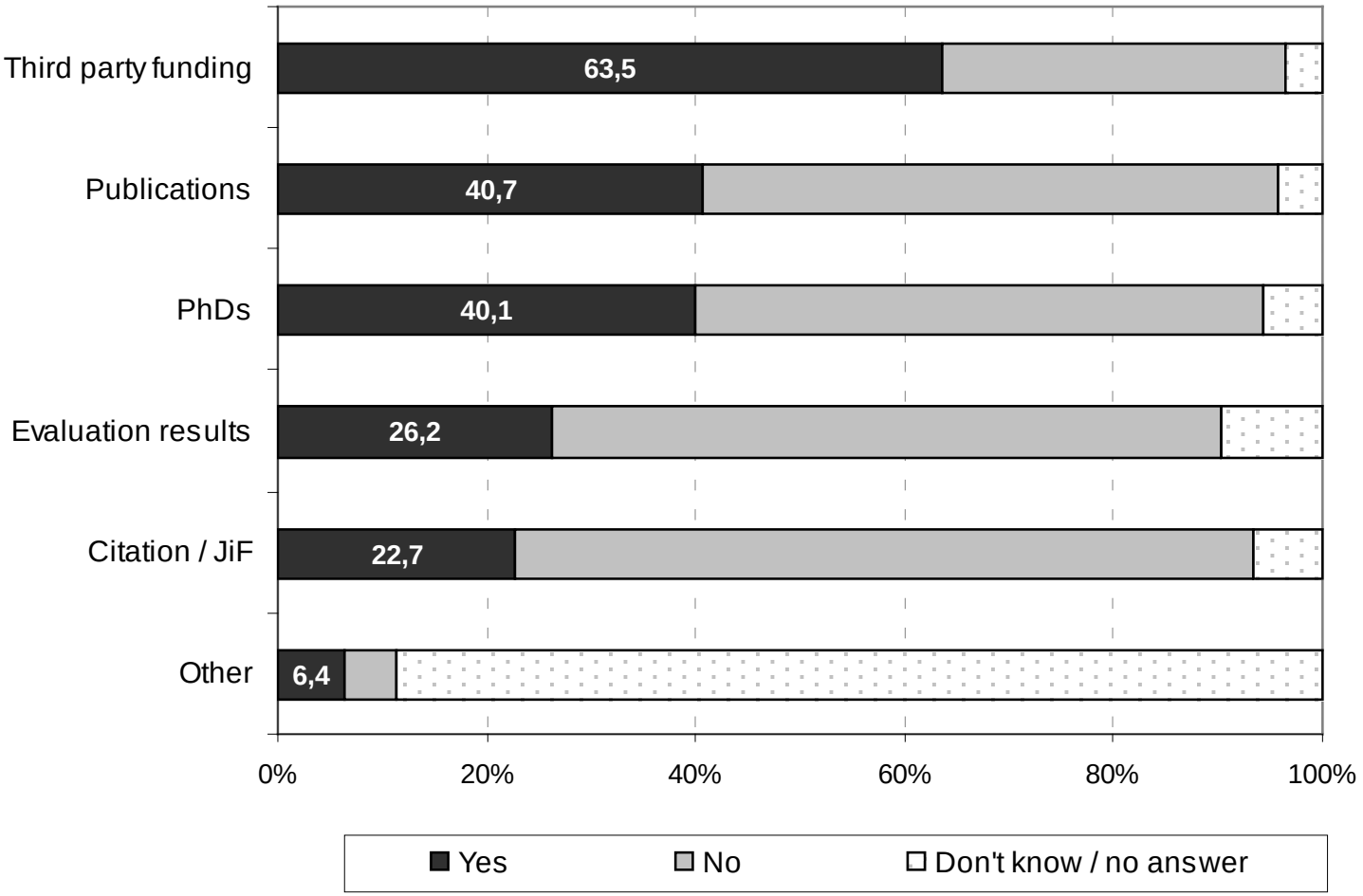
# Application and use: performance based funding




Germany: Average no. of indicators applied by discipline

Source: Böhmer/ Neufeld/ Hinze/ Klode / Hornbostel (2011): Wissenschaftler-Befragung 2010: Forschungsbedingungen von Professorinnen und Professoren an deutschen Universitäten. iFQ Working Paper No. 8, p. 91

# Application and use




Source: Böhmer/ Neufeld/ Hinze/ Klode / Hornbostel (2011): Wissenschaftler-Befragung 2010: Forschungsbedingungen von Professorinnen und Professoren an deutschen Universitäten. iFQ Working Paper No. 8

# Application and use: Performance based funding

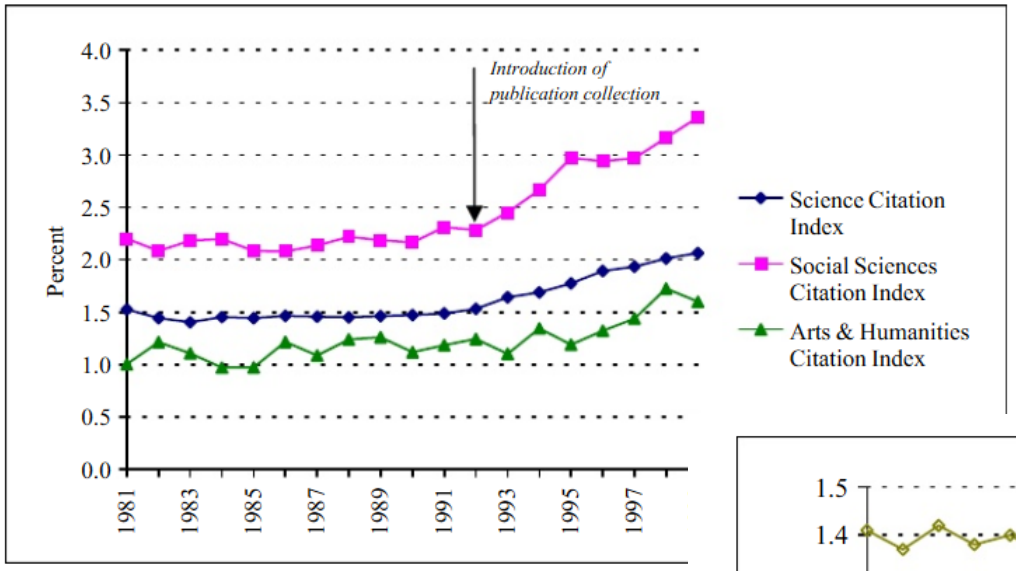



Figure 1: University share of publications in ISI's three main ind

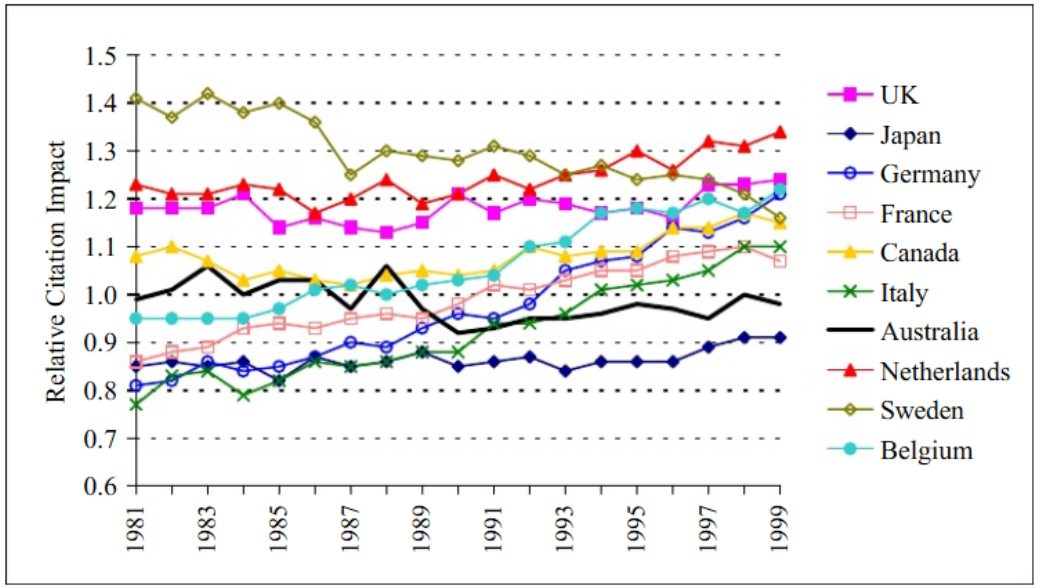
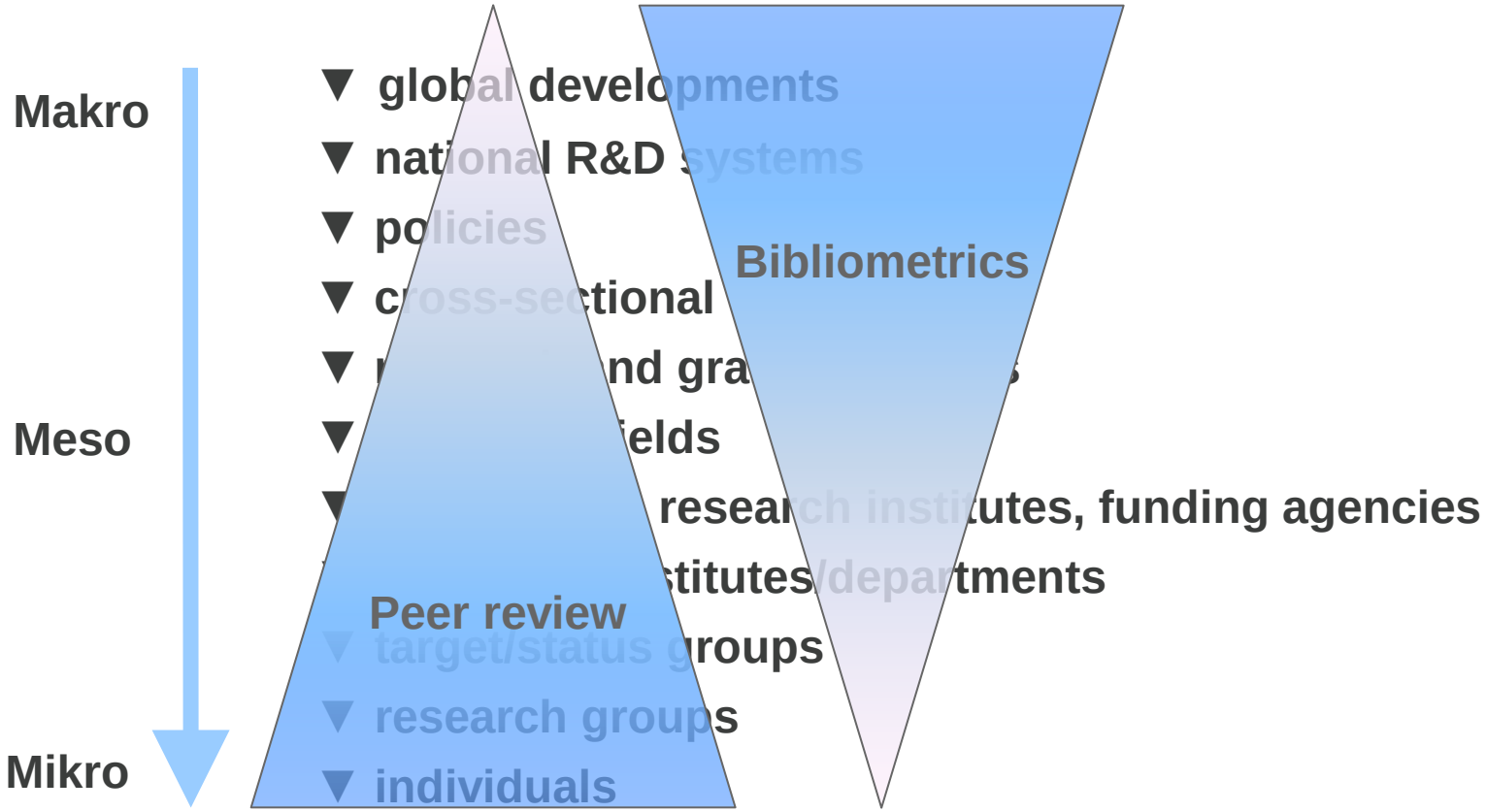



Figure 2: National trends in relative citation impact, selected OECD countries, 1981-99[9]

Source: Butler et al 2002: Impact of evaluation-based funding on the production of scientific knowledge: What to worry about, and how to find out. S. 13.

# Application and use



# Application and use

**c. Ten-year track record (max. 2 pages)[27]:**
The Principal Investigator must provide a list of achievements in the last 10 years.

The PI should list his/her activity as regards:

1. **Ten representative publications, as senior author** (or in those fields where alphabetic order of authorship is the norm, joint author) in **major international peer-reviewed multi-disciplinary scientific journals** and/or in the **leading international peer-reviewed journals and peer-reviewed conferences proceedings** of their respective research fields, also indicating the number of citations (excluding self-citations) they have attracted (if applicable).
2. **Research monographs and any translations thereof** (if applicable).
3. Granted **patents** (if applicable).
4. **Invited presentations to peer-reviewed, internationally established conferences** and/or **international advanced schools** (if applicable).
5. ***Research expeditions*** *that the applicant Principal Investigat*
6. *Organisation of* ***international conferences*** *in the field of the steering and/or organising committee) (if applicable).*
7. ***International Prizes/ Awards/ Academy memberships*** *(if a*
8. ***Major contributions to the early careers of excellent resea***
9. ***Examples of leadership in industrial innovation or design (***

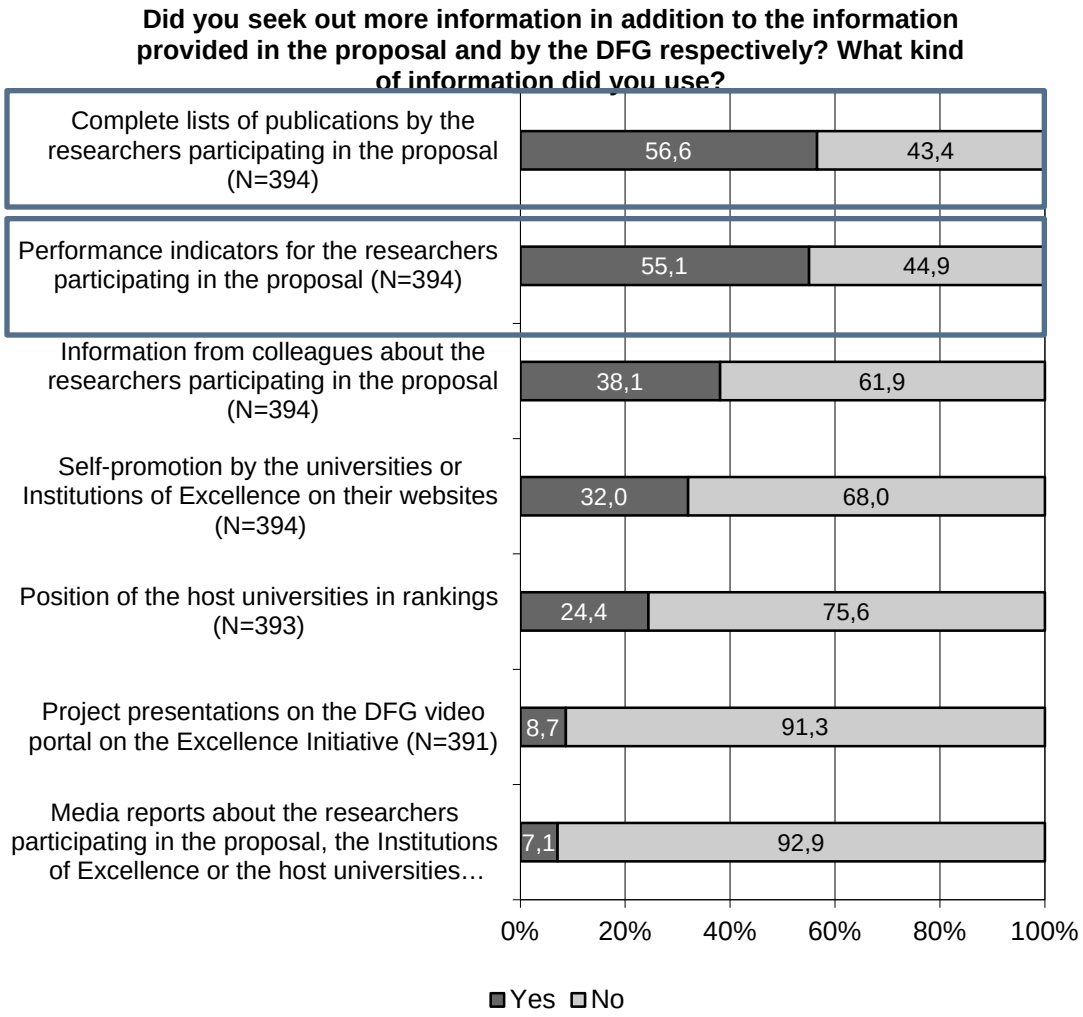
**c. Early achievements track-record[27] (max. 2 pages):**
The Principal Investigator (PI) must provide a list of achievements reflecting their track record.

The PI should list his/her activity as regards:

1. **Publications** in **major international peer-reviewed multi-disciplinary scientific journals** and/or in the **leading international peer-reviewed journals, peer-reviewed conferences proceedings and/or monographs** of their respective research fields, highlighting five (Starting Grant) or ten (Consolidator Grant) representative publications, those without the presence as co-author of their PhD supervisor, and the number of citations (excluding self-citations) they have attracted (if applicable).
2. Granted **patent(s)** (if applicable).
3. **Invited presentations to peer-reviewed, internationally establishe nferences** and/or **international advanced schools** (if applicable).
4. **Prizes and Awards** (if applicable).

Source: ERC: Information for applicants to the Starting and Consolidator Grant 2014 Call", p. 25. and Advanced Grant 2014 Call, p. 22

# Application and use




Source: Möller, T. / Antony, P. / Hinze, S. / Hornbostel, S. (2012): Exzellenz begutachtet. Befragung der Gutachter in der Exzellenzinitiative. iFQ-Working Paper No.11. Berlin. http://www.forschungsinfo.de/Publikationen/Download/working_paper_11_2012.pdf

# Application and use

- None the least due to the availability and accessibility of the underlying data the application of bibliometric methods is expanding as is the group of actors providing respective services

- This expansion may be also accompanied by inappropriate or uninformed use of bibliometric information:
  - Insufficient knowledge of data source and methodology
  - Misinterpretation due to insufficient contextualization

- Need to actively contribute to informed and cautious used
- Strive for standardization and implementation of guiding principles
  - Picking up a discussion that started 1995 at the ISSI conference
  - Workshops at ISSI 2013, STI2013, STI2014, Paris Workshop on Guidelines and good practices on quantitative assessments of research

Objective: develop standards for accountability and expert advice on good scientometric practices

# Guiding Principles – “Leiden Manifesto”

Drafted and discussed during STI2014, Leiden, September 4-6 (based on Diana Hicks)

- Metrics properly used support assessments; they do not substitute for judgment. Everyone retains responsibility for their assessments.
- Accurate, high quality data requires considerable time and money to produce. It is easy to underestimate the difficulty of constructing accurate data. Those mandating use of metrics should be able to provide assurance that the data is accurate.
- Metrics should be transparent, the construction of the data should follow a clearly stated set of rules. Everyone should have access to the data.
- Data should be verified by those evaluated, who should be offered the opportunity to contribute explanatory notes if they wish

# Guiding Principles – “Leiden Manifesto”

- Different metrics suite different fields.  Sensitivity to field differences is important. Humanists will not be able to use citation counts; computer scientists will need to ensure conference papers are included; and chemists will look the best in raw metrics constructed from Web of Science data.  The state-of-the-art is to select a suite of possible indicators and allow fields to choose among them.

- Data must be normalized to account for variation in citation and publication rates by field and over time.

- Metrics should align with strategic goals.

Thank you very much for your attention!

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