



# TOWARDS SCIENTOMETRICS 3.0 – BACKGROUND, PROMISES, CHALLENGES AND LIMITATIONS OF BIBLIOMETRICS OF THE FUTURE

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**If we wish to know something about the future, we need to explore and understand the roots, the past and present.**

### Background

Garfield's vision and pioneering ideas on using citation indexing has led to the creation of a unified citation index.

👉 Scientometrics proceeded from a quasi “monolithic” groundwork.

### *Characteristics of the first version: Scientometrics 1.0*

- Analysis of quantitative aspects of scholarly communication in basic sciences
- First applications focused on scientific information.
- Underlying research by enthusiastic scientists with various educational backgrounds

## Major strengths

- Closed dynamic universe with clear definition of actors and concepts
- Potential for standardisation and integration of indicators
- Facilitates reproducibility, comparative studies and benchmarking exercises
- Mathematical-statistical models for a variety of processes
- Allows testing and validating of methodology
- Works at any level of aggregation

### Extensions towards applied sciences and SSH

The expansion of data sources and the partial broadening the scope of the discipline opened up new opportunities for scientometricians and users.

- ☞ The sharp rise of our discipline from the 1990s on, was fostered and facilitated by the rapid development of information technology and computer science.
- ☞ “Big funding” has become a common way for financing research and providing services (cf. GLÄNZEL, 1994).

### *Two main characteristics of this process*

- Scientometrics evolved from a sub-discipline of library and information science to an instrument for evaluation and benchmarking (“perspective shift” – GLÄNZEL, 2006)
- Due to the dynamics in evaluation, the focus has shifted away from macro studies towards meso and micro studies of both actors and topics. (WOUTERS et al., 2013)

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### *New features and challenges*

- New data sources and opening the formerly closed universe
- Limited suitability of some indicators in an evaluative context (e.g., *Journal Impact Factor*)
- Database-related issues (data coverage, lacking or incomplete information ...)
- Big-data related issues (data cleaning, name disambiguation, data harmonisation ...)
- Different publication and citation cultures (SSH) and micro-level specific issues
- New methodologies, supported by related fields (CS, linguistics, econometrics, social sciences)
  - ☞ Scientometrics provided a strong cognitive feedback to these fields strengthening the integration into interdisciplinary research networks.

## ≡ Scientometrics 2.0 – A new model of metrics ≡

Fifteen years ago, Priem and Hemminger heralded the emergence of the new paradigmatic “Scientometrics 2.0” model with ‘social media metrics’ or ‘alternative metrics’ as components (PRIEM & HEMMINGER, 2010).

- ☞ Moved scientometrics towards the measurement of “broader impacts” of research (societal impact) and to cover “open science”

### Promises

Sugimoto (2016) pointed to the increasing demand for

- showing impact of research beyond academia,
- democratising the impact by giving greater voice and vote, e.g., to underrepresented groups (gender, ethnicity, disability, geographic etc.) in determining impact.

This Scientometrics 2.0 has opened the concept of “closed” universe and “monolithic” databases towards new horizons to include and combine differently, even unstructured sources.

- ☞ The concept of scientific communication has opened towards broader communication processes and non-academic (economic, societal, policy ...) impacts.

*New opportunities and tearing down walls does not go without risks.*

### Challenges, risks, and limitations

Challenges and limitations have already been summarised very early by e.g., SUGIMOTO (2016), GUMPENBERGER et al. (2016), GLÄNZEL & CHI (2016)

- Most benefits at the micro level, questionable at higher levels of aggregation
- Large scale studies form one of the main challenges (validity, reliability and feasibility)
- Rapid development of communication and permanent change of structures and contents
- Metrics not always sufficiently underpinned by theory nor supported by large empirical evidence
- No clear definition of actors (impact upon whom?)
- High dynamics and rapid development of communication and permanent change of structures and contents
- Automated processes produce errors and influence social media metrics
- No clear interpretation of metrics/results and lacking standards (cf. GLÄNZEL, 1994, **1996!**)

👉 *Can new metrics keep pace with this development once validated and implemented?*



## ≡ Scientometrics 3.0 – The future ≡

### New horizons

- At present, we witness a new, possibly more fundamental perspective shift paving the way for even more dramatic changes towards a 3.0 model.

### *Main characteristics Scientometrics 3.0*

- Data sources become increasingly independent from traditional bibliographic databases
- Further broadening the concepts of research output and scientometric inputs adding to those already used by Scientometrics 2.0
- Open sources gained increasing importance, also for scientometric methods, data, and results
  - 👉 “Open” in a double sense (open universe and open science)
- Emergence of AI in scientific research and scientometrics
  - 👉 Use of LLM in a double sense: in doing research and publishing results *and* in scientometrics for data processing and in evaluative contexts (cf. THELWALL, 2025; KOUSHA & THELWALL, 2025)

👉 *Scientometrics 3.0 promises to evolve towards an open scientometrics.*

### New opportunities, challenges and risks

- The diversity of new and *large data sources* (in part OA), the increasing availability of *full-text documents*, the almost unlimited *data storage* capacities, advanced *data-science techniques* with text and data mining and the advent of AI with LLM for data analysis, harmonisation and integration offer the probably most fascinating opportunities.
- The rich opportunities harbour also dangers: The temptation to use ready-made tools promising all-in-one solution may impair the quality and scientific rigour of research.
- The need for standards will be even more important since integrating data from different sources is going to become a regular practice.
- Documentation and reproducibility of procedures and validation of results will take increasing effort and space (e.g., GLOBAL Delphi Survey, 2024; NG ET AL., 2025).

The future of our discipline depends on **two fundamental factors**, particularly on *external conditions* (achievements in related fields) *and demands* (science policy, economy and society) as well as on the *internal potential and dynamics of our discipline*.

- ➡ The proper balance between both research and services towards the scientific communities (scientific information), and users in research assessment, economy and society needs to be ensured.

*So finally: Are we prepared for the future of scientometrics?*

Maybe we are. – I think we do contribute to shaping this future with our daily work, but there will also be another not negligible factor influencing the future of scientometrics: *serendipity* and the *unexpected*.

Let's stay prepared for these challenges with tireless and high-quality work.

## ≡ Epilogue: “Unimpeded bibliometric standards” ??? ≡

*István Örkény (1912–1979): More One-Minute Stories. Corvina, Budapest, 2007.  
Selected and translated by Judith Söllösy.*

### **Unimpeded production standards**

“Hello? Machine shop?”

“Skultéti here.”

“How much, Skultéti?”

“Thirty-three, Comrade.”

“What’s thirty-three, Skultéti?”

“What’s thirty-three, Comrade?”

“Yes, what’s thirty-three, Skultéti.”

“Why? Wasn’t thirty-three the right answer, Comrade?”

“The right answer to what, Skultéti.”

“To your question, Comrade.”

“Never mind, Skultéti, just resume where you left off.”

*(Heavy industry folklore, 1978)*



Thank you very much for your attention!