

Collective Scientometrics

Why We Need a New Way to Measure Science

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DZHW

German Centre for Higher Education Research
and Science Studies ■

My aim

Find the way to analyze scientific communities

- I do not introduce a new debate into scientometrics. Quite the opposite: I aim to restart a discussion that effectively disappeared more than two decades ago.
- This debate concerns how we describe and measure *thought collectives*, *scientific specialties*, *paradigms*, and *scientific communities* within scientometrics.



To bridge the gap, the sociology of science must initiate a theoretical renewal of research on specialties. Scientometrics, for its part, must undertake a theoretically guided investigation of specialties.

Gläser, J. (2001). Scientific specialties as the (currently missing) link between scientometrics and the sociology of science. *Proceedings of the 8th International Conference on Scientometrics & Informetrics*, 191–210.

Scientific Specialties as the (Currently Missing) Link Between Scientometrics and the Sociology of Science

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1. Introduction: Scientometrics as the main keeper of research on scientific communities

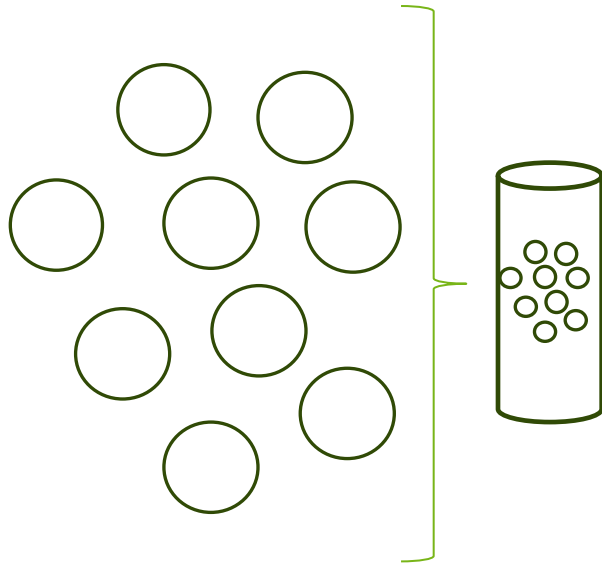
The aim of this paper is to review and synthesise empirical knowledge about scientific communities that has been accumulated by scientometric studies. This attempt is part of a project that aims to revive a forgotten subject within the sociology of science, namely scientific communities. With its microsociological turn at the end of the 1970s, the sociology of science lost interest in collectivities of scientists that extend beyond local settings and micro-processes. Empirically focussing on knowledge production at the micro-level and programmatically rejecting the old Mertonian paradigm, some researchers even denied the existence of scientific specialties and explicitly excluded them from their sociological analyses (Knorr-Cetina 1982, Callon et al. 1983, pp. 191-192). As several criticisms of the sociology of scientific knowledge have shown, this blindness for macro-structures in science leads to accounts of the sciences' dynamics that are incomplete (Whitley 1983, pp. 698-699; Gingras 1995, pp. 138-144). Criticizing the rapidly growing fashion for microsociological single-case studies, Whitley wrote in 1983:

The many case studies that litter the literature seem satisfied with demonstrating that scientists are human and social creatures who are subject to similar explanatory structures as any other occupation. What they don't do is to suggest how such people manage to produce and change some thing called scientific knowledge, largely because they are so concerned to deny any special status to it. (Whitley 1983, p. 681)

The question inherent to Whitley's criticism applies a basic sociological question to science - how social order is possible among numerous autonomously acting individuals. Scientific knowledge and, consequently, the process of its production represent a specific type of social order. How this order emerges and is maintained cannot be explained from a microsociological perspective alone. Social order refers to collectivities, and we must study these collectivities in order to explore social order in science. In other words: the question of social order that is central to the sociology of science cannot be answered by a sociology of scientific knowledge.

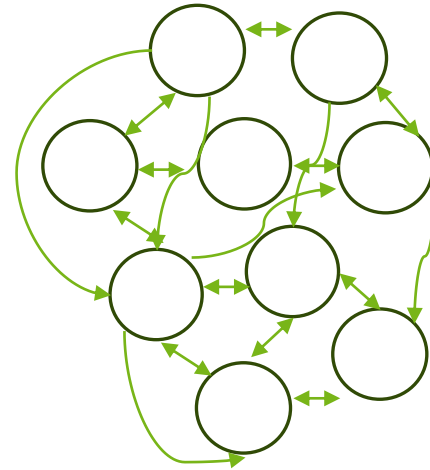
Any attempt to rekindle research on scientific communities must start with collecting the scattered results of some 20 years of 'unintended' research on scientific communities. Although scientific communities have not been the subject of a research programme during this time, science studies have accumulated empirical knowledge that can be built upon. In research on the sociology of scientific knowledge, scientific communities have simply 'resisted' the conceptually implemented ignorance and imposed themselves on empirical observations and their interpretations. They have been reinvented as "superorganisms" (Knorr-Cetina 1995) and "epistemic cultures" (Knorr-Cetina 1999). However, one of the richest sources of knowledge about scientific communities is scientometrics because in this field

Are Collectives Just Sums of Individuals?



Collective as an Agregation (Sum) of Individuals

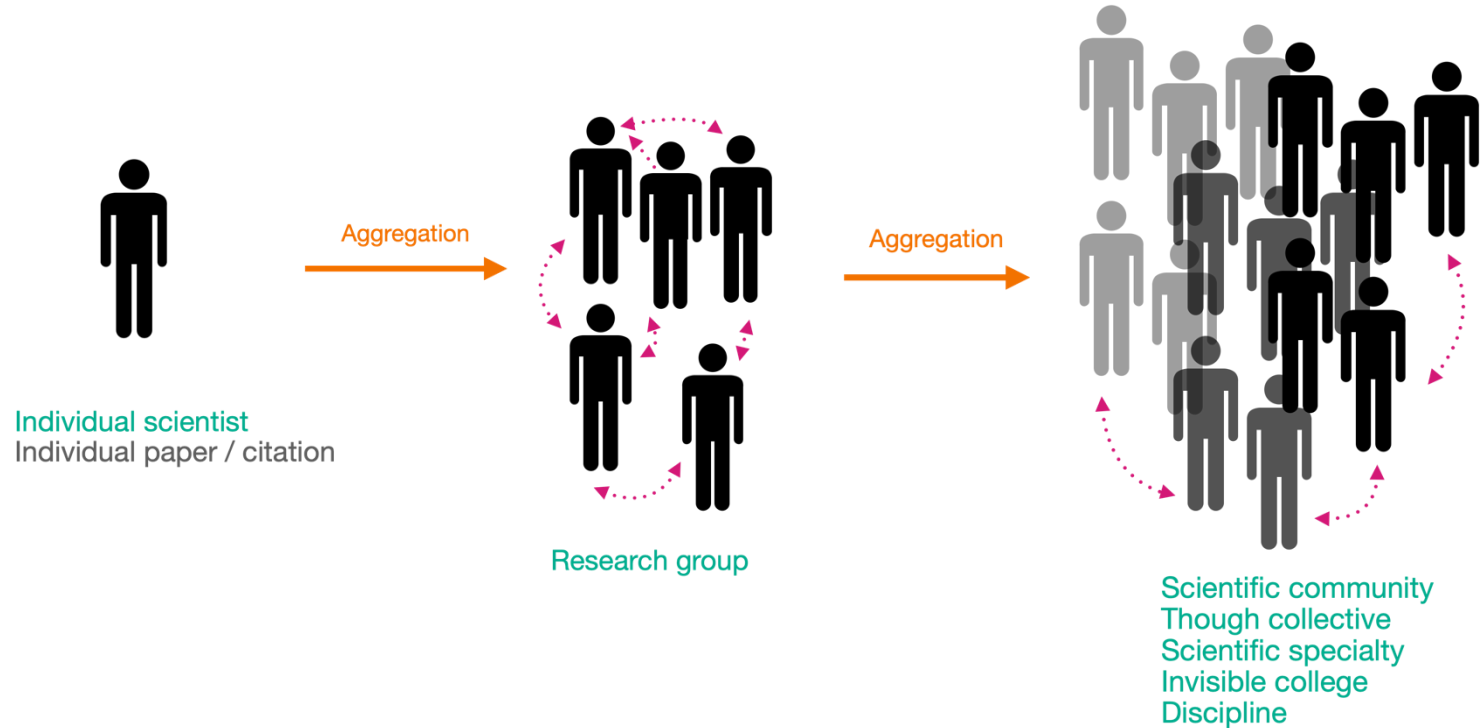
Individualized Scientometrics



Collective as a Relational Structure

Collective Scientometrics

Individualized scientometrics

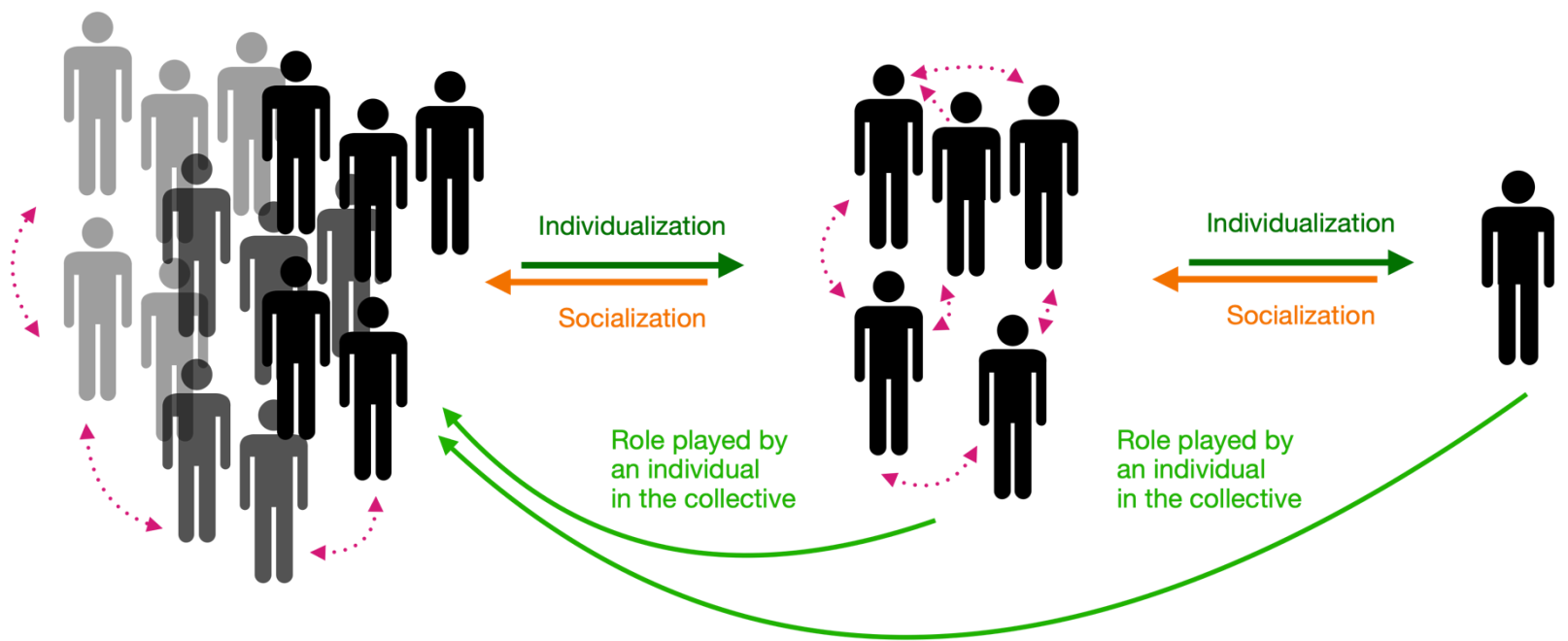




The Social Construction of Knowledge

- Science is produced within collectives
- Scientists act within social roles
- Knowledge emerges from relations, not individuals
- What happens if we ignore this?

Collective scientometrics



Fathers of individualized scientometrics



Science Citation Index

1955

Eugene Garfield



Little Science, Big Science

1963

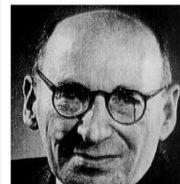
Derek de Solla Price



Quantitative science of science

1939

John Desmond Bernal



Thought collective

1935

Ludwik Fleck

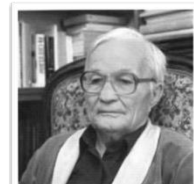
Parents of collective scientometrics



Science of Science

1935

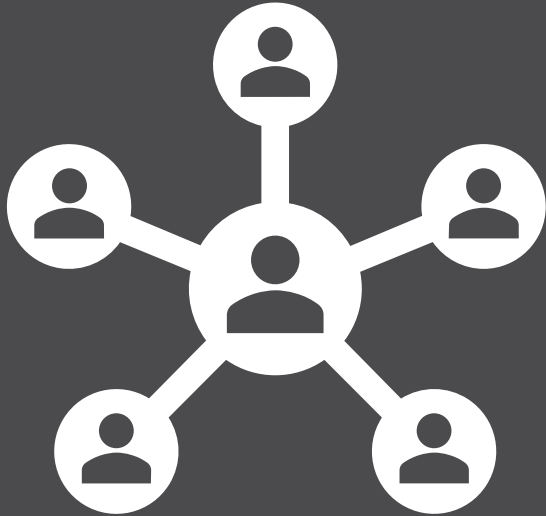
Maria and Stanisław Ossowsky



Scientometrics

1969

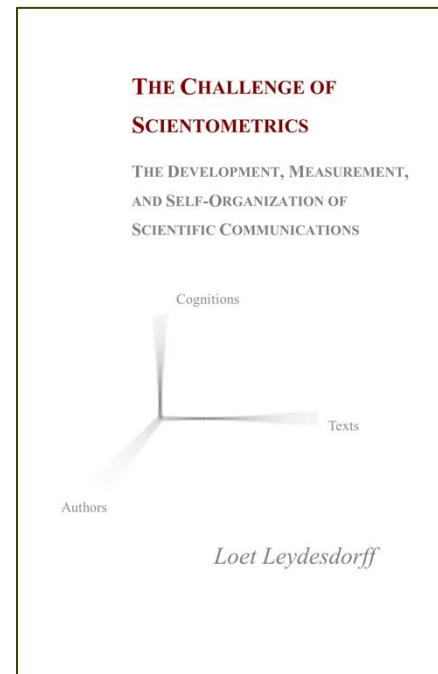
Zinaida Mulchenko Vasily Nalimov



Key previous attempts
to analyze collectives

Loet Leydesdorff – aggregation problem

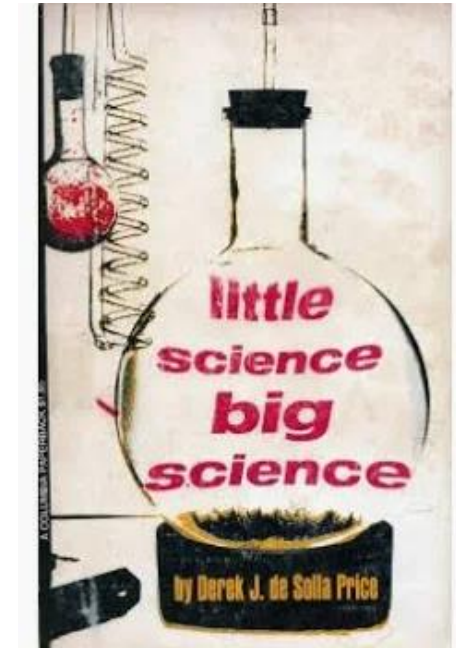
- **Science = interaction of** texts – cognitions – scientists
- **Key claim:** Higher-order units \neq sum of parts
- **However:** Empirical scientometrics still reduces everything to texts + individuals
- **Missing:** communication processes (formal + informal)
- **Core limitation:** Methodologically aware of complexity, but empirically reductive



Leydesdorff, L. (1995). *The Challenge of Scientometrics: The Development, Measurement, and Self-Organization of Scientific Communications*. DSWO Press.

Invisible colleges (Price, Crane, Lievrouw)

- **Derek de Solla Price**
Invisible college as a group of powerful scientists (*oldboys*)
- **Diana Crane**
focus on informal communication networks
- **Leah A. Lievrouw critique**
studies measure traces (publications, citations) not actual communication
- **Problem**
mapping texts \neq mapping social relations
- **Key limitation**
Confusion between communication and its bibliometric traces



Price, D. J. de S. (1963). *Little Science, Big Science*. Columbia University Press.

Henry Small & the “paradigm problem”

- **Henry Small:**
tried to operationalize Thomas Kuhn’s *paradigm* (method: co-citation clustering)
- **Kuhn’s critique**
you map highly cited texts, not communities sharing paradigms
- **Outcome**
paradigm remains unmeasurable bibliometrically
- **Core limitation**
Cognitive structures reduced to citation patterns

Science Studies, 4 (1974), 17–40

The Structure of Scientific Literatures I: Identifying and Graphing Specialties

HENRY SMALL
*Institute for Scientific Information, Philadelphia**

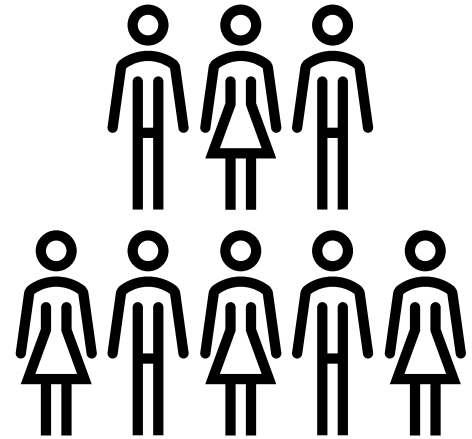
BELVER C. GRIFFITH
Graduate School of Library Science, Drexel University, Philadelphia

In this paper we report a first experiment using a new computer-based technique to identify clusters of highly interactive documents in science. We contend that these clusters represent the scientific specialties which currently exhibit high levels of activity. This technique, we believe, opens the way to a systematic exploration of the entire specialty structure of science, including both the internal structure of specialties and their relationship to one another.

Small, H., & Griffith, B. C. (1974). The Structure of Scientific Literatures I: Identifying and Graphing Specialties. *Science Studies*, 4(1), 17–40

Science of Science Teams (SciTS)

- Teams as units of production
- **Measures:** interdisciplinarity, gender, rank, etc.
- **Two definitions:**
 - input (institutional teams)
 - output (co-authorship teams)
- **However:** teams = aggregated individual attributes
- **Invisible:**
 - Mentoring;
 - ongoing collaboration & informal structures



Why do current approaches fail to capture scientific communities?



**Across all approaches
collectives treated as:**

aggregates
networks of outputs



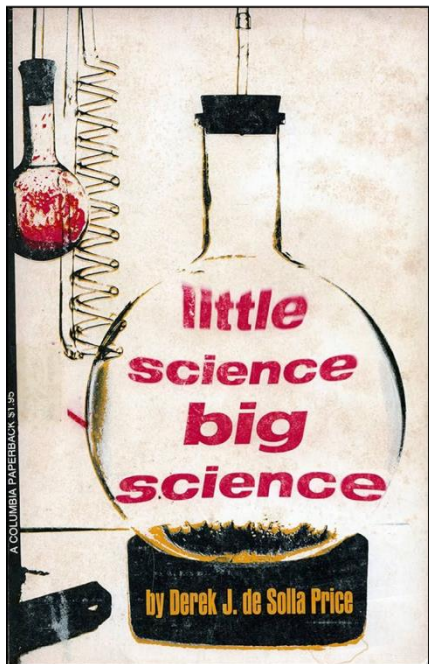
Not as: interactional, communicative, role-structured systems



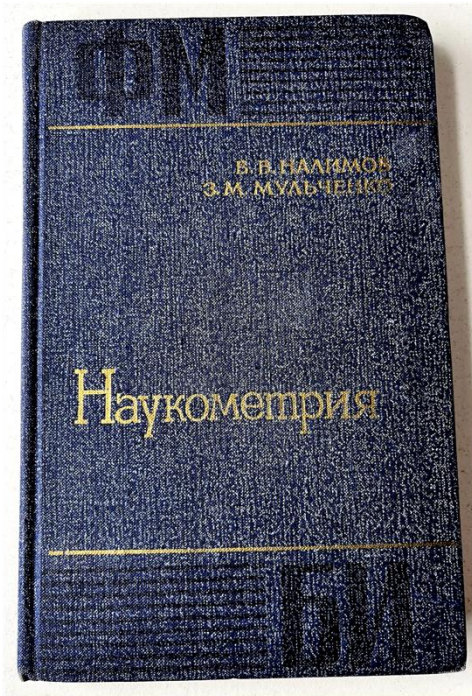
**This is the gap *collective*
scientometrics wants to address:**

move from aggregation → interaction
from outputs → processes
from positions → roles

Two Tiny Great Books

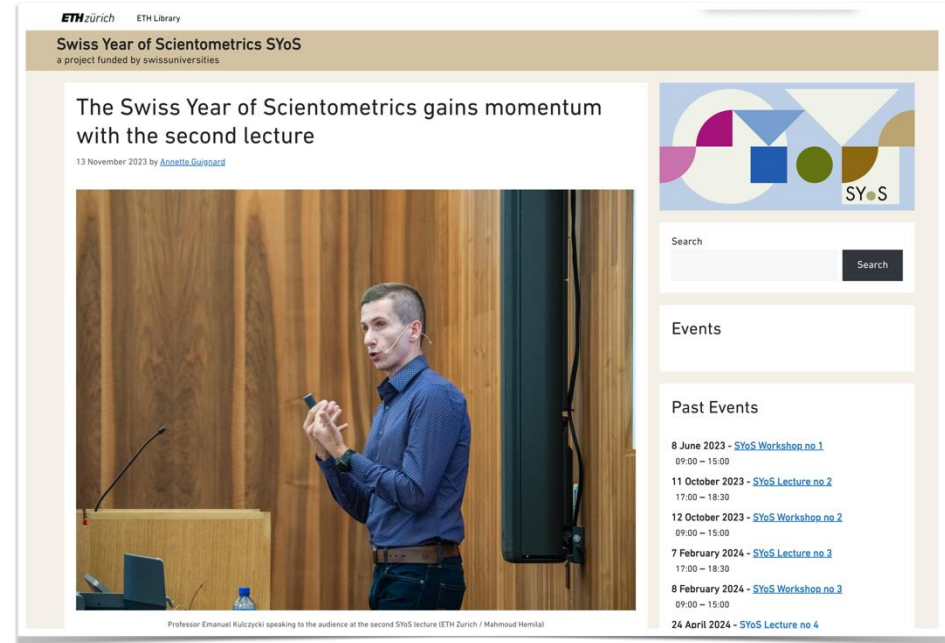
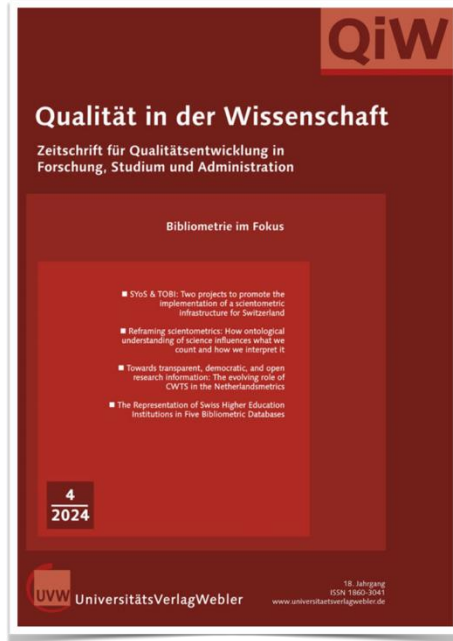


1963



1969

Brief version of the political ontology analysis



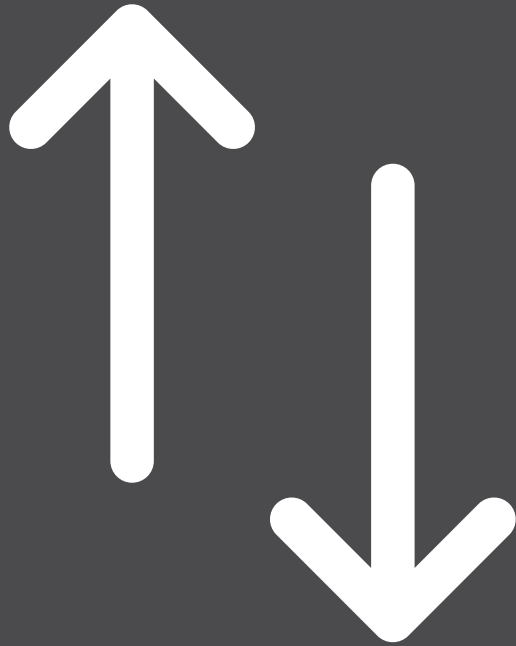
Kulczycki, E. (2024). Reframing scientometrics: How ontological understanding of science influences what we count and how we interpret it. *Qualität in der Wissenschaft*, 4, 102–108.

The Collective Scientometrics

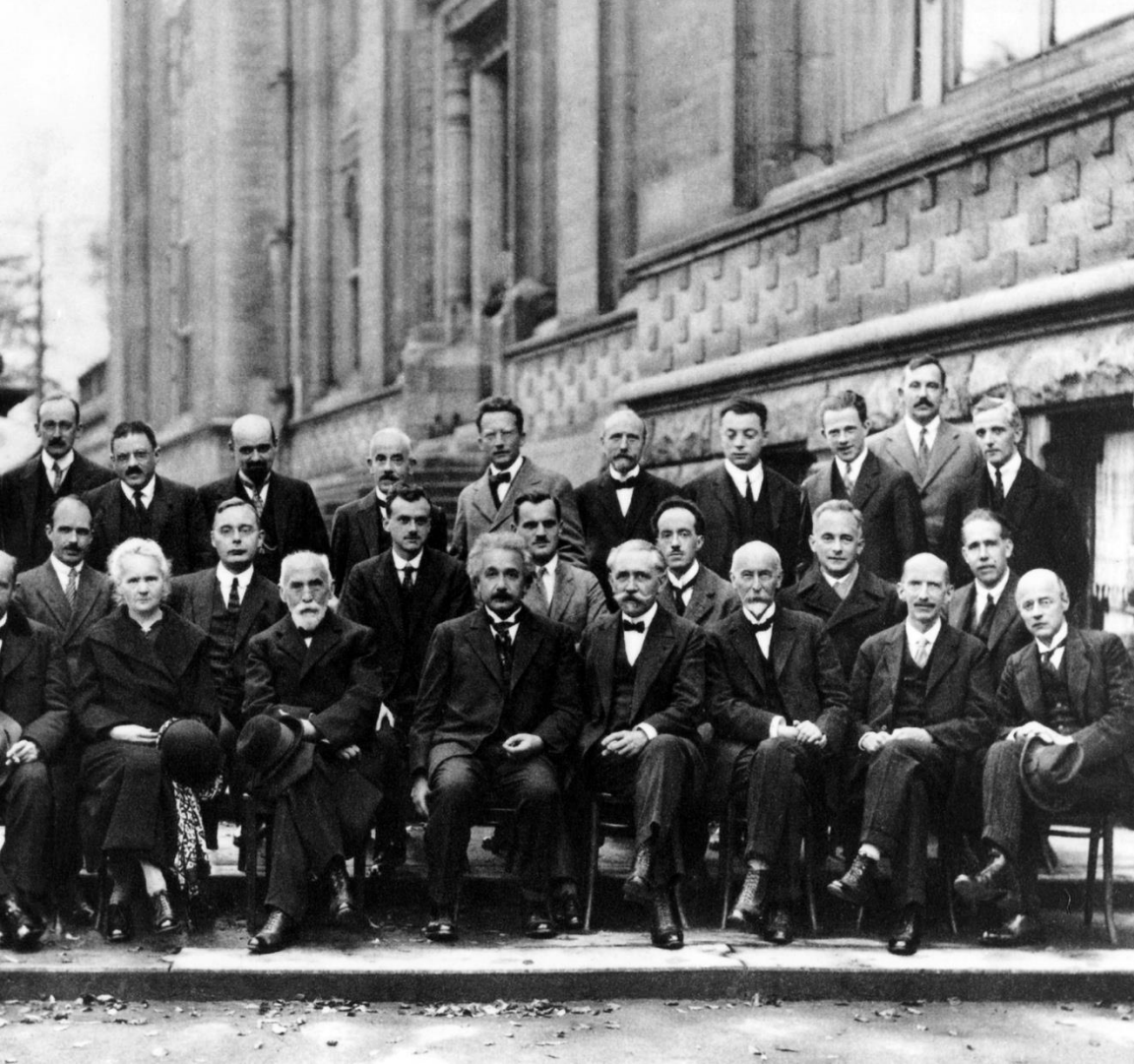
Why We Need a New Way to Measure Science

Emanuel Kulczycki

Written, not yet published



Three principles of collective scientometrics



1. Role recognition of scholars

- Scholars are more than authors. They mentor, organize, and lead
- Measuring scientists means recognizing how they build relationships and socialize others into their communities
- Collaboration and care are the framework of progress



2. Informal communication

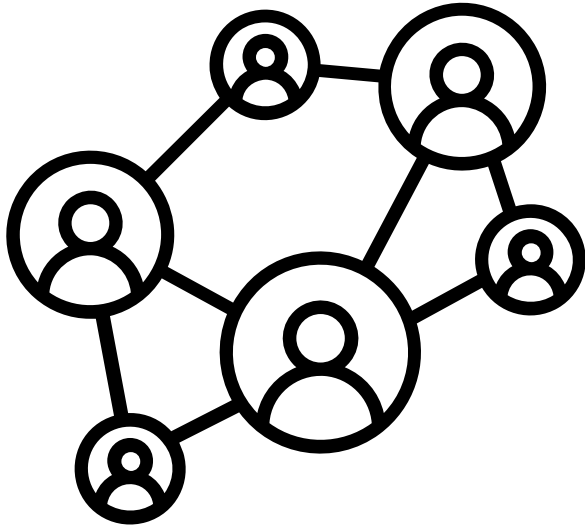
- Not all science is written. Much is spoken, shared, and built together
- Collective scientometrics must capture these invisible (in the publications) connections.
- Knowledge flows through collaboration long before it becomes a paper.



3. Temporality of scientific achievements

- Today's system rewards speed while the disruptiveness of science declines.
- Collective scientometrics must value depth, continuity, and shared growth that stimulate real progress.
- Measure trajectories — not just products.

New Indicators



- **Roles in collectives**
 - Role-Weighted Contribution Score
 - Mentorship Index
- **Collaboration structure**
 - Contribution Diversity Index
 - Collaboration Stability Score
- **Invisible exchange**
 - Informal Communication Index

Contribution Diversity Index (CDI)

Collective Type	Structure	CDI value
Centralized	One or two senior members perform most core functions (design, writing, leadership) and others assist.	0.30 (low)
Clustered	Roles are shared and rotated; different members lead in different contexts; high mutual engagement.	0.60 (medium)
Balanced	Group divided into functional subgroups (e.g., analysts, writers); roles are consistent within modules.	0.85 (high)



Why might this work now?

- **Alternative ontology:**
collective / Eastern European Science of Science traditions
- **New data reality:**
full-text + informal communication at scale
- **New tools:** AI / LLMs for large-scale relational analysis



Change won't be easy

- Infrastructures are built for individuals, not collectives
- We need new architectures: maps, histories, networks
- Integration, not replacement.
- Institutional resistance is inevitable.

Thank you

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emanuelkulczycki.com