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DEPARTMENT OF SCIENCE POLICY AND SCIENTOMETRICS

Beyond scientific impact

Evolving frameworks and novel methods in scientometrics

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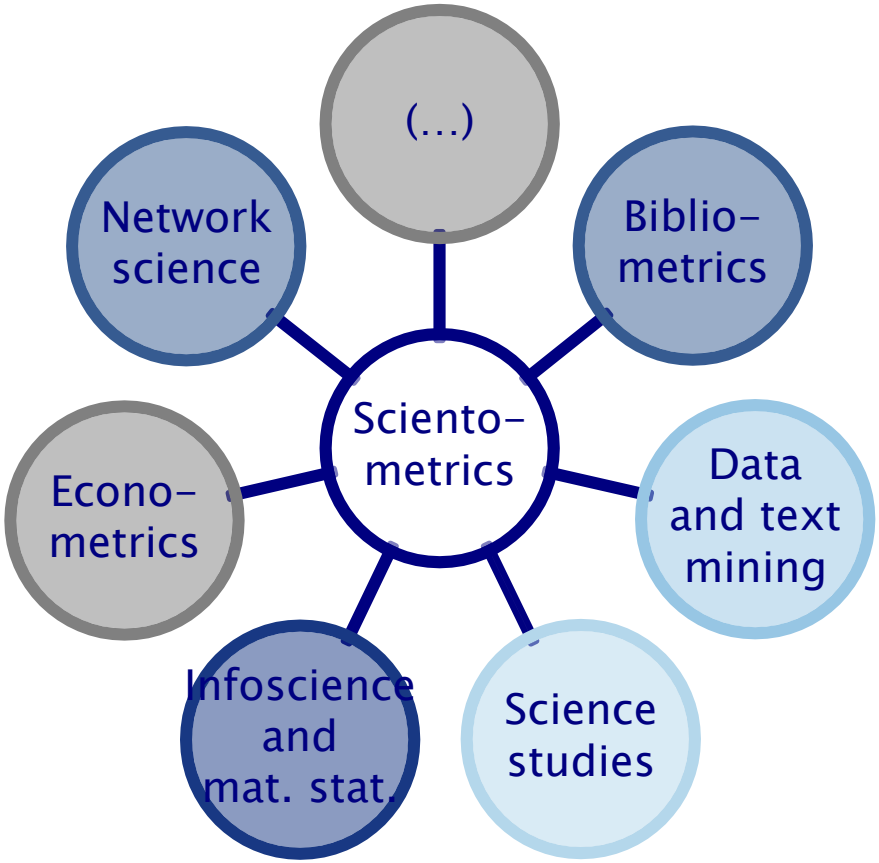
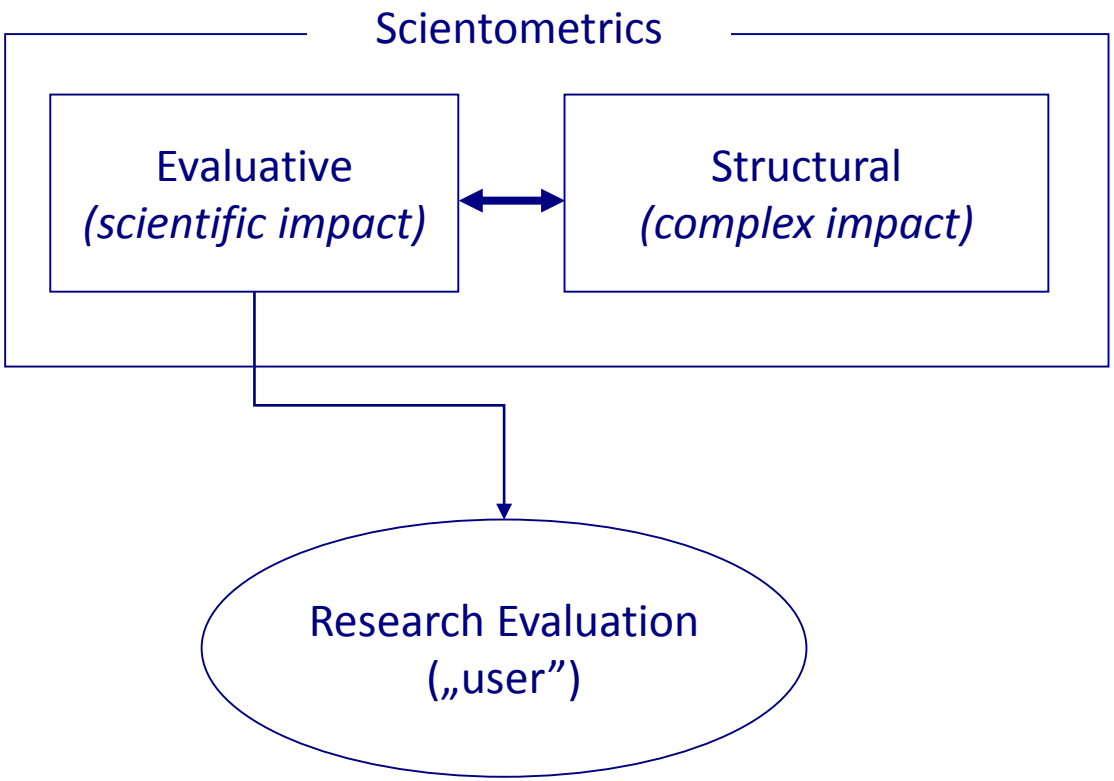
Scientometrics and research evaluation

- Three common misperceptions:
  - Scientometrics is publication statistics (science administration's view)
  - Scientometrics is exclusively concerned with the measurement of scientific performance (researcher's view)
  - Scientometrics is a form of research evaluation (policy maker's view)

Scientometrics and research evaluation



Scientometrics and research evaluation



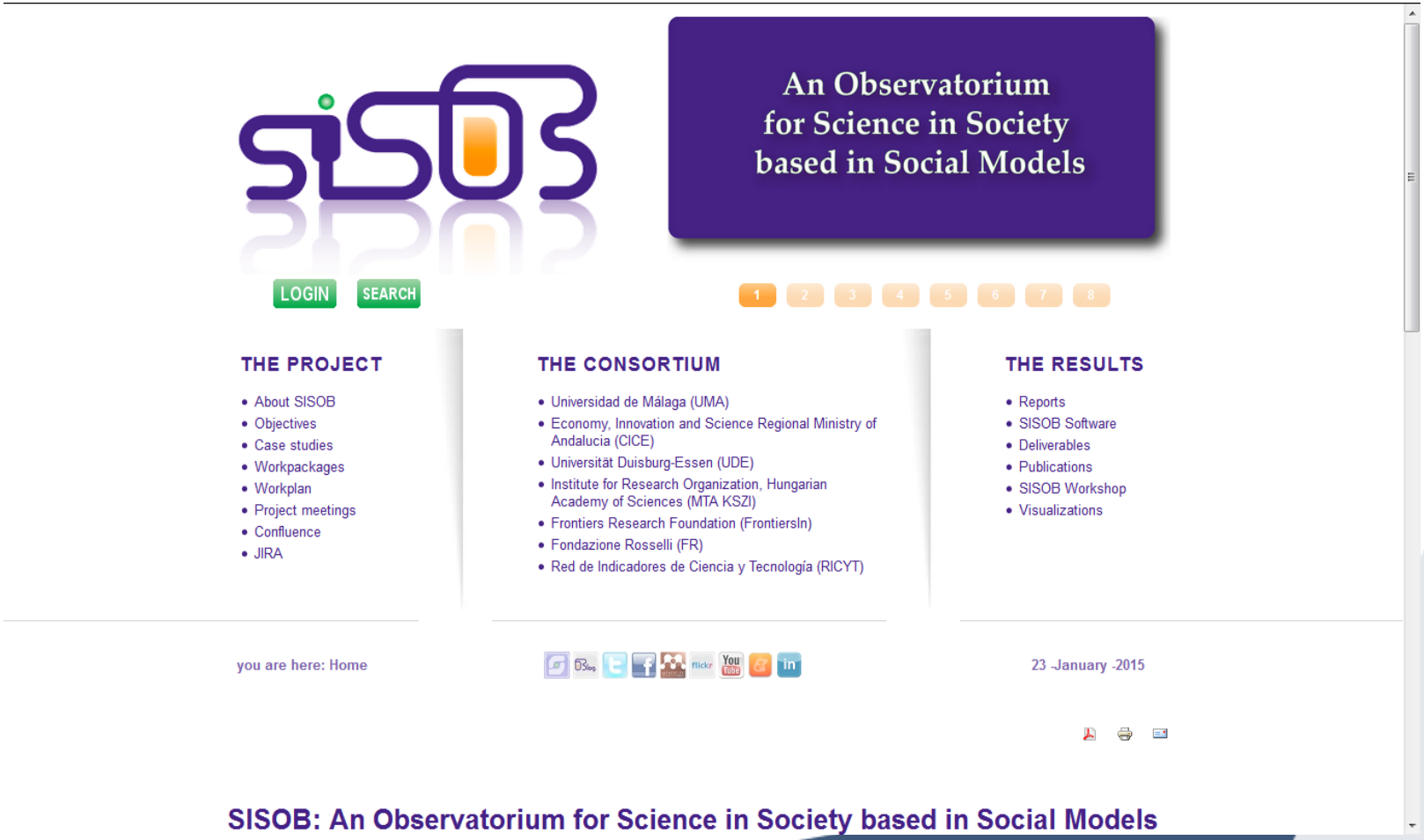
Paradigm change?

- *„Is there currently a scientific revolution in scientometrics?”*

  Lutz Bornmann, forthcoming in JASIST

„One of the key terms in scientometrics
is **scientific impact** which nowadays is understood to mean not only the impact on science but the impact on every area of society”

Running examples of addressing broad impact



Running examples of addressing broad impact

Measuring „social" dimensions of scientific impact

- Known unavioidable difficulties in evaluation practice:
  - Causality problem (scientific developments as causal factors)
  - Attribution problem (the role of knowledge production in „complex systems")
  - Time-scale problem (long-term vs. short-term outcomes)

Ben Martin, SPRU

Direct scientometric approach

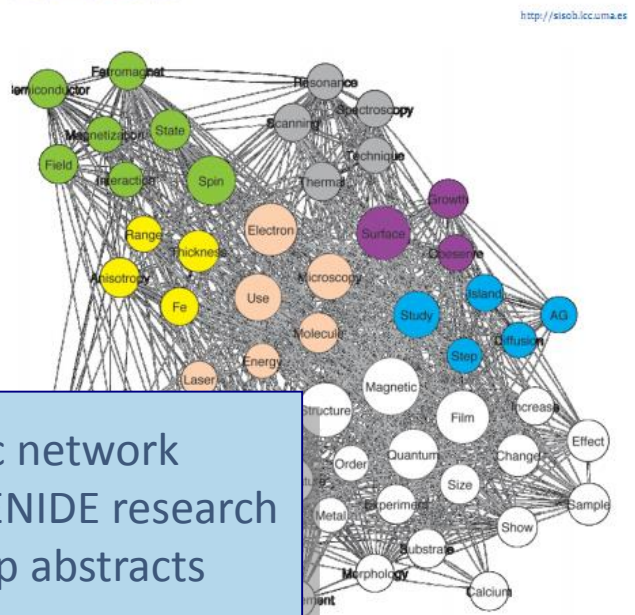
- Impact: direct quantification of knowlege flows between within-science and outside-science venues of societal importance
  - Patent references to publications (**economic impact**), patent citation network analysis
  - Collaboration of academic and private sector → InCites™: % of industry co-authorship (**economic impact**)
  - Clinical guidelines based on medical research results (**social impact: life quality**)
  - Policy document and legislation referring to social science research and results (**SSH impact on policy making**) → IMPACT-EV baselines
  - Research affecting the public discourse, on-line social venues, Webometrics, ALTMETRICS → SISOB „Knowledge Sharing” (**societal impact**)

Direct scientometric approach

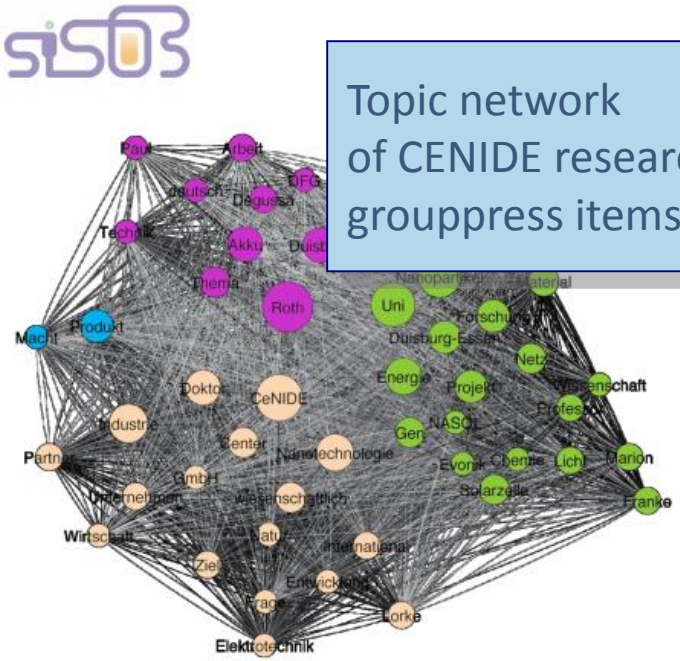
- Problems with direct approaches:
  - Narrow operationalization of impact (only direct relations)
  - Use of scientific knowledge is not a priori imact: criticism of patent citation analysis (role of citations is not knowledge utilization, economic value is not attributed to patenting, tc)
  - Data is sporadic (direct references to scholarly venues, e.g. press releases) and noisy (ALTMETRICS, on-line venues)
  - **Further step: reconceptualizing the measurement of broad impact…**

Towards structural approaches

- SISOB and societal impact, *„P-map", „S-map" algorithm*: Contrasting the scientific and social „relevance" of research subjects (based on the work of Leydesdorff)



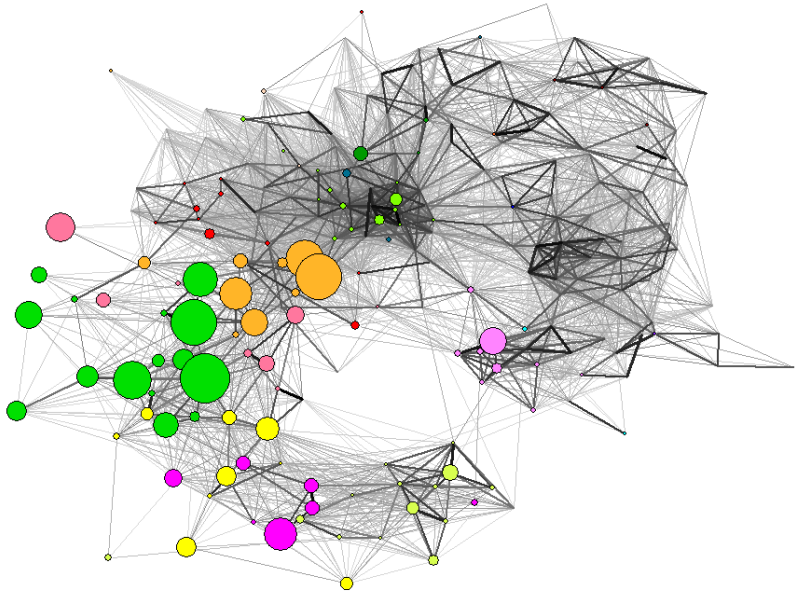
Topic network of CENIDE research group abstracts



Topic network of CENIDE research grouppress items

Structural approach: S&T mapping

- Mapping and measuring the socio-cognitive organization, processes and dynamics in science by analyzing various dimensions of knowledge flow
- Broad impact can be identified, even quantified
- Example: IDR (interdisciplinarity research) and its applications: The overlay technique (Rafols—Leydesdorff)



Structural approach: S&T mapping

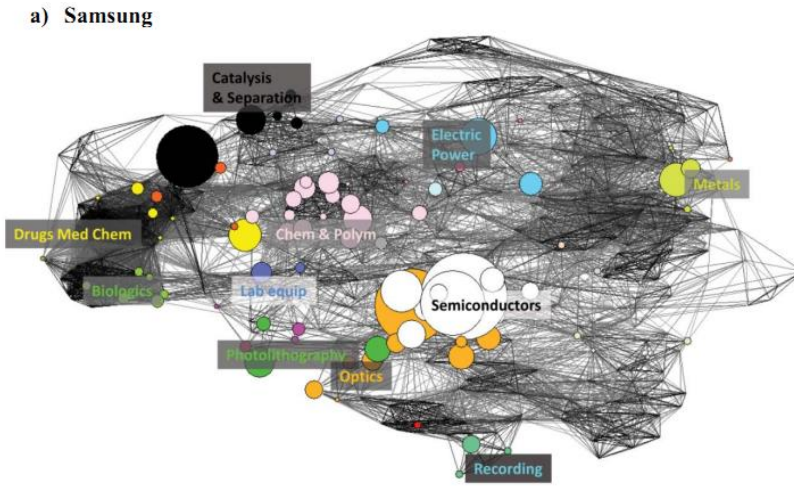
- Measuring multi- and interdisciplinarity (IDR) upon this model: the Stirling index
- Novelty: Three structural features accounted for:
  - Number of SCs („variety")
  - Distribution of pubs over SCs („balance")

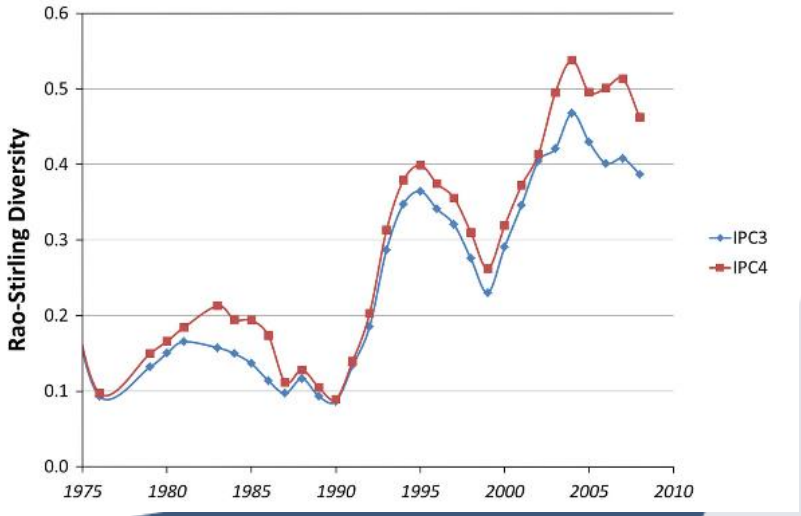
Table 1 *Typology of the Stirling index in measuring research diversity*

	Formula (versions of the generalized Stirling index)	d_{ij}	Underlying science map (level of aggregation)	Measuring diversity of…
1	$\sum_{ij(i\neq j)} d_{ij} p_i p_j$	$1 - s_{ij}$, where sij=cos(i,j)	Similarity network of (1) journals (2) ISI Subject Categories (based on the cited and citing dimension) Rafols, Meyer, Porter, Leydesdorff	(1) journals, (2) work of researchers, (3) output of organizations
2	$\sum_{ij(i\neq j)} d_{ij}$	g_{ij} shortest path from i to j (# edges)	Similarity network of papers (based on bibliographic coupling) Rafols, Meyer	particular research area

Structural approach: S&T mapping

- Patent overlay mapping (basemap: global proximity network of technology classes, based on aggregate patent citations)
- Benchmarking firms (Rotolo et al. 2014)
- Measuring trends of diversification/specialization in a technological market
- Evaluation may be a result of such a mapping of output contrasted with policy goals for funding schemes





Structural approach: S&T mapping

- Proposed uses to detect economic/outward impact (under elaboration):
  - Distance within scientific impact profile in terms of applied/application-oriented and basic research fields (shift toward markets)
  - Funding information (especially for FP outputs): distance within scientific profile in terms of funding agencies (competitiveness of science)

Conclusion

- Broad impact measurement is not necesserily different from measuring scientific impact (i.e. citation analysis)
- Structural methods of citation analysis reveal broad impact outside the realm of science
- Large-scale data is available (not only case study fashion)
- A single value measurement should be replaced by structural insights in scientometrics

- Thank you for your attention!