



## **Beyond scientific impact**

Evolving frameworks and novel methods in scientometrics

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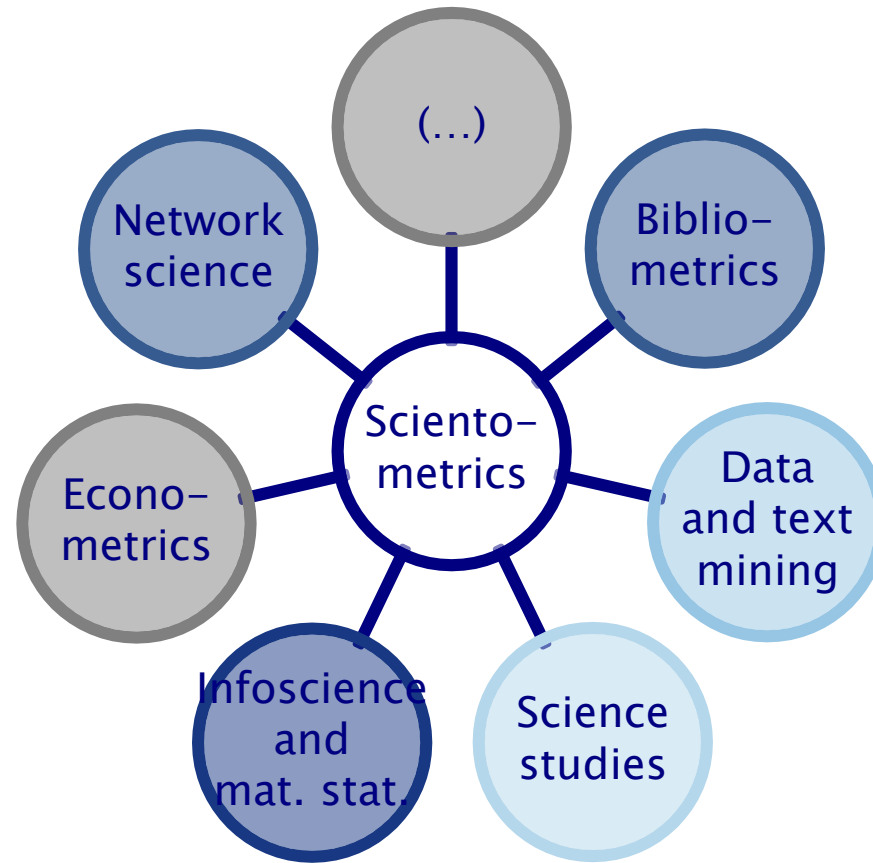


## Scientometrics and research evaluation

- 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)

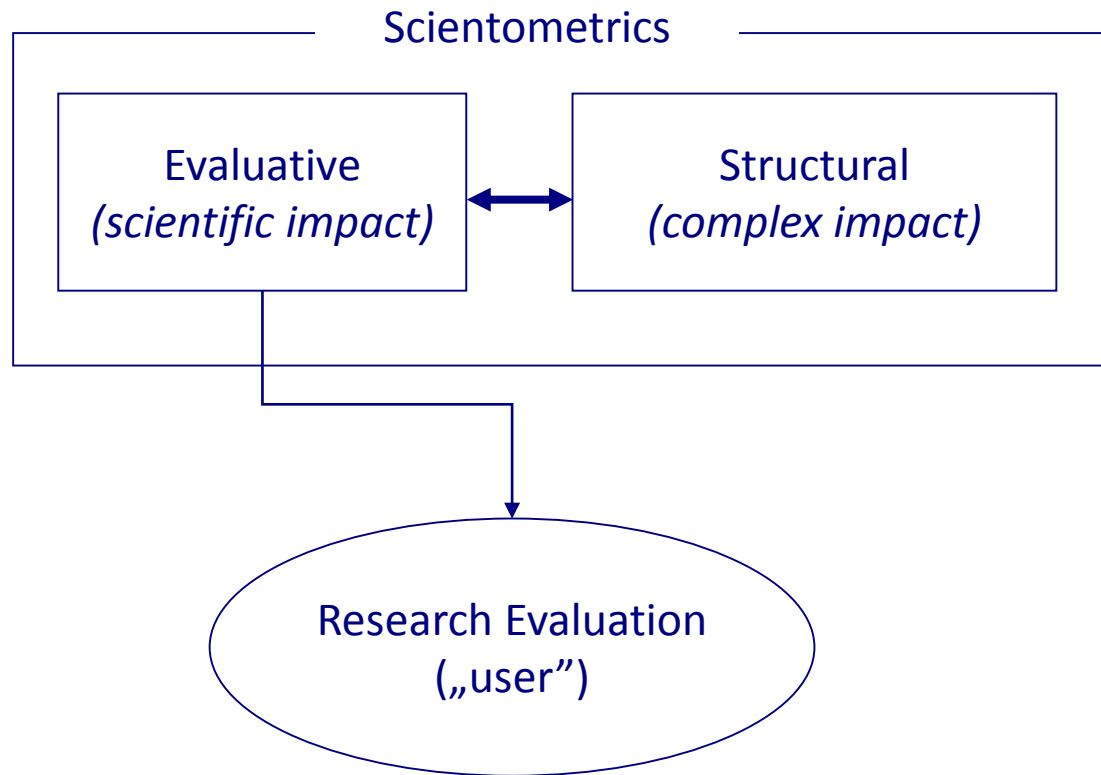


## Scientometrics and research evaluation





## 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

The screenshot shows the homepage of the SISOB website. At the top left is the SISOB logo, a stylized purple 'SISOB' with a green dot above the first 'S' and a yellow bar in the 'O'. Below the logo are 'LOGIN' and 'SEARCH' buttons. To the right is a purple box with the text 'An Observatorium for Science in Society based in Social Models'. Below this is a navigation bar with numbered tabs 1 through 8. The main content area is divided into three columns: 'THE PROJECT', 'THE CONSORTIUM', and 'THE RESULTS', each with a list of bullet points. At the bottom, there is a 'you are here: Home' breadcrumb, social media icons, and a date '23 -January -2015'.

### An Observatorium for Science in Society based in Social Models

1 2 3 4 5 6 7 8

#### THE PROJECT

- About SISOB
- Objectives
- Case studies
- Workpackages
- Workplan
- Project meetings
- Confluence
- JIRA

#### THE CONSORTIUM

- Universidad de Málaga (UMA)
- Economy, Innovation and Science Regional Ministry of Andalucía (CICE)
- Universität Duisburg-Essen (UDE)
- Institute for Research Organization, Hungarian Academy of Sciences (MTA KSZI)
- Frontiers Research Foundation (FrontiersIn)
- Fondazione Rosselli (FR)
- Red de Indicadores de Ciencia y Tecnología (RICYT)

#### THE RESULTS

- Reports
- SISOB Software
- Deliverables
- Publications
- SISOB Workshop
- Visualizations

you are here: Home

23 -January -2015



## Running examples of addressing broad impact

Evaluating the impact and outcomes of European SSH research | Workspace 



**IMPACT-EV**  
Evaluating the impact and outcomes of EU SSH research



This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration (FP7/2014-2017) under grant agreement n° 613202.

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News & Events

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Social Media





## Measuring „social” dimensions of scientific impact

- Known unavoidable 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 knowledge 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**)

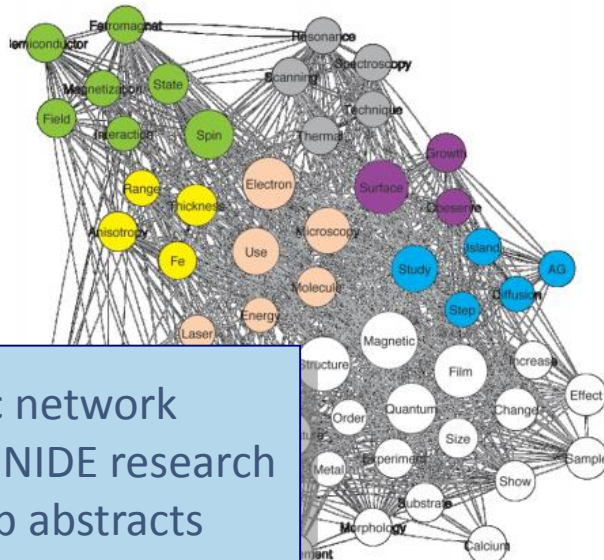


## Direct scientometric approach

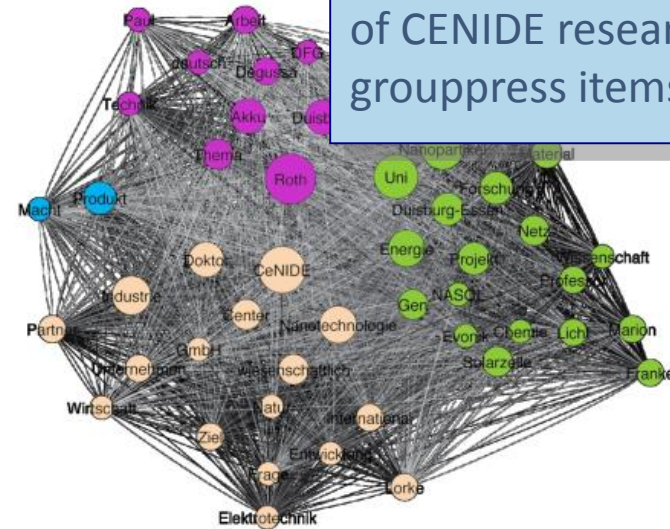
- Problems with direct approaches:
  - Narrow operationalization of impact (only direct relations)
  - Use of scientific knowledge is not a priori impact: criticism of patent citation analysis (role of citations is not knowledge utilization, economic value is not attributed to patenting, etc)
  - Data 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)



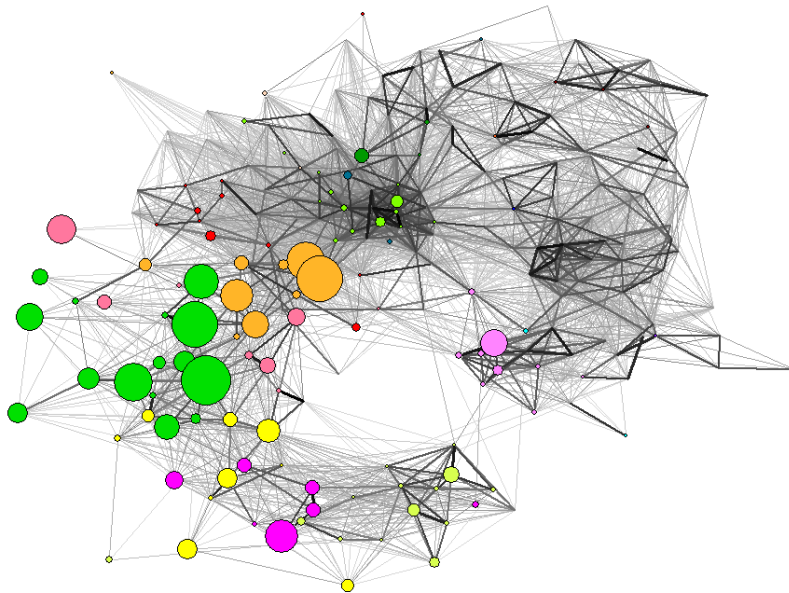
Topic network  
of CENIDE research  
group abstracts



Topic network  
of CENIDE research  
group press 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”)

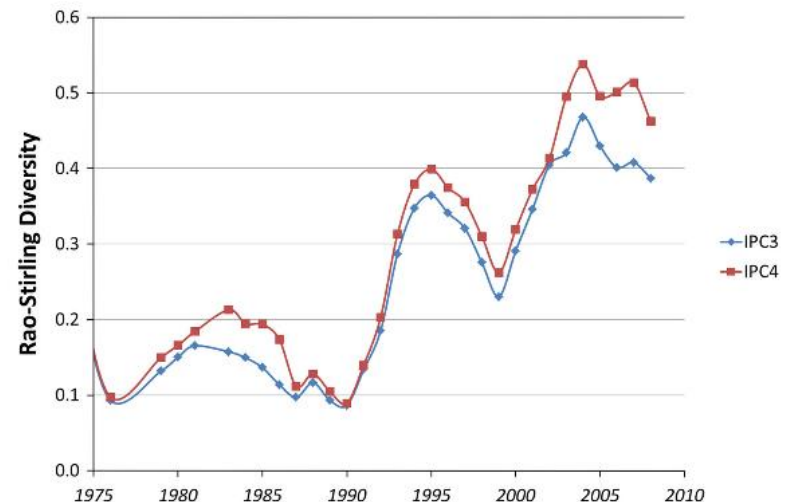
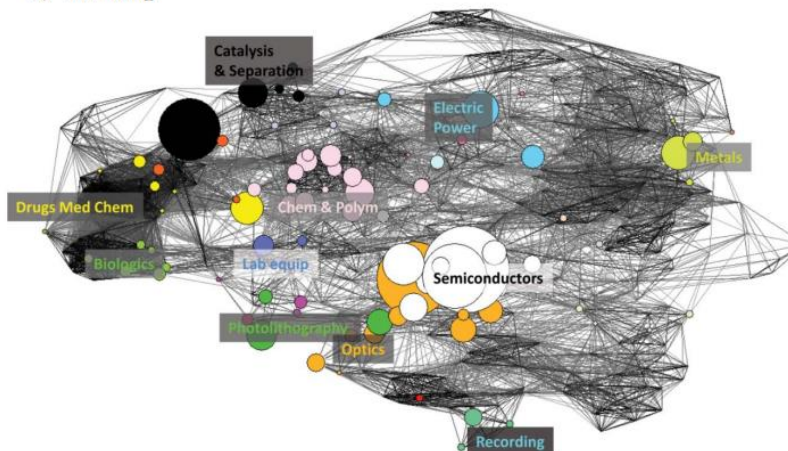
**Table 1** *Typology of the Stirling index in measuring research diversity*

	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 $s_{ij} = \cos(i, j)$	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

a) Samsung





## 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 necessarily 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!