CWTS
Meaningful metrics

Responsible metrics for societal value of scientific research

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Universiteit Leiden

Rathenau Instituut
Research & dialogue | Science, technology and innovation

Outline

1. Introduction
2. Overview of methods for evaluating societal value
3. The principles of evaluative inquiry
4. Some supportive tools
5. Conclusions

Part I: Introduction

Impact or value?

Evaluation of societal value

A brief history

- Evaluation of economic value of science since 1950s
- Analyses of scientific value since 1960s
- Evaluation of societal value since 1980s; systematic practices since 2000
- Prominent examples: Research Excellence Framework (UK) and Strategy Evaluation Protocol (NL)

Indicators of societal value

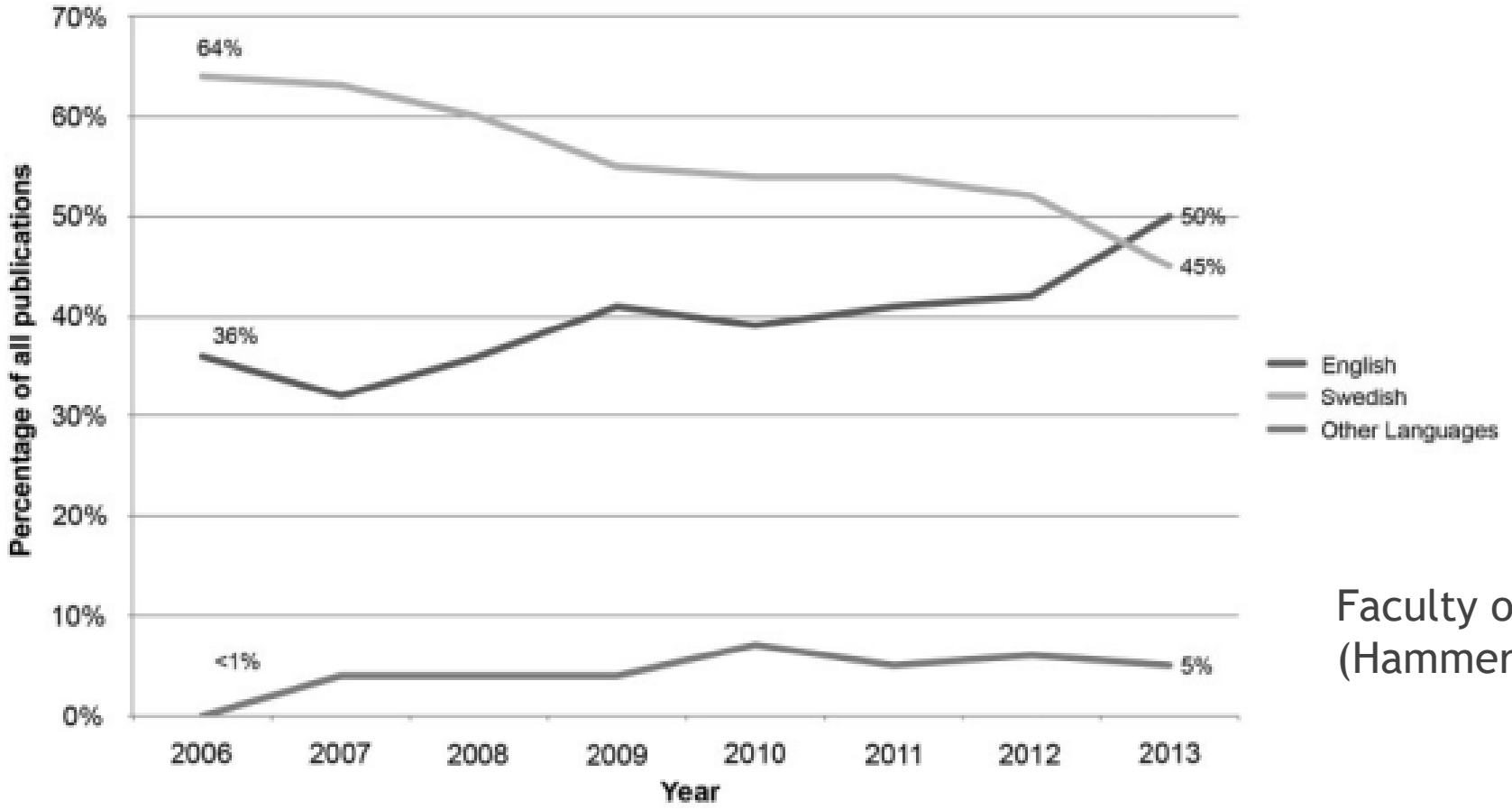
Advantages

- precise
- allow for comparison and ranking
- reduces time and costs
- increase sense of objectivity and transparency
- reduce complexity

Challenges

- causal attribution
- time lag
- heterogeneity of impacts

The performative nature of evaluations



Faculty of Arts, Uppsala University
(Hammerfelt & de Rijcke, 2015)

The Leiden Manifesto for research metrics (2015)

Responsible metrics

1) Quantitative evaluation should support qualitative, expert assessment.

2) Measure performance against the research missions of the institution, group or researcher.

3) Protect excellence in locally relevant research.

4) Keep data collection and analytical processes open, transparent and simple.

5) Allow those evaluated to verify data and analysis.

6) Account for variation by field in publication and citation practices.

7) Base assessment of individual researchers on a qualitative judgement of their portfolio.

8) Avoid misplaced concreteness and false precision.

9) Recognize the systemic effects of assessment and indicators.

10) Scrutinize indicators regularly and update them.

Part II: Overview of evaluation methods

(Based on Smit & Hessels, 2021)

Key variables

(Smit and Hessels 2021)

Main characteristics

- evaluation type (purpose)
- level of analysis
- quantitative and qualitative data used

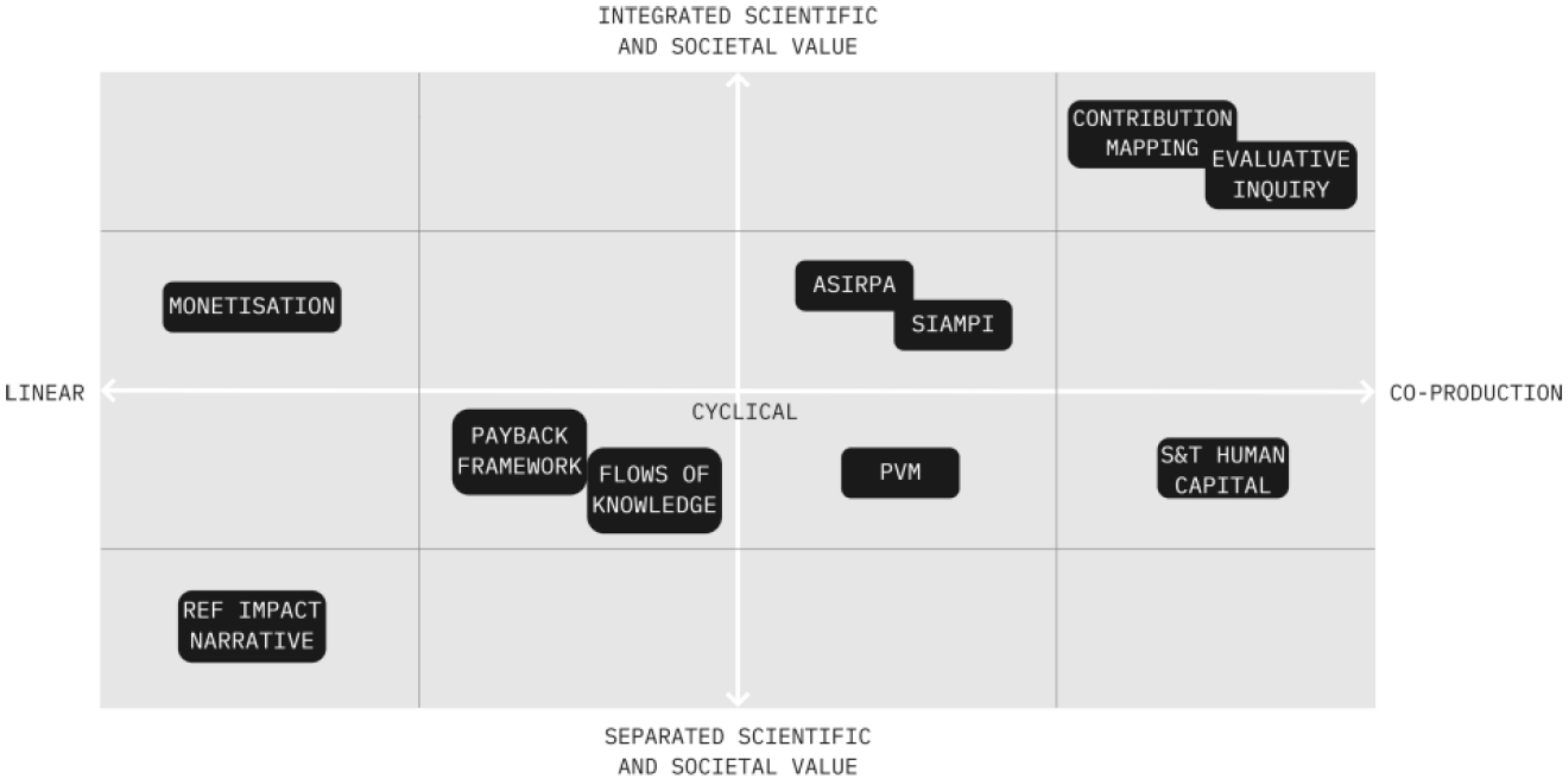
Theoretical assumptions

- actors considered part of knowledge production
- understanding of interaction mechanisms
- concept of societal value
- Relationship societal-scientific value

Method	Evaluation type	Level of analysis	Qualitative data	Quantitative data	Original context
Payback Framework (Buxton and Hanney 1996)	Ex-post; summative	Program	documents, interviews, surveys	-	UK medical research
Science and Technology Human Capital (Bozeman, Dietz, and Gaughan 2001)	Ex-post; formative	Research group or program	interviews, surveys, diaries, resumes, contracts	citation and patent patterns	US STEM research
Public Value Mapping (Bozeman 2003)	Ex-ante & ex-post; formative	Program or organization	case studies, documents, surveys, focus groups, expert opinions	indicators	US science policy
Monetisation (HERG and RAND Europe 2008)	Ex-post; summative	Program or system	-	measures of investment and (health) gains	UK medical research
Flows of Knowledge (Meagher, Lyall, and Nutley 2008)	Ex-post; summative	Program	case studies, documents, interviews, surveys, focus groups	bibliometrics	UK research council funding
SIAMPI (Spaapen and Van Drooge 2011)	Ex-ante & ex-post; formative	Project, program or organization	case studies	contextual response analysis and indicators of (im)material interactions	Research institutes (ICT, health, SSH, nano) for European Commission
Contribution Mapping (Kok and Schuit 2012)	Ex-post; summative & formative	Project or program	interviews with all actors	-	Global health sector
Impact Narratives (Research Excellence Framework 2012)	Ex-post; summative	Research group	structured case studies, (user) expert opinions	indicators for causal impact	UK assessment of university research (REF)
ASIRPA (Joly et al. 2015)	Ex-post; summative	Program or organization	standardized case studies	econometric, bibliometric and statistical methods	French public agricultural research institute
Evaluative Inquiry (de Rijcke et al. 2019)	Ex-post; formative	Research group or organization	documents, interviews, workshop	contextual scientometrics, contextual response analysis	Dutch assessment of university research (SEP)

Method	Actor roles	Interaction mechanisms
Payback Framework	Policymakers and professionals as contractors, agenda-setters and users	Cyclical: 7 stages with interfaces and feedback
Science and Technology Human Capital	Scientists and engineers as producers and carriers of knowledge	Linear: People mobility
Public Value Mapping	Institutional, social and economic 'end-users'; 'knowledge value collectives' as translators of research to new uses	Cyclical: Knowledge value collectives
Monetisation	Clinicians as users, patients as beneficiaries	Linear: Linear chain
Flows of Knowledge	Practitioners and policymakers as specific users; organizations and individuals as intermediaries	Cyclical: Dynamic process of iterative dialogue and reciprocal benefits
SIAMPI	Actors from science, industry, government and non-profits as stakeholders in knowledge use	Cyclical: Productive interactions
Contribution Mapping	Scientific and societal actors (including organizations, objects) engaged in priority-setting, proposal selection; producing, combining and using knowledge	Co-production: Alignment
Impact Narratives (REF)	Non-academic actors from society, economy, culture and public policy as (potential) beneficiaries	Linear: Linear exchange
ASIRPA	Academic, economic, knowledge transfer and governmental actors as part of research production and, with media and farmers, as intermediaries and beneficiaries. Also objects as intermediaries	Cyclical: Translation networks and iterative learning processes
Evaluative Inquiry	Networks of people, technologies and resources connected to research units enable achievement of academic and societal value	Co-production: Translations within and between networks

Method	Concept of societal value	Relationship societal-scientific value
Payback Framework	Mixed: Successively as products for, use by or benefits to research, policy, (health) practice and economy	Distinctive, successive categories
Science and Technology Human Capital	Product: Increase in human capital	Embodied
Public Value Mapping	Mixed: Tracked backwards from public benefits to societal use and research outcome	Integrated
Monetisation	Benefit: Improvements to healthcare	Implicitly connected
Flows of Knowledge	Benefit: 5 types of impact (Instrumental, conceptual, capacity, cultural and connectivity)	Distinctive categories
SIAMPI	Use: (productive interactions)	Not clearly distinguishable
Contribution Mapping	Use: Contribution to actor-scenarios	Integrated
Impact Narratives (REF)	Benefit: Effect, change or benefit beyond academia	Causally related
ASIRPA	Mixed: Effects on economy, environment, health etc.	Integrated
Evaluative Inquiry	(Not predefined)	Integrated


INTEGRATED SCIENTIFIC AND SOCIETAL VALUE
CONTRIBUTION MAPPING
EVALUATIVE INQUIRY
MONETISATION
ASIRPA
SIAMPI
LINEAR
CYCLICAL
CO-PRODUCTION
PAYBACK FRAMEWORK
FLOWS OF KNOWLEDGE
PVM
S&T HUMAN CAPITAL
REF IMPACT NARRATIVE
SEPARATED SCIENTIFIC AND SOCIETAL VALUE

Part III: Evaluative Inquiry

The evaluative inquiry

Four principles (De Rijcke et al. 2019; Leiden Madtrics 2020)

1. Quality and value

- Mission-oriented, context-driven approaches
- Room for different contributions of researchers to the world
- Evaluating output and impact in relation to mission of research organization

2. Contextualisation

- Understanding and valuing vs. ranking and comparing
- Making visible diversity of stakeholders and dynamics involved in production and communication of knowledge (‘productive interactions’)

The evaluative inquiry

Four principles (De Rijcke et al. 2019; Leiden Madtrics 2020)

3. Mixing methods

- Using a selection of relevant quantitative and qualitative methods to make visible different elements of academic work
- Inclusion of stakeholders (incl. external partners) to make sense of the analyses at multiple moments in the process

4. Learning

- help to reflect on past performance
- support in developing stakeholder relationships, providing insights and formulating a research agenda

Three phases in evaluative inquiry

1. **Exploratory phase**
   - Articulation questions and issues
2. **Data collection and analysis**
   - *Document analysis*
   - *Quantitative methods*
   - *Interviews towards an Impact Pathways Analysis*
3. **Workshop and/or reporting**

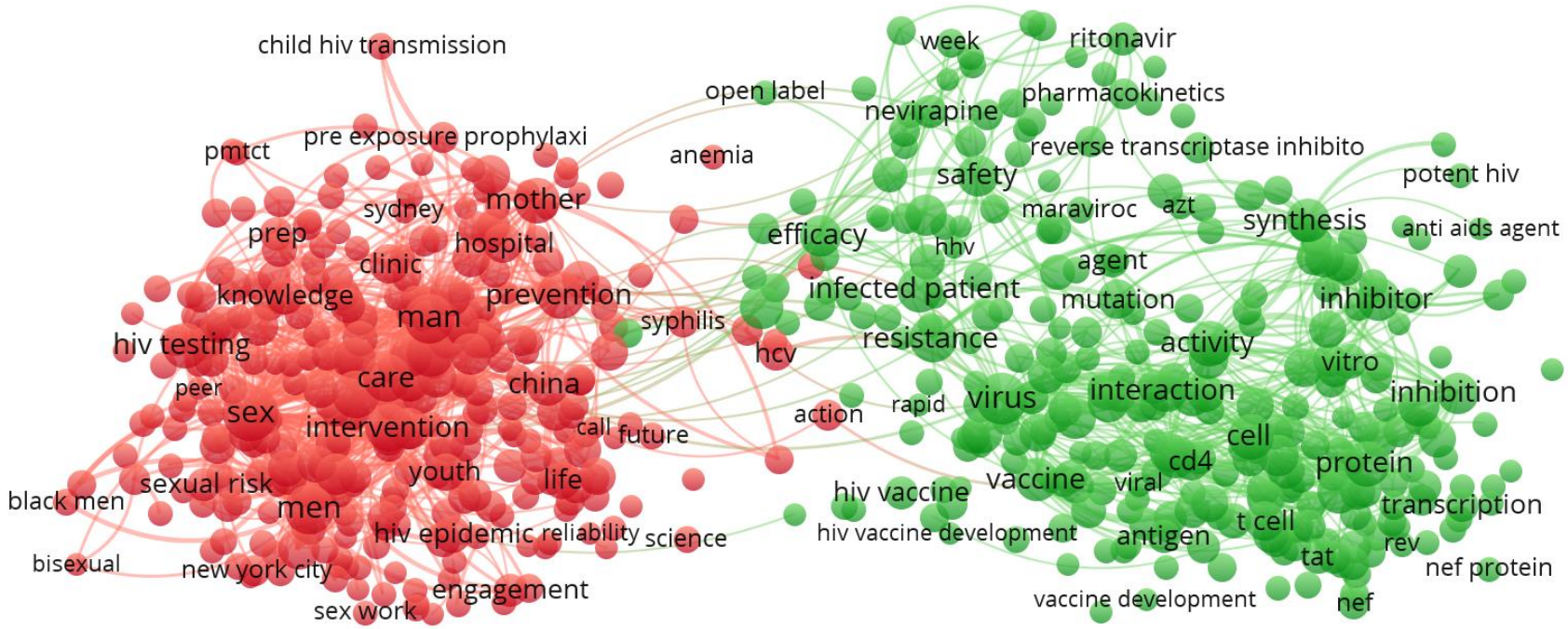
Part IV: Some supportive tools

Digital response analysis

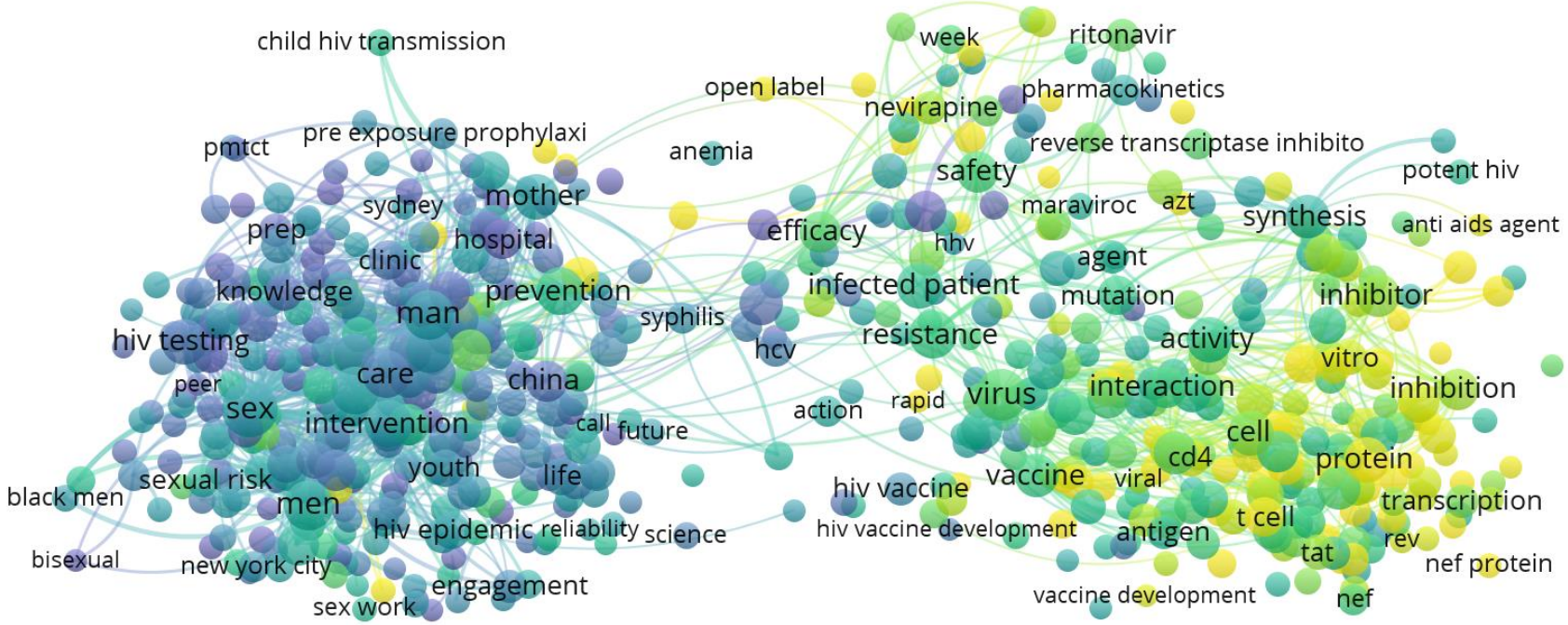
- Mapping response to research output (instead of measuring eventual impact)
- Using bibliometrics and altmetrics
- As in input for a conversation rather than assessment

Term maps – titles & abstracts

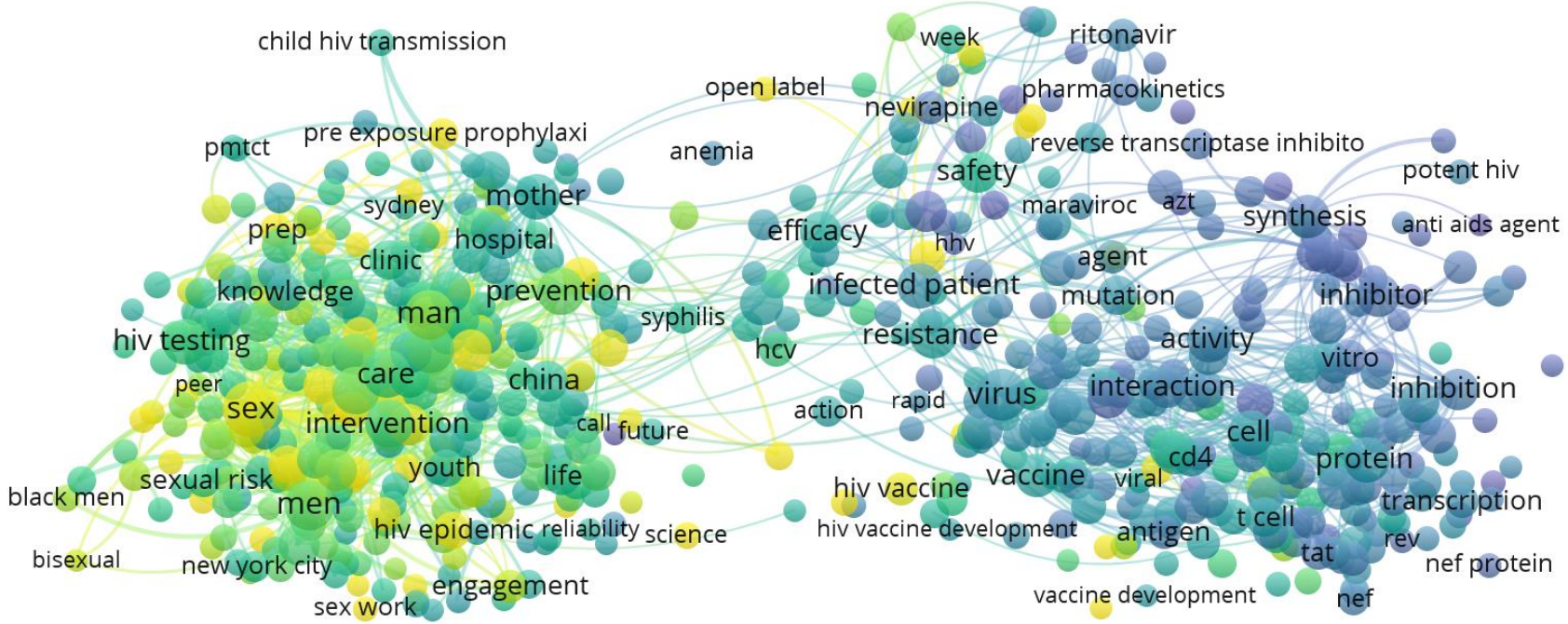
HIV research [Dimensions] - VOSviewer



Altmetric landscapes:
HIV research [Dimensions] – citations

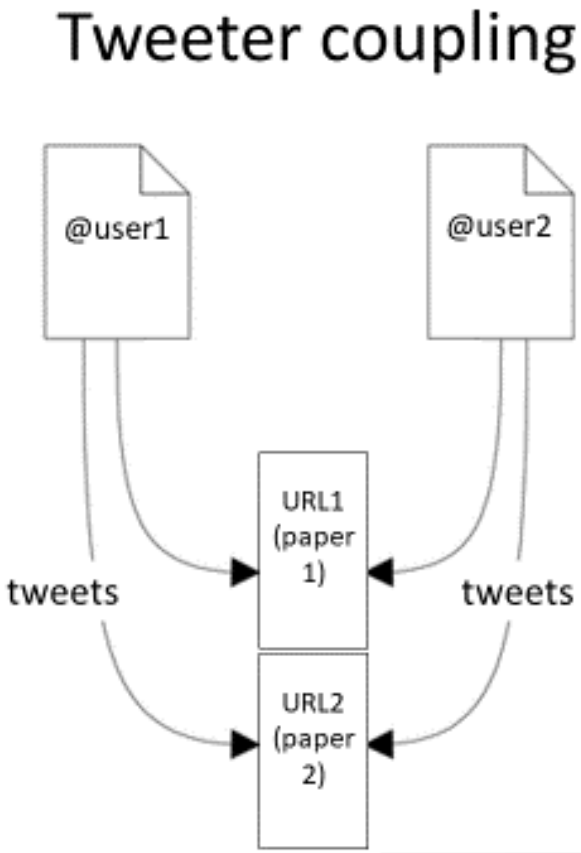


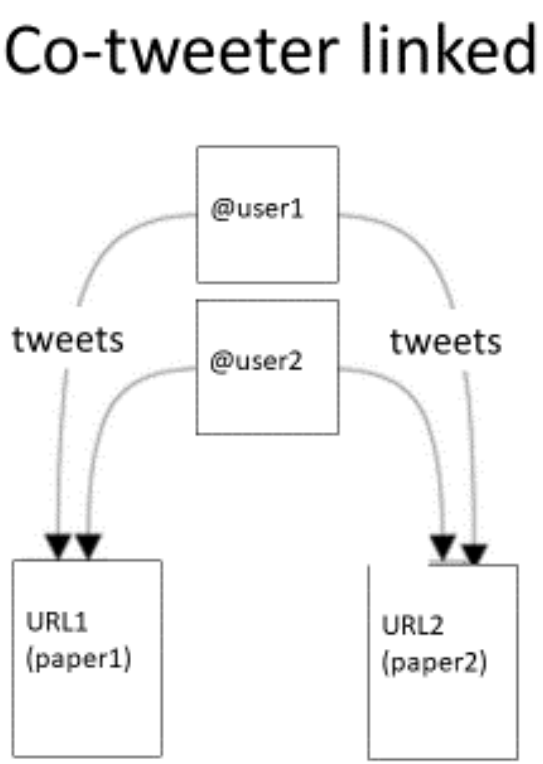
Altmetric landscapes:
HIV research [Dimensions] – tweets



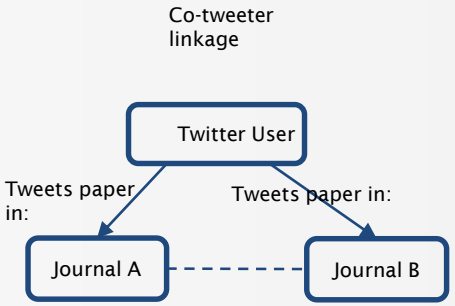
VOSviewer

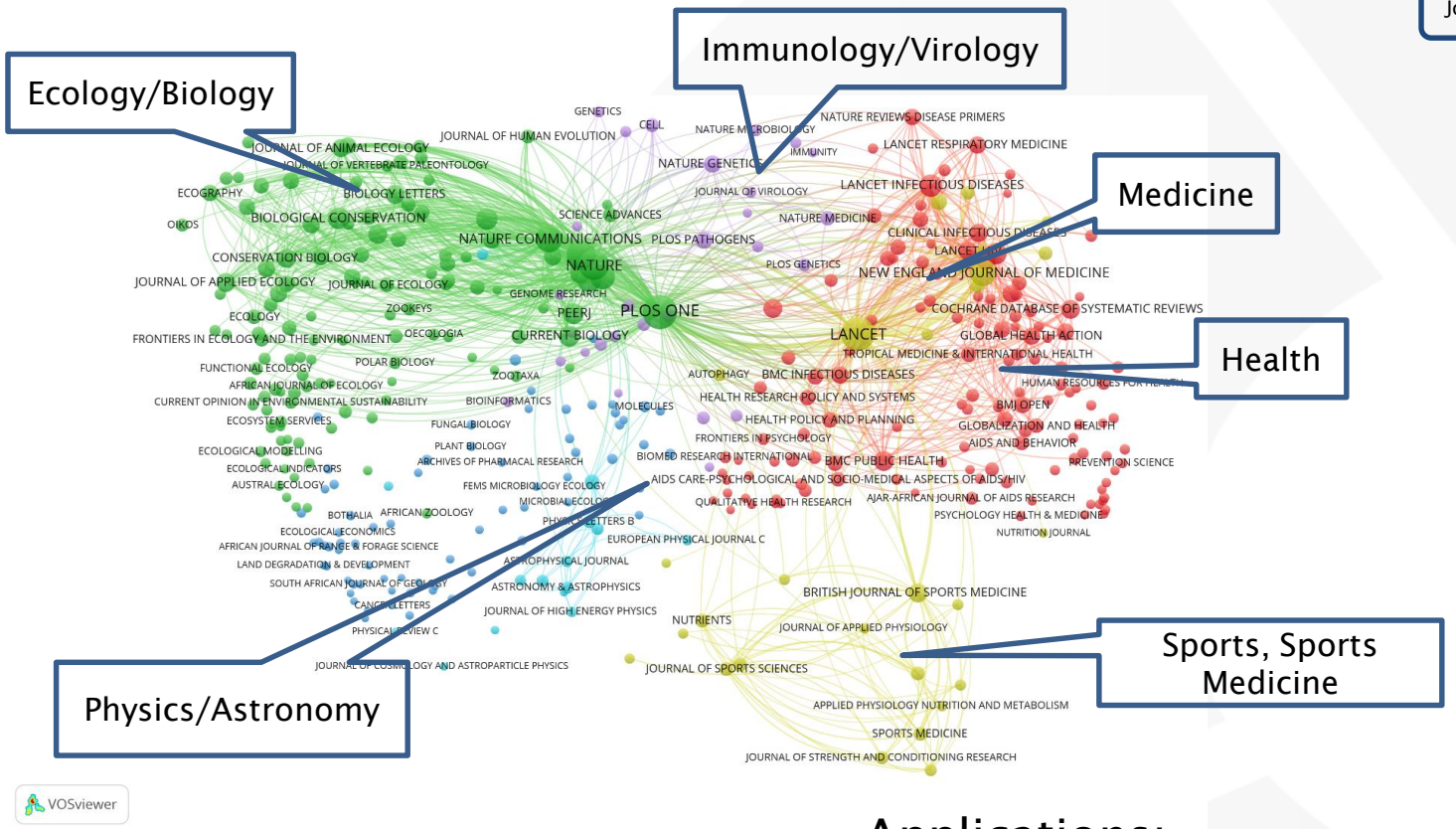
Heterogeneous couplings on Twitter – tweeter [actor]





Co-tweeter linkage of journals based on ZA-research





Applications:

- New maps of science
- *Societal* mapping of science (?)
- Cognitive gaps, misinformation

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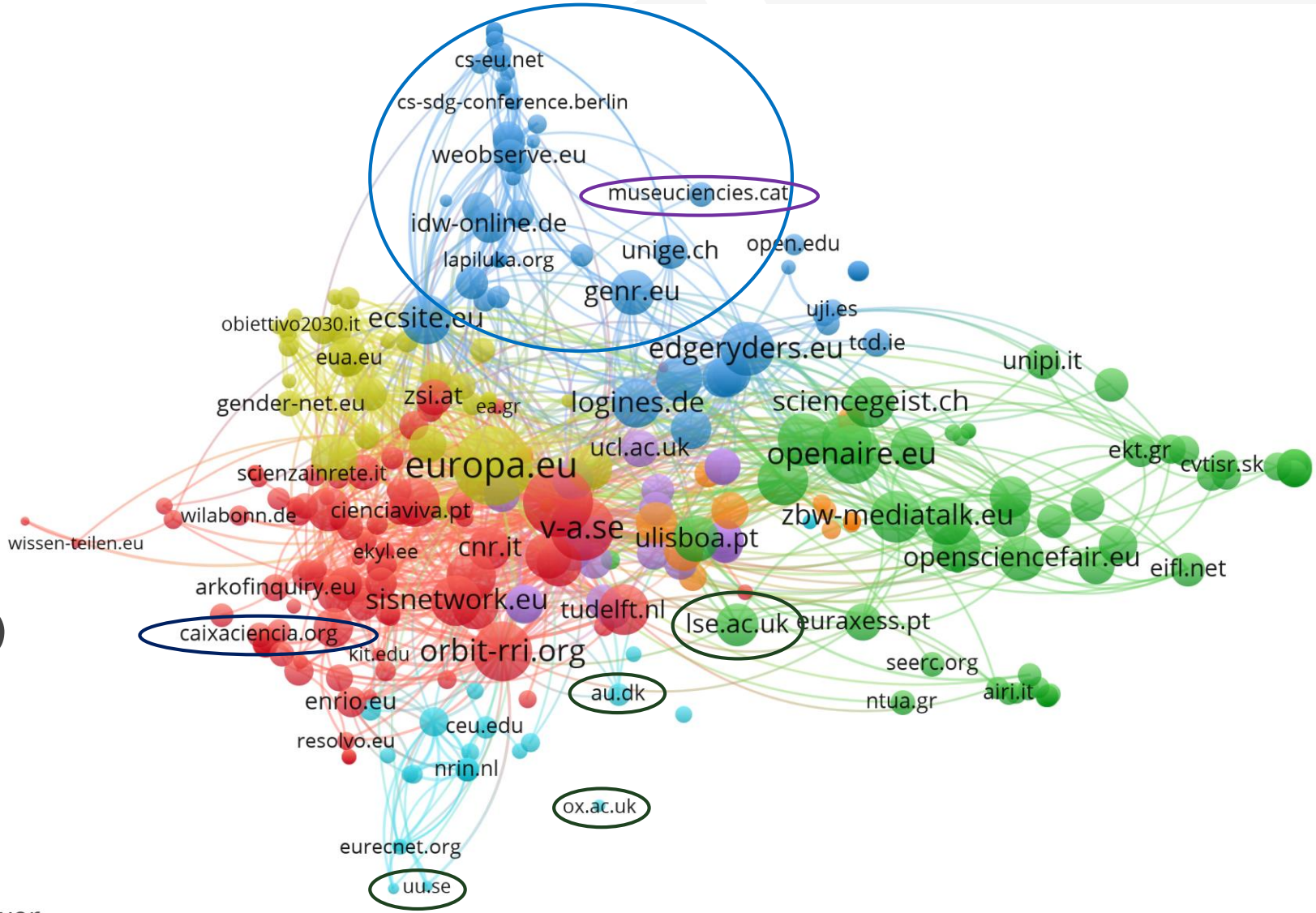
Links to research websites: the SwafS projects

- 121 research projects from the H2020 funded SwafS programme, each with its own website
- Displayed: websites linking to the project websites
- The websites in the network are connected via a mutual link to a project website (“bibliographic coupling”)
- Topical clusters & central societal actors emerge



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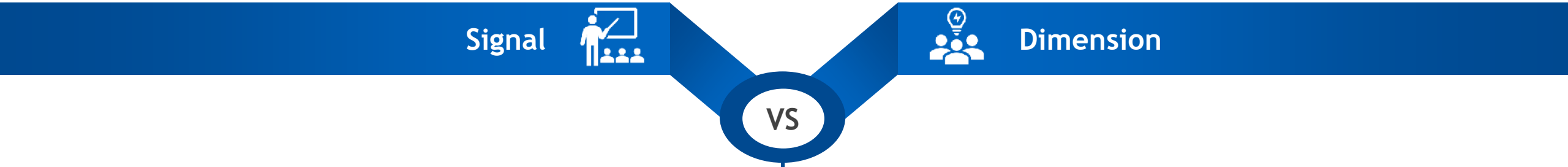
VOSviewer

Area-based connectedness

Main principles

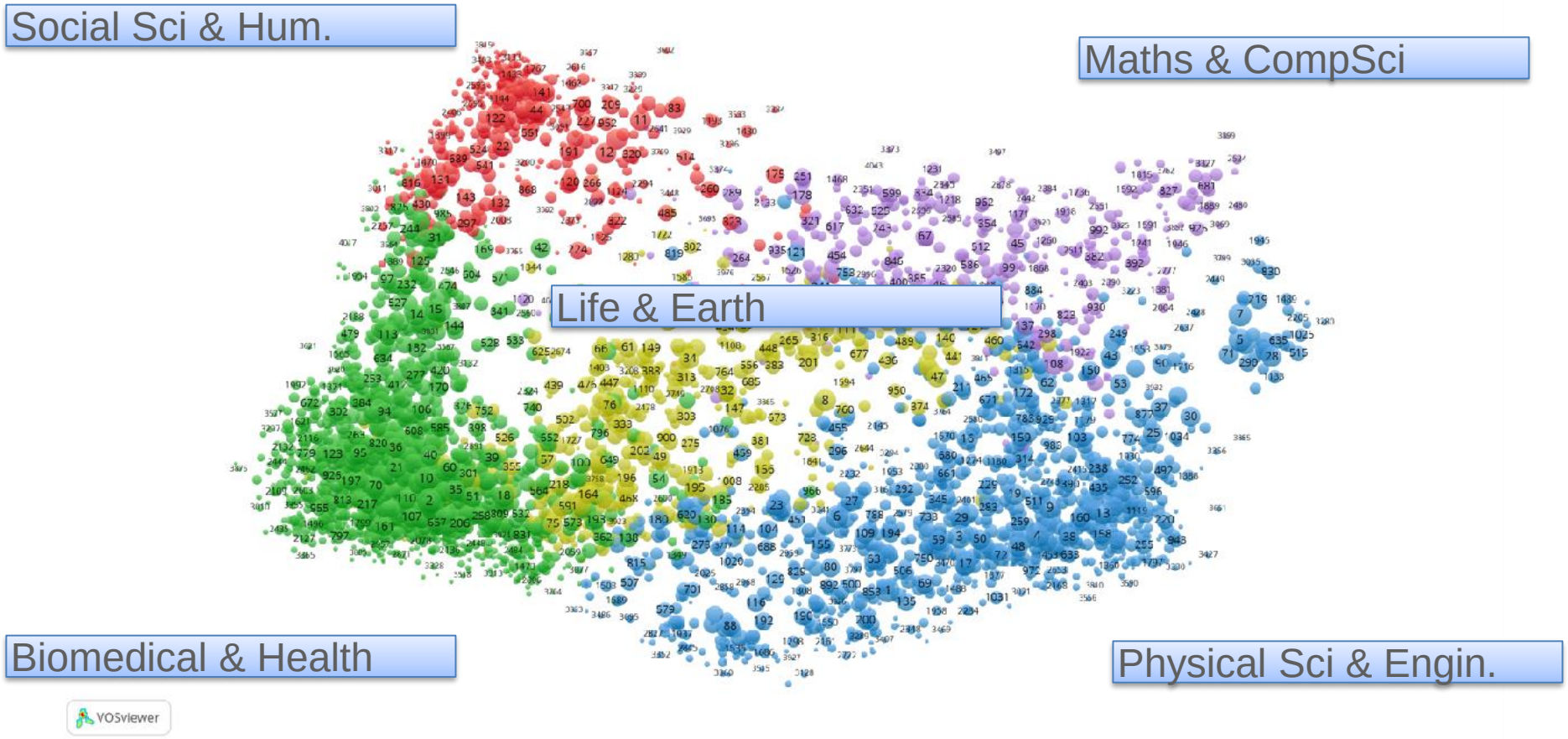
- Focus on societal connectedness as a proxy of (potential) impact.
- Connectedness as the achievement of a community (research area)
- Measuring signals between research and society, from both sides
- Distinguishing between different dimensions of connectedness

Signals and dimensions

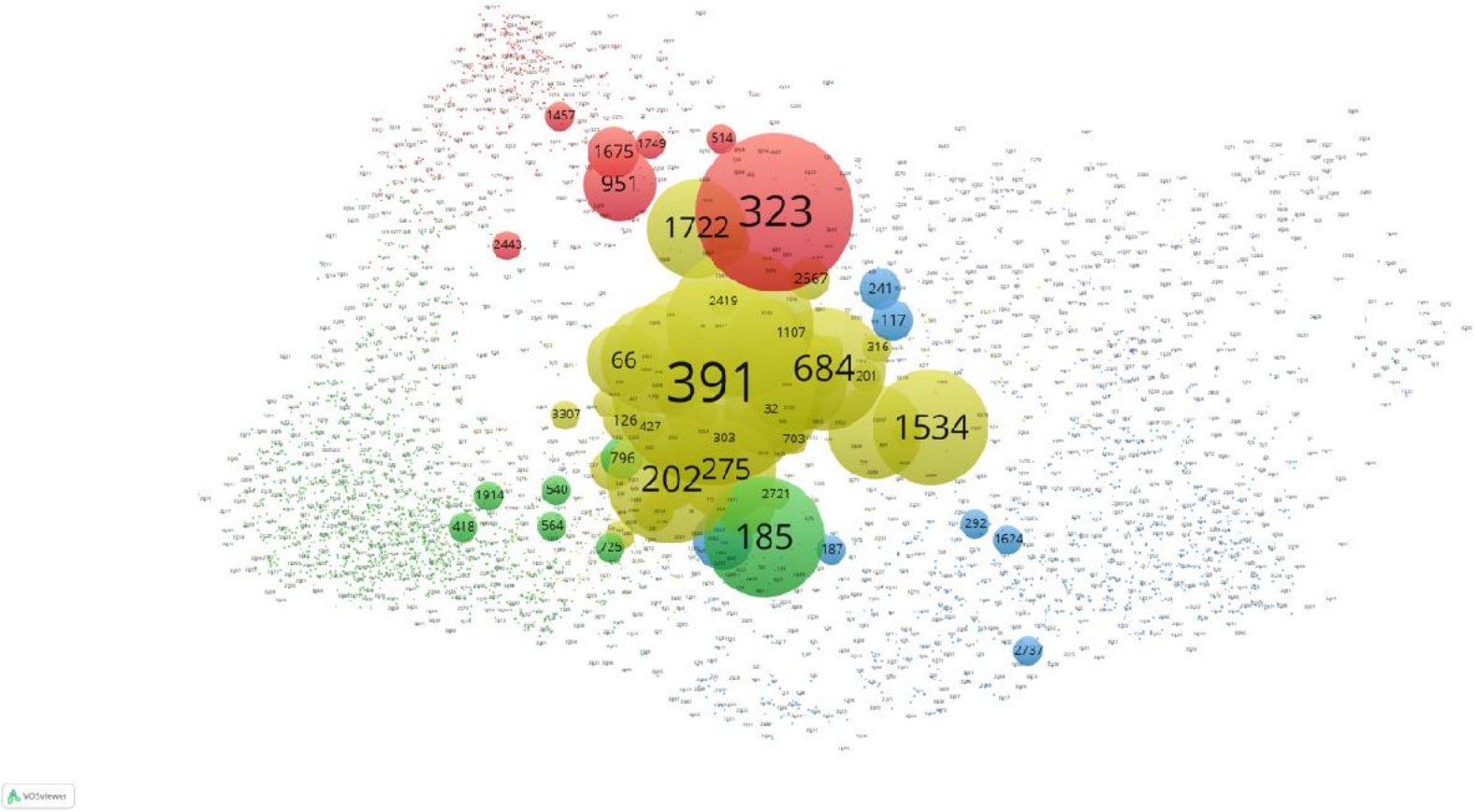


Signal	Dimension
Papers (co-)authored by industry	Industry R&D
Papers published in local languages	Local interest or focus
Papers cited by patents	Technological or commercial interest
Papers mentioned on twitter (or other social media)	Link to general public
Papers mentioned in policy documents	Relating to political issues
Papers mentioned in news	Link to general public
...	

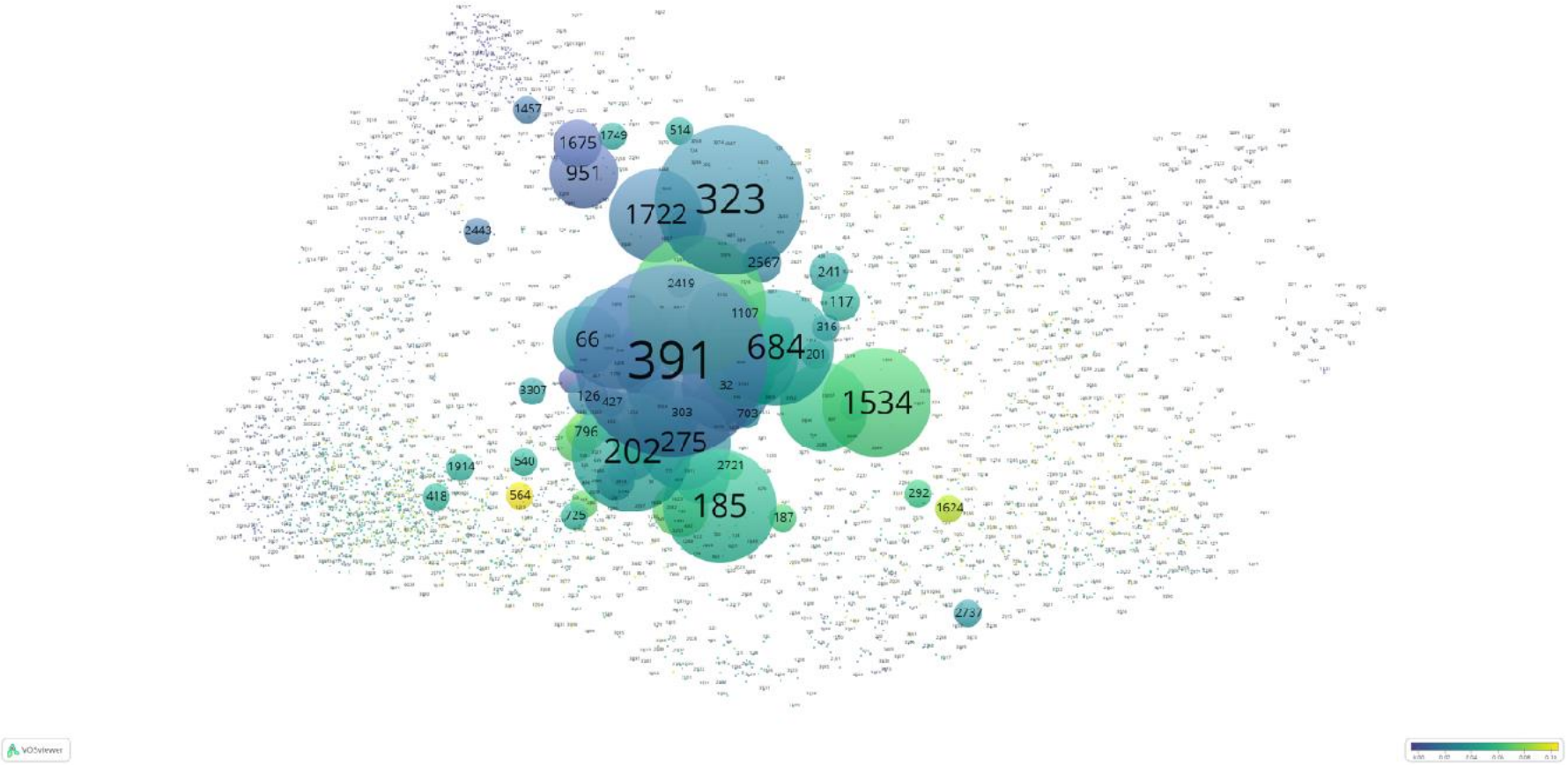
Web-of-Science landscape
(publication based classification, 4000 clusters)



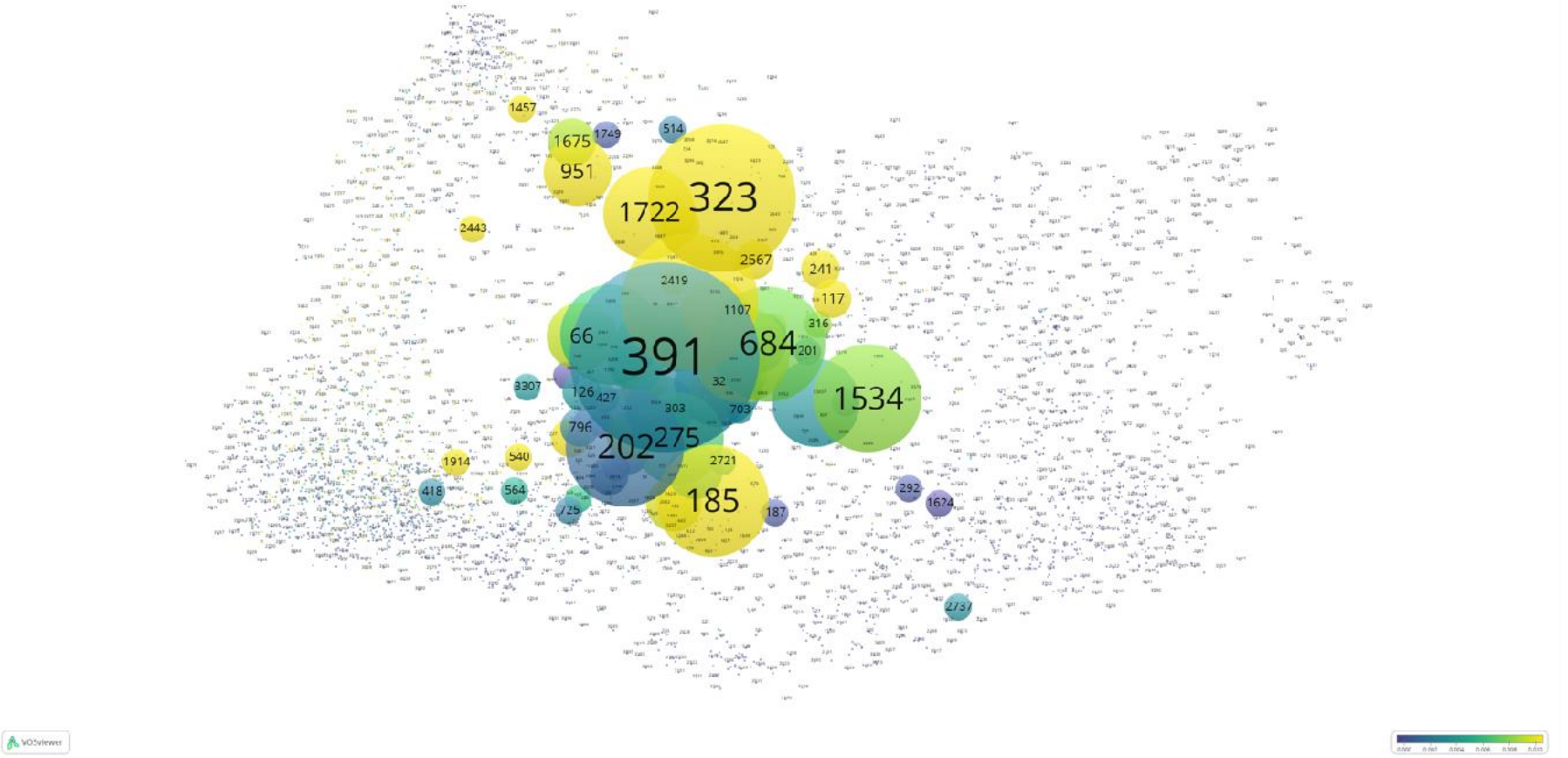
Institute of Environmental Sciences (Leiden University)



Institute of Environmental Sciences output colour-coded by ABC(industry)



Institute of Environmental Sciences output colour-coded by ABC(policy)

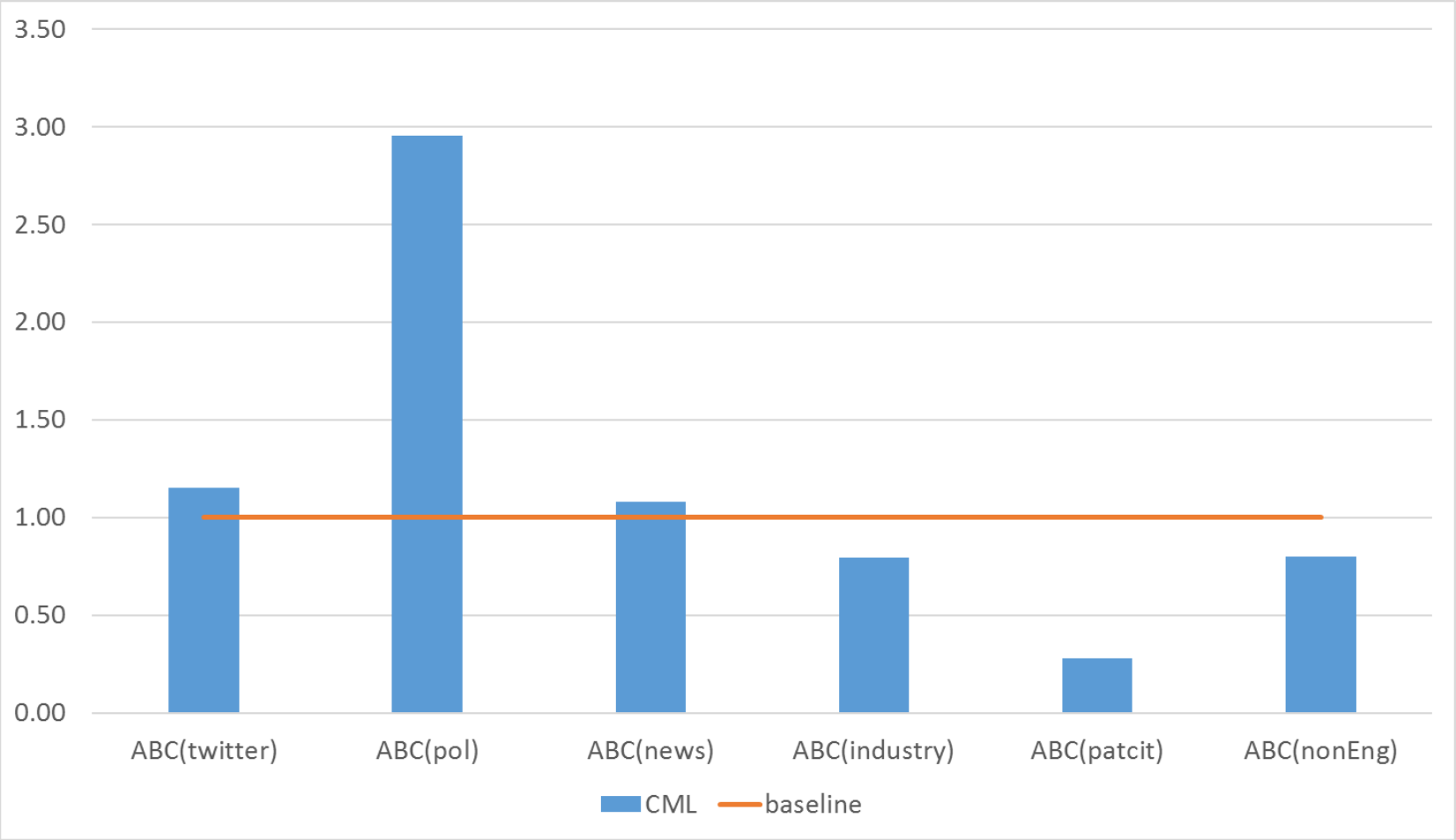


Area-based vs actor-based

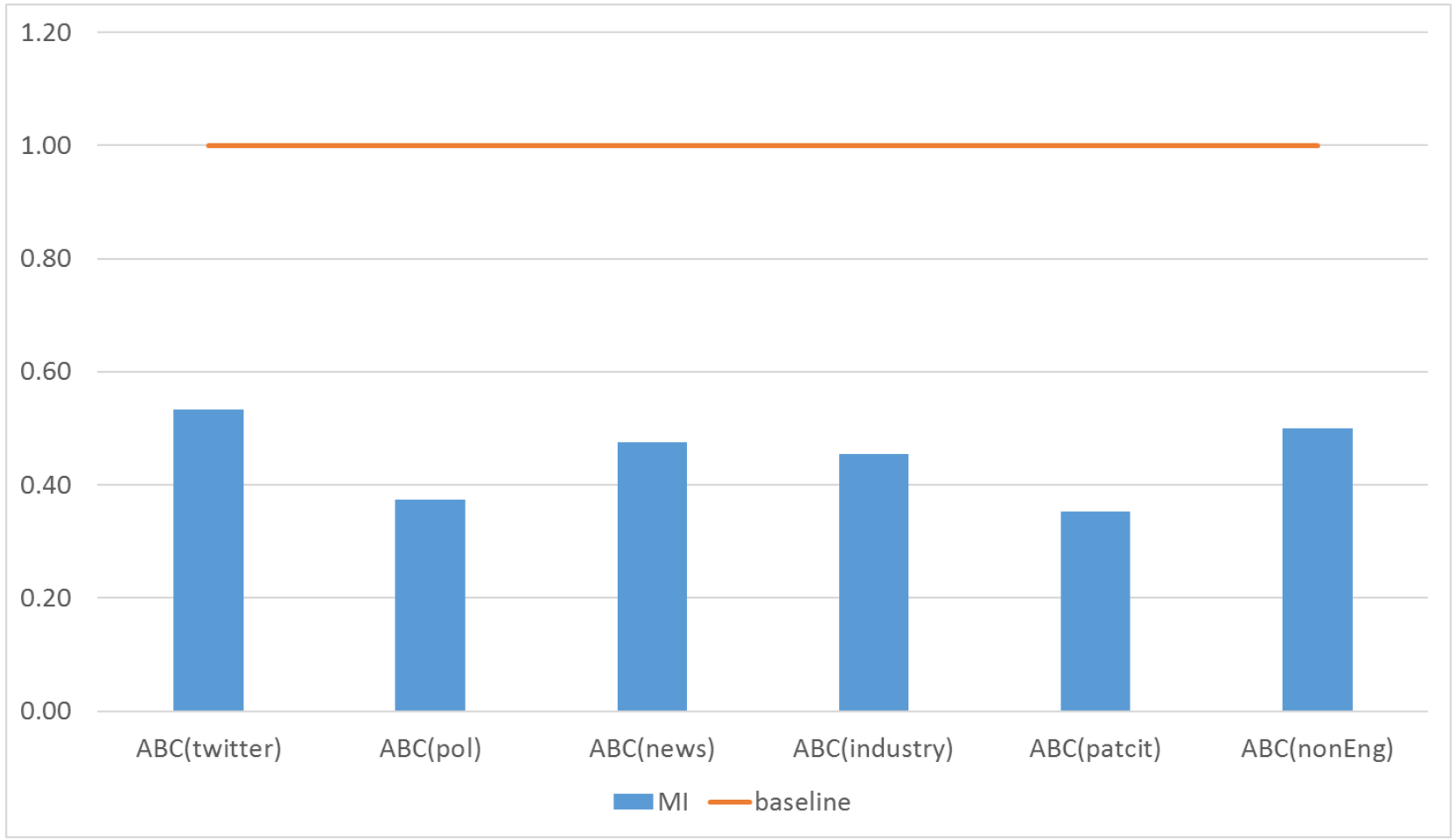
- Actor-based: share of papers from actor A mentioned in policy docs
- Area-based: output of actor A, characterised by the area Z in which A is active (inherited from Z)

ABC profile of Institute of Environmental Sciences

Strong connectedness to policy



ABC profile of Mathematical Institute



Interviews and workshops

- With researchers, stakeholders, management and other crucial participants
- Explore connection between scientific missions and impact
- Interpretation of quantitative analyses: exploring impact pathways

Workshop for anthropology department

An example

The aim of the workshop: Test preliminary analyses and enrich our understanding

- Discussion of some of the preliminary findings
  - Term maps
  - Response analysis: academic and social response
- Focus group discussions about three contextual issues
- Impact Pathways exercise (themes, mobilization, outputs, impact)

Part V: Conclusions

Conclusions

- Research evaluation is a performative act
- Evaluation methods vary in purpose, data requirements and theoretical assumptions
- Indicating societal value is attractive but methodologically complex
- Measuring process indicators is a promising strategy
- Quantitative indicators should support qualitative assessment

Recommendations

- Choose methods that match the purpose of evaluation
- Choose methods that fit to the evaluation context (mission, discipline, organisation)
- Choose methods compatible with your theoretical assumptions
- Combine qualitative and quantitative methods

Key references

- Costas, R., de Rijcke, S., & Marres, N. (2021). “Heterogeneous couplings”: Operationalizing network perspectives to study science-society interactions through social media metrics. *Journal of the Association for Information Science and Technology, 72*(5), 595-610.
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- Noyons, E. (2019). Measuring societal impact is as complex as ABC. *Journal of Data and Information Science, 4*(3), 6-21.
- Smit, J. P., & Hessels, L. K. (2021). The production of scientific and societal value in research evaluation: a review of societal impact assessment methods. *Research Evaluation, https://doi.org/10.1093/reseval/rvab002*.

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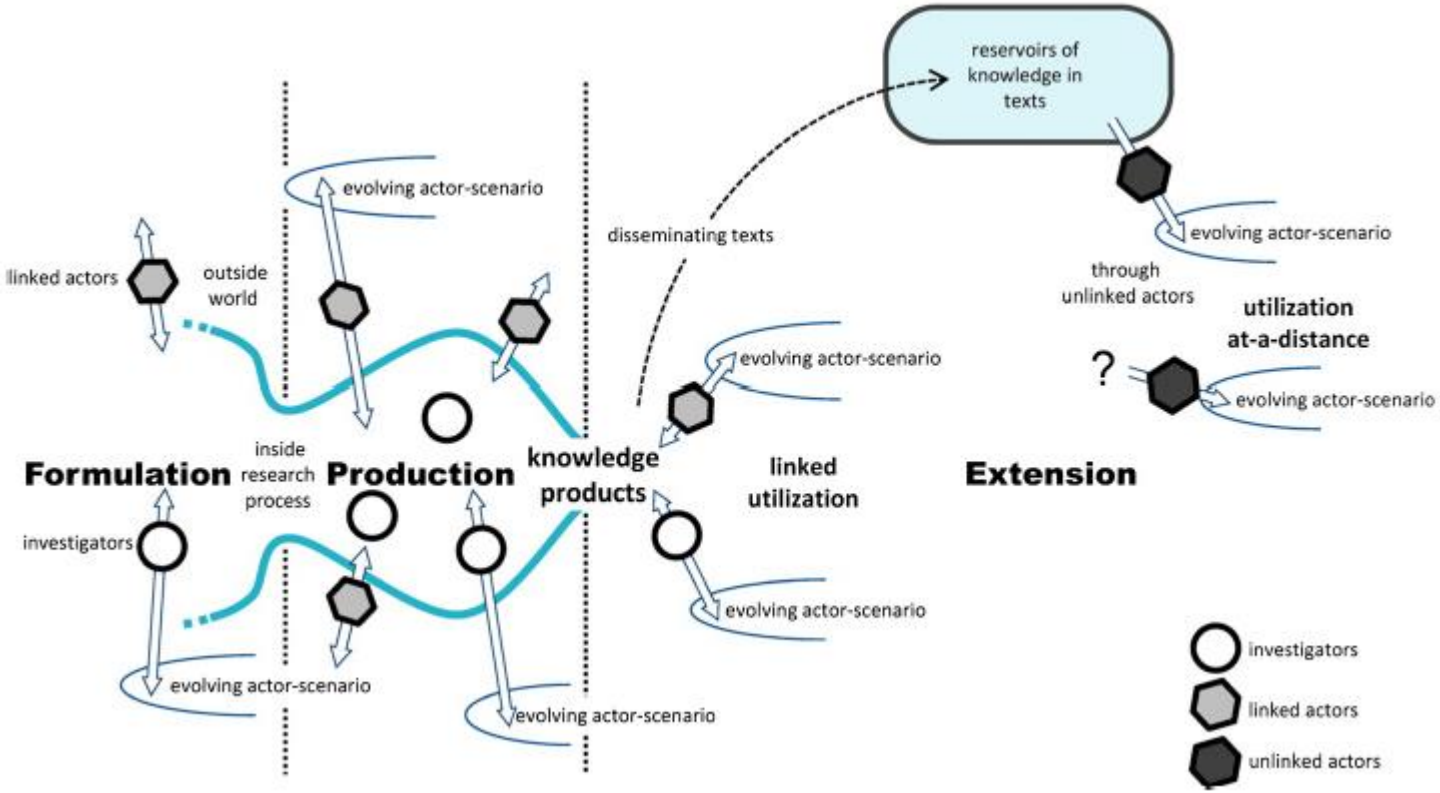
Bonus slides

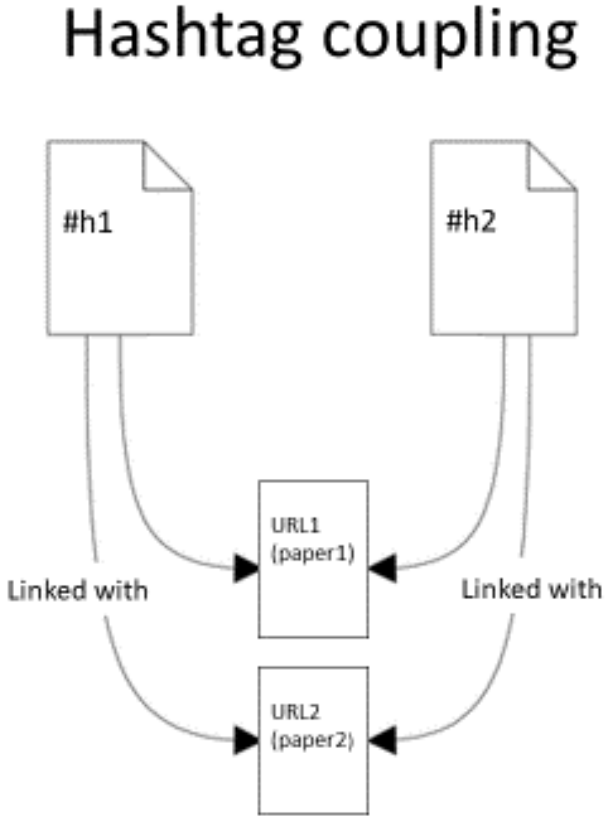
A constructivist perspective on research (evaluation)

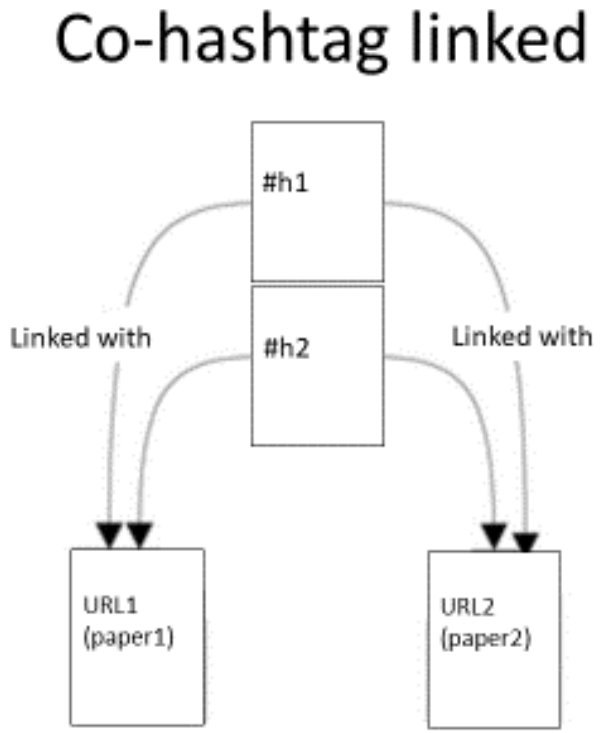
- Focus on research practices
- No *a priori* distinction between knowledge users and knowledge producers
- Research, societal value, impact are all (re)produced by actor-networks
- Activities and actors for scientific and societal value part of the same practice!



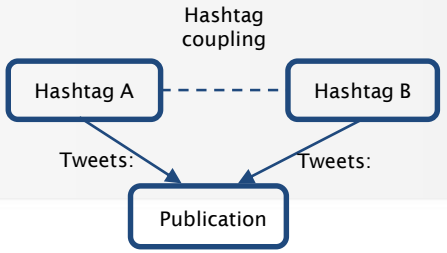
Kok & Schuit, 2012

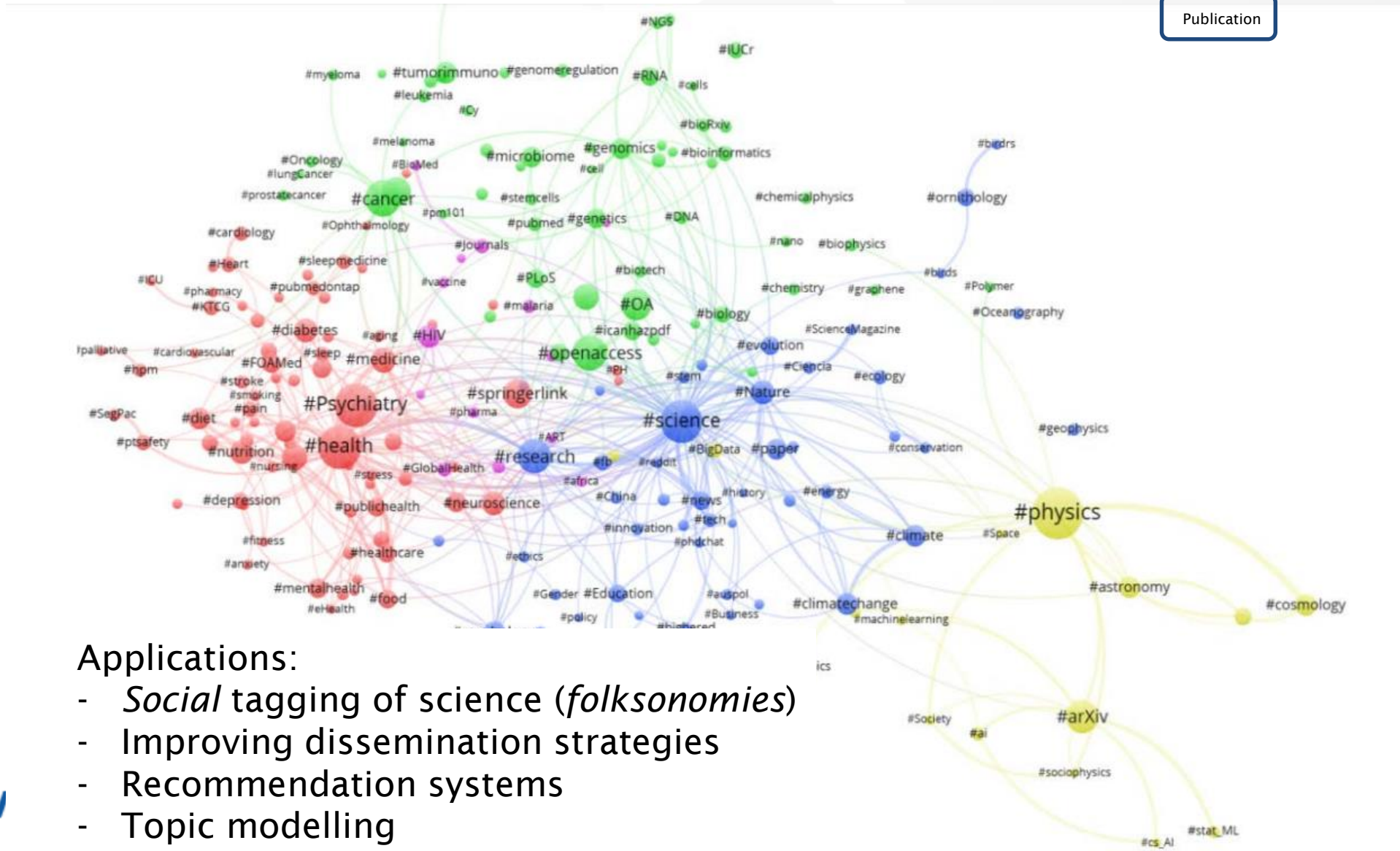
Heterogeneous couplings on Twitter – hashtag [reference format]





Hashtag coupling
(top hashtags Altmetric.com)





Applications:

- *Social* tagging of science (*folksonomies*)
- Improving dissemination strategies
- Recommendation systems
- Topic modelling
- Field delineation (!)