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Towards indicators for ‘opening up’ science, tech and innovation policy

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Building on work with Tommaso Ciarli and Andy Stirling (SPRU),
Jordi Molas-Gallart (*Ingenio*), Matt Wallace (IDRC) and Loet Leydesdorff (Amsterdam),

1. What are indicators for transformative change?

Biases of this presentation:

- More research than innovation
- More evaluation than foresight

Engaged critique:

- SPRU tradition of participating in indicator design and use
(Frascati, Citation-informed, Oslo, Interdisciplinarity)
- Reflexive on the harm WE are causing

Indicators for transformative change

Mismeasuring our lives

“We will not change our behaviour unless we change the ways we measure our (...) performance.

Our statistics and accounts reflect our aspirations, the values that we assign to things. They are inseparable from our vision of the world and the economy, of society, and our conception of human being and our interactions.

Treating these as objective data, as if they are external to us, beyond question or dispute, is undoubtedly reassuring and comfortable, but it's dangerous.

It's dangerous because we get to the point where we stop asking ourselves about the purpose of what we are doing; what we are actually measuring, and what lessons we need to draw.”

Nicolas Sarkozy in prologue to “Mismeasuring our lives” by Stiglitz, Sen and Fitoussi (2010)

Pressing demands of research management and evaluation

- Increasing size of research endeavour
 - 1.5 M papers per year only in Web of Science
 - Globalisation. Many mid-income countries have multiplied their publication / innovation output (China)
 - Within a country: 3,000 postgraduate programmes are evaluated in 48 panels in BR
- Increasing competition— globally and locally
 - Success rates of research calls are very low in the US, EU (10%-20%)
- Increasing societal demands
 - Interactions with industry and social actors (NGOs)
 - Grand challenges (climate change, epidemics, water & food security)

**Traditional qualitative techniques of management cannot cope.
Hope that use of indicators can help...**

Can indicators help?

Yes, indicators can help make decisions...

- Increase transparency and sense of objectivity
- Reduce complexity
- Reduce time and costs

The dream of rationality, “the science of science policy”
(De Solla Price, Garfield, 1960s....Marburguer, Julia Lane, 2000s)

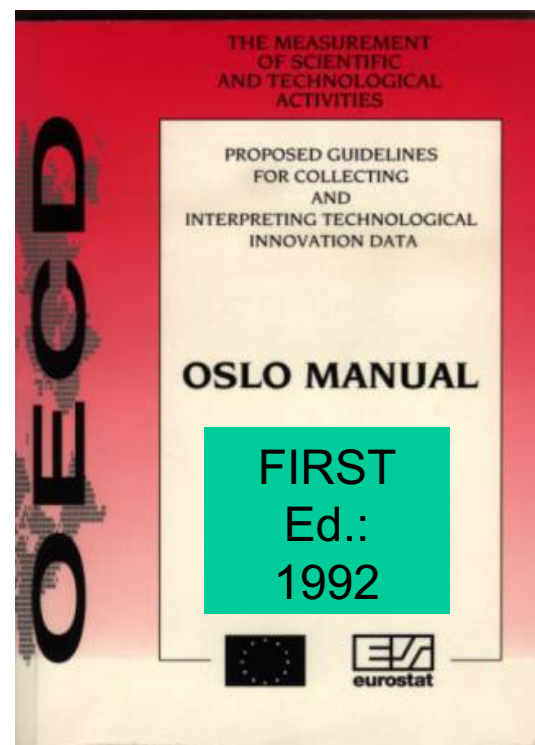
but do they lead to the “right” decisions?

Innovation Policy Frames and OECD Manuals

1st Frame – Inputs (outputs)
Linear model



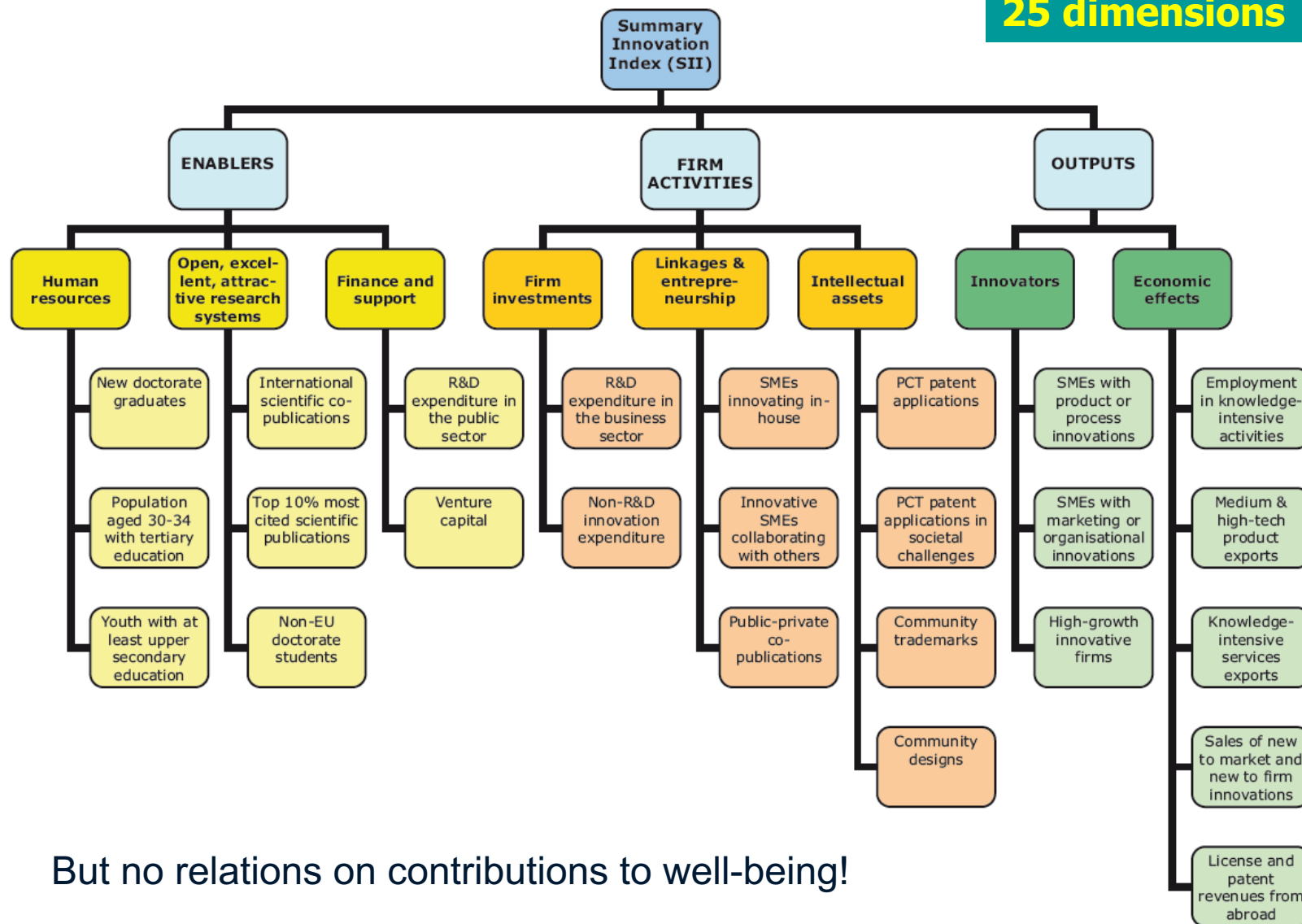
2nd Frame – Linkages & processes
Innovation systems



In both cases, welfare is assumed to come from economic growth
Data collection infrastructure – Manuals as describing routines

Union (EU) Innovation Scoreboard 2011

25 dimensions



But no relations on contributions to well-being!

Misalignment between research priorities and societal needs



Perceived mismatch between discourses (or expectations) of and actual outcomes of research

Energy, environment, health, the digital economy

More research does not mean better societal outcomes

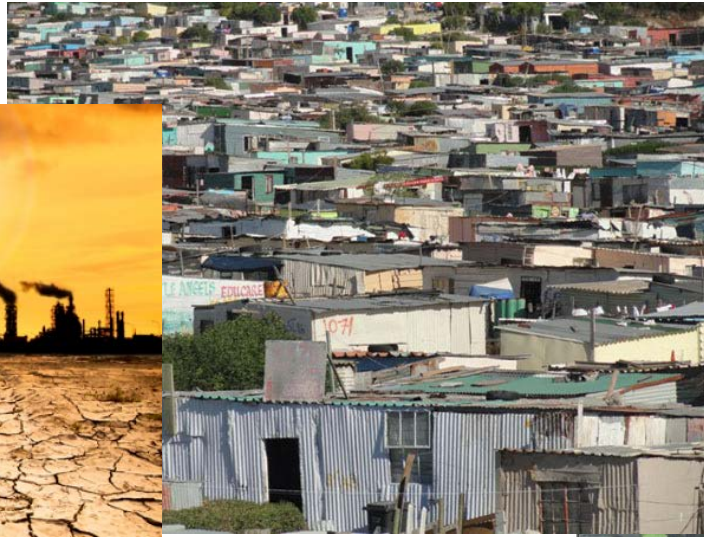
Lock-in, interests and institutional dynamics shape priorities towards “sub-optimal” !@? configurations.

Indicators of STI can remain “positive” while...

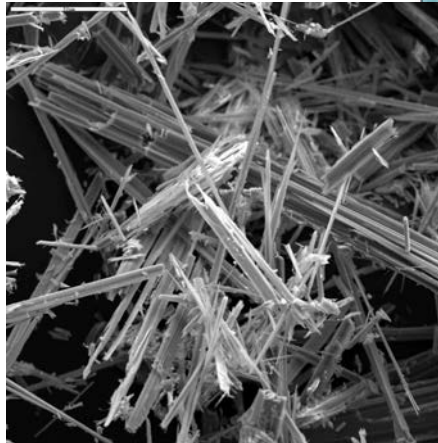
Climate change



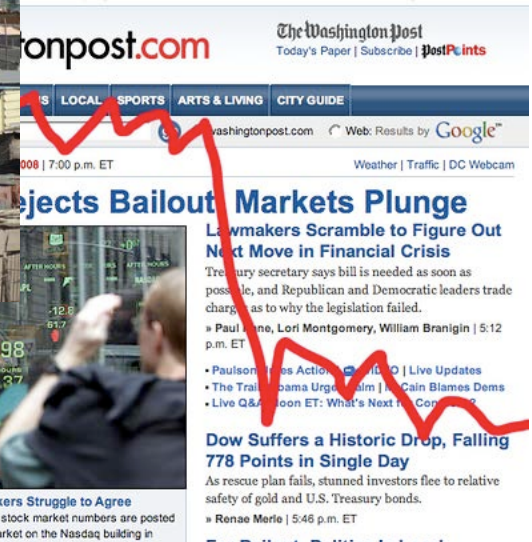
Poor housing



Asbestos



Cultural and ethnic suppression



Casino capitalism in financial innovation

The parable of Prussian scientific forestry

The performative ways of seeing and control (*Seeing like a state*, J. Scott)

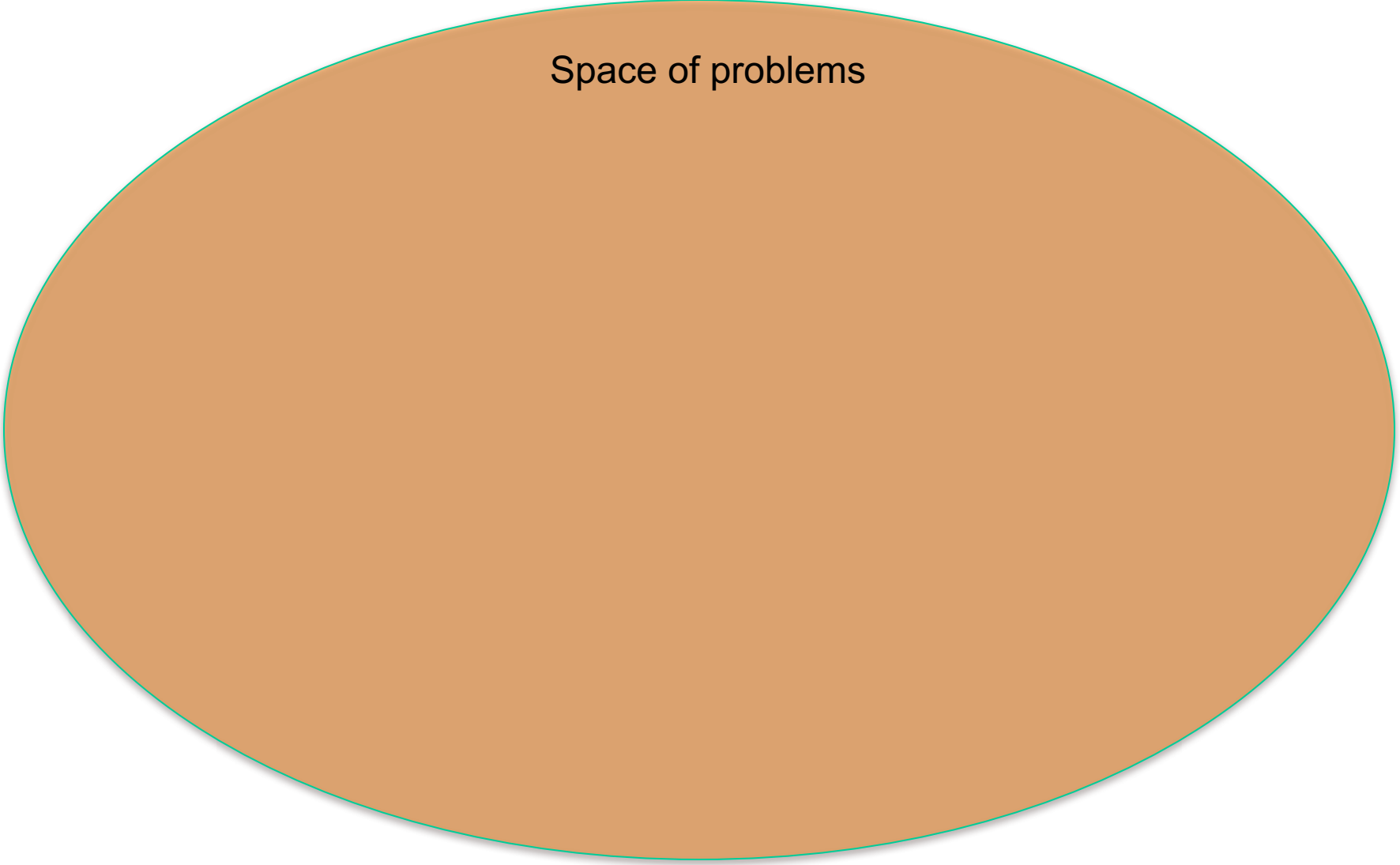
“No administrative system is capable of representing any existing social community except through a heroic and greatly schematized process of **abstraction and simplification**. (...)”

“Exaggerating only slightly, one might say that the crown's interest in forests was resolved through its fiscal lens into **a single number: the revenue yield of the timber** that might be extracted annually.. ”

“Backed by state power through records, courts, and ultimately coercion, **these state fictions transformed the reality they presumed to observe**, although never so thoroughly as to precisely fit the grid.”

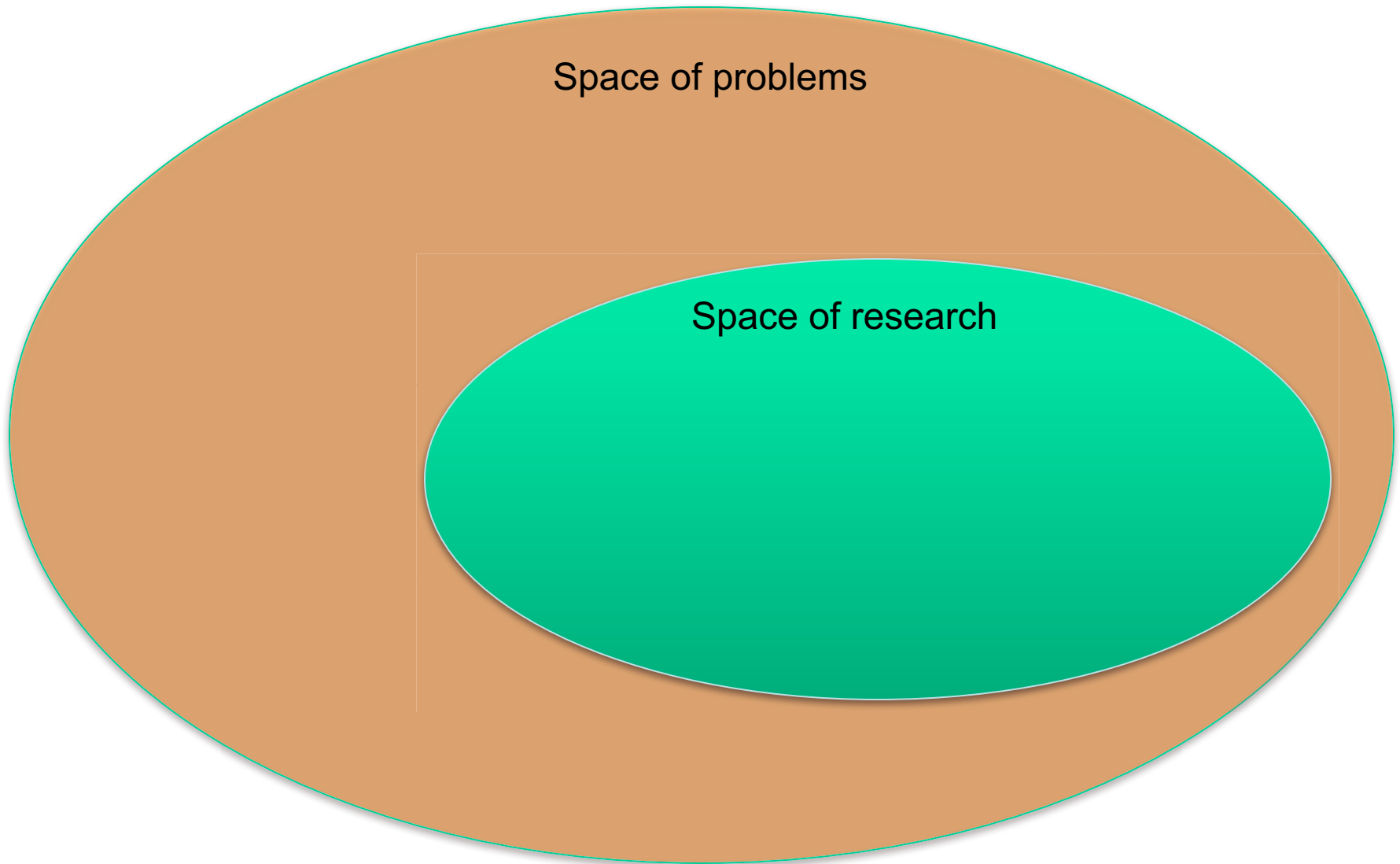


Problems, research and indicators

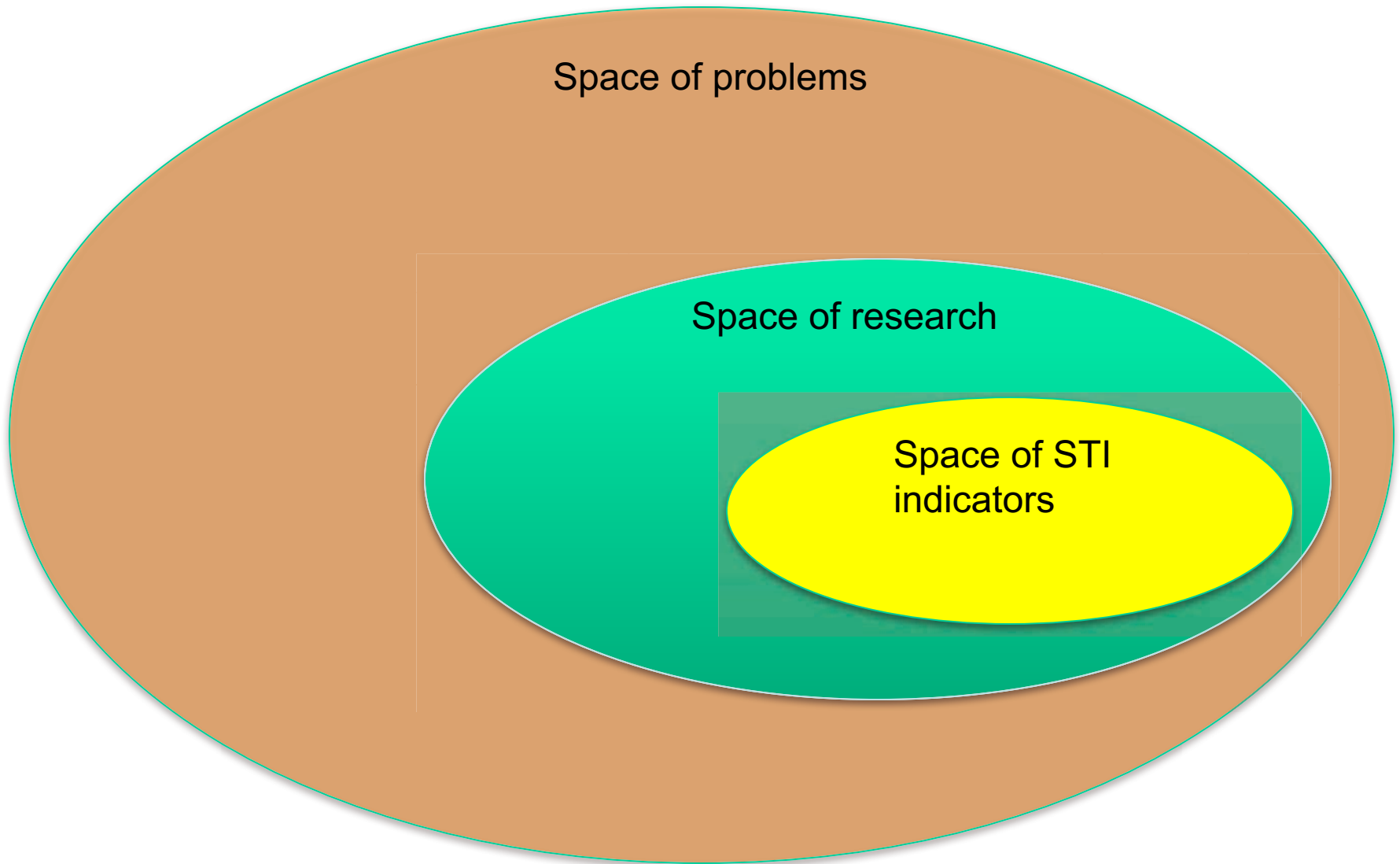


Space of problems

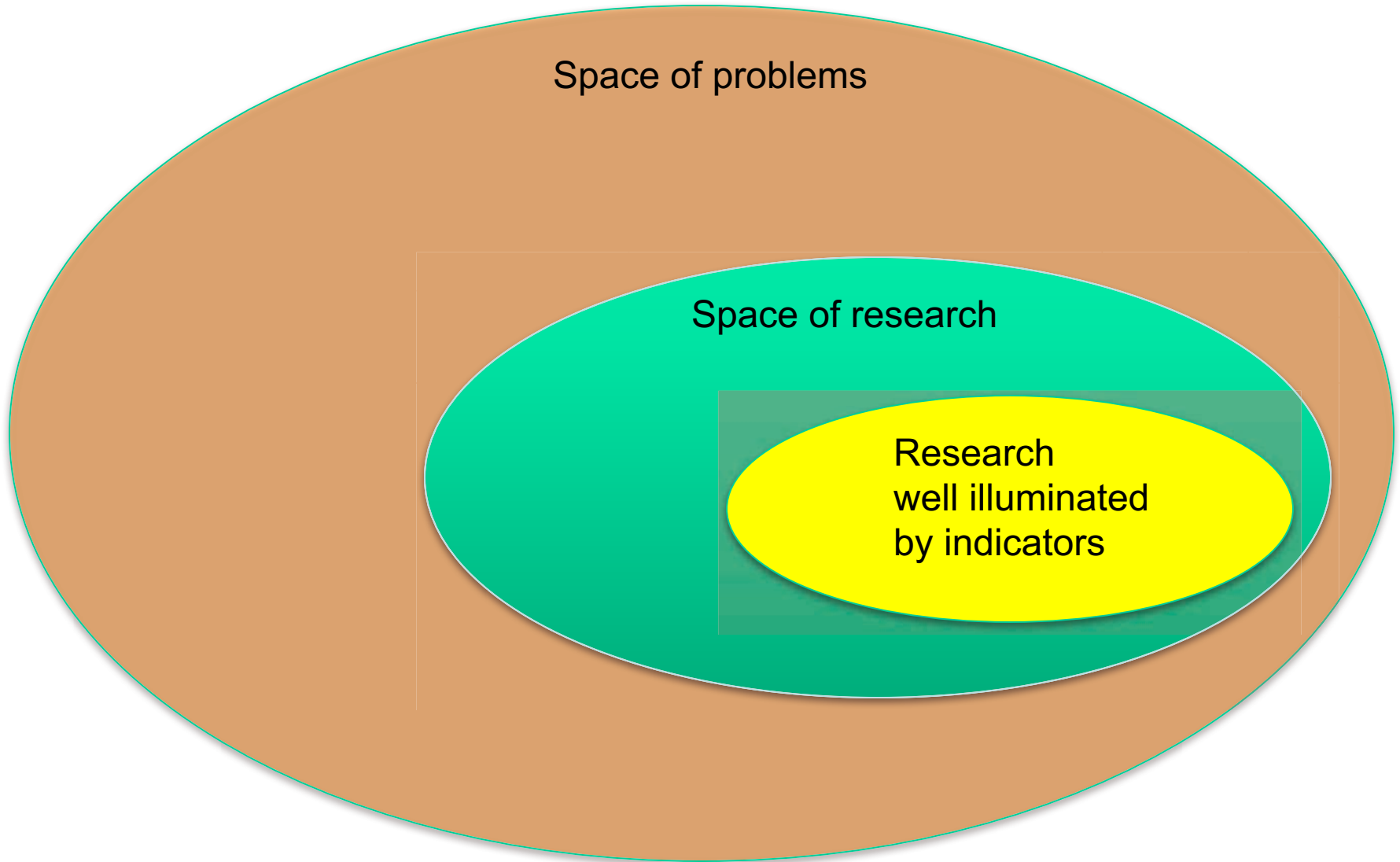
Problems, research and indicators



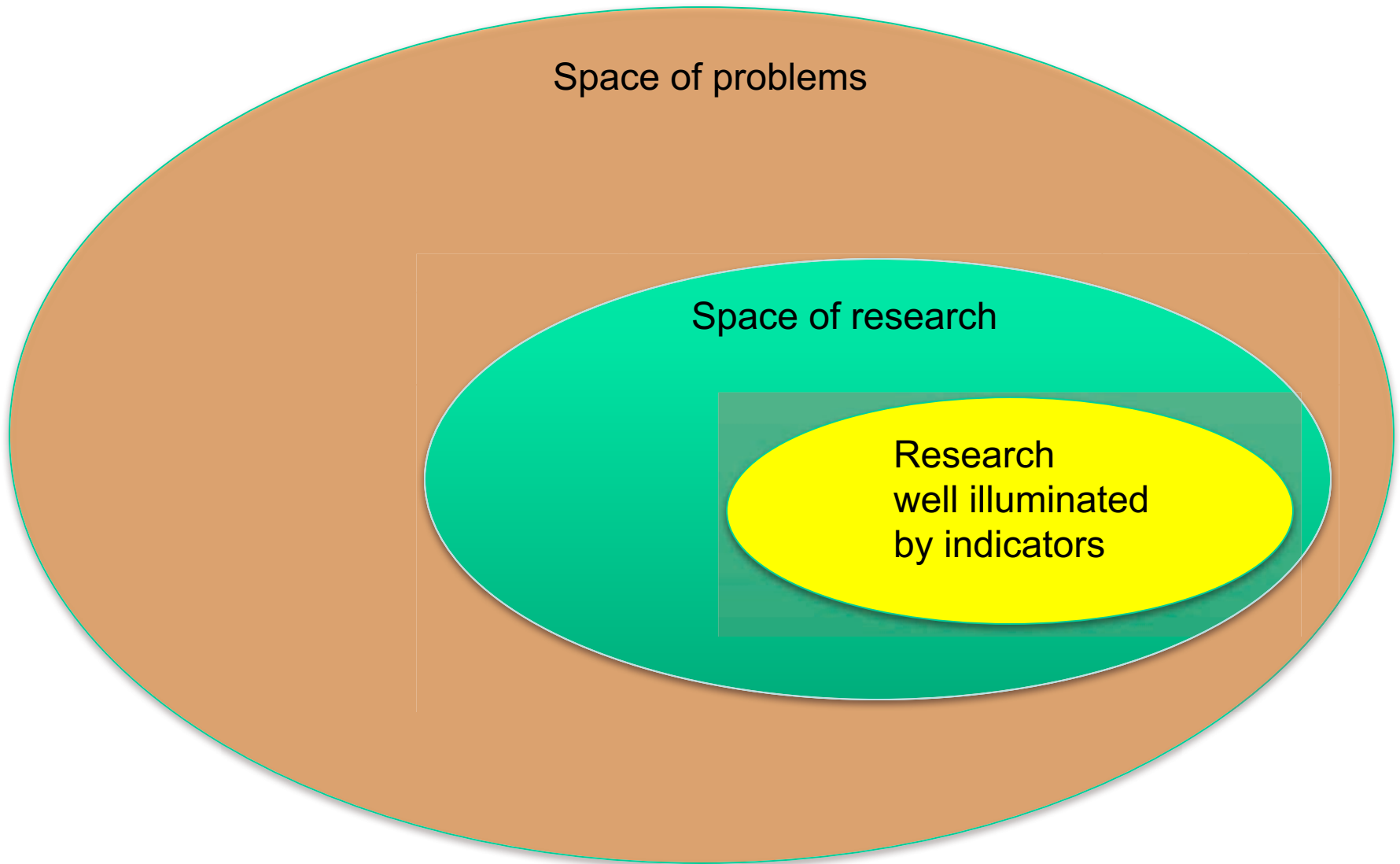
Problems, research and indicators



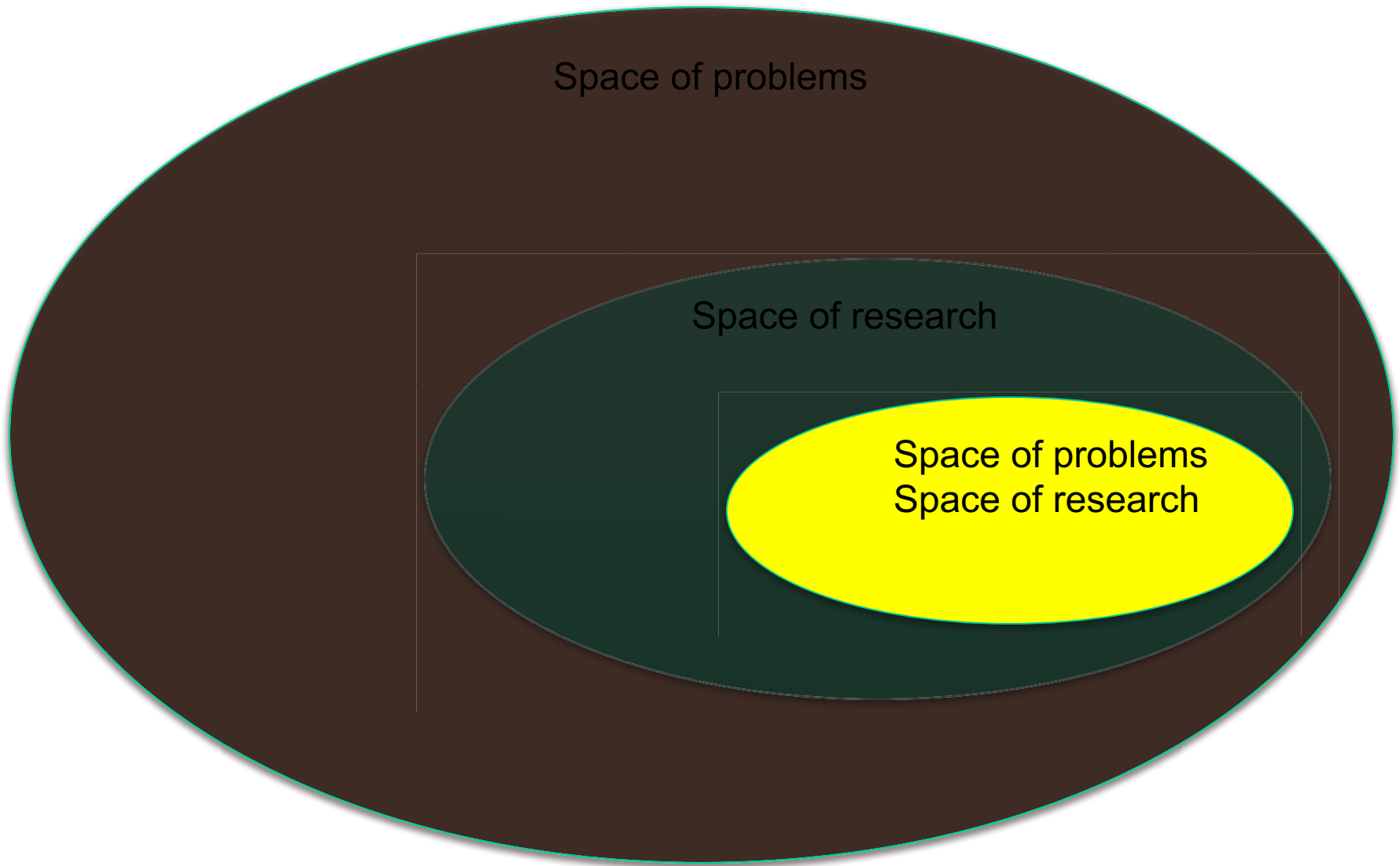
Problems, research and indicators



Streetlight effect in indicators: mistaking light with “problems”



Streetlight effect in indicators: mistaking light with “problems”



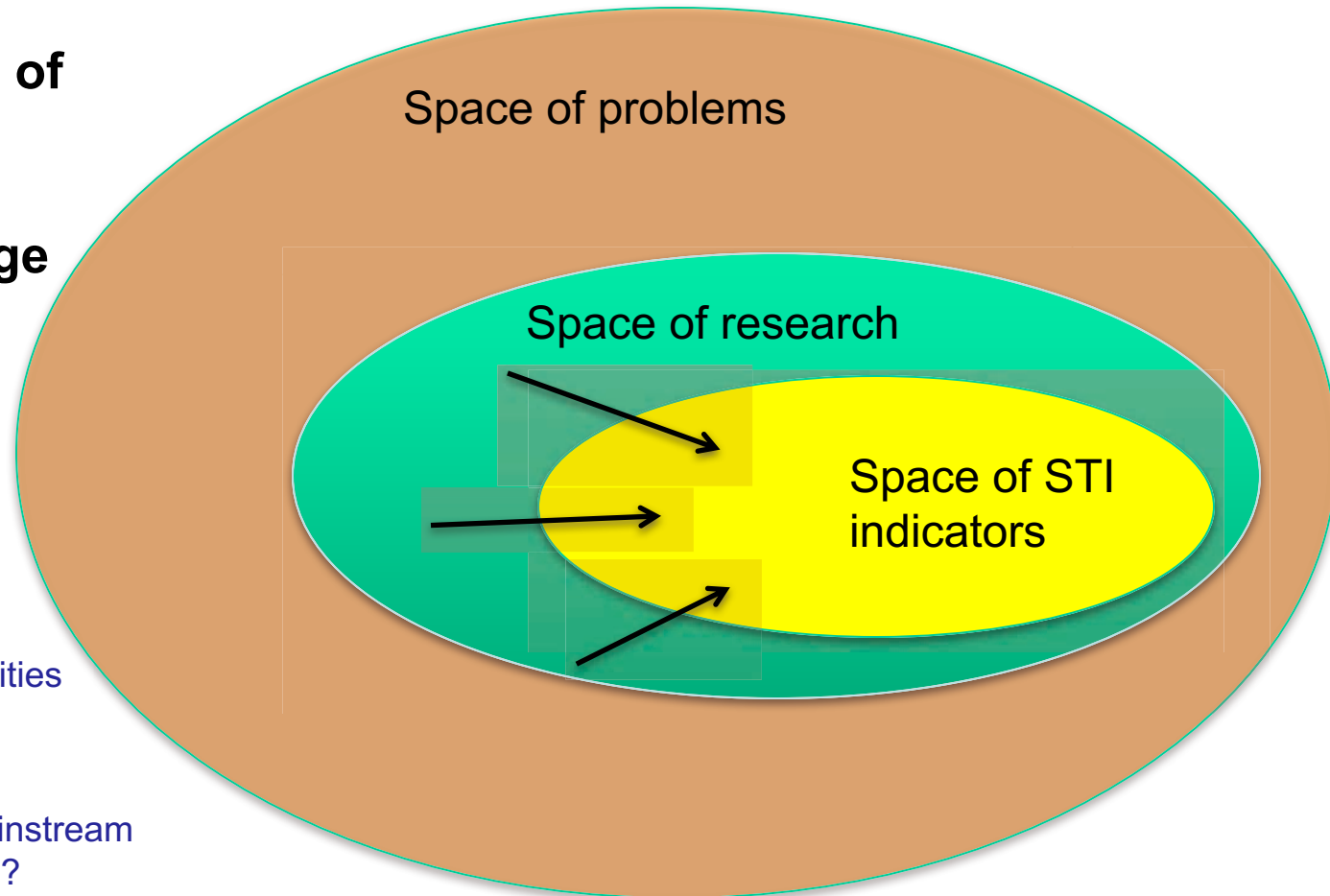
Hypothesis: reduced indicator coverage may contract research space

The societal needs dealt by research that is under the streetlight effect, will be better rewarded.

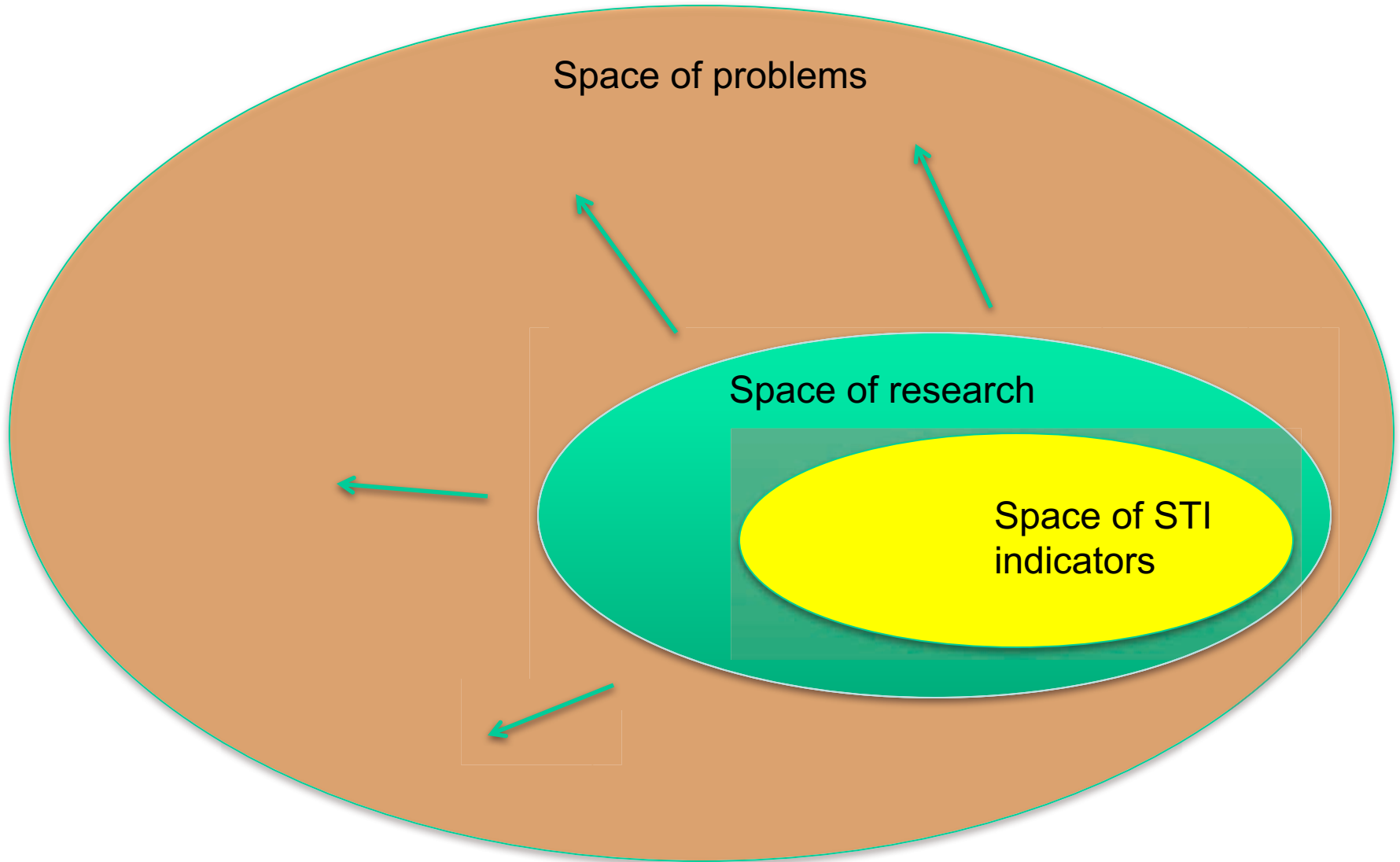
Reduced diversity of research efforts...

...reduced coverage of societal needs

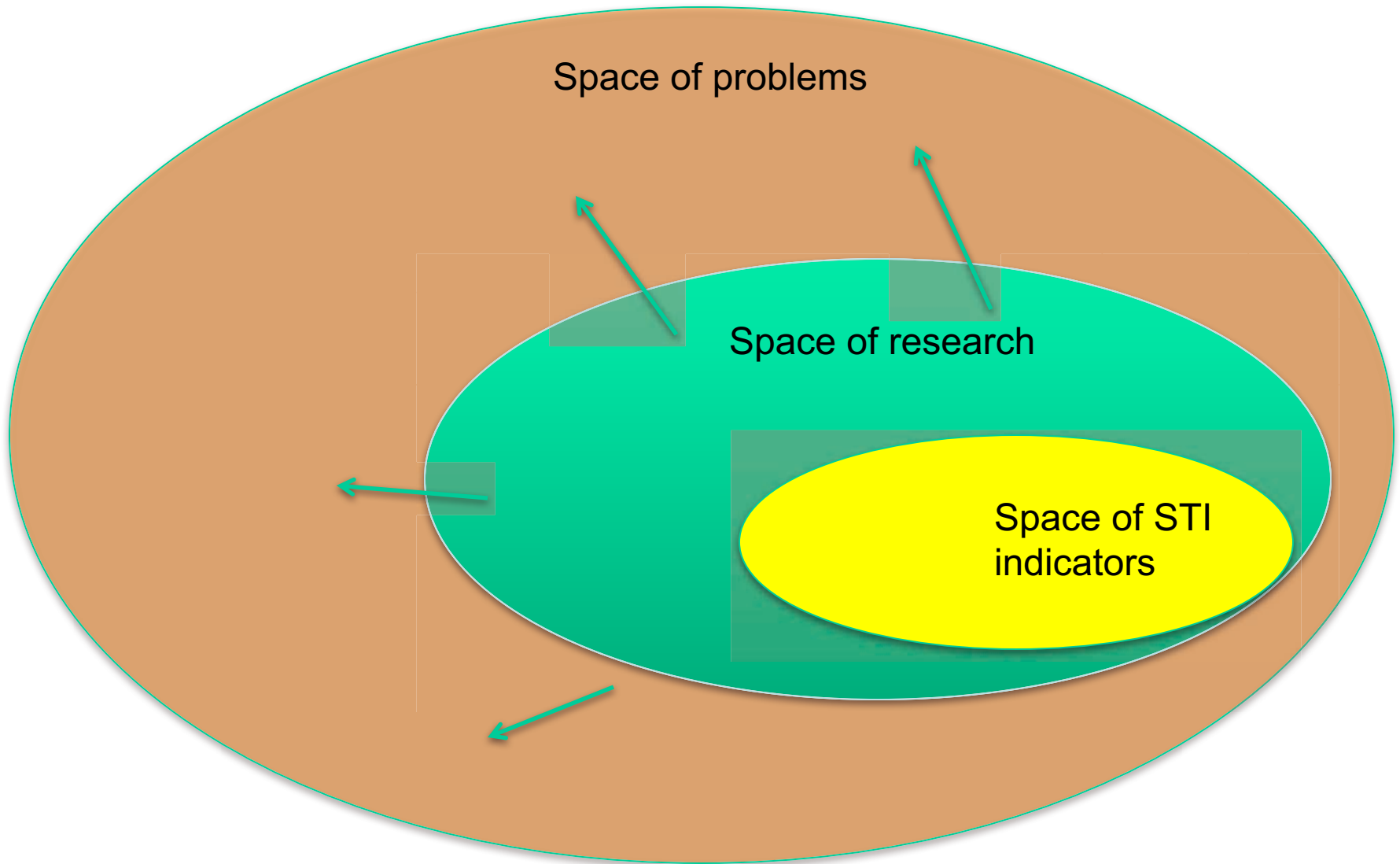
- Field res.(epidemiology)
- Applied research
- Social science and humanities
- Non-hegemonic countries
- Non-English publications
- Topics outside outside mainstream (e.g. preventive medicine)??



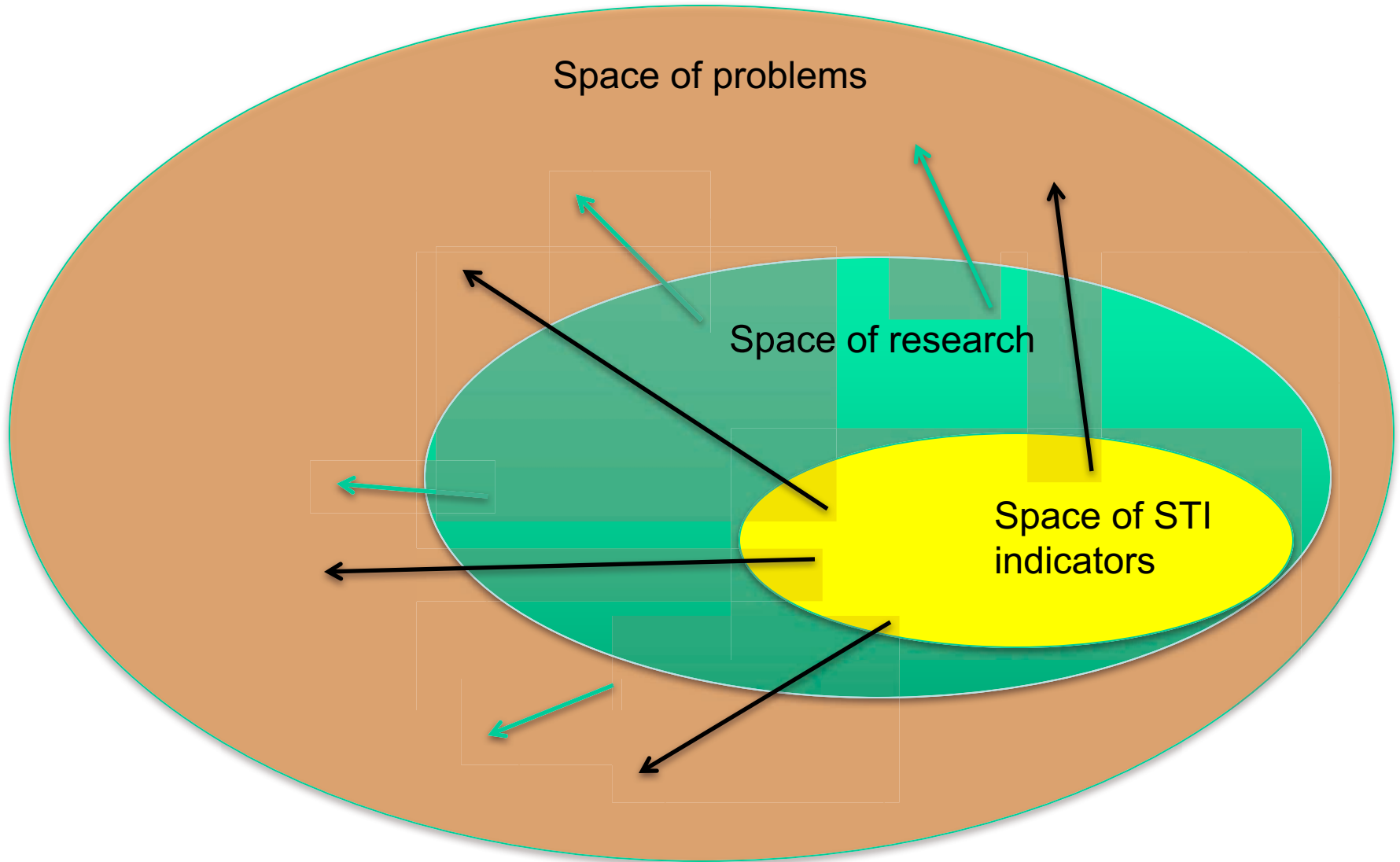
Demands for expanding role of science in society...



Demands for expanding role of science in society...



...may require **expanded sets of data and indicators**



Towards new STI indicators

- **Current STI Indicators may be harmful – via exclusion (Erika)**
 - Use for justification of incumbents
 - Only (partially) appropriate for some types of STI activities
 - Biases against and potential suppression of creative and valuable types of R&I. Threat to diversity.
 - Harmful forms of innovation maybe counted as positive

Indicators for transformative change?

- **Uses of indicators**
 - What uses? What institutional contexts?
- **Other types of indicators?**
 - What criteria? What types?

Propose indicators, and their use and context of use for

- **Cenicaña – Research Institute for Sugar (Cali, Colombia)**
 - Mission: support the development, competitiveness and sustainability of the sugar agroindustrial sector
- **Fiocruz Institute on tropical diseases (Salvador de Bahia, Brazil)**
 - Mission: to support the improvement of life quality in the population by the management and diffusion of scientific and technological knowledge.

2- Towards inclusive metrics











An agenda for more inclusive metrics

- **Inclusiveness in the inputs (more info)**
 - *Broadening out:* Create more diverse indicators
 - Indicators of open science, RRI, hidden, social innovation
 - Improve representation of SSH scholarship, languages other than English, the “South”,...
- **Inclusiveness in the outputs (multiple goals)**
 - *Opening up:* develop toolkits that allow exploration of choices. New ways of presenting indicators
 - Multi-ranking tools
 - Interactive visualisations
- **Inclusiveness in the policy process (??)**
 - Develop new social processes on use of indicators
 - STI indicators as tools for interpretation and deliberation (R. Barré)

What type of indicators?

Model 1: Unique and prescriptive Proposing “best choices”

Rankings -- ranking list of preferences

Academic Ranking of World Universities - 2011				
World Rank	Institution	Country	National Rank	Total Score
1	Harvard University		1	100.0
2	Stanford University		2	72.6
3	Massachusetts Institute of Technology (MIT)		3	72.0
4	University of California, Berkeley		4	71.9
5	University of Cambridge		1	70.0
6	California Institute of Technology		5	64.7
7	Princeton University		6	61.2
8	Columbia University		7	60.4
9	University of Chicago		8	57.5
10	University of Oxford		2	56.4











how much?
how fast?
what risk?
who's ahead?

What type of indicators?

Model 1: Unique and prescriptive Proposing “best choices”

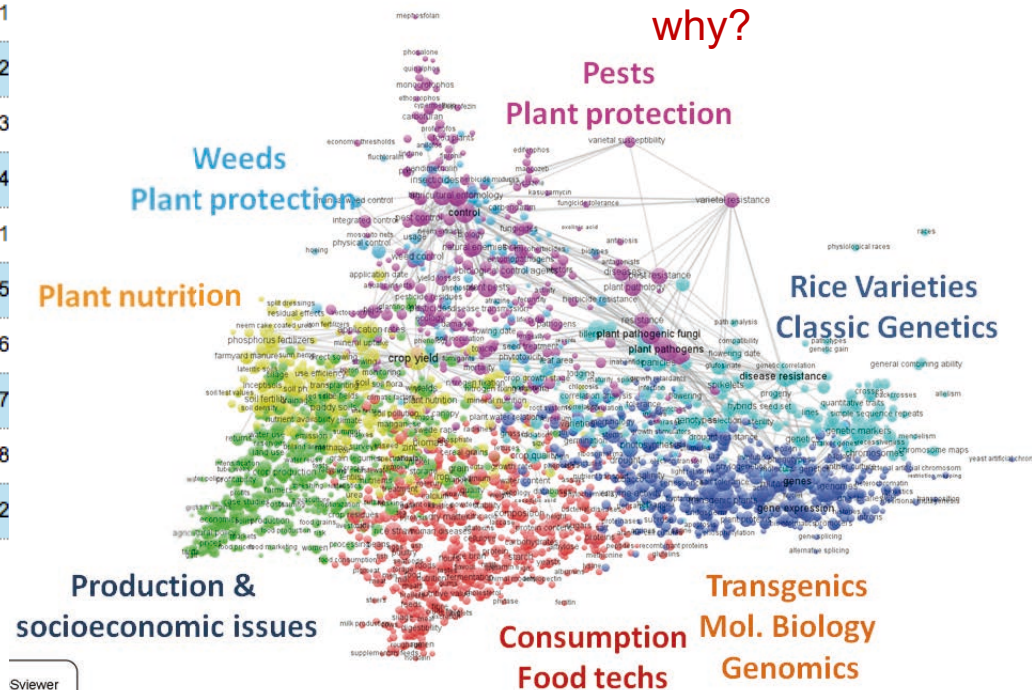
Rankings -- ranking list of preferences

► Academic Ranking of World Universities - 2011

World Rank	Institution	Country	National Rank	Total Score
1	Harvard University		1	
2	Stanford University		2	
3	Massachusetts Institute of Technology (MIT)		3	
4	University of California, Berkeley		4	
5	University of Cambridge		1	
6	California Institute of Technology		5	
7	Princeton University		6	
8	Columbia University		7	
9	University of Chicago		8	
10	University of Oxford		2	

Model 2: Plural and conditional Exploring complementary choices Facilitating options/choices in landscapes

which way?
what alternatives?
why?



S&T indicator as a tools to open up the debate

- ‘Conventional’ use of indicators (‘Pure scientist’ --Pielke)
 - Purely analytical character (i.e. free of normative assumptions)
 - Instruments of objectification of dominant perspectives
 - Aimed at legitimising /justifying decisions (e.g. excellence)
 - Unitary and prescriptive advice
- ‘Opening up’ indicators(‘Honest broker’ --Pielke)
 - Aimed at locating the actors in their context and dynamics
 - Not predictive, or explanatory, but exploratory
 - Construction of indicators is based on choice of perspectives
 - Make explicit the possible choices on what matters
 - Supporting debate
 - Making science policy more ‘socially robust’
 - Plural and conditional advice

Barré (2001, 2004, 2010), Stirling (2008)

From S&T indicators for justification and disciplining...

Justification in decision-making

- Weak justification, “Give me a number, any number!”
- Strong justification, “Show in numbers that X is the best choice!”

S&T Indicators have a **performative** role:

- They don't just measure. Not ‘just happen to be used’ in science policy (neutral)
- Constitutive part incentive structure for “disciplining” (loaded)
- They signal to stakeholders what is important.

Institutions use these techniques to discipline subjects

- Articulate framings, goals and narratives on performance, collaboration, interdisciplinarity...

... towards S&T indicators as tools for **deliberation**

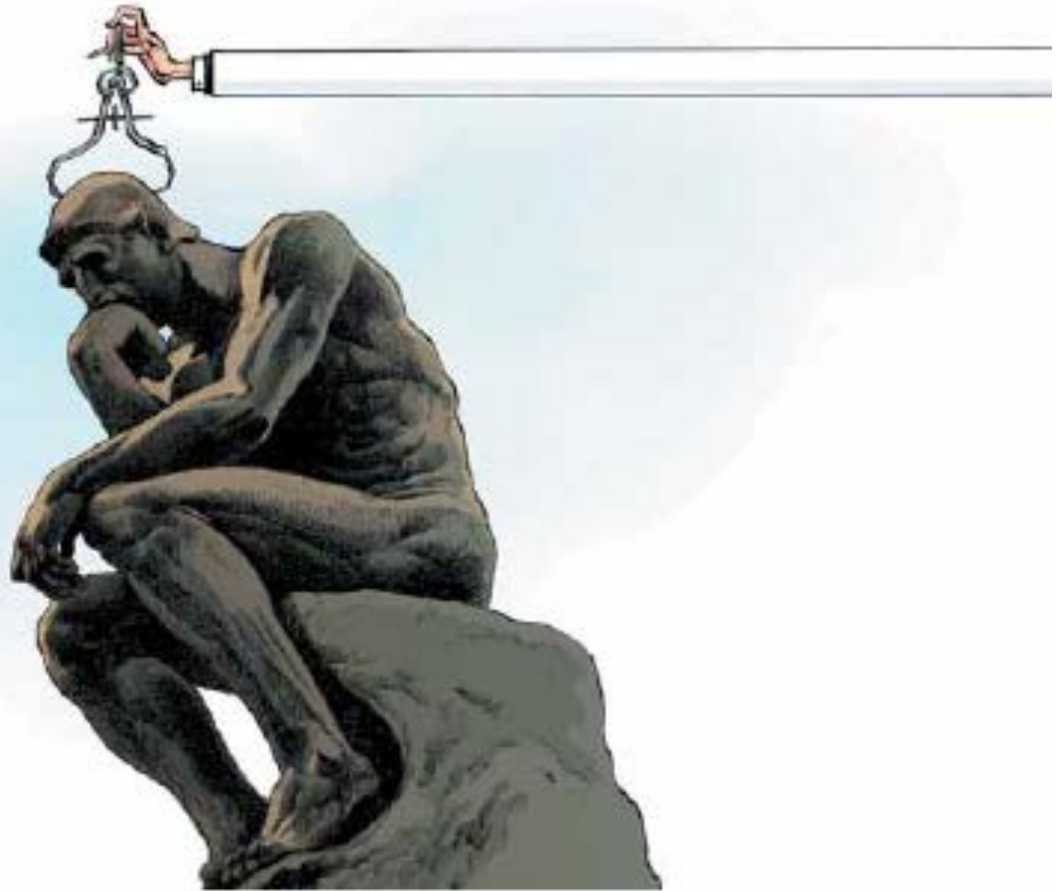
Yet is possible to design indicators that foster plural reflection rather than justifying or reinforcing dominant perspectives

This shift is facilitated by trends pushed by ICT and visualisation tools

- More inputs (pubs, pats, but also news, webs, etc.)
- Multidimensional outputs (interactive maps)
- Institutional repositories
- Multiple solutions -- highlighting variation, confidence intervals
- More inclusive and contrasting classifications (by-passing private data ownership? Pubmed, Arxiv)
- More possibilities for open scrutiny (new research groups)

Nature (23 April 2015)

Hicks, Wouters,
De Rijcke, Waltman
and Rafols (2015)



Step 1: Damage control
Fostering better uses

The Leiden Manifesto for research metrics

Principles of the “The Leiden Manifesto”

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 and indicators.
10. Scrutinize indicators regularly and update them.

Judgement

Sensitive to
Contexts

Transparency

Pluralism

Reflexivity

2. Conceptual framework:

“Broadening out” vs. “Opening up” policy appraisal

Policy use of S&T indicators: Appraisal

Appraisal:

‘the ensemble of processes through which knowledges are gathered and produced in order to inform decision-making and wider institutional commitments’ Leach et al. (2008)

Breadth: extent to which appraisal covers diverse dimensions of knowledge

Openness: degree to which outputs provide an array of options for policies.

Policy use of S&T indicators: Appraisal

Appraisal:

‘the ensemble of processes through which knowledges are gathered and produced in order to inform decision-making and wider institutional commitments’ Leach et al. (2010)

Example:

Allocation of resources based on research “excellence”

Breadth: extent to which appraisal covers diverse dimensions of knowledge

Narrow: citations/paper

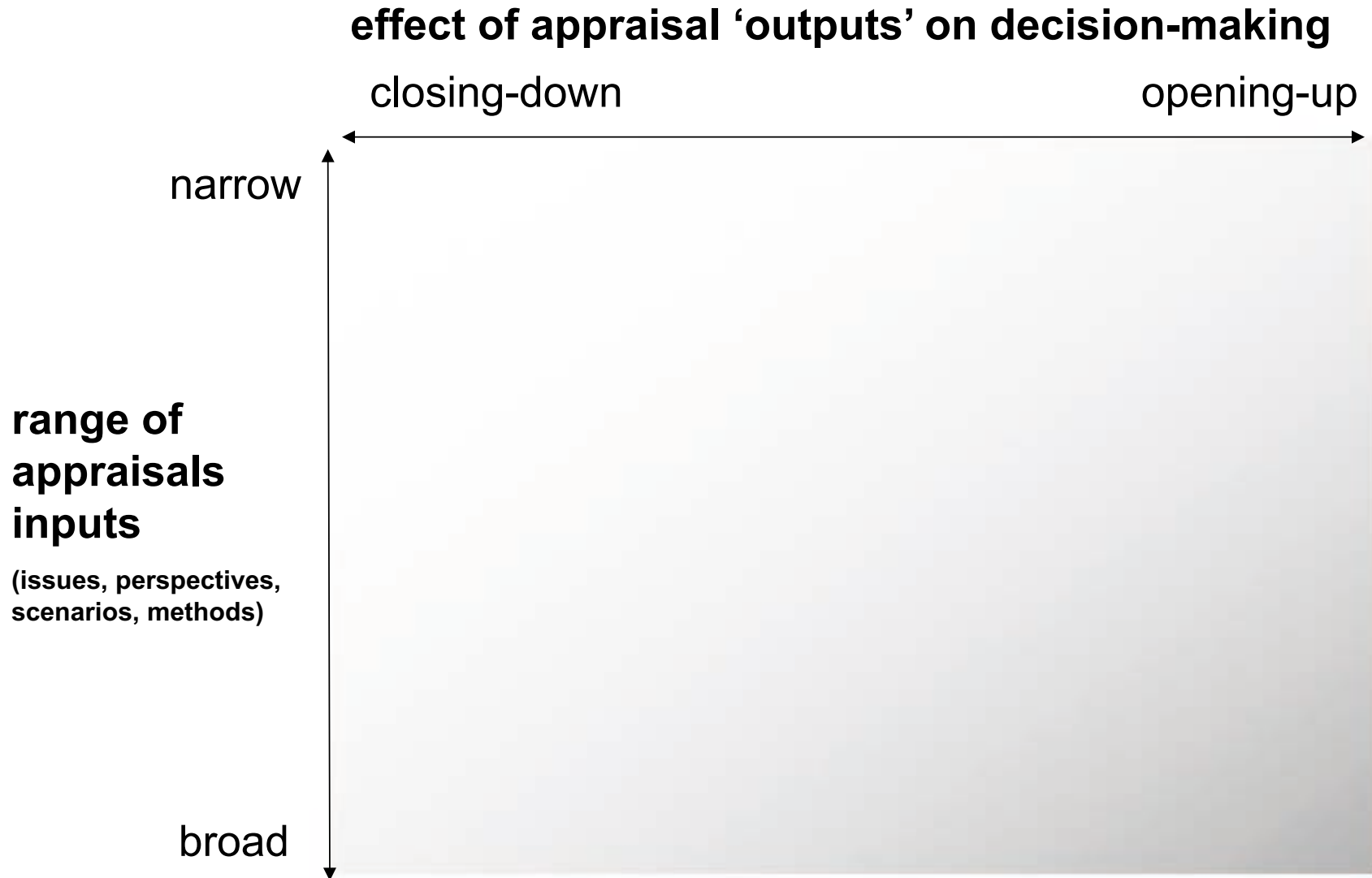
Broad: citations, peer interview, stakeholder view, media coverage, altmetrics

Openness: degree to which outputs provide an array of options for policies.

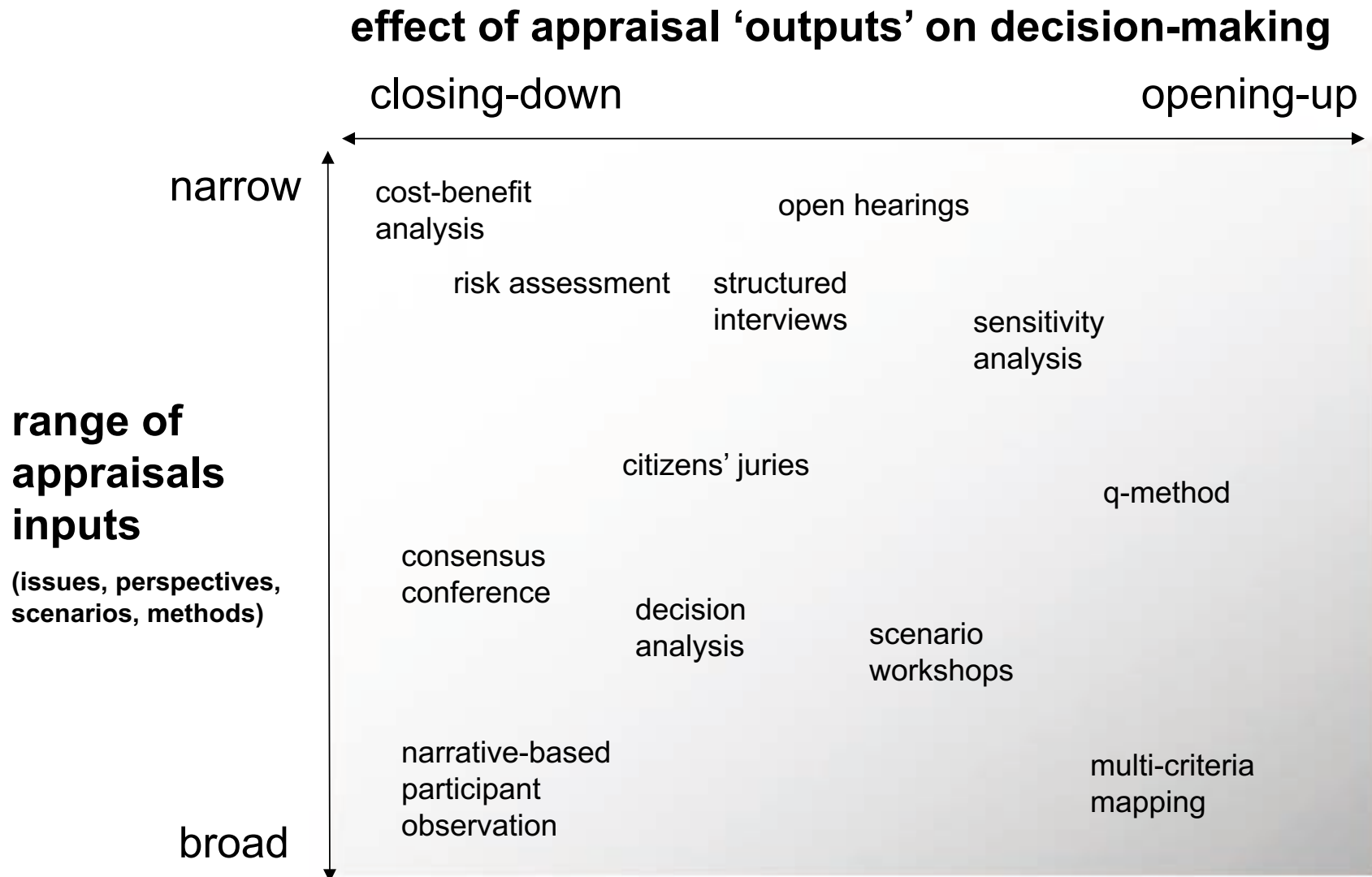
Closed: fixed composite measure of variables → unitary and prescriptive

Open: consideration of various dimensions → plural and conditional

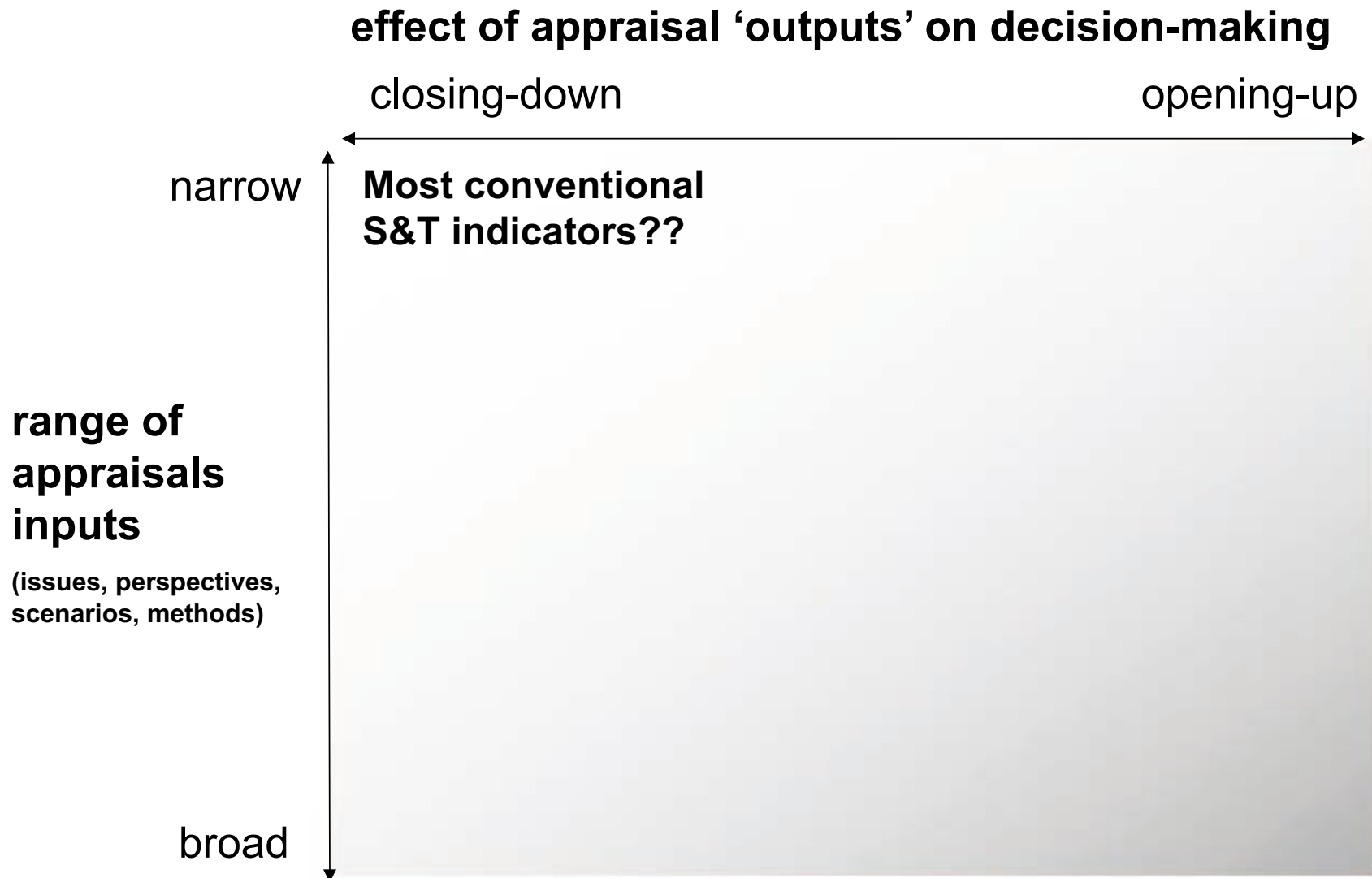
Appraisal methods: broad vs. narrow & closing vs. opening



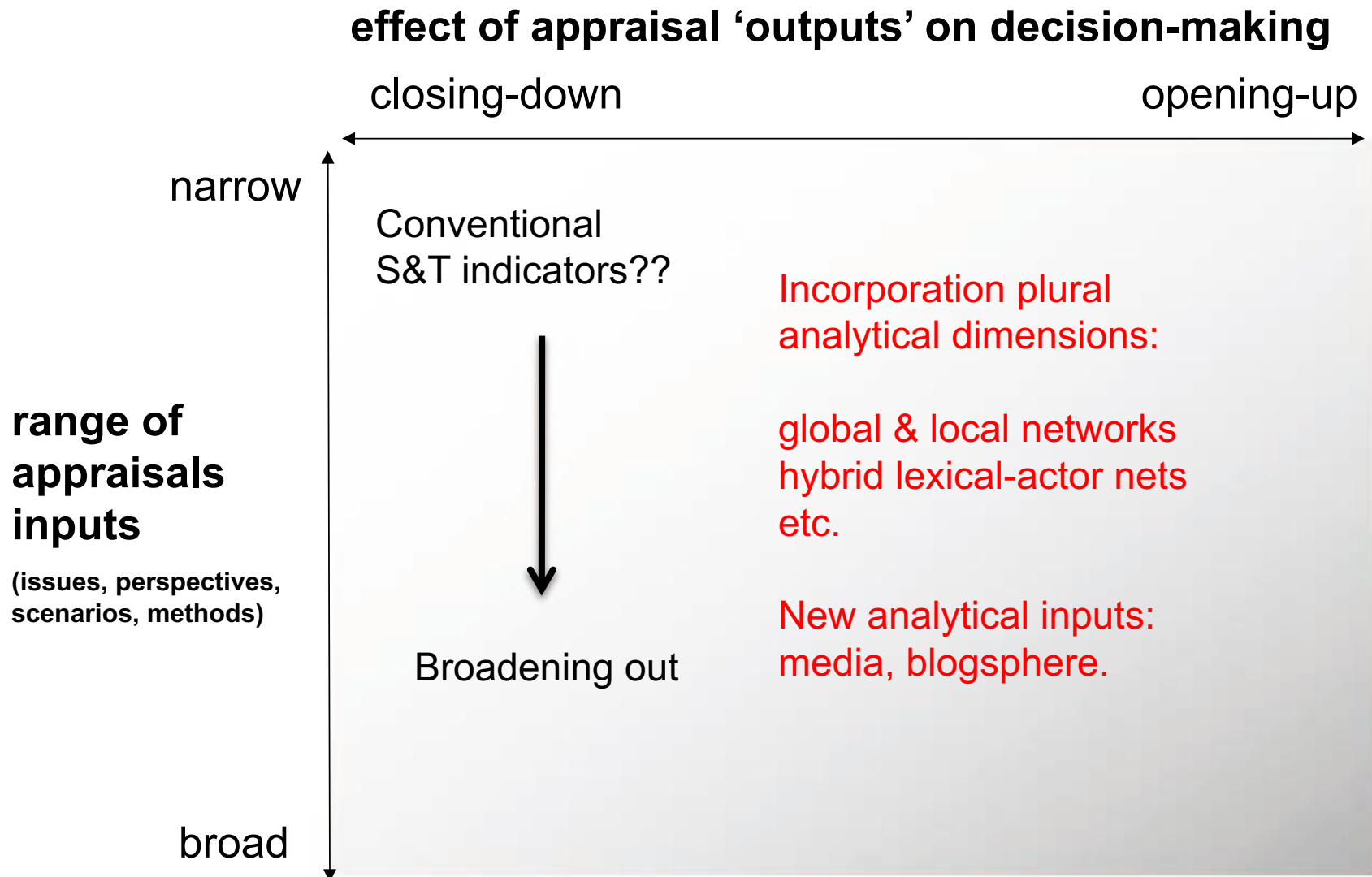
Appraisal methods: broad vs. narrow & close vs. open



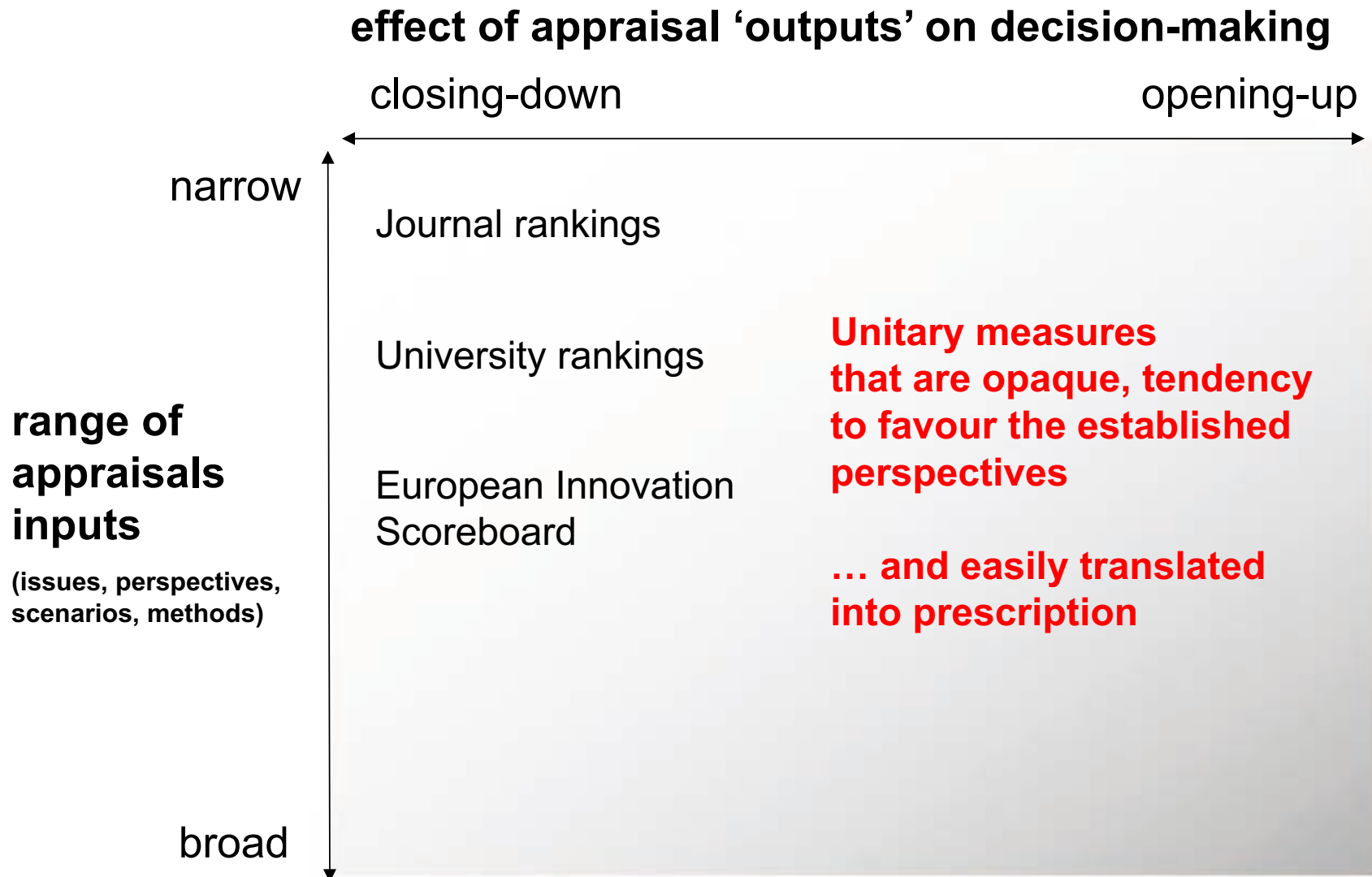
Appraisal methods: broad vs. narrow & closing vs. opening



Broadening out S&T Indicators

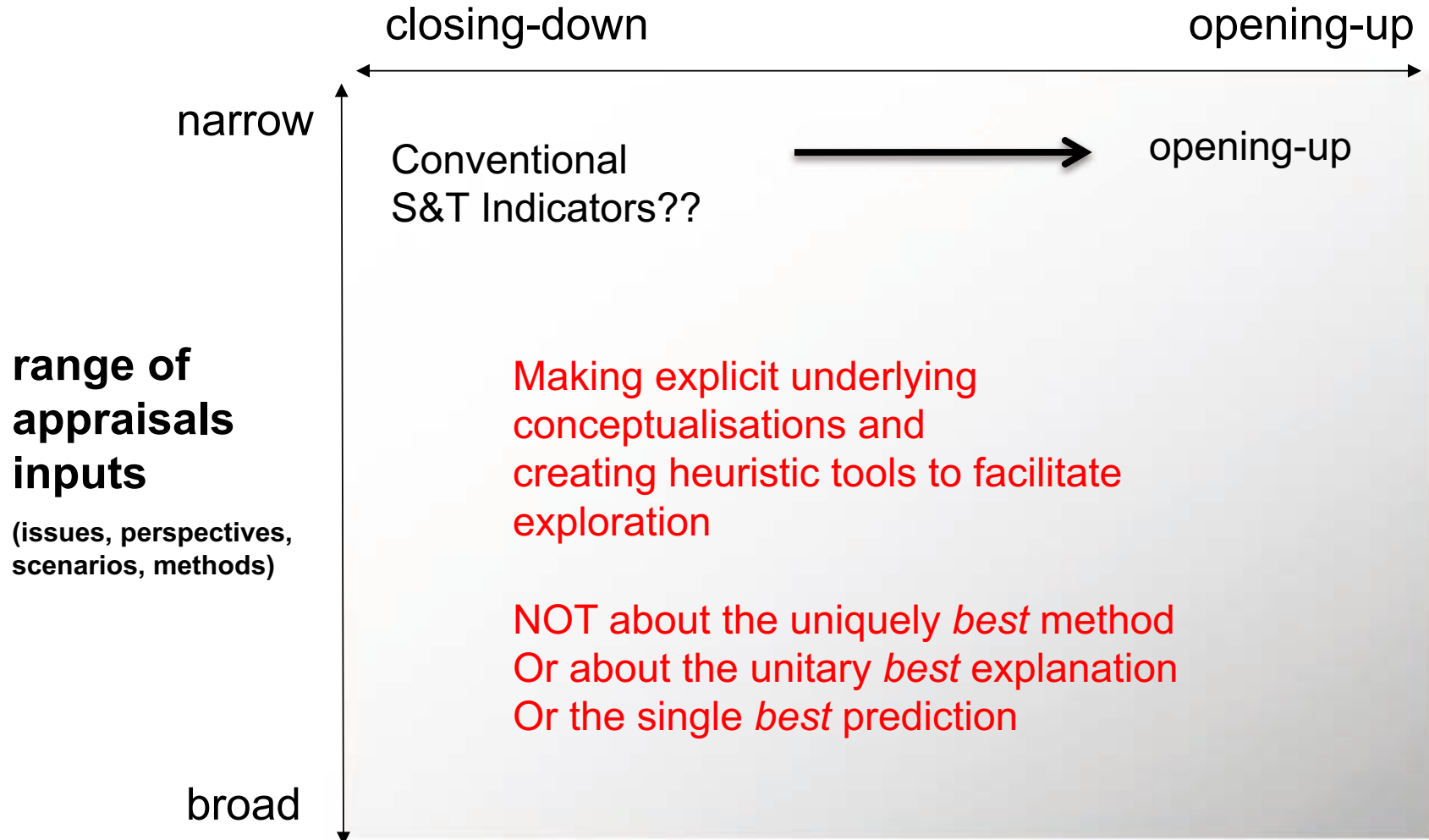


Appraisal methods: broad vs. narrow & closing vs. opening



Opening up S&T Indicators

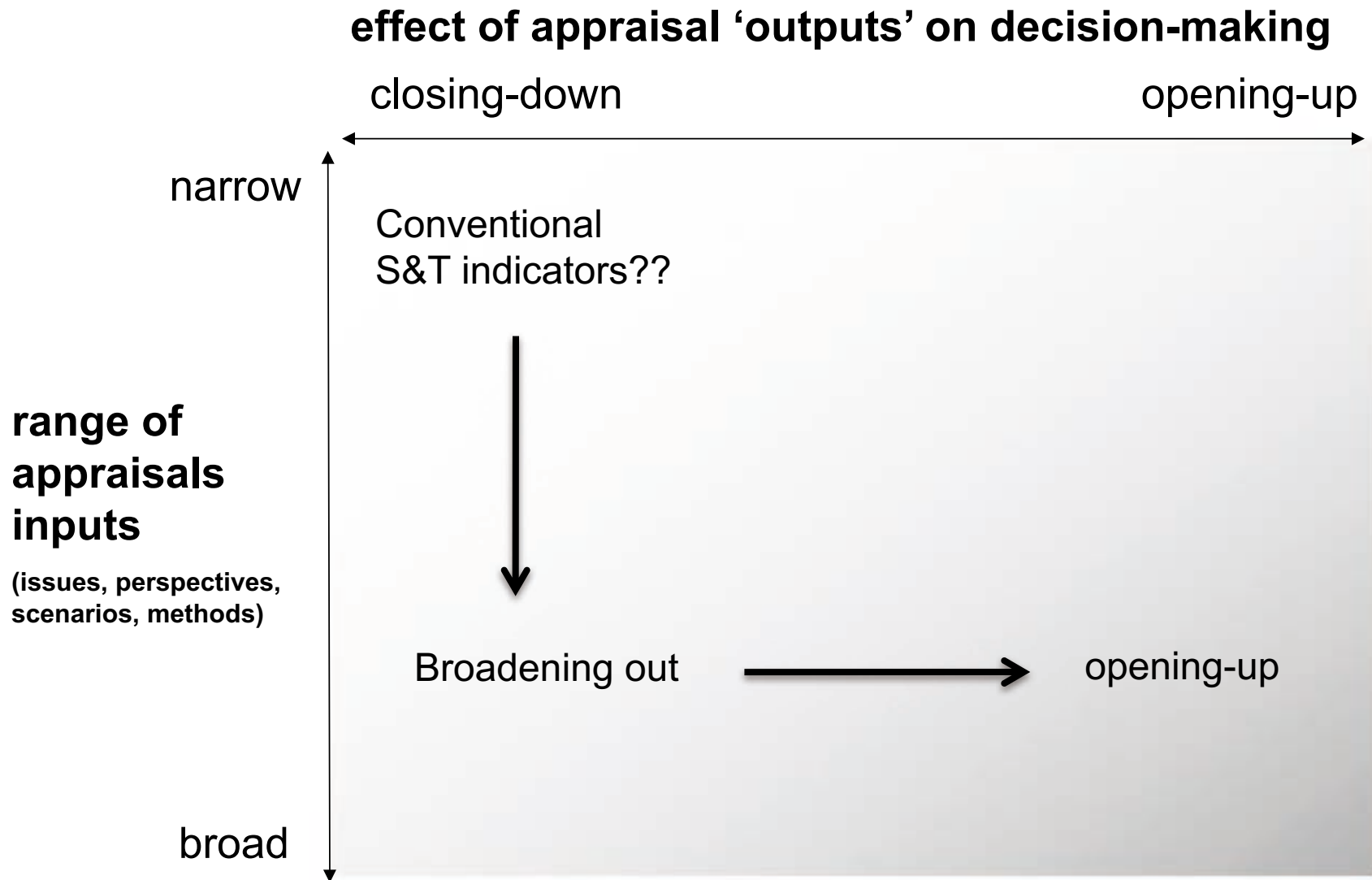
effect of appraisal 'outputs' on decision-making



3.1. Examples of Opening Up with more data

- a. Broadening out AND Opening up
- b. Opening up WITH NARROW inputs

1. Preserving multiple dimensions in broad appraisals



Composite Innovation Indicators (25-30 indicators)

European (Union) Innovation Scoreboard

Grupp and Schubert (2010) show that order is highly dependent on indicators weightings.

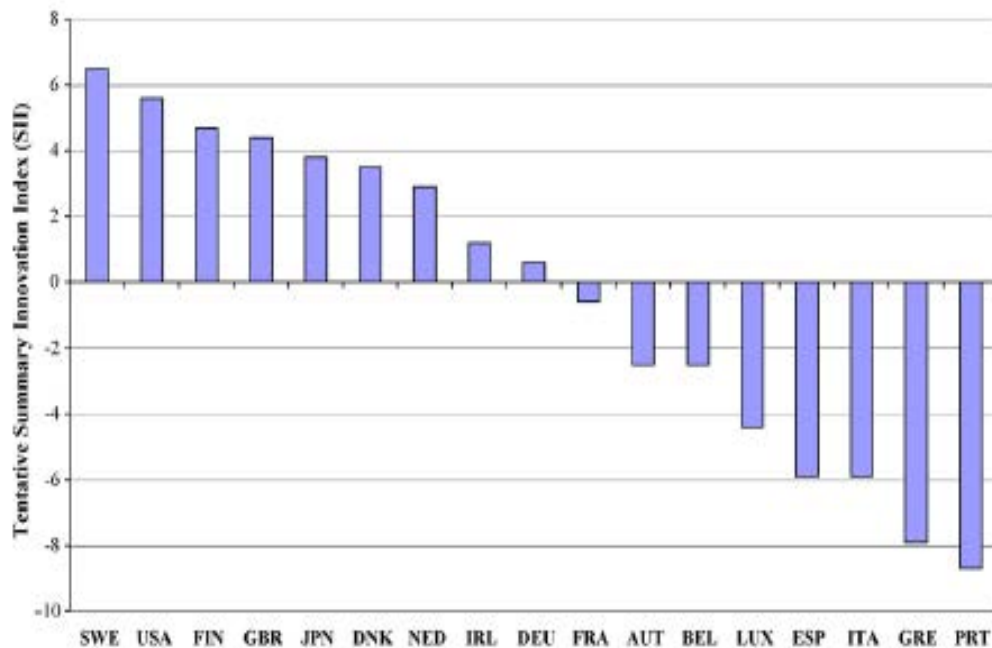


Fig. 1. Summary Innovation Index of the European Innovation Scoreboard 2001 (modified graph from European Commission, 2001, p. 12).

Sensitivity analysis

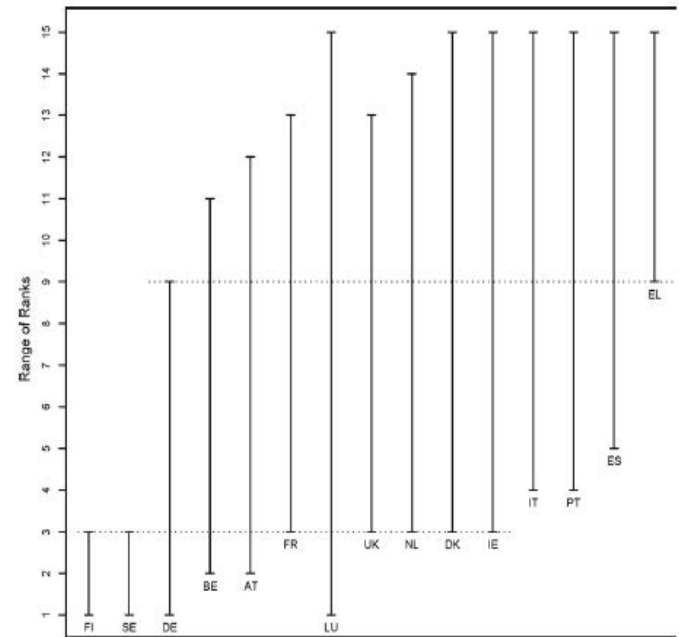
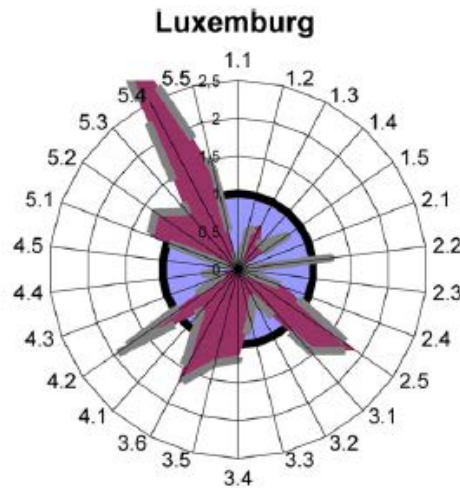
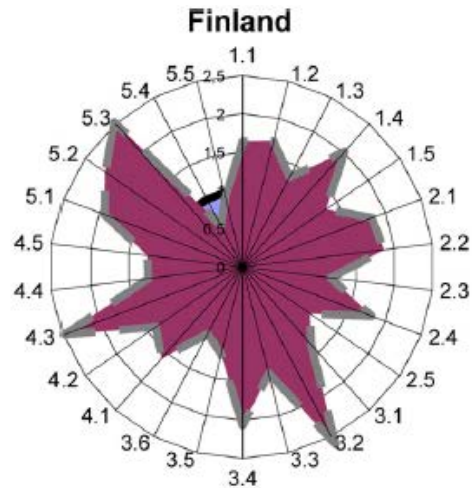


Fig. 2. Sensitivity analyses for the European Innovation Scoreboard 2005 (sources: original data European Commission, 2005).

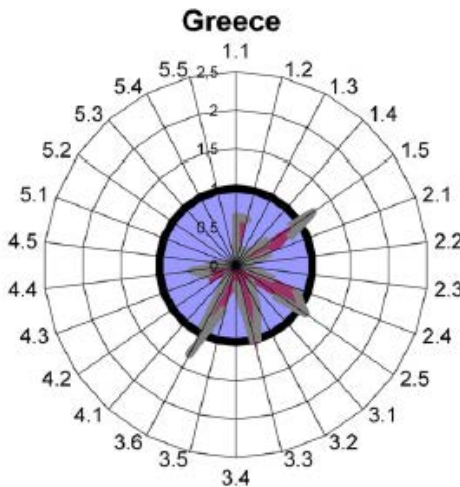
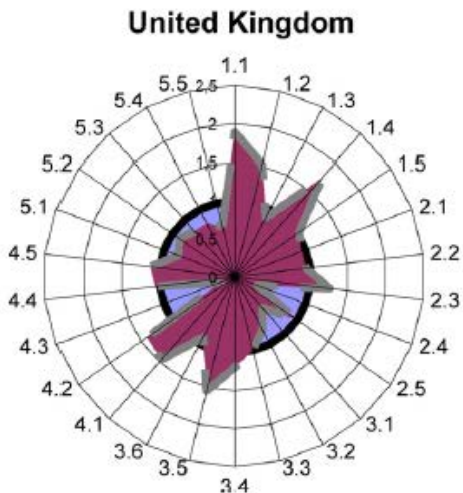
Solution: representing multiple dimensions

(critique by Grupp and Schubert, 2010)



Use of spider diagrams allows comparing like with like

U-rank,
University performance
Comparison tools
(Univ. Twente)



5.4 Community trademarks indicator

Examples of Opening Up with same data

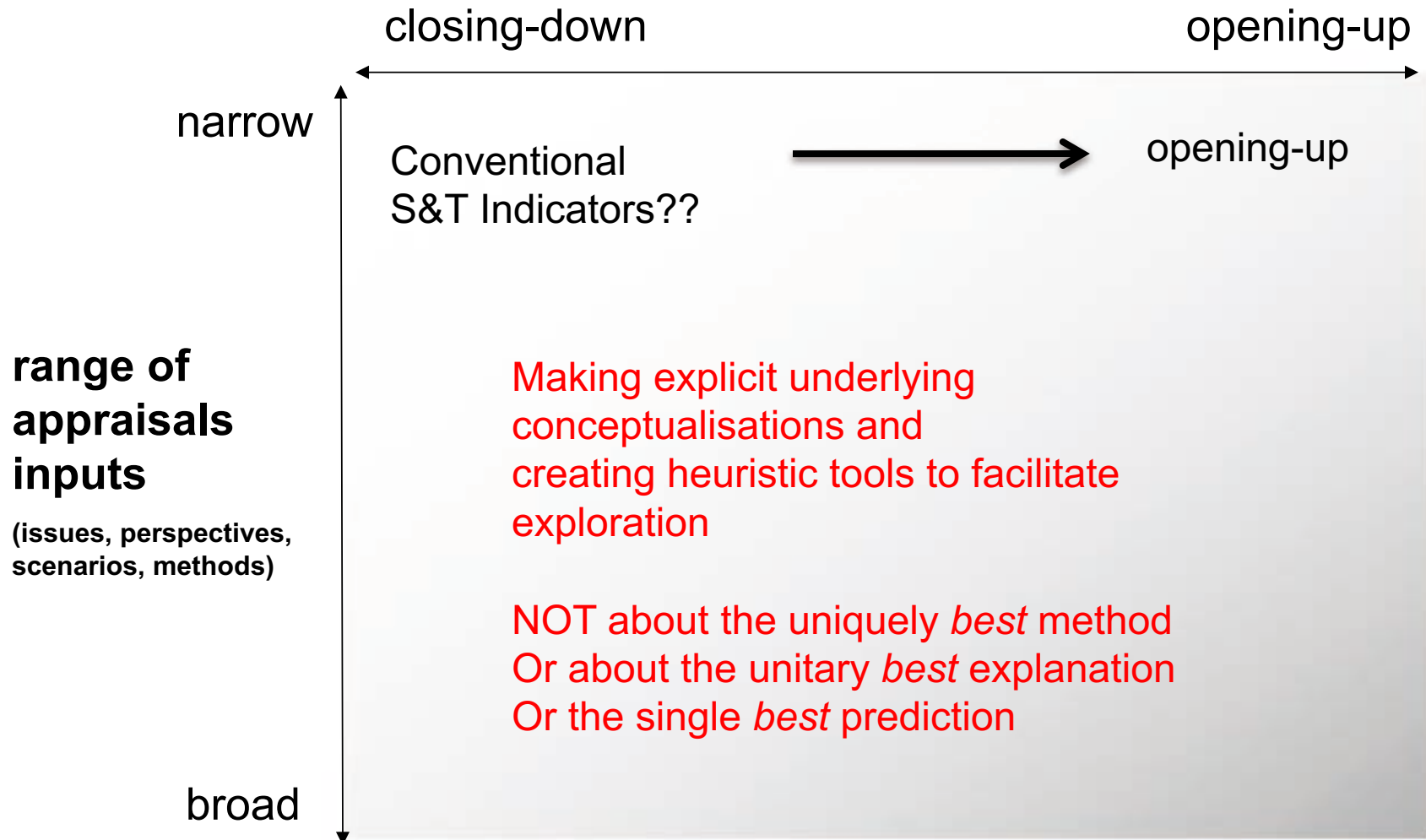
Sensitivity analysis

– checking the robustness of insights against:

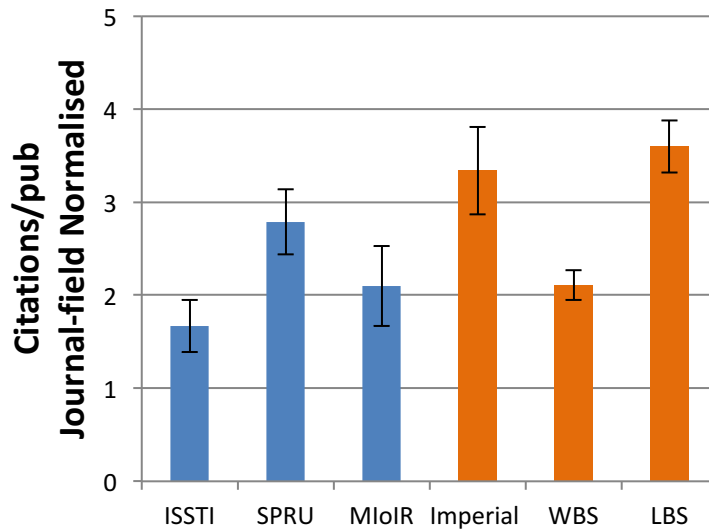
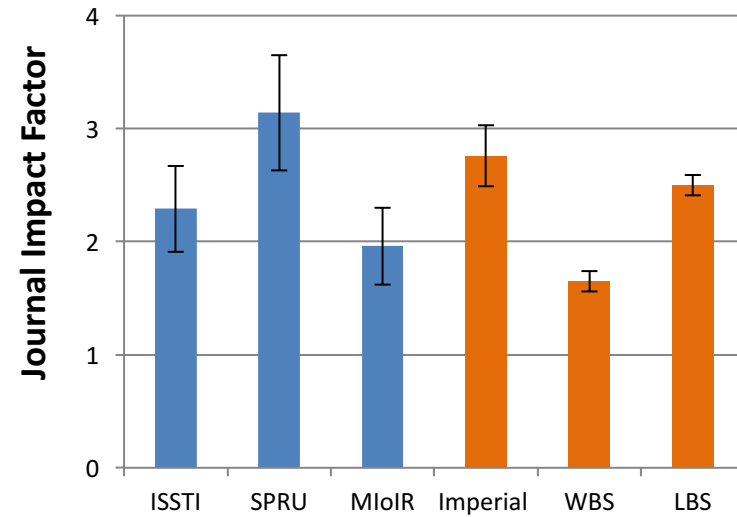
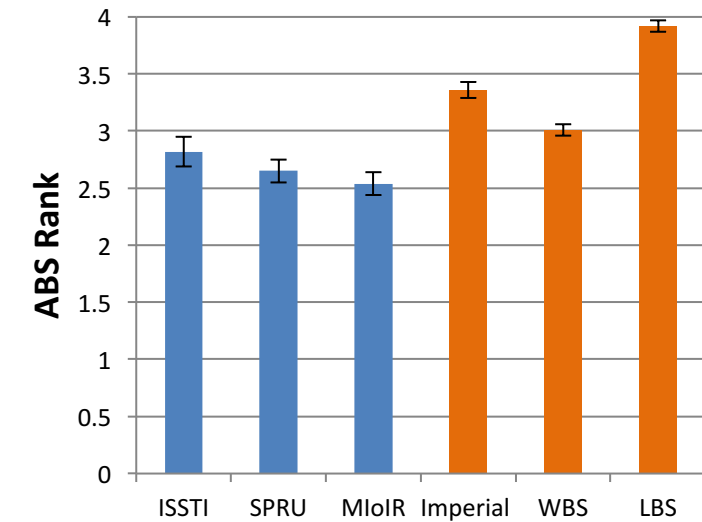
- different assumptions/algorithms
- coverage
- examine uncertainties

Opening up S&T Indicators

effect of appraisal 'outputs' on decision-making



Measures of “scientific excellence”



Which one is more meaningful??

Are measures of “excellence” consistent and robust?

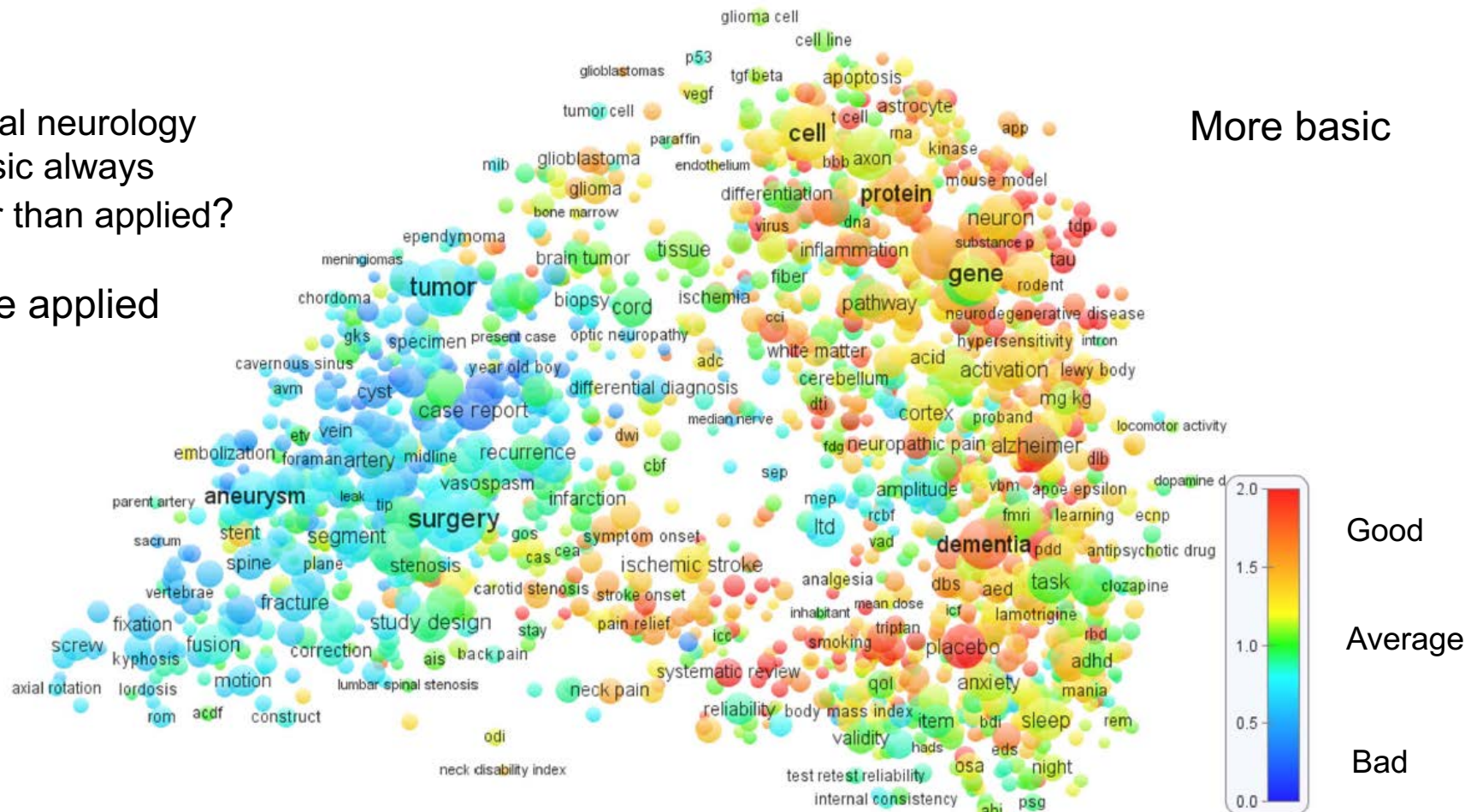
Citations: not stable to changes in classification and granularity (Zitt et al., 2005; Adams et al., 2008).

Clinical neurology

Is basic always better than applied?

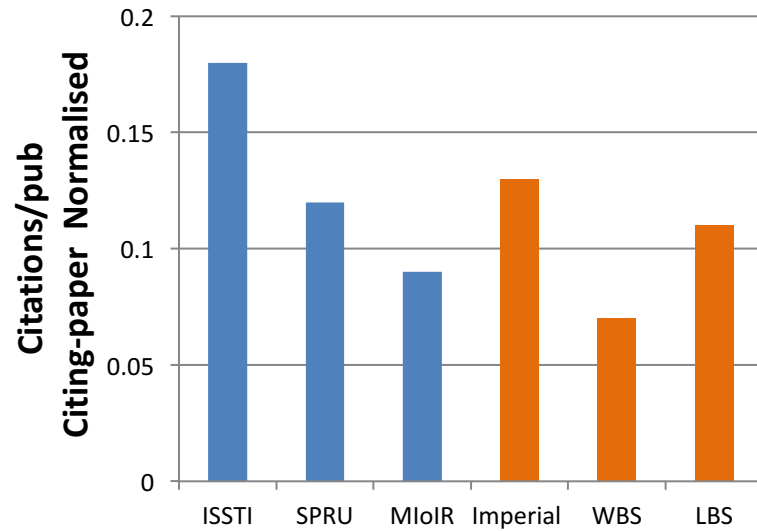
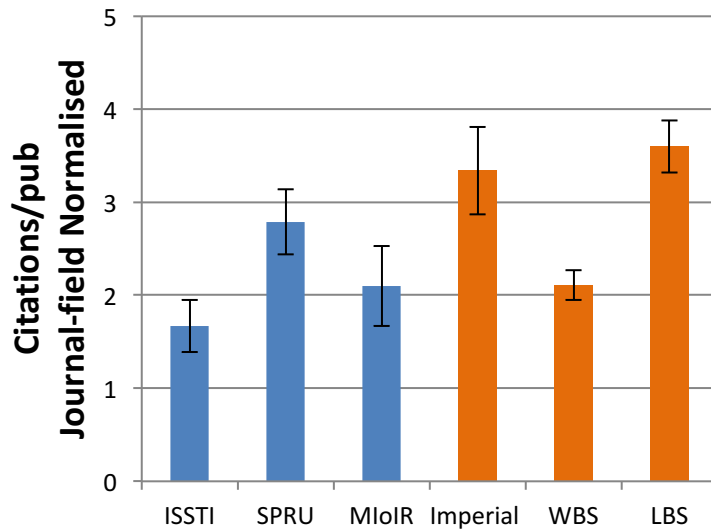
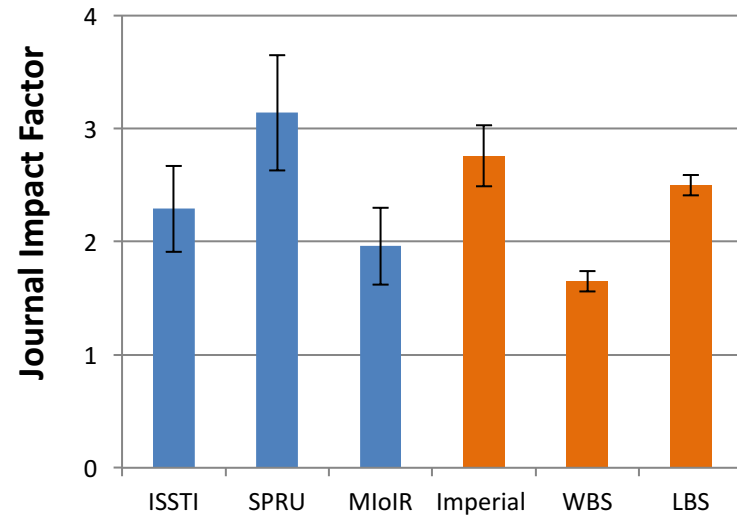
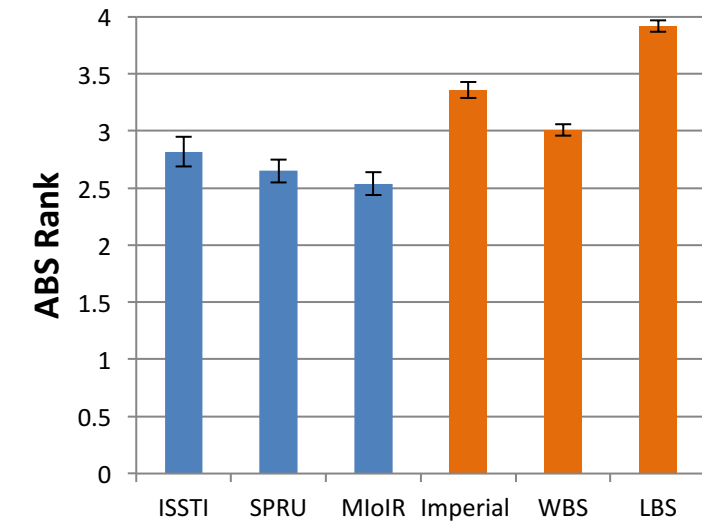
More applied

More basic



Van Eck, Waltman et al. (2013)

Measures of “scientific excellence”



Which one is more meaningful??

The University Leiden ranking (2011-12)

The University Leiden ranking (2011-12)

- Different measures of performance
 - Mean Citations per fields, Top 10%,
- Under different conditions (fractional, language)
- Include **stability interval** (bootstrapping)

Select indicators

Dimension of scientific performance:

Impact



Rank universities based on:

PP(top 10%)



☒ Show stability intervals

Select method of calculation

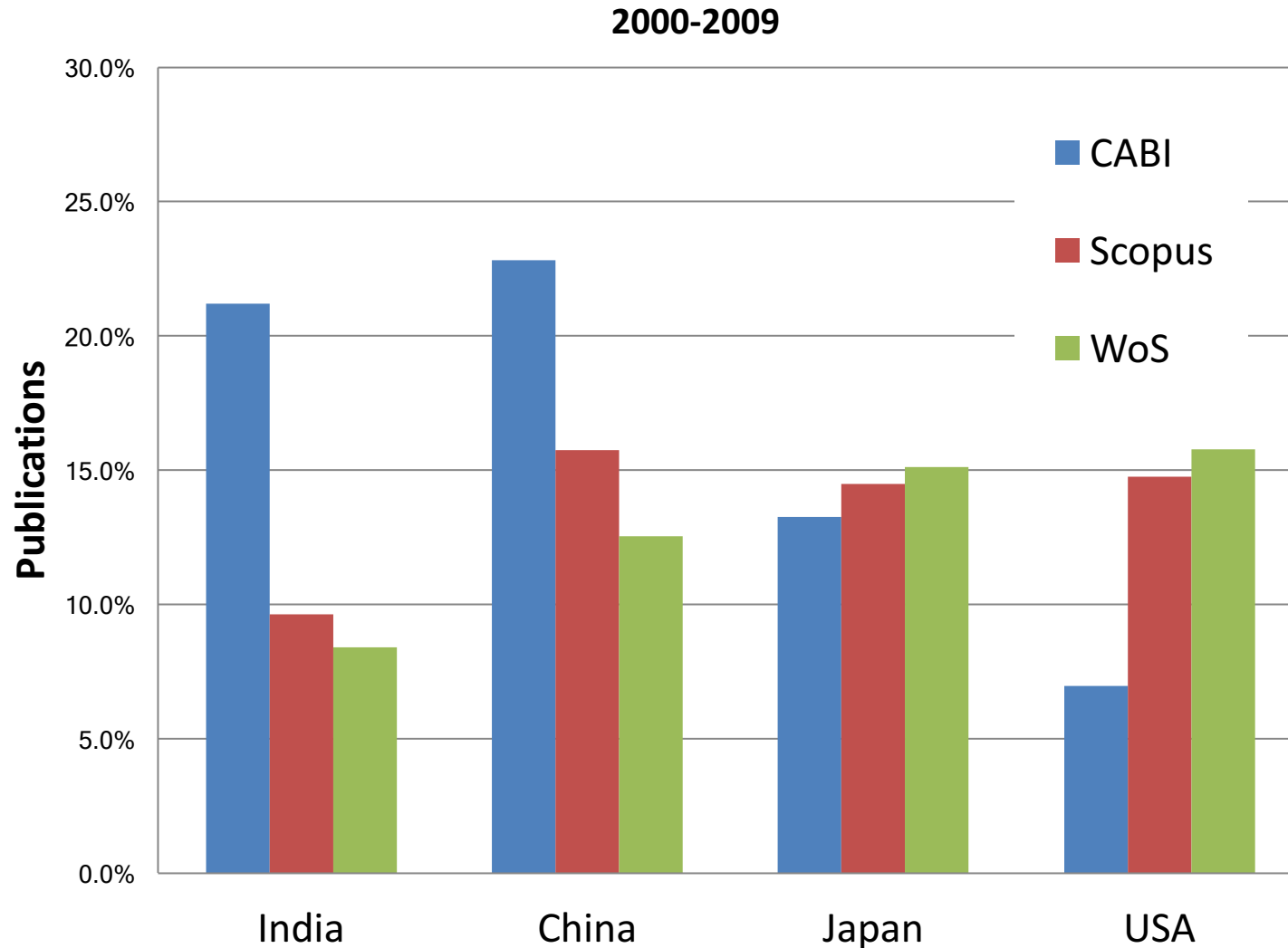
☒ Normalize for university size

☒ Assign collaborative publications fractionally to universities

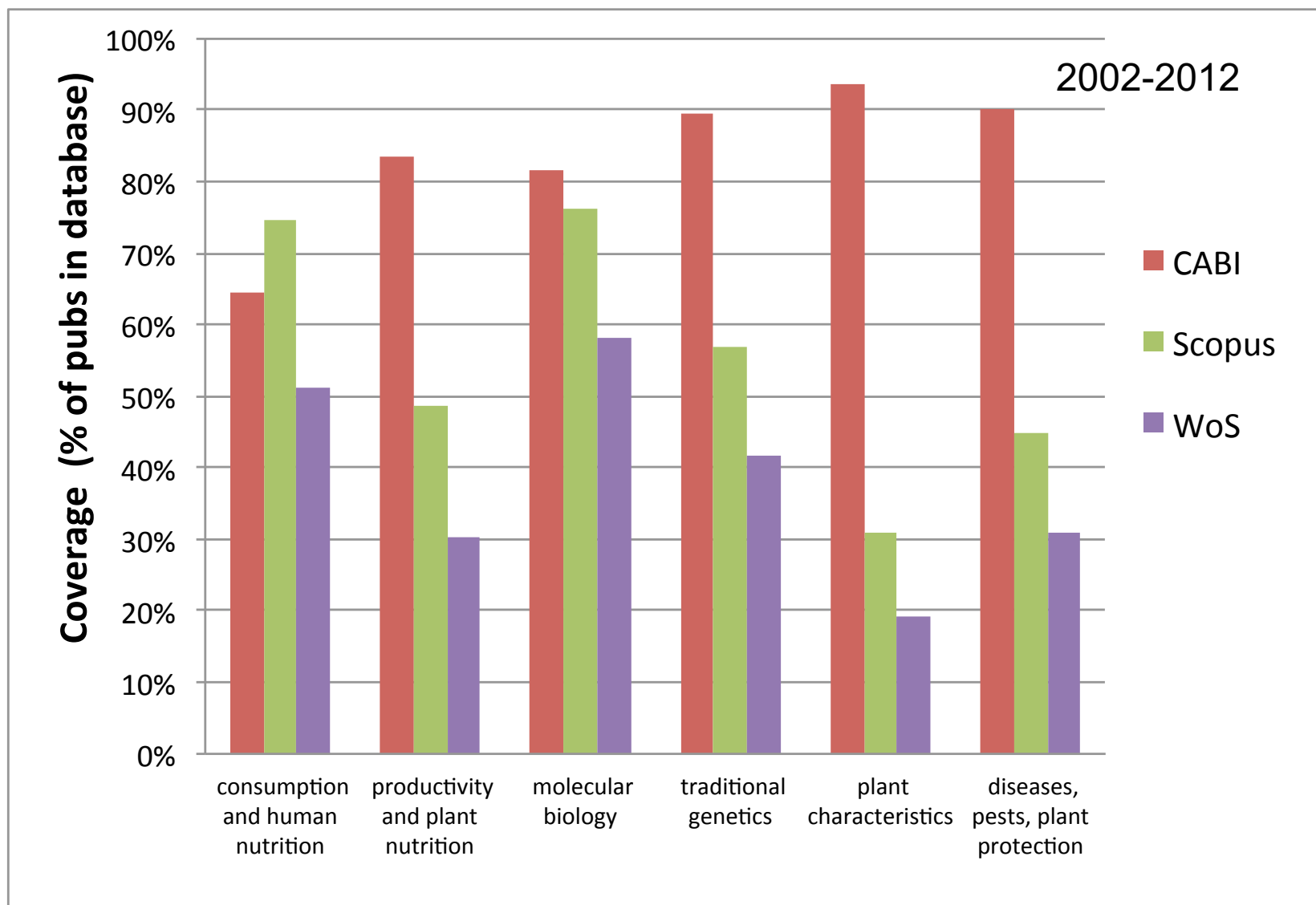
☒ Leave out non-English language publications

Rank	University	Country	P	PP _{top 10%}	PP _{top 10%} stability interval		
1	MIT		10465	25.2%			
2	Princeton Univ		5763	22.6%			
3	Harvard Univ		33511	22.5%			
4	Rice Univ		2635	22.2%			
5	Stanford Univ		15032	21.9%			
6	Caltech		6569	21.7%			

Coverage: Knowledge production on rice by country



Coverage: Knowledge production on rice by topic

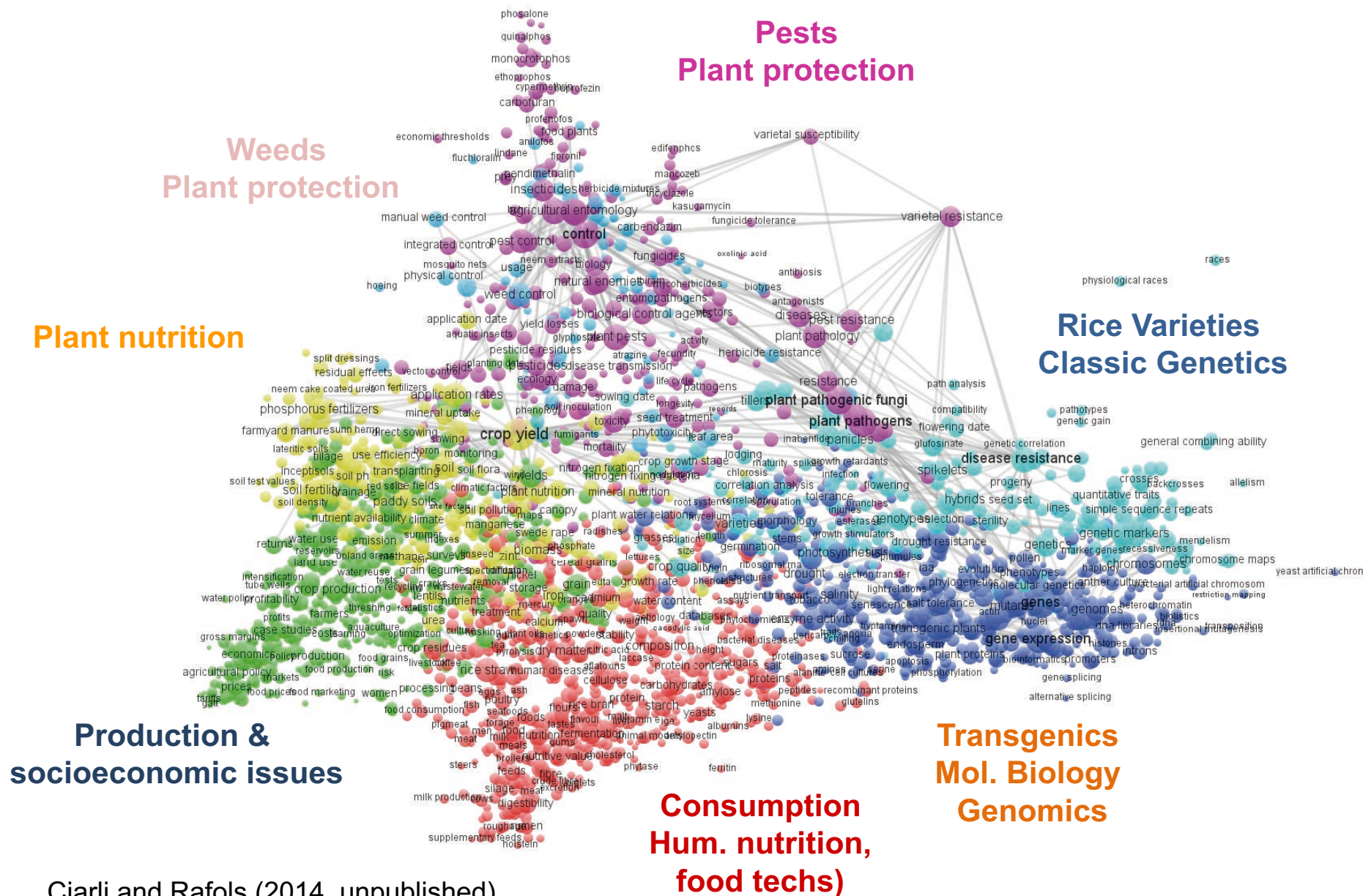


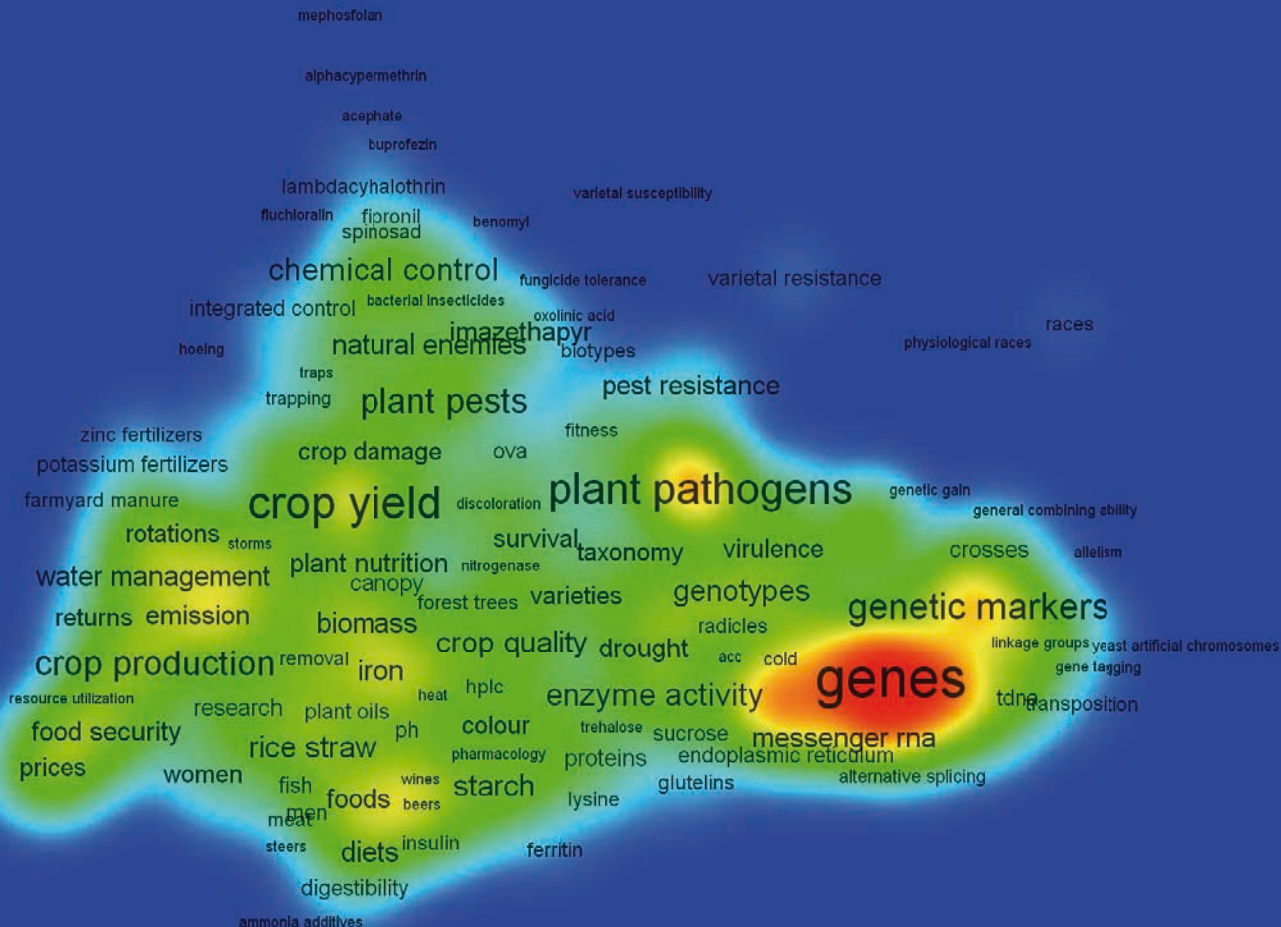
Examples of Opening Up with same data

Exploring options

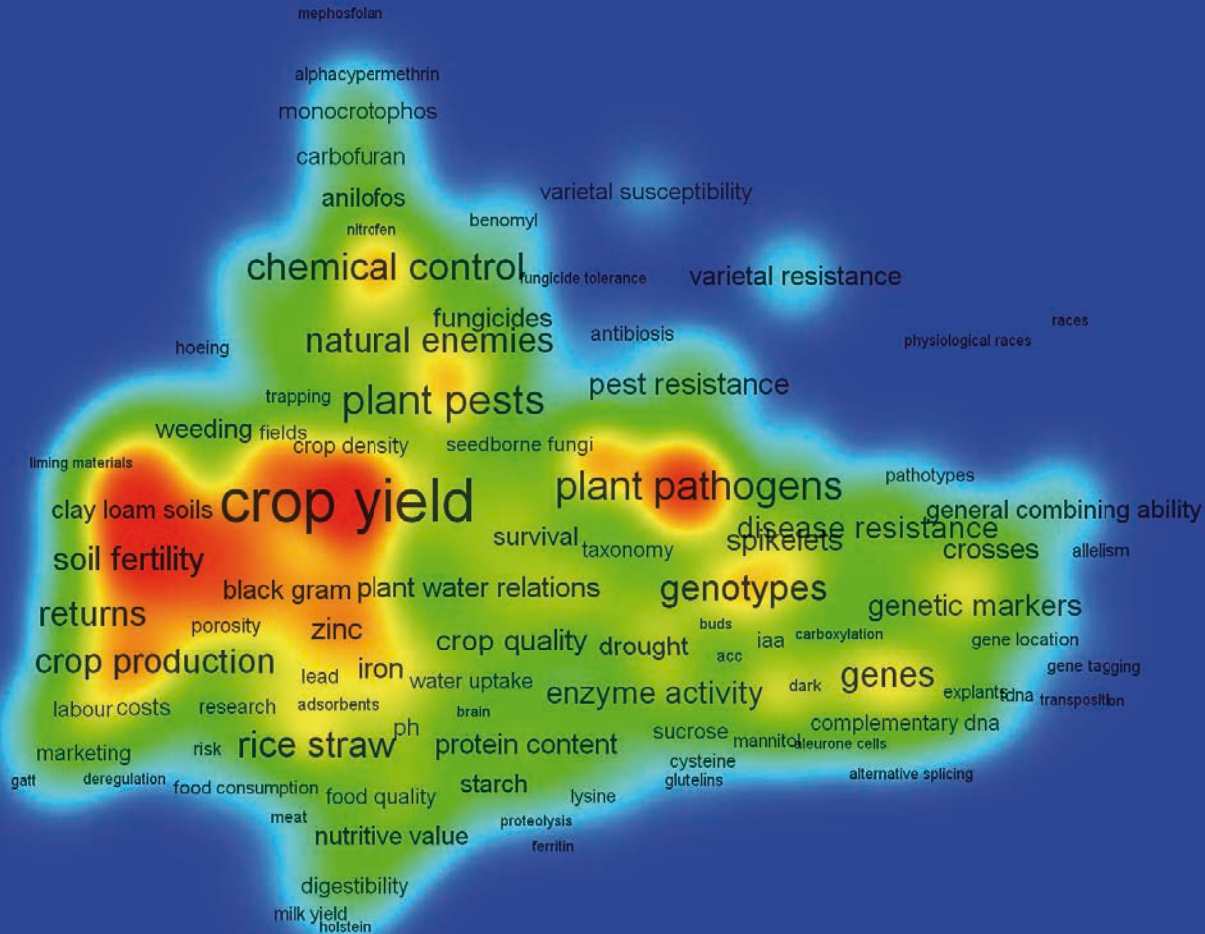
- focus on directions / vectors instead of scalars
 - Maps or networks
- examine over time

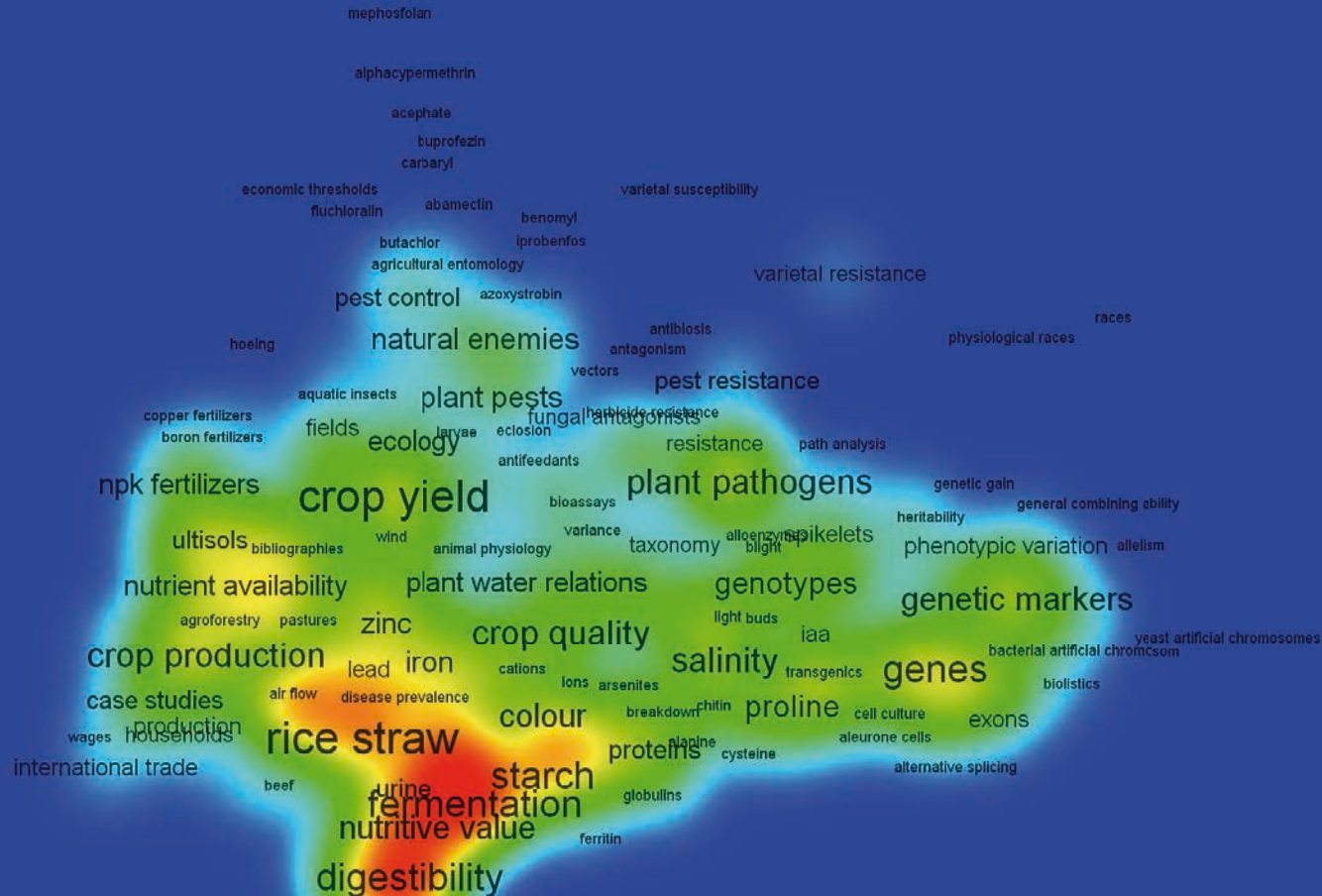
Thinking in terms of research portfolios: the case of rice

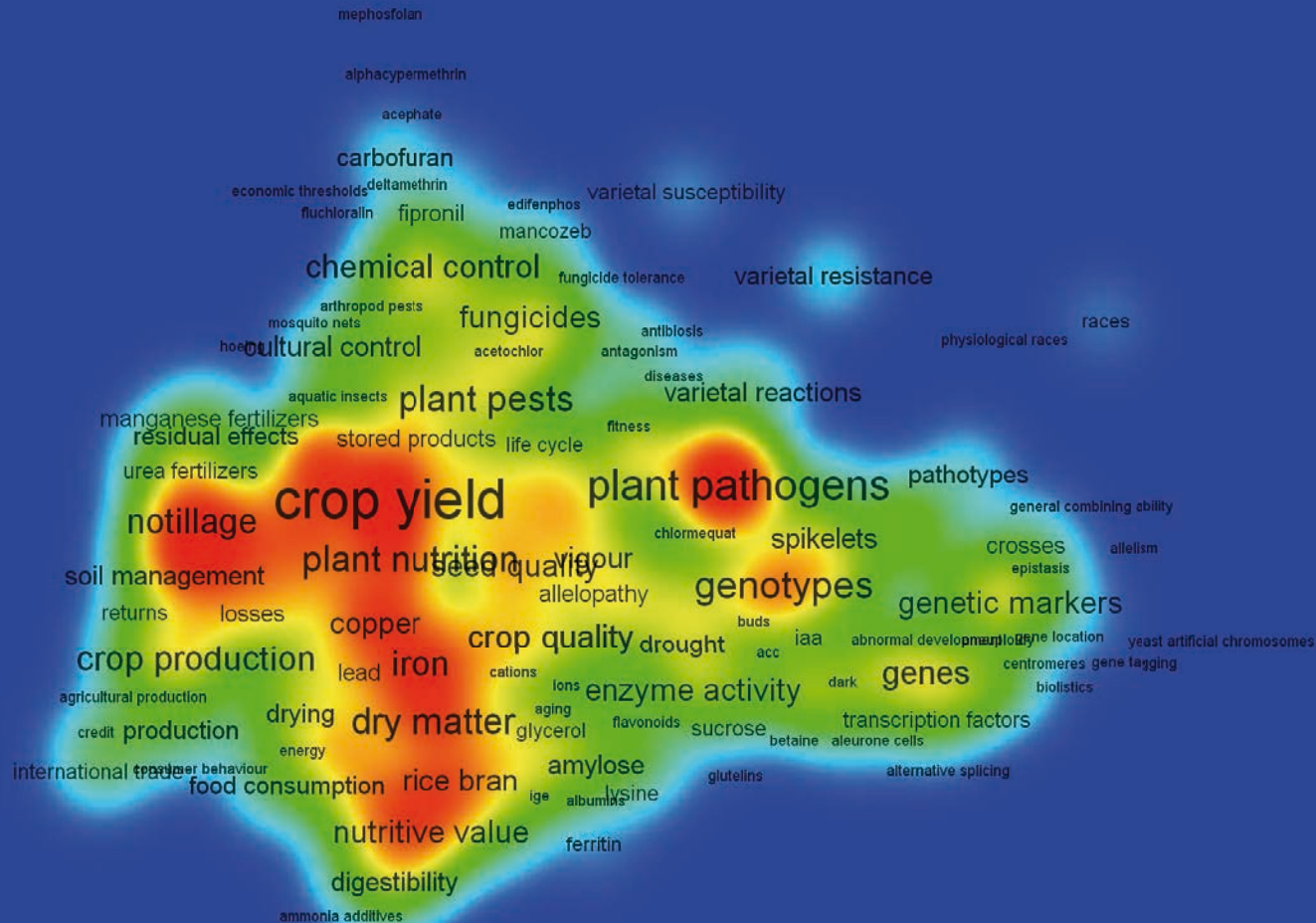




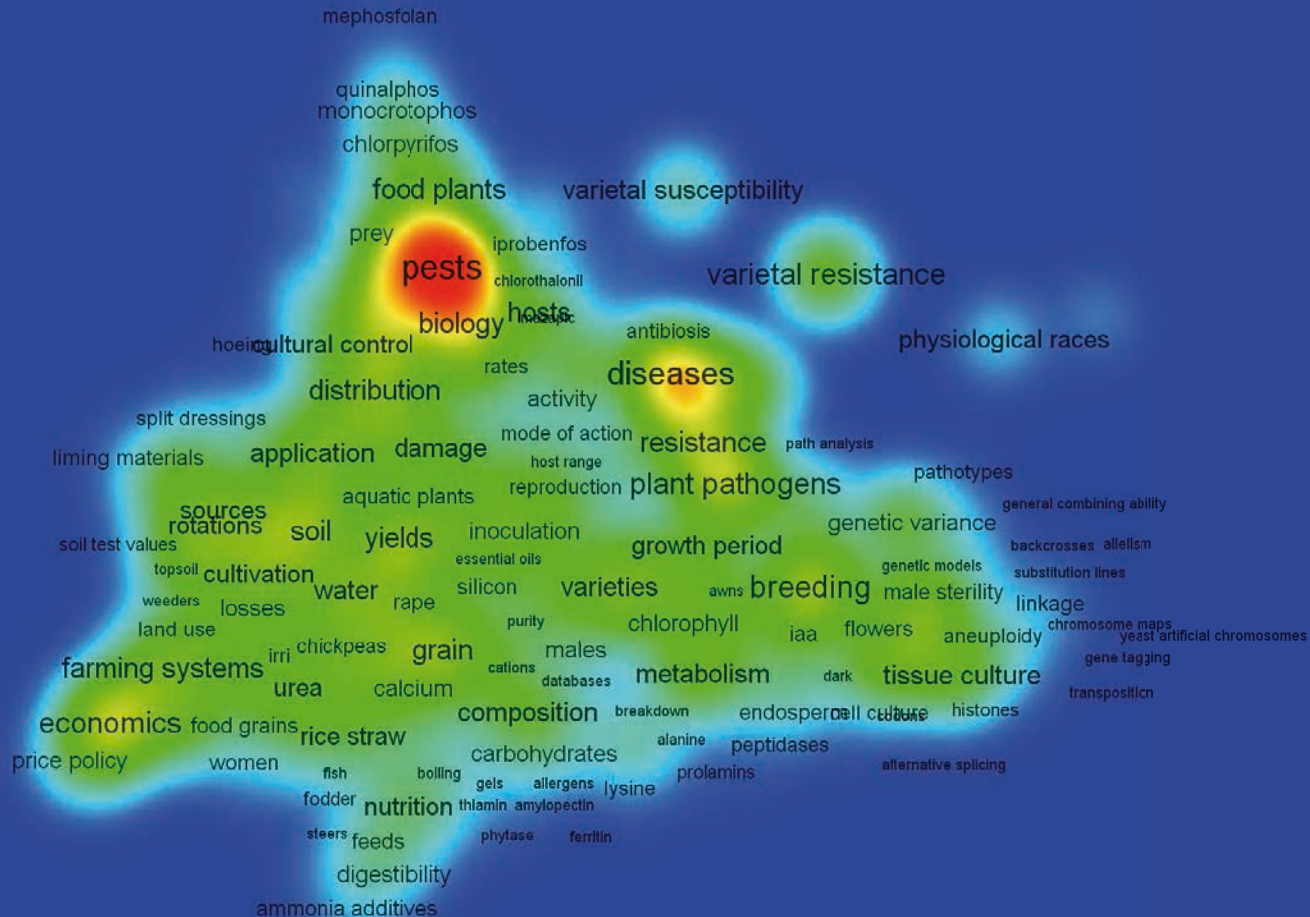
VOSviewer



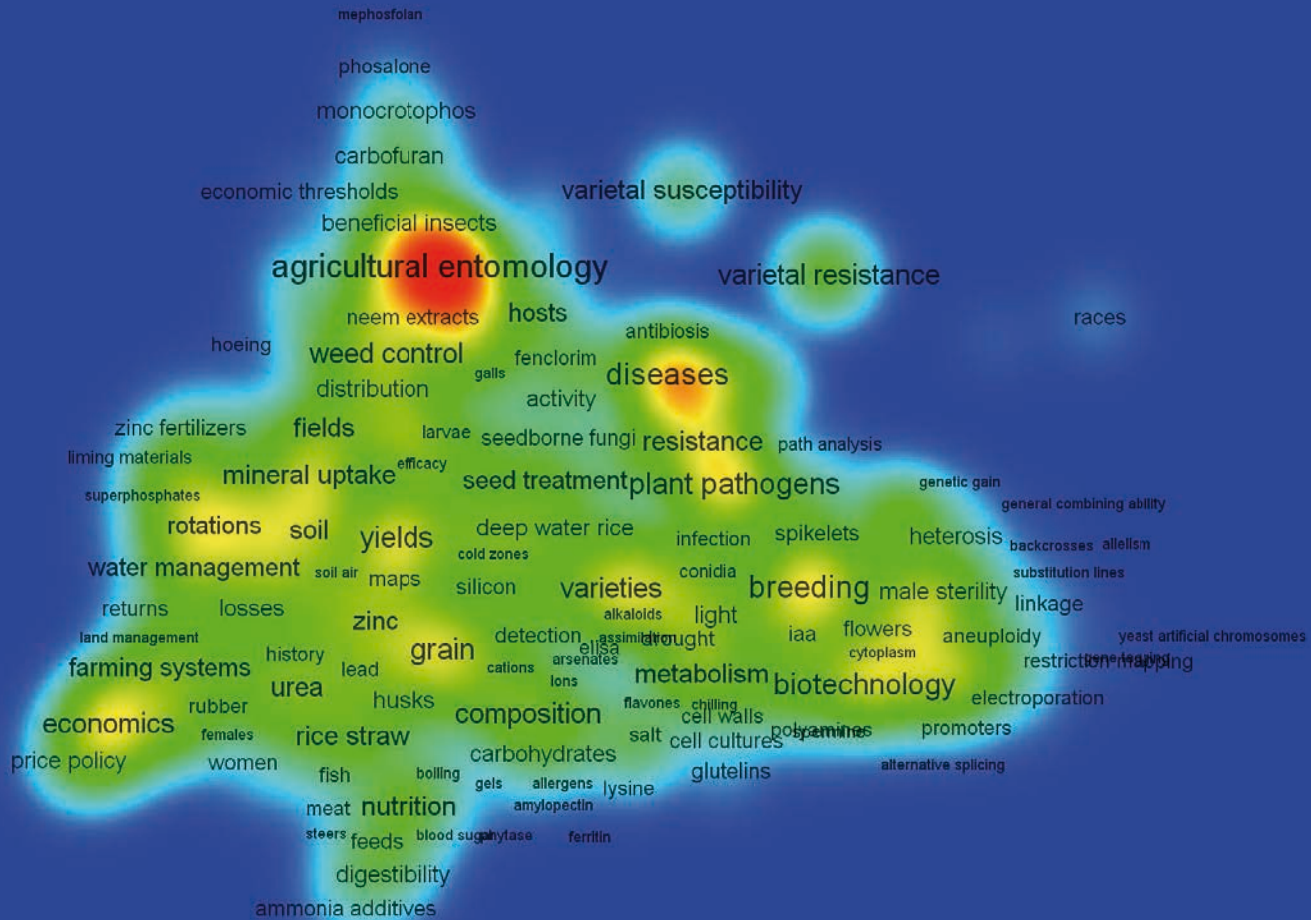




Trajectory of rice research, 1983-2012

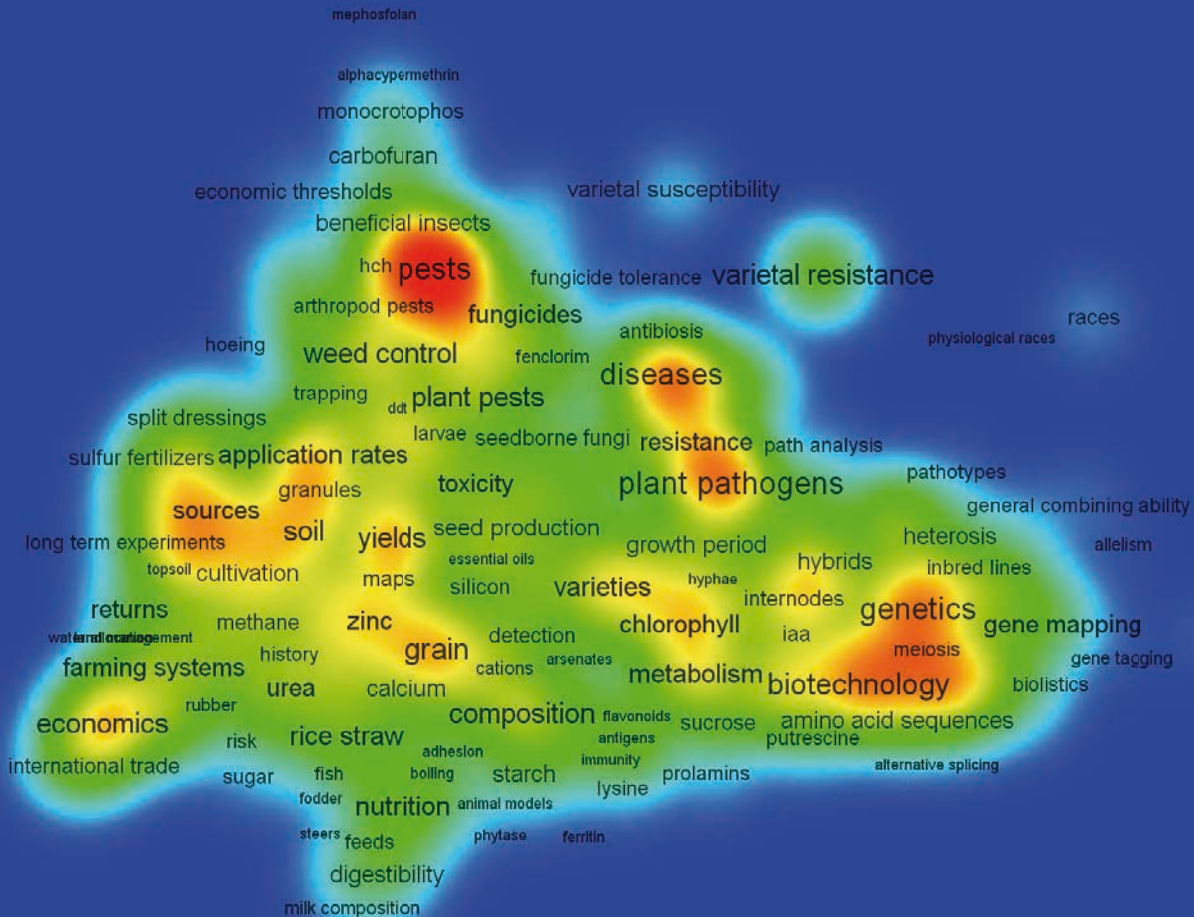


Trajectory of rice research, 1983-2012



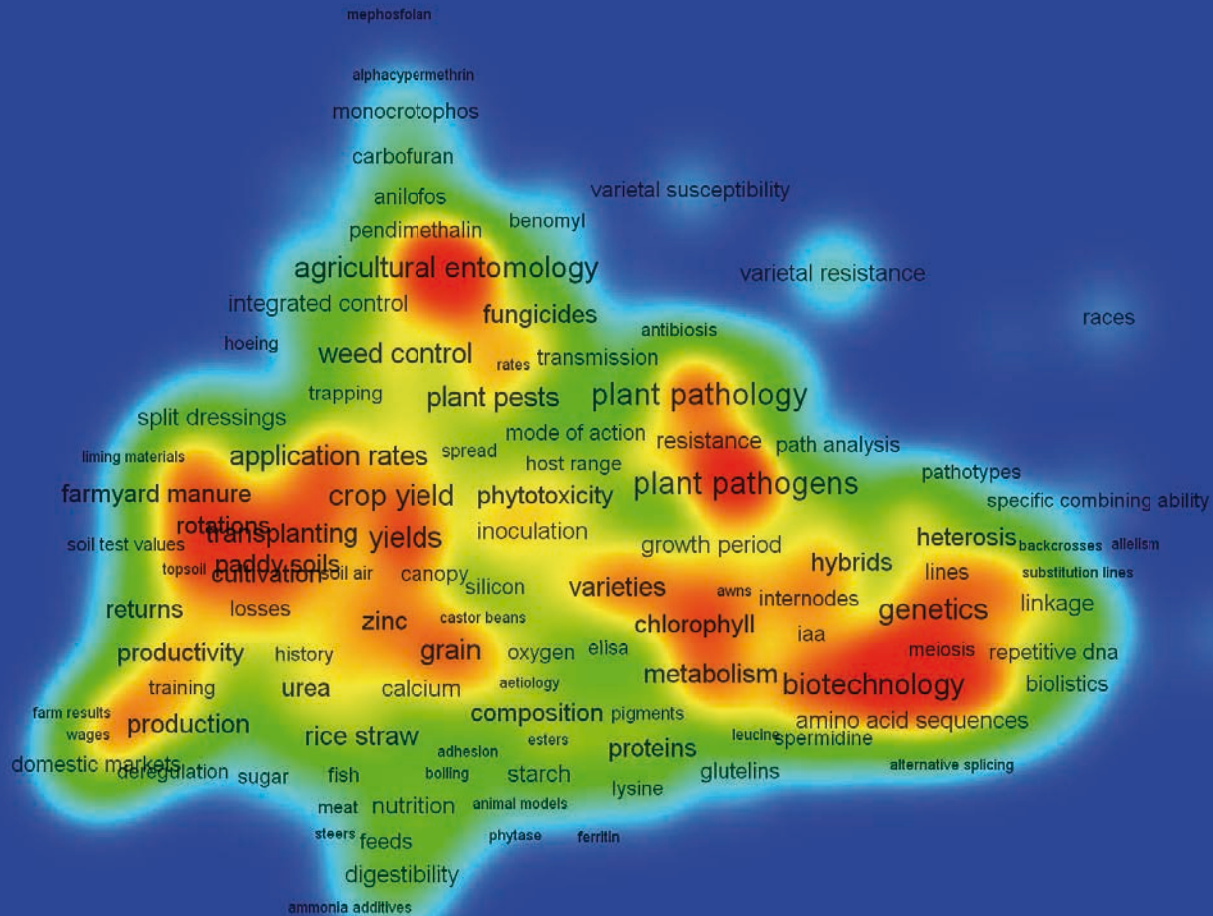
1988-91

Trajectory of rice research, 1983-2012



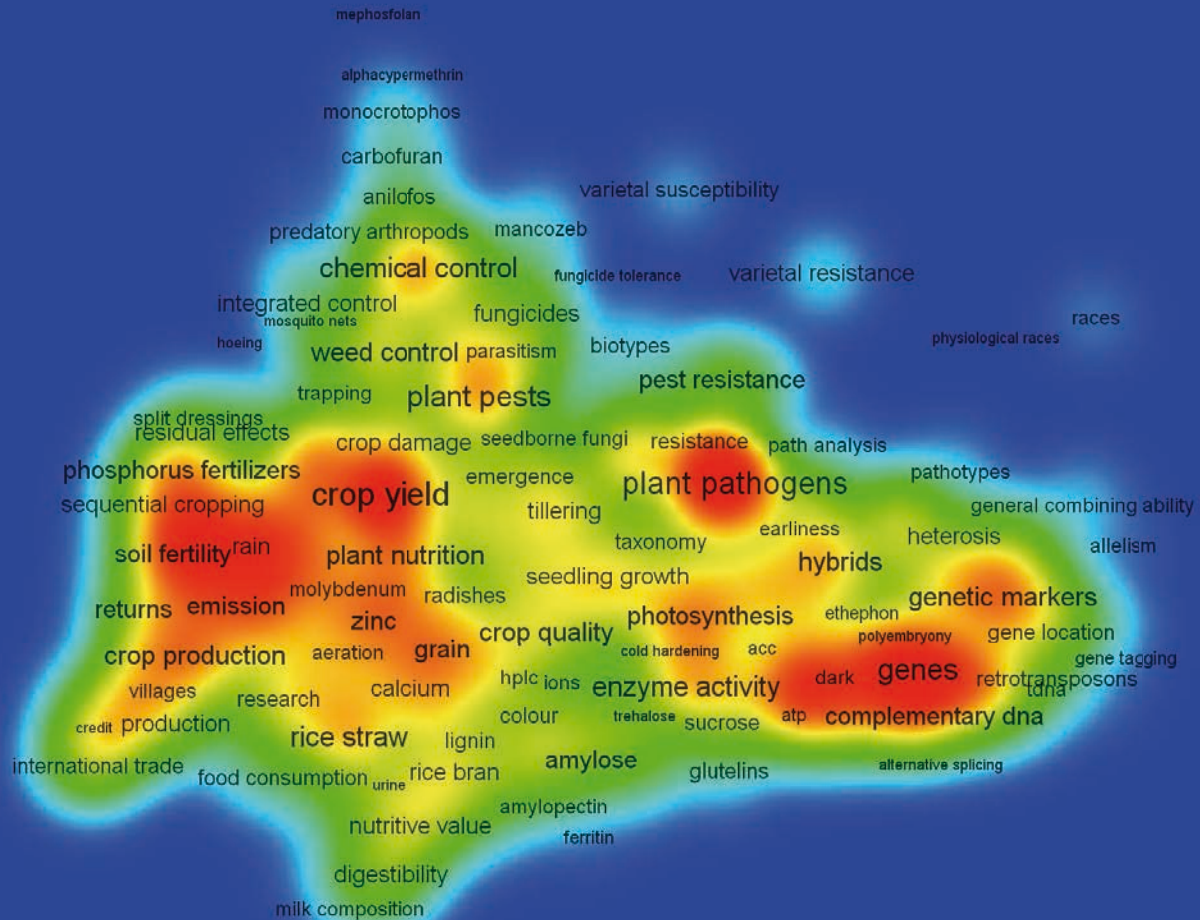
1992-95

Trajectory of rice research, 1983-2012



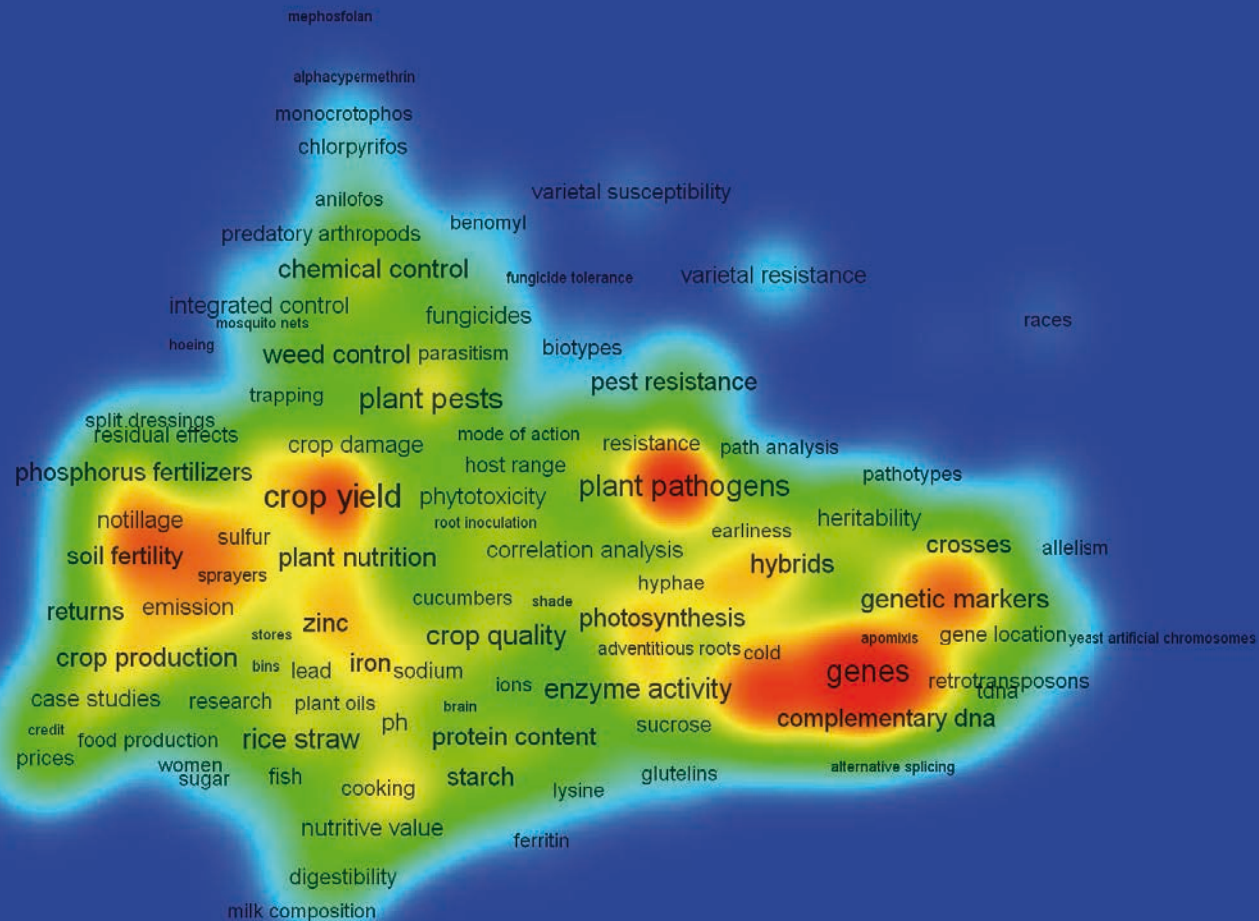
1996-99

Trajectory of rice research, 1983-2012



2000-02

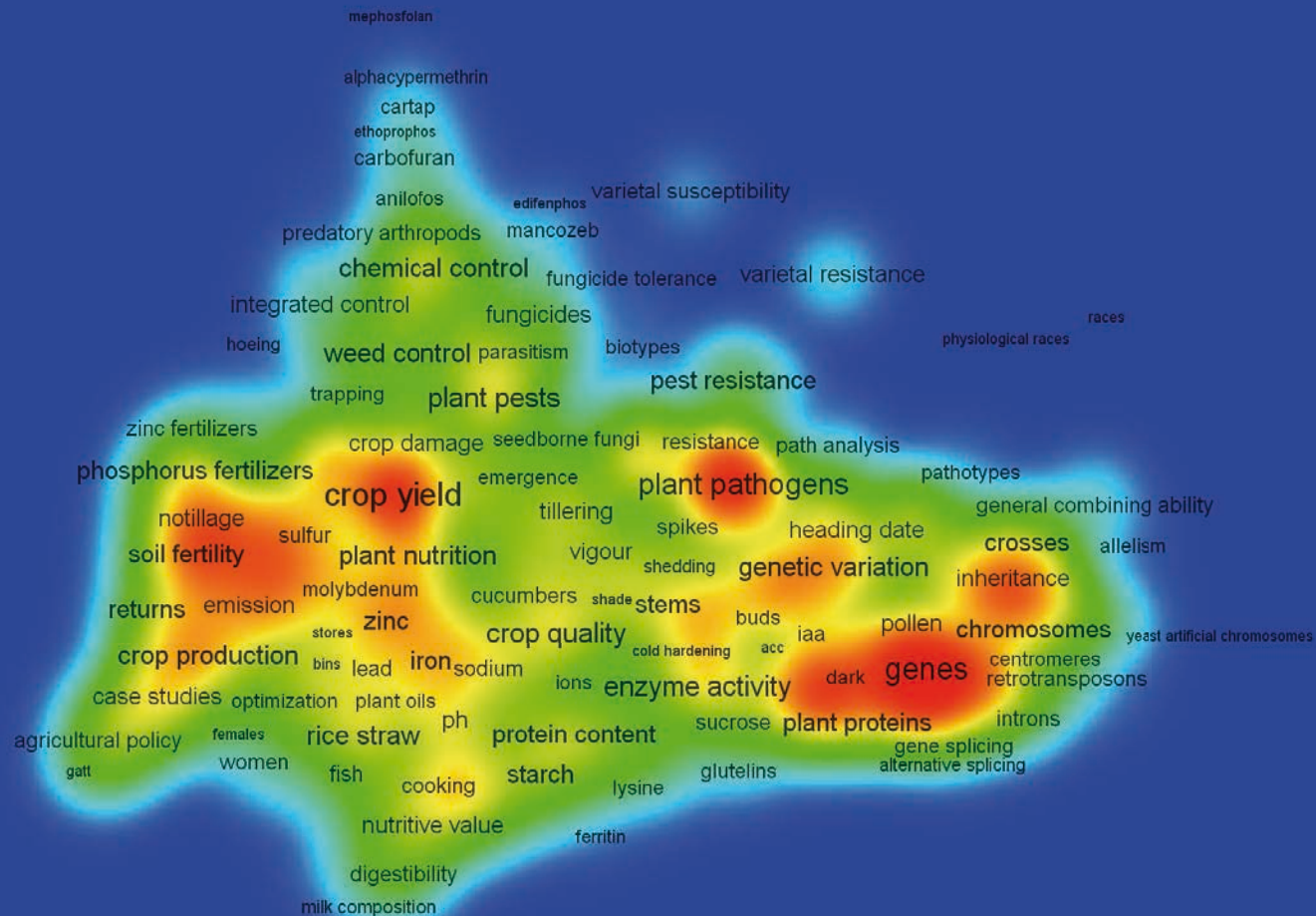
Trajectory of rice research, 1983-2012



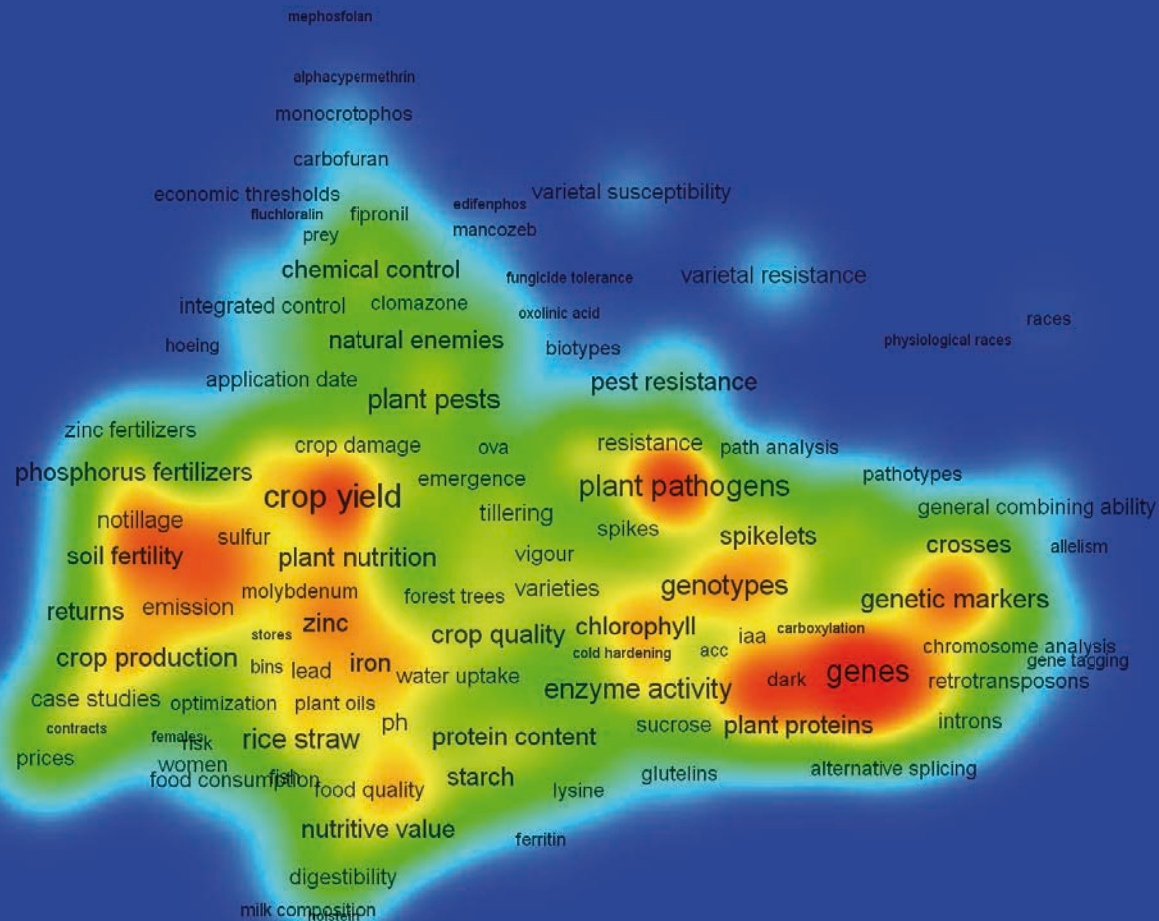
VOSviewer

2003-04

Trajectory of rice research, 1983-2012

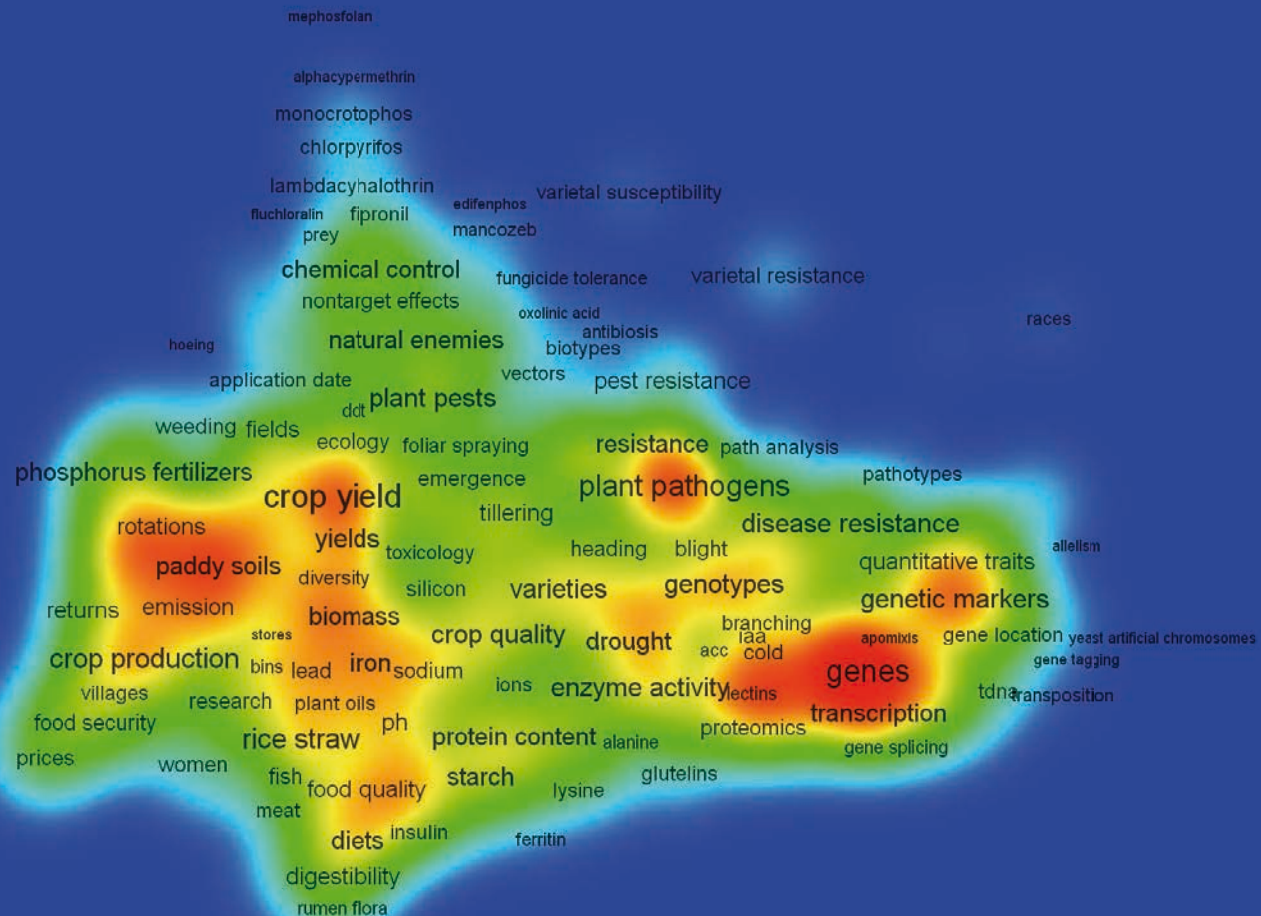


Trajectory of rice research, 1983-2012



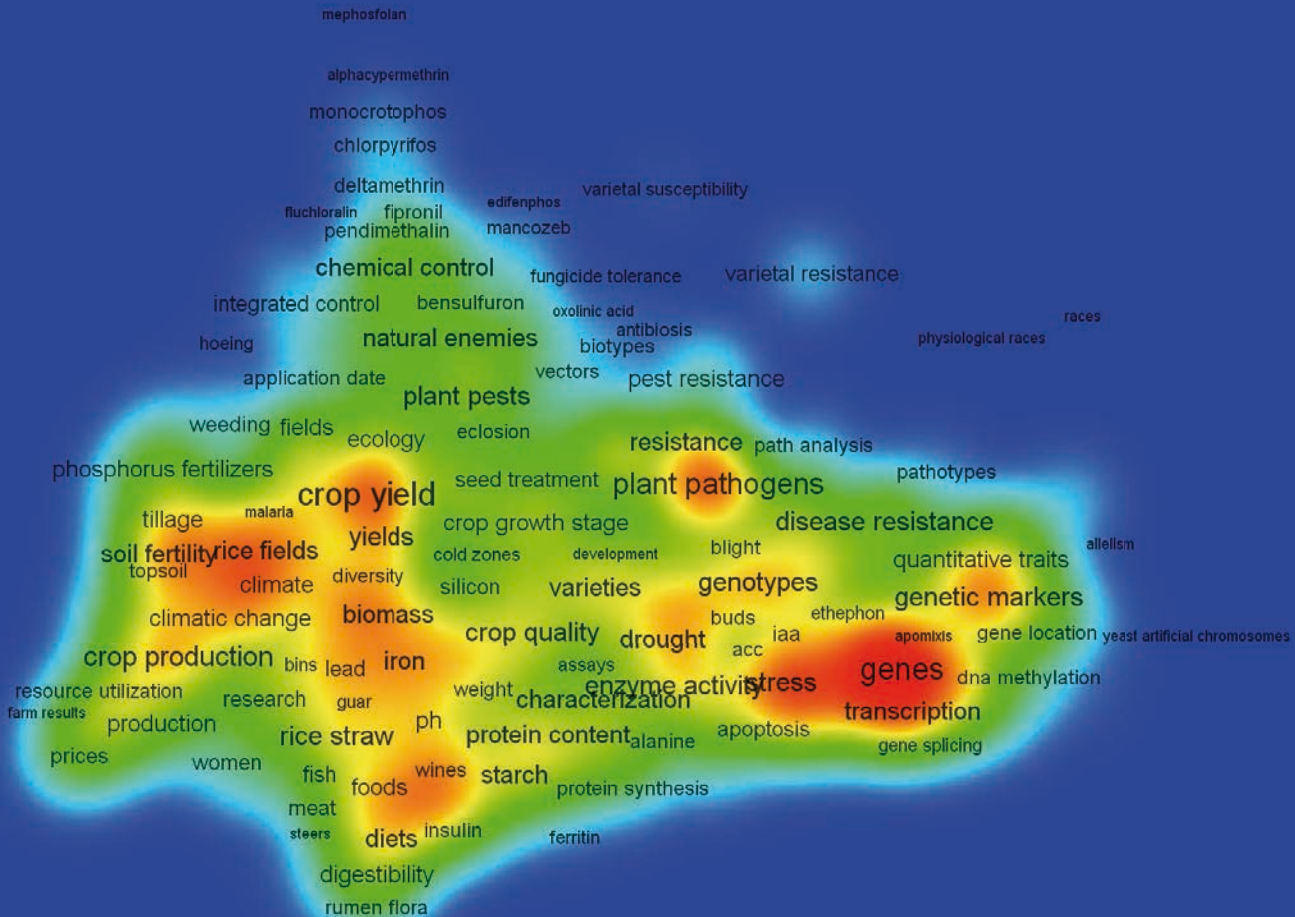
2007-08

Trajectory of rice research, 1983-2012



2009-10

Trajectory of rice research, 1983-2012



2011-12

Examples of Opening Up with same data

Avoid misplaced concreteness

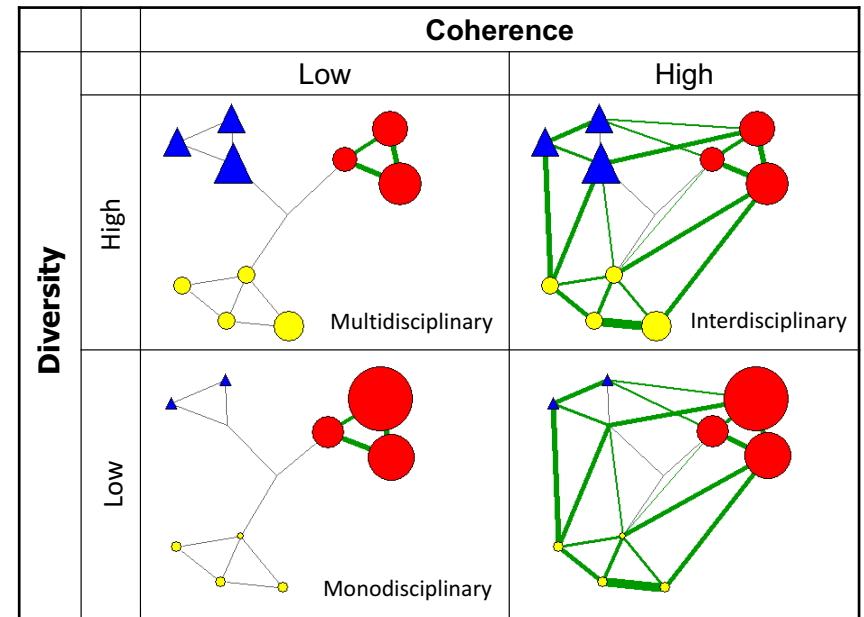
- Explore different concepts of same policy notion

Multiple concepts of interdisciplinarity:

Conspicuous lack of consensus but most indicators aim to capture the following concepts

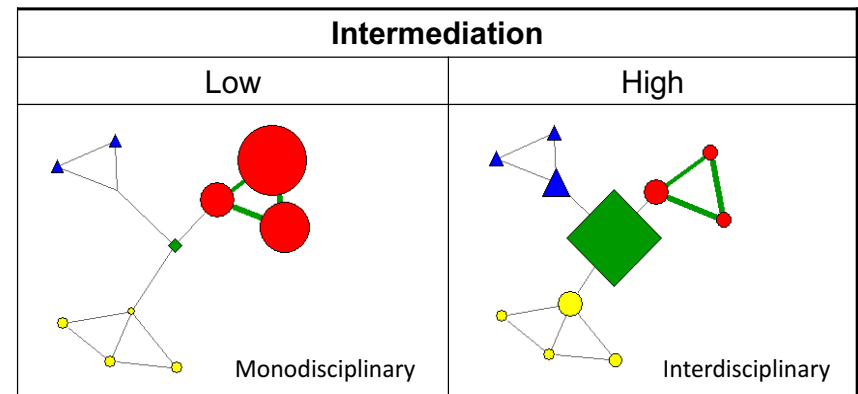
Integration (diversity & coherence)

- Research that **draws on diverse** bodies of knowledge
- Research that **links different** disciplines



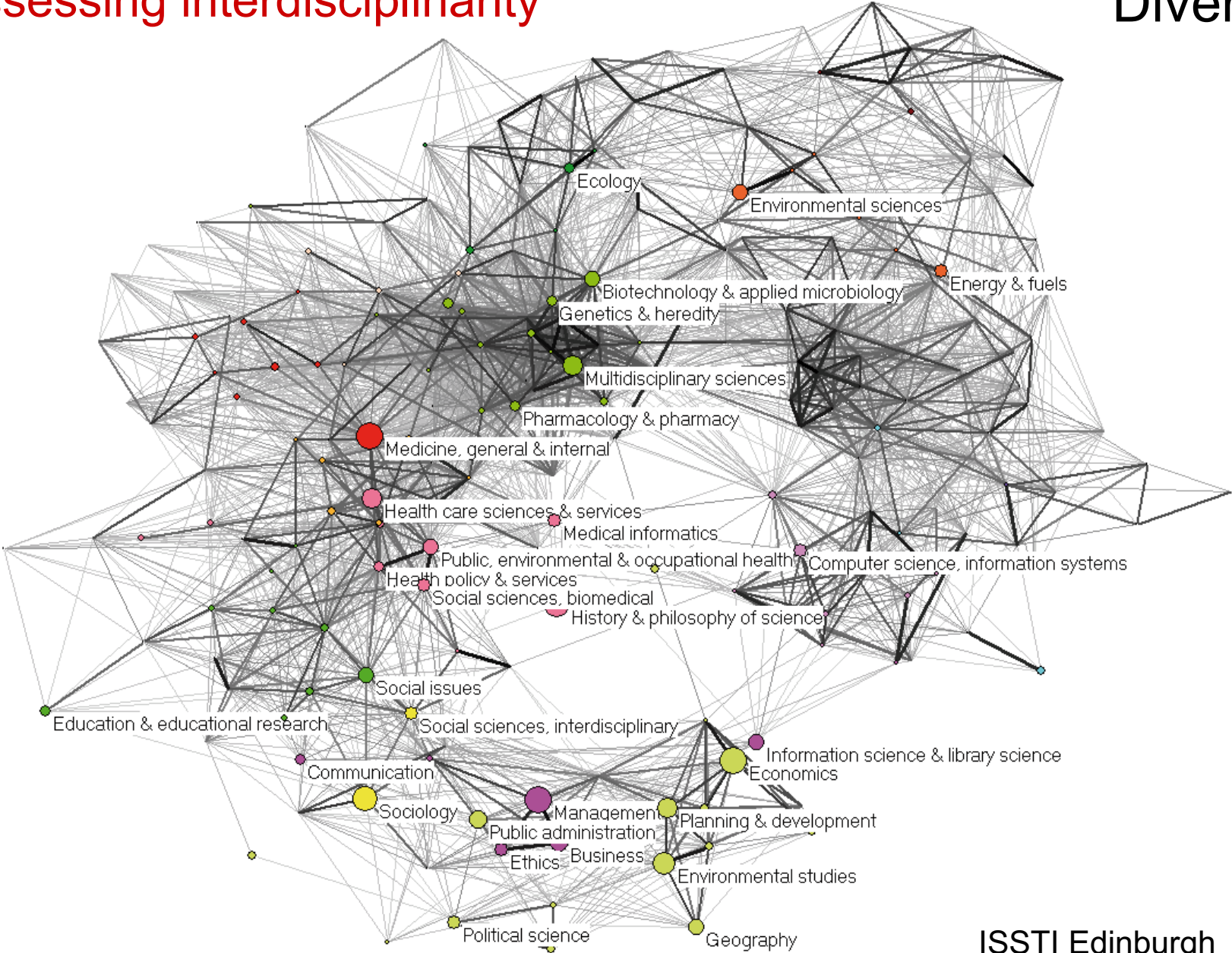
Intermediation

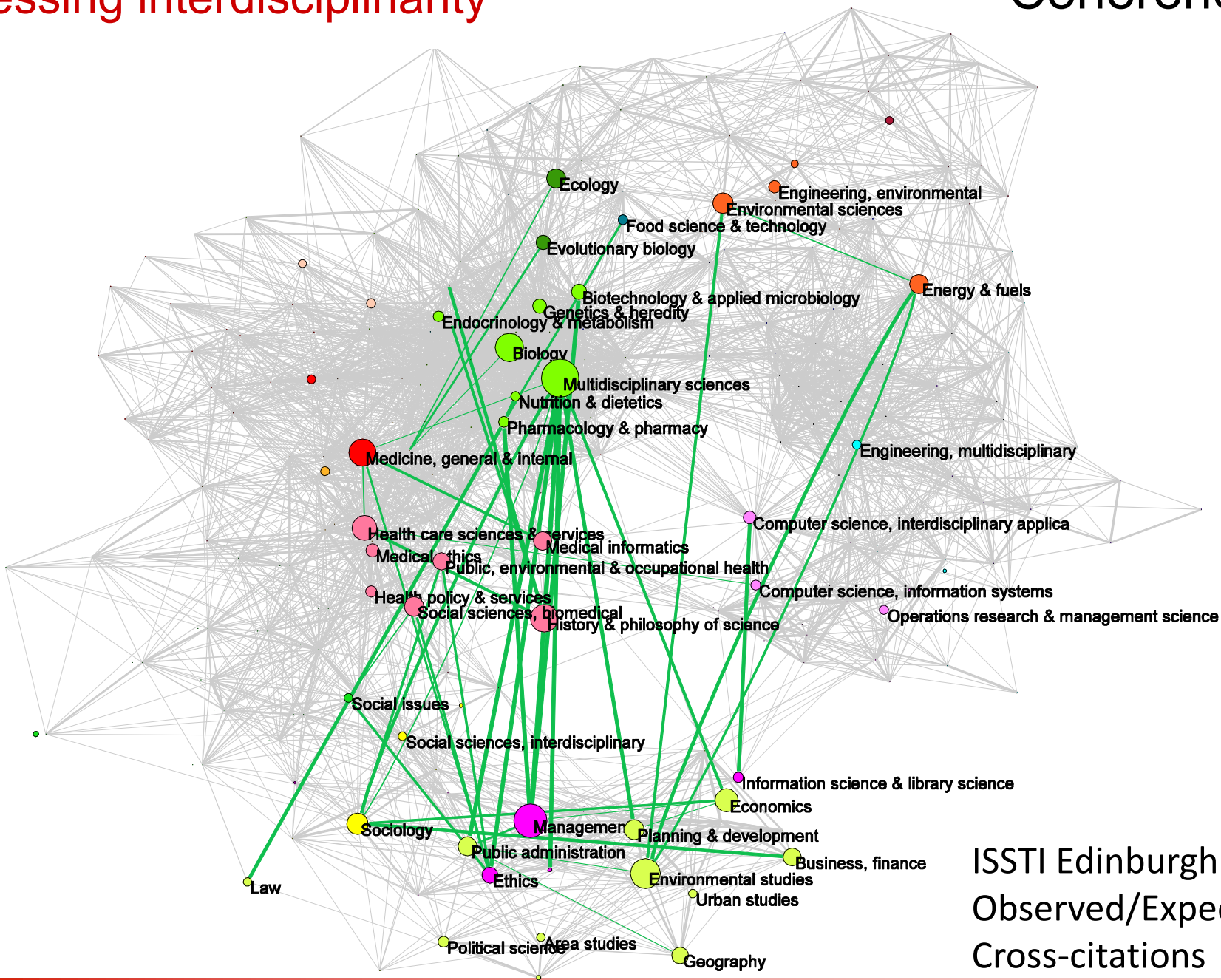
- Research that **lies between** or outside the dominant disciplines



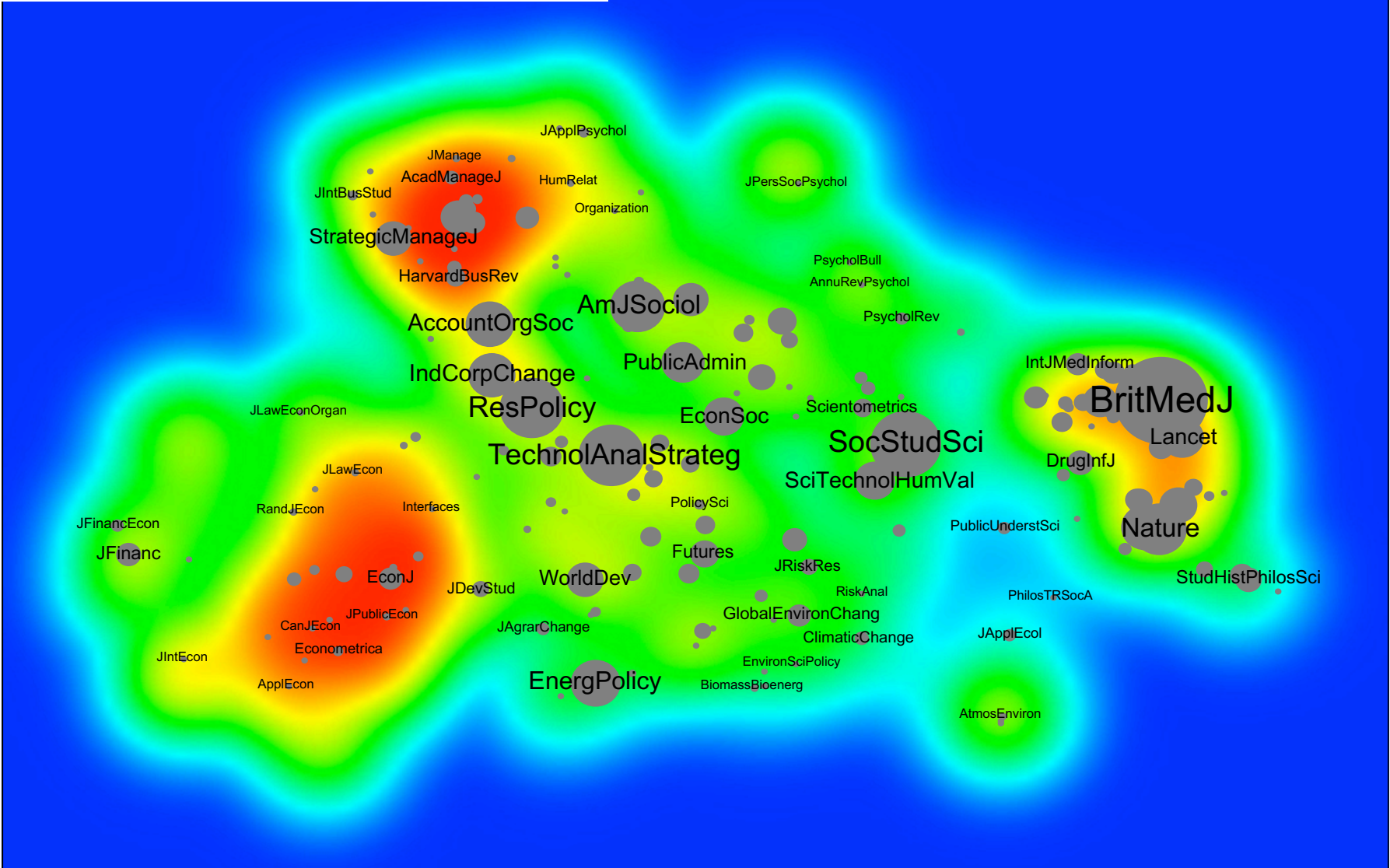
Assessing interdisciplinarity

Diversity



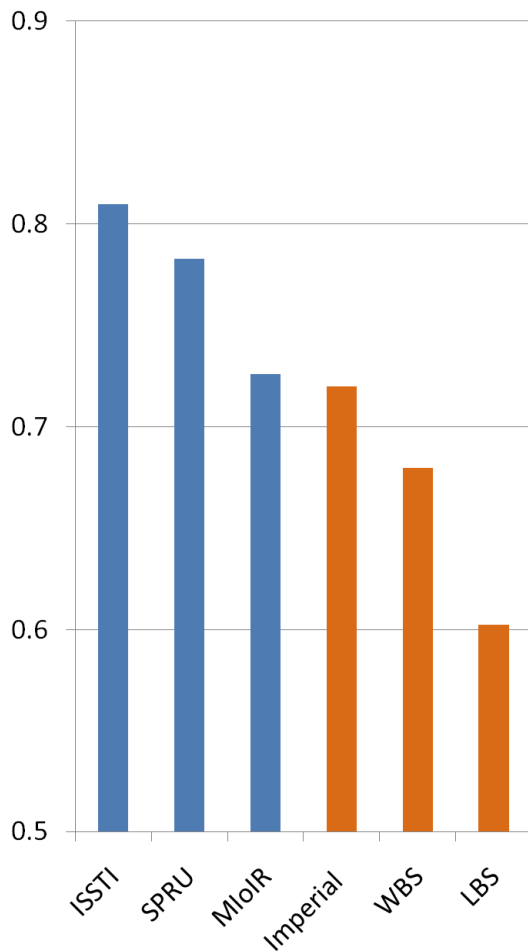


ISSTI Edinburgh
Observed/Expected
Cross-citations

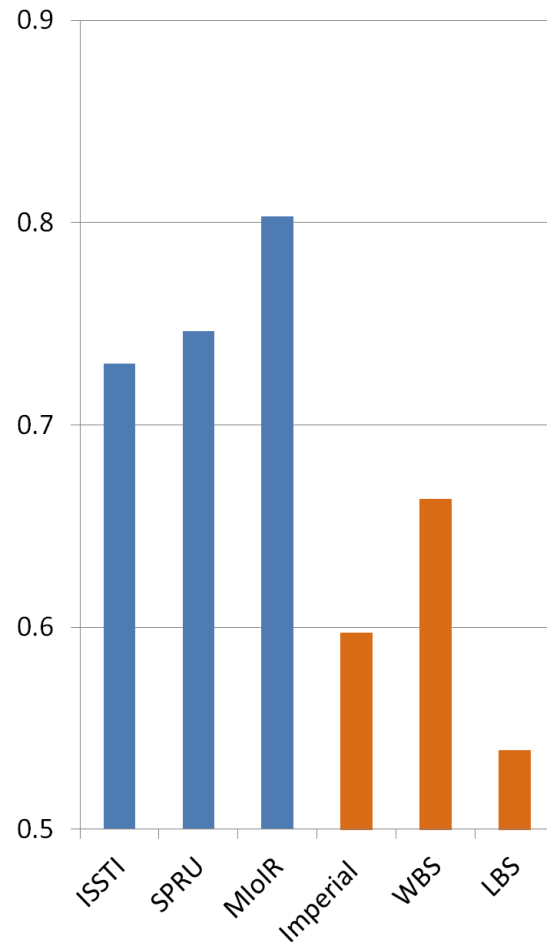


Summary: IS (blue) units are more interdisciplinary than BMS (orange)

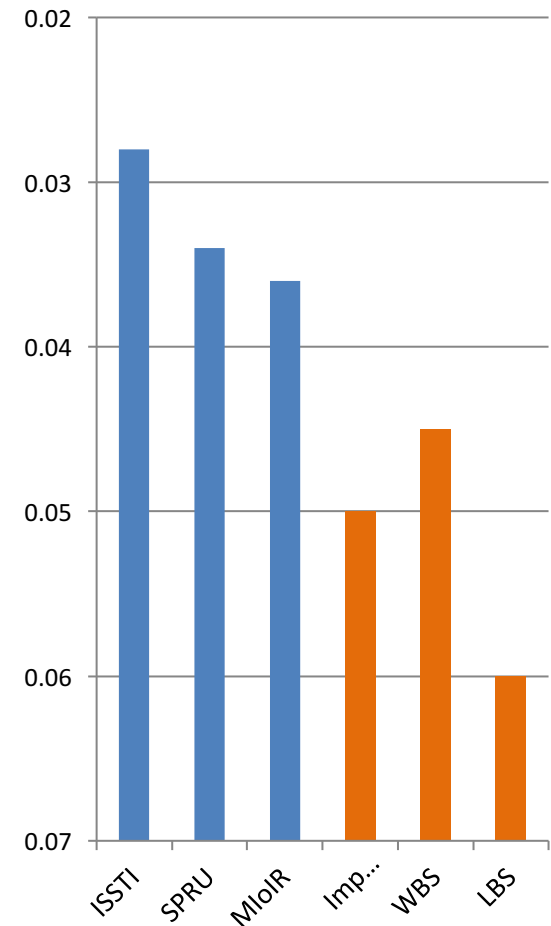
More Diverse
Rao-Stirling Diversity



More Coherent
Observed/Expected
Cross-Citation Distance



More Interstitial
Average Similarity













3. Summary and conclusions

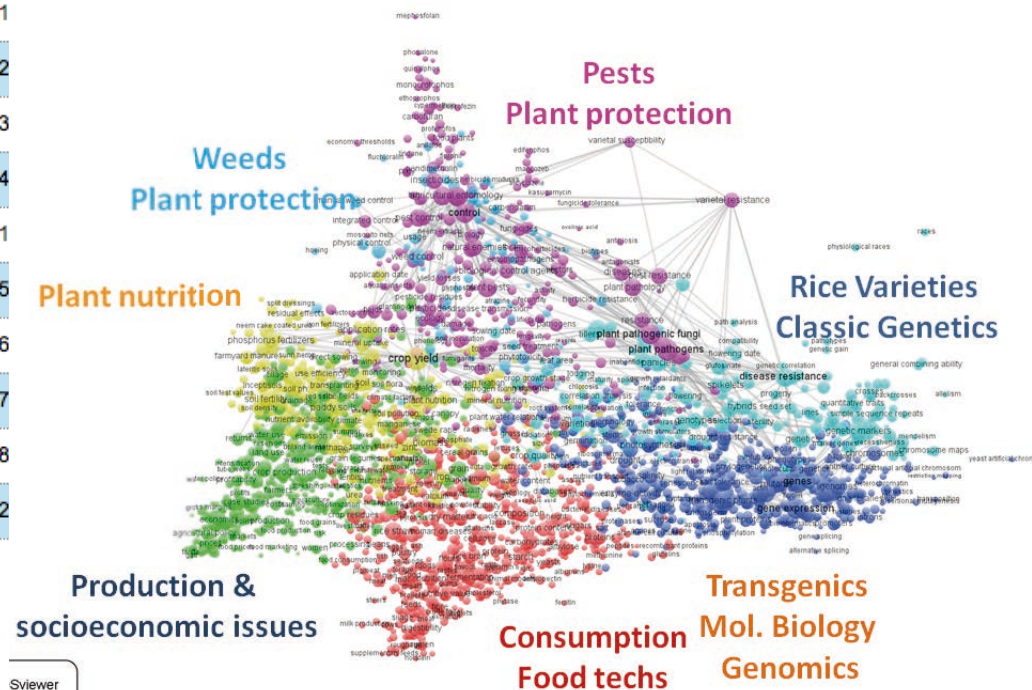
From S&T indicators for justification and disciplining... ... towards S&T indicators as tools for **deliberation**

Model 1: Unique and prescriptive
Proposing “best choices”
Rankings -- ranking list of preferences

Model 2: Plural and conditional
Exploring diverse choices
Facilitating options/choices in landscapes

► Academic Ranking of World Universities - 2011

World Rank	Institution	Country	National Rank	Total Score
1	Harvard University		1	
2	Stanford University		2	
3	Massachusetts Institute of Technology (MIT)		3	
4	University of California, Berkeley		4	
5	University of Cambridge		1	
6	California Institute of Technology		5	
7	Princeton University		6	
8	Columbia University		7	
9	University of Chicago		8	
10	University of Oxford		2	



Strategies for opening up indicators

- From prescriptive indicators to quantitative evidence
 - Deliberation on indicators and “indicators” for **informing** deliberation processes (Barré)
- Incorporating relevant invisible dimensions
 - Activities and outcomes so far marginalised
- Presenting contrasting perspectives
 - At least TWO, in order to allow choices
- Simultaneous visualisation of multiple dimensions / options
 - Maps, networks Allowing the user take its own perspective
- Exploration of multiple realisations of same concepts
 - Avoiding misplaced concreteness
- Interactivity for checking conditions
 - Allowing the user give its own weigh to criteria / factors
 - Allowing the user manipulate visuals

An agenda for more inclusive metrics

- **Inclusiveness in the inputs**
 - *Broadening out:* Create more diverse indicators
 - Indicators of open science, RRI, hidden, social innovation
 - Improve representation of SSH scholarship, languages other than English, the “South”,...
- **Inclusiveness in the outputs**
 - *Opening up:* develop toolkits that allow exploration of choices. New ways of presenting indicators
 - Multi-ranking tools
 - Interactive visualisations
- **Inclusiveness in the policy process (??)**
 - Develop new social processes on use of indicators
 - STI indicators as tools for interpretation and deliberation (R. Barré)



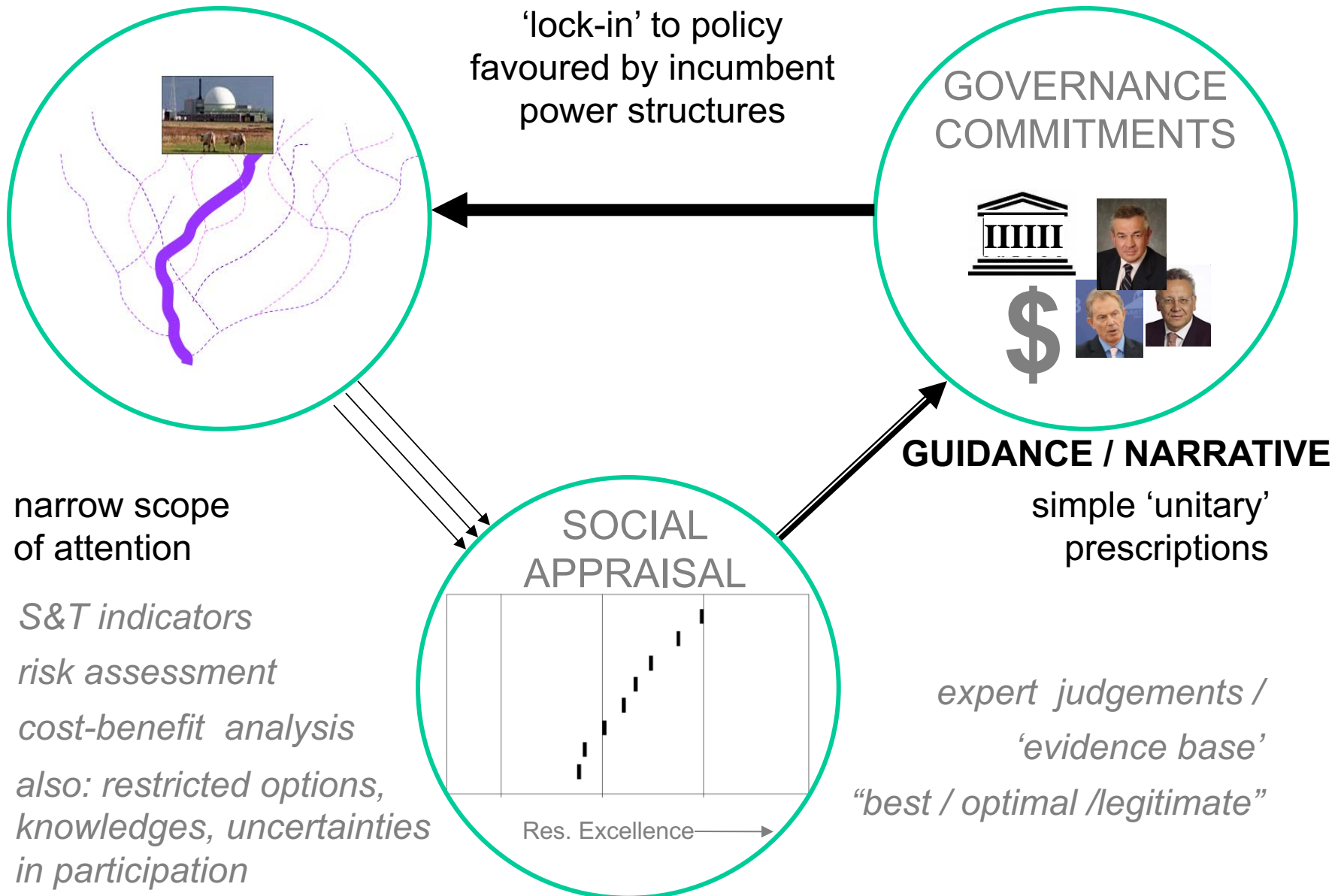
S&T indicator as a tools to open up the debate

- ‘Conventional’ use of indicators (‘Pure scientist’ --Pielke)
 - Purely analytical character (i.e. free of normative assumptions)
 - Instruments of objectification of dominant perspectives
 - Aimed at legitimising /justifying decisions (e.g. excellence)
 - Unitary and prescriptive advice
- Opening up scientometrics (‘Honest broker’ --Pielke)
 - Aimed at locating the actors in their context and dynamics
 - Not predictive, or explanatory, but exploratory
 - Construction of indicators is based on choice of perspectives
 - Make explicit the possible choices on what matters
 - Supporting debate
 - Making science policy more ‘socially robust’
 - Plural and conditional advice

Barré (2001, 2004, 2010), Stirling (2008)

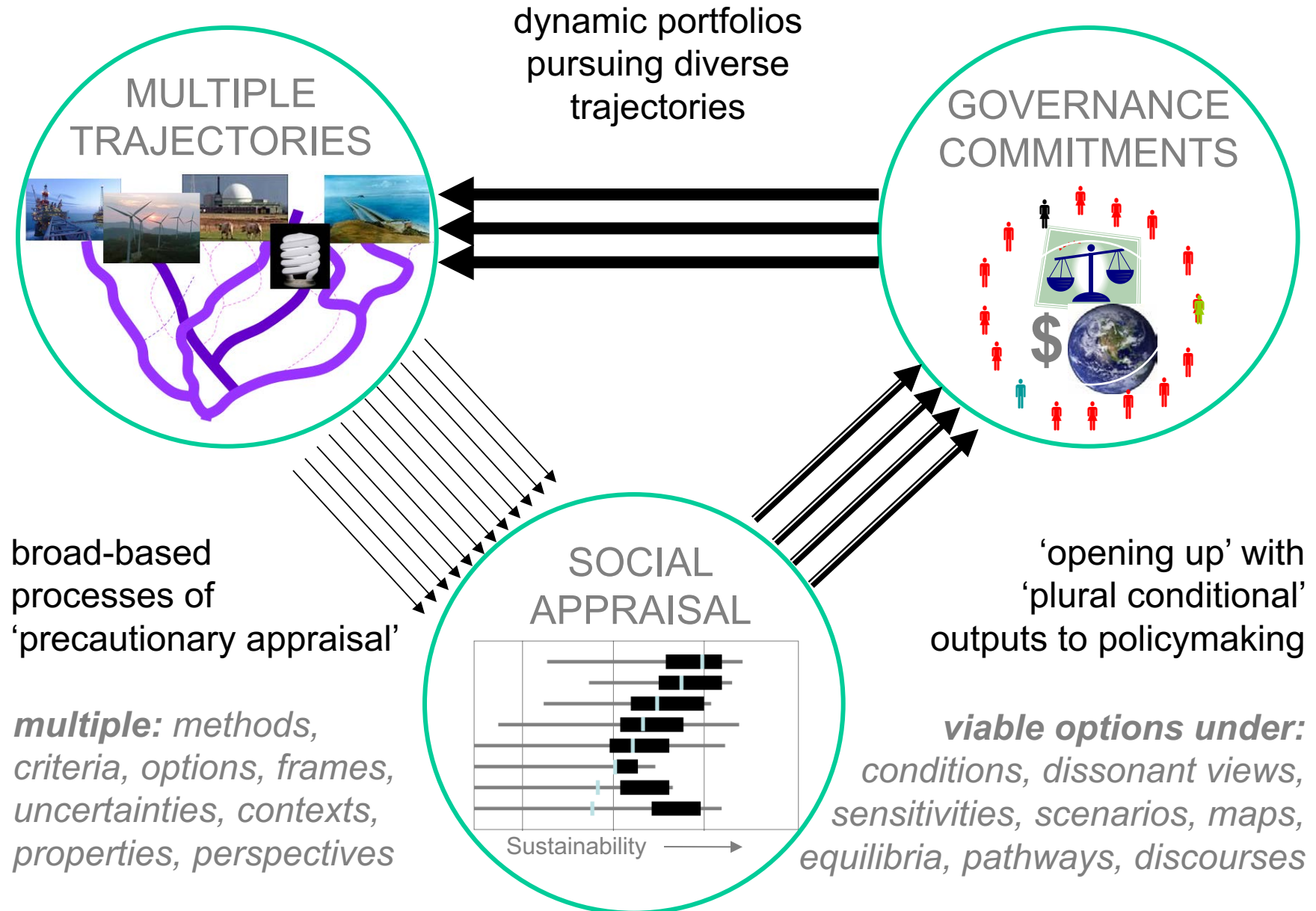
Conventional Policy Dynamics

Stirling (2010)

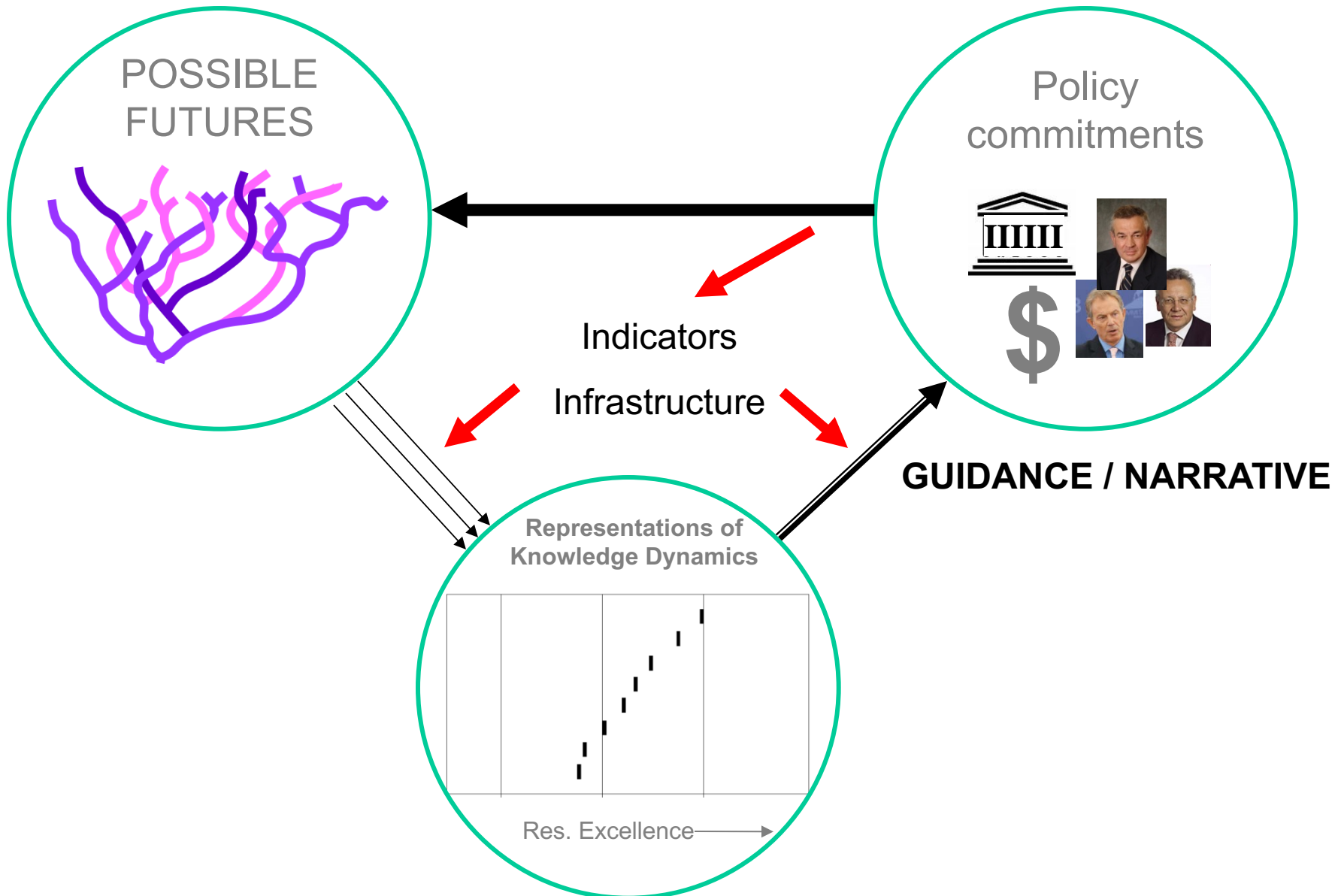


Breadth, Plurality and Diversity

Stirling (2010)



Conventional Policy Dynamics



2. Interdisciplinarity: Opening Up Perspectives

Explore different concepts of same policy notion

Integration (1) -- Diversity:

Do Units contribute to or draw on different disciplines?

Heuristics of diversity

(Stirling, 1998; 2007)

Diversity:

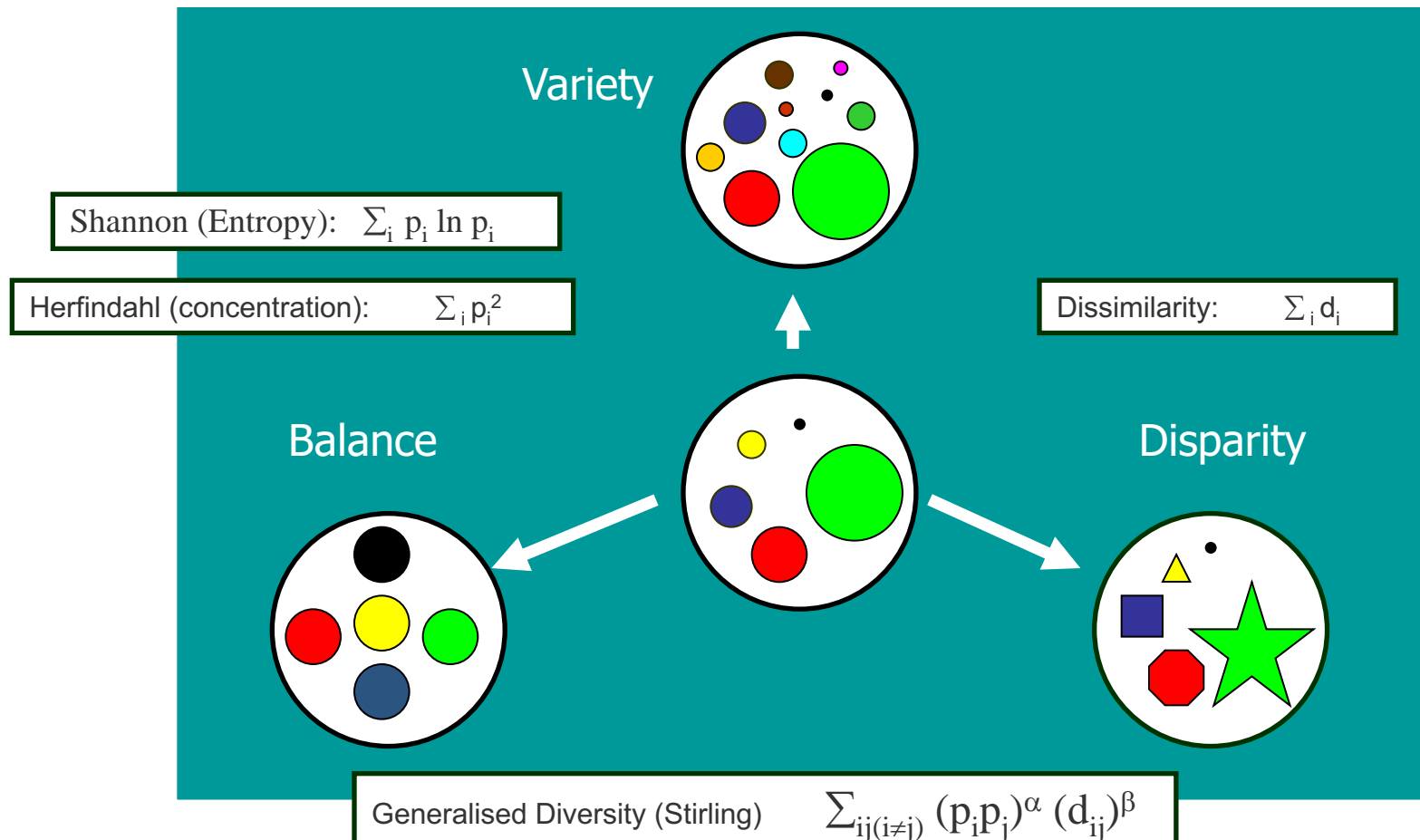
'attribute of a system whose elements may be apportioned into categories'

Characteristics:

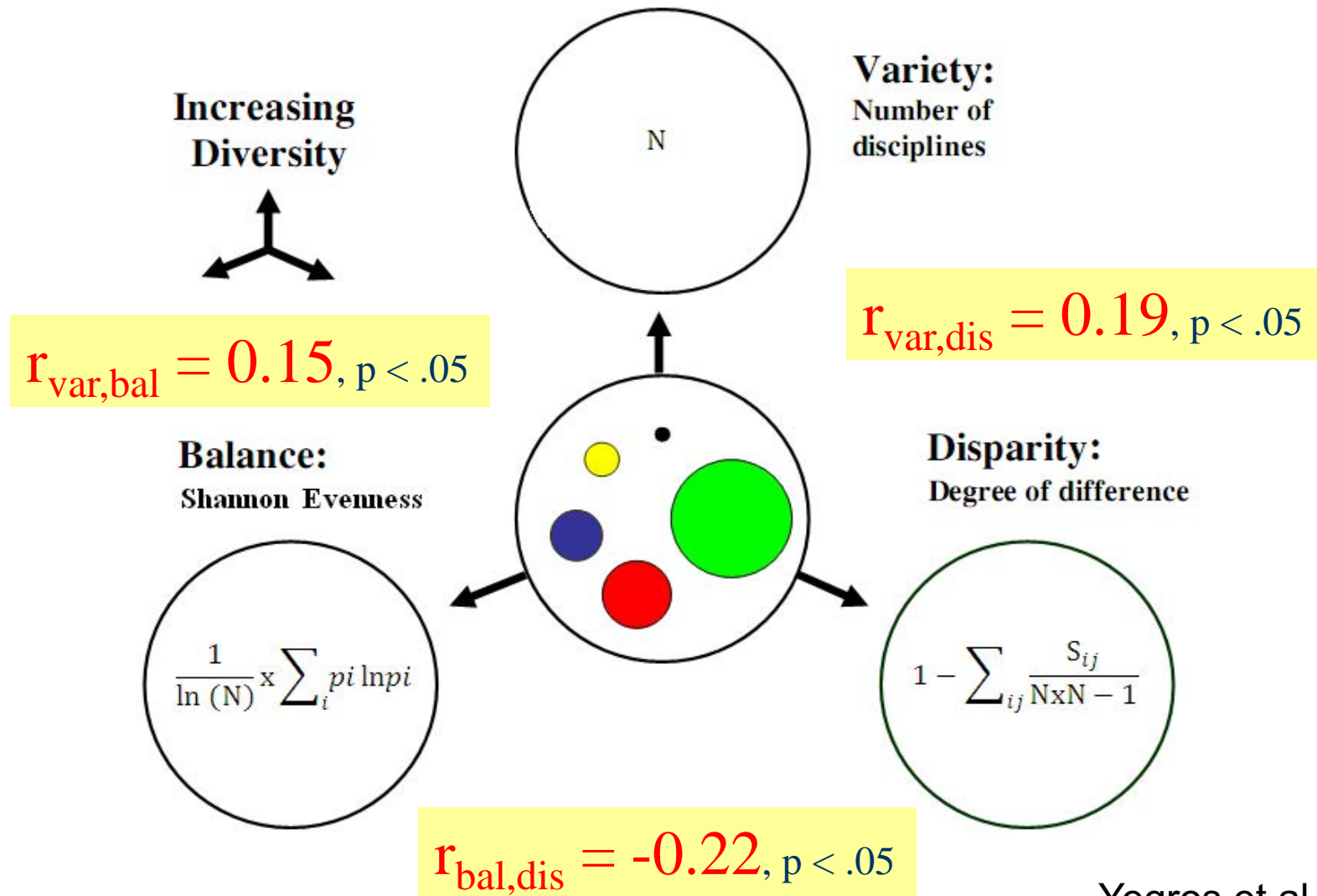
Variety: Number of distinctive categories

Balance: Evenness of the distribution

Disparity: Degree to which the categories are different.

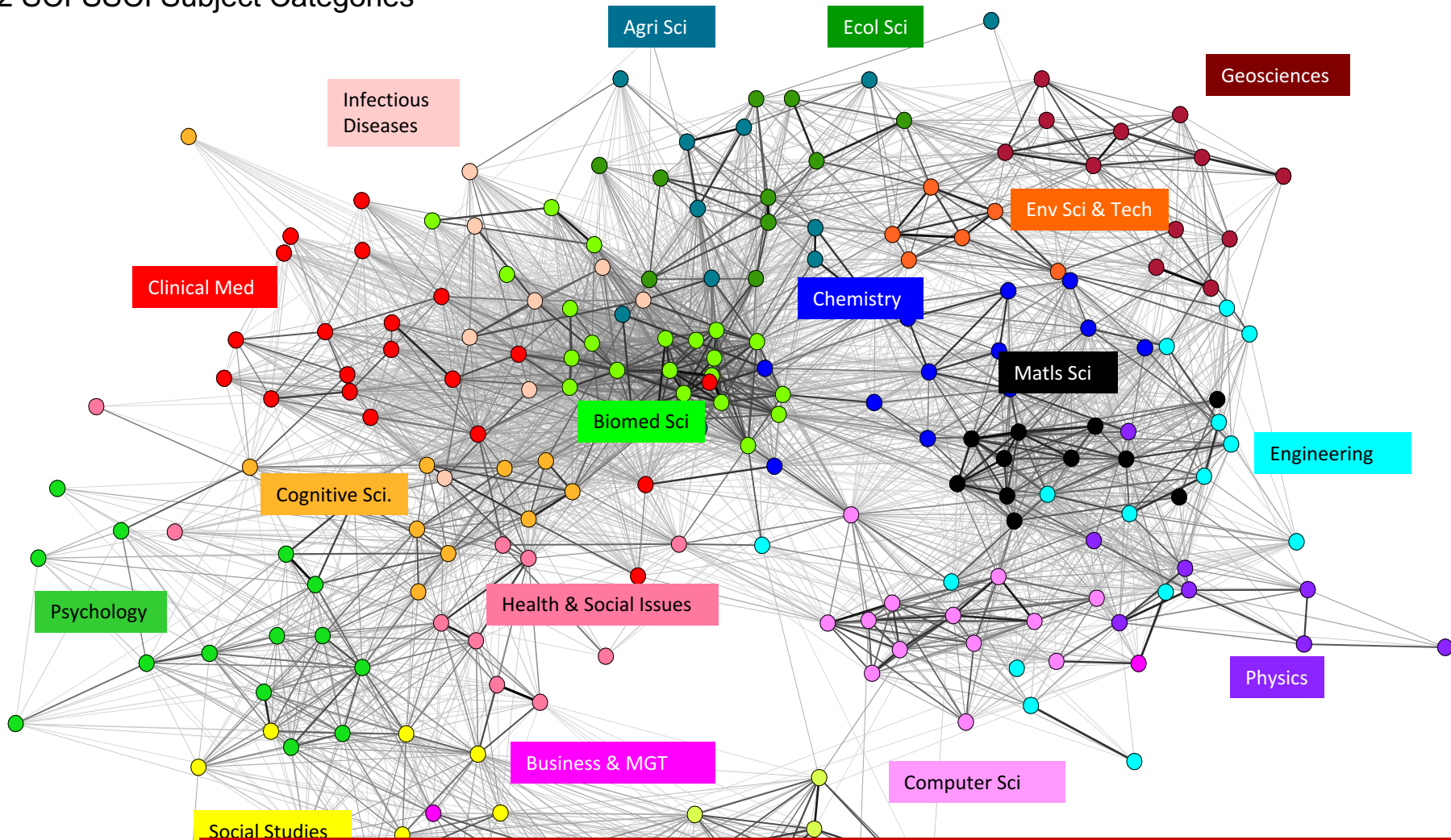


Different aspects of diversity are uncorrelated



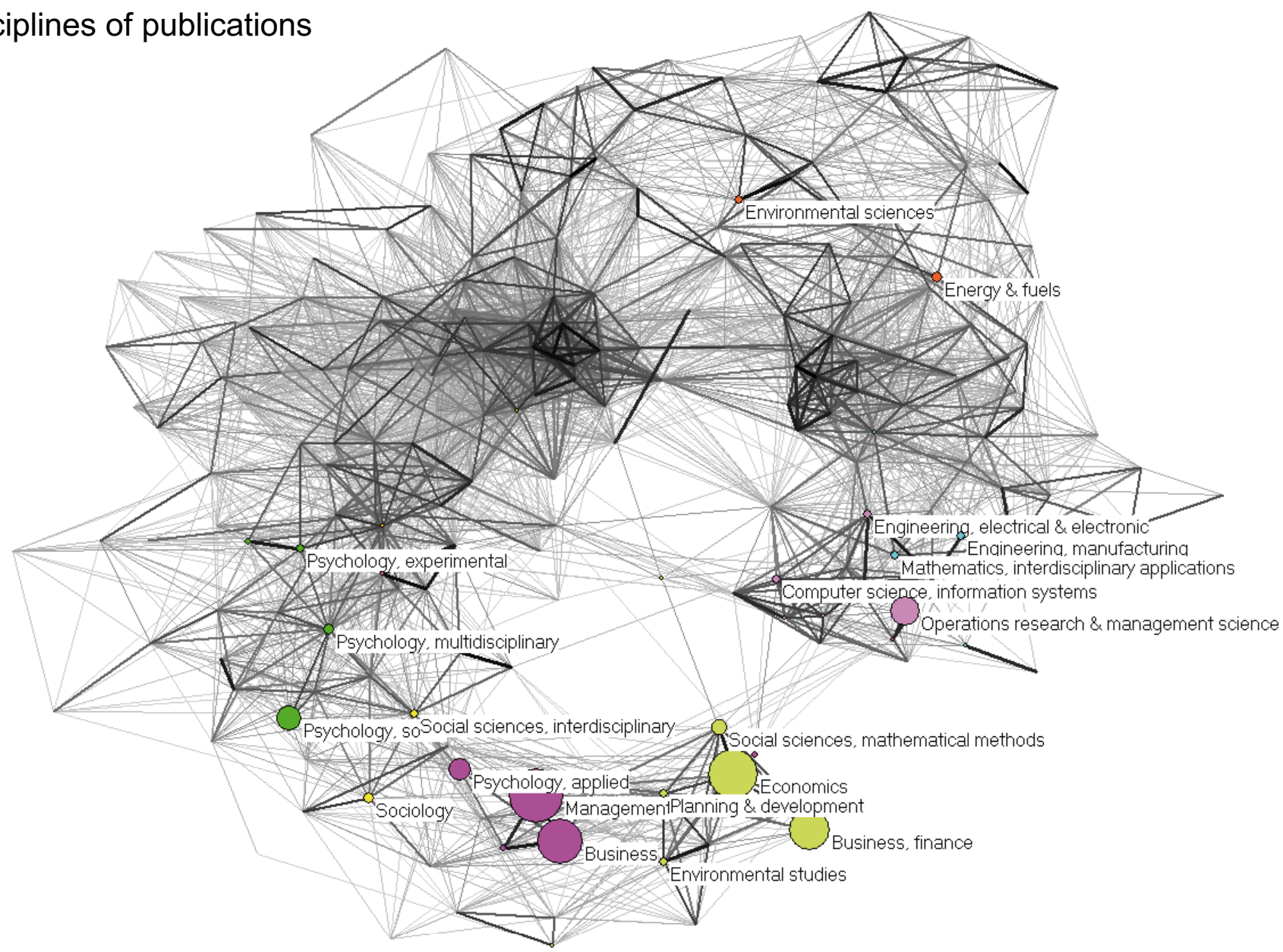
A Global Map of Science

222 SCI-SSCI Subject Categories



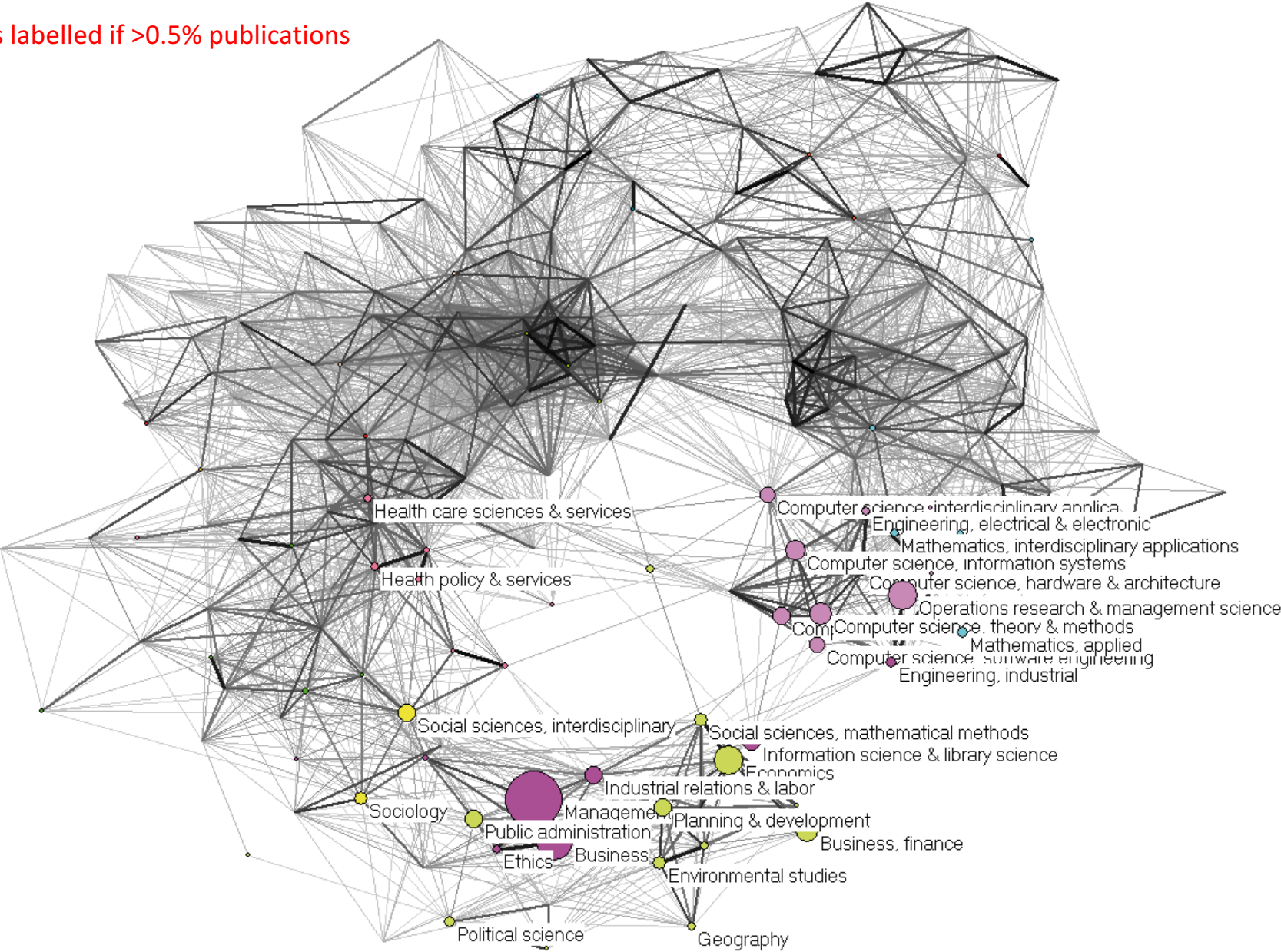
- CD-ROM version of the JCR of SCI and SSCI of 2009.
- Matrix of cross-citations between journals (9,000 x 9,000)
- Collapse to ISI Subject Category matrix (222 x 222)
- Create similarity matrix using Salton's cosine

London Business School
Disciplines of publications



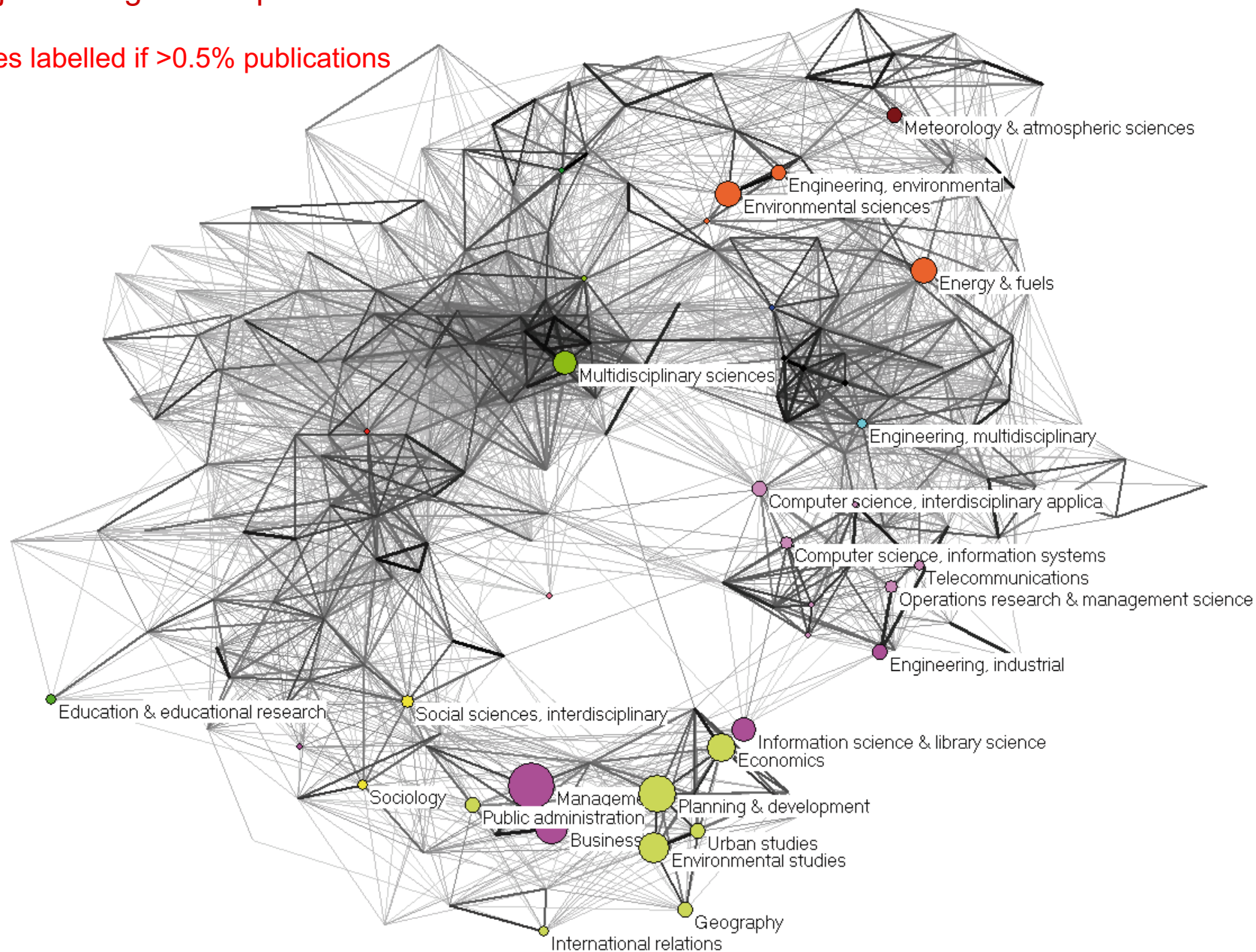
	Edinburgh ISSTI	LBS
# of Publications	129	348
SC of Publications		
Variety	28	9
Balance	0.653	0.370
Disparity	0.832	0.768
Shannon Entropy	3.558	2.343
Rao-Stirling Diversity	0.810	0.603
# of References	6413	16713
SC of References		
Variety	28	15
Balance	0.510	0.287
Disparity	0.829	0.825
Shannon Entropy	4.115	2.802
Rao-Stirling Diversity	0.833	0.682
# of Cites	316	1593
SC of Cites		
Variety	32	15
Balance	0.669	0.379
Disparity	0.852	0.767
Shannon Entropy	4.222	2.985
Rao-Stirling Diversity	0.851	0.679

Nodes labelled if >0.5% publications



Subject Categories of publications

Nodes labelled if >0.5% publications



	Edinburgh ISSTI	Manchest MloIR	WBS	LBS
# of Publications	129	115	450	348
SC of Publications				
Variety	28	19	20	9
Balance				
Disparity				
Shannon Entropy				
Rao-Stirling Diversity				
# of References	6413	5515	21342	16713
SC of References				
Variety	28	17	20	15
Balance				
Disparity				
Shannon Entropy				
Rao-Stirling Diversity				
# of Cites	316	419	1246	1593
SC of Cites				
Variety	32	22	24	15
Balance				
Disparity				
Shannon Entropy				
Rao-Stirling Diversity				

	Edinburgh ISSTI	Manchest MloIR	WBS	LBS
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SC of Publications				
Variety	28	19	20	9
Balance				
Disparity				
Shannon Entropy	3.558	2.966	3.078	2.343
Rao-Stirling Diversity				
# of References	6413	5515	21342	16713
SC of References				
Variety	28	17	20	15
Balance				
Disparity				
Shannon Entropy	4.115	3.378	3.153	2.802
Rao-Stirling Diversity				
# of Cites	316	419	1246	1593
SC of Cites				
Variety	32	22	24	15
Balance				
Disparity				
Shannon Entropy	4.222	3.415	3.503	2.985
Rao-Stirling Diversity				

	Edinburgh ISSTI	Manchest MloIR	WBS	LBS
# of Publications	129	115	450	348
SC of Publications				
Variety				
Balance	0.653	0.543	0.460	0.370
Disparity	0.832	0.817	0.770	0.768
Shannon Entropy				
Rao-Stirling Diversity				
# of References	6413	5515	21342	16713
SC of References				
Variety				
Balance	0.510	0.415	0.325	0.287
Disparity	0.829	0.846	0.780	0.825
Shannon Entropy				
Rao-Stirling Diversity				
# of Cites	316	419	1246	1593
SC of Cites				
Variety				
Balance	0.669	0.505	0.454	0.379
Disparity	0.852	0.836	0.801	0.767
Shannon Entropy				
Rao-Stirling Diversity				

	Edinburgh ISSTI	Manchest MloIR	WBS	LBS
# of Publications	129	115	450	348
SC of Publications				
Variety				
Balance				
Disparity				
Shannon Entropy				
Rao-Stirling Diversity	0.810	0.726	0.680	0.603
# of References	6413	5515	21342	16713
SC of References				
Variety				
Balance				
Disparity				
Shannon Entropy				
Rao-Stirling Diversity	0.833	0.729	0.689	0.682
# of Cites	316	419	1246	1593
SC of Cites				
Variety				
Balance				
Disparity				
Shannon Entropy				
Rao-Stirling Diversity	0.851	0.771	0.736	0.679

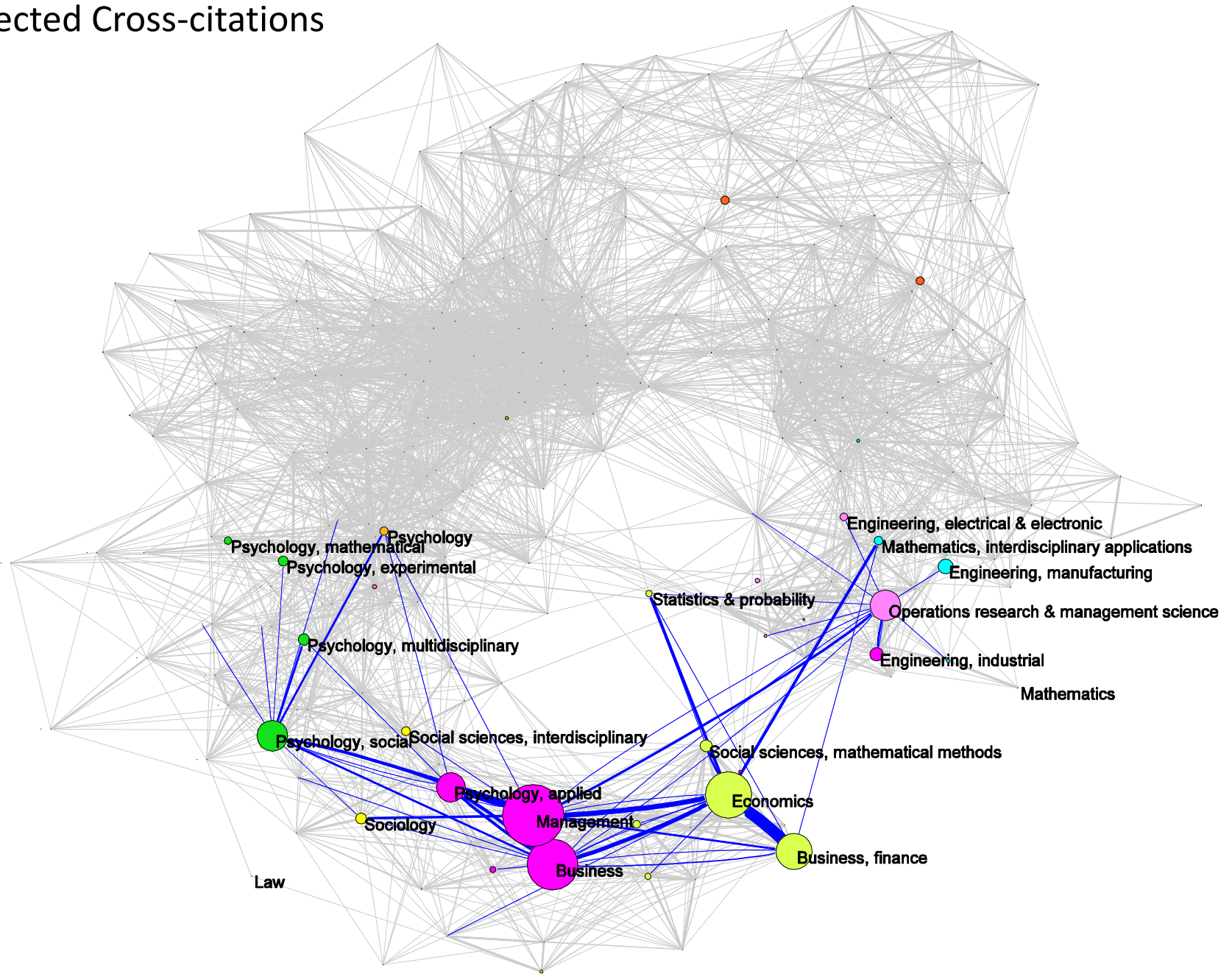
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Shannon Entropy	4.222	3.415	3.503	2.985
Rao-Stirling Diversity	0.851	0.771	0.736	0.679

Integration (2) -- Coherence:

Do Units link disparate disciplines?

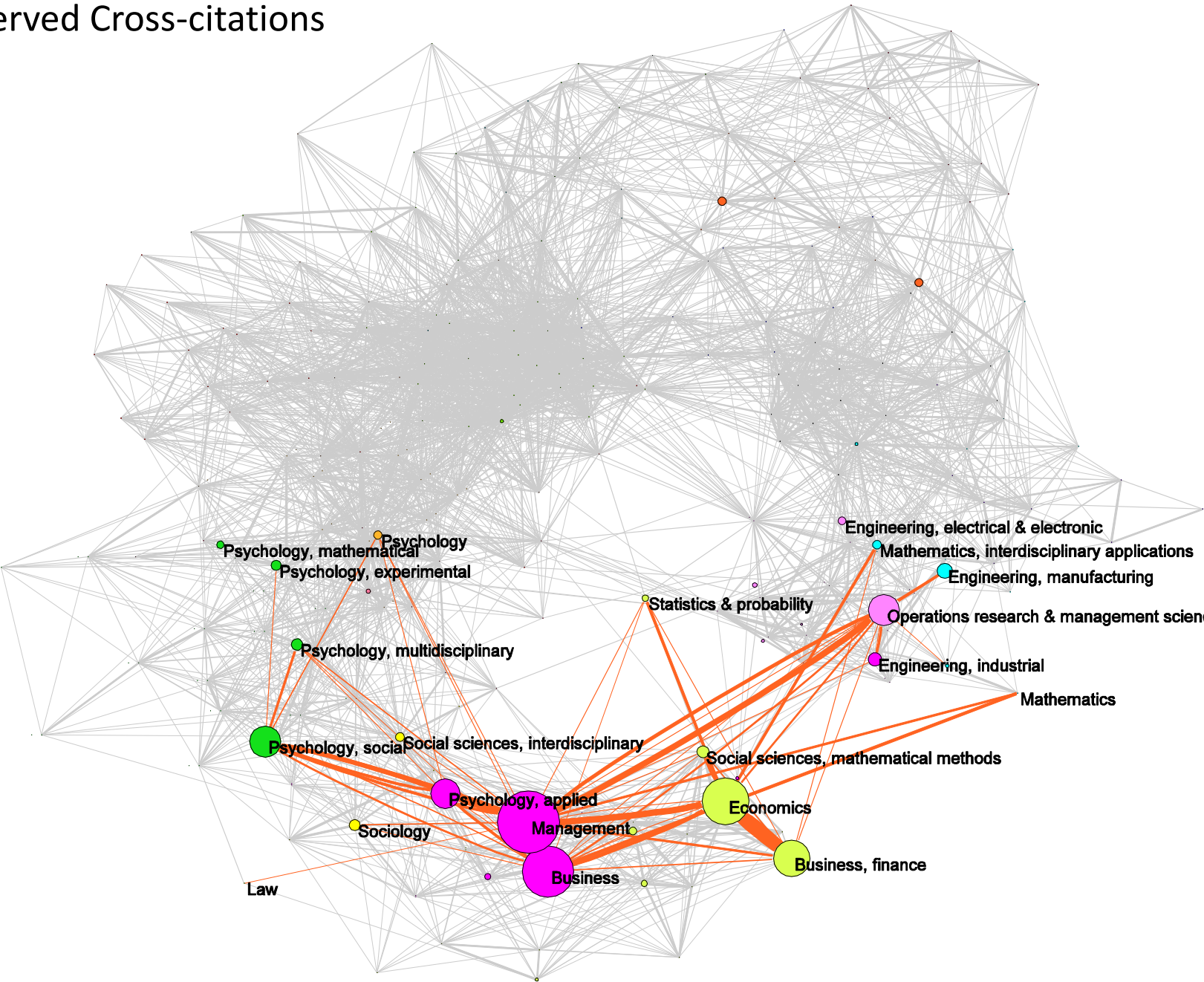
London Business School

Expected Cross-citations



London Business School

Observed Cross-citations

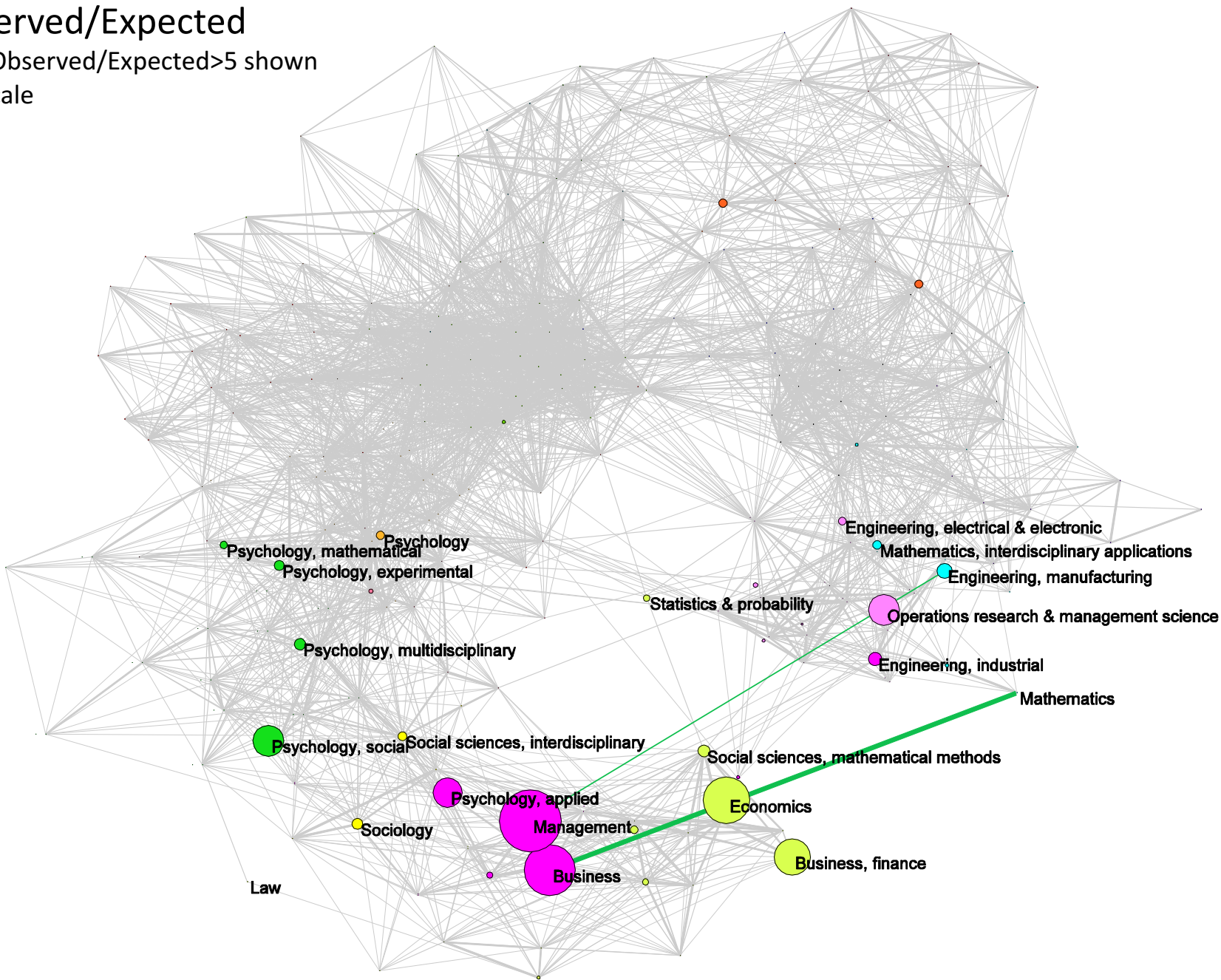


London Business School

Observed/Expected

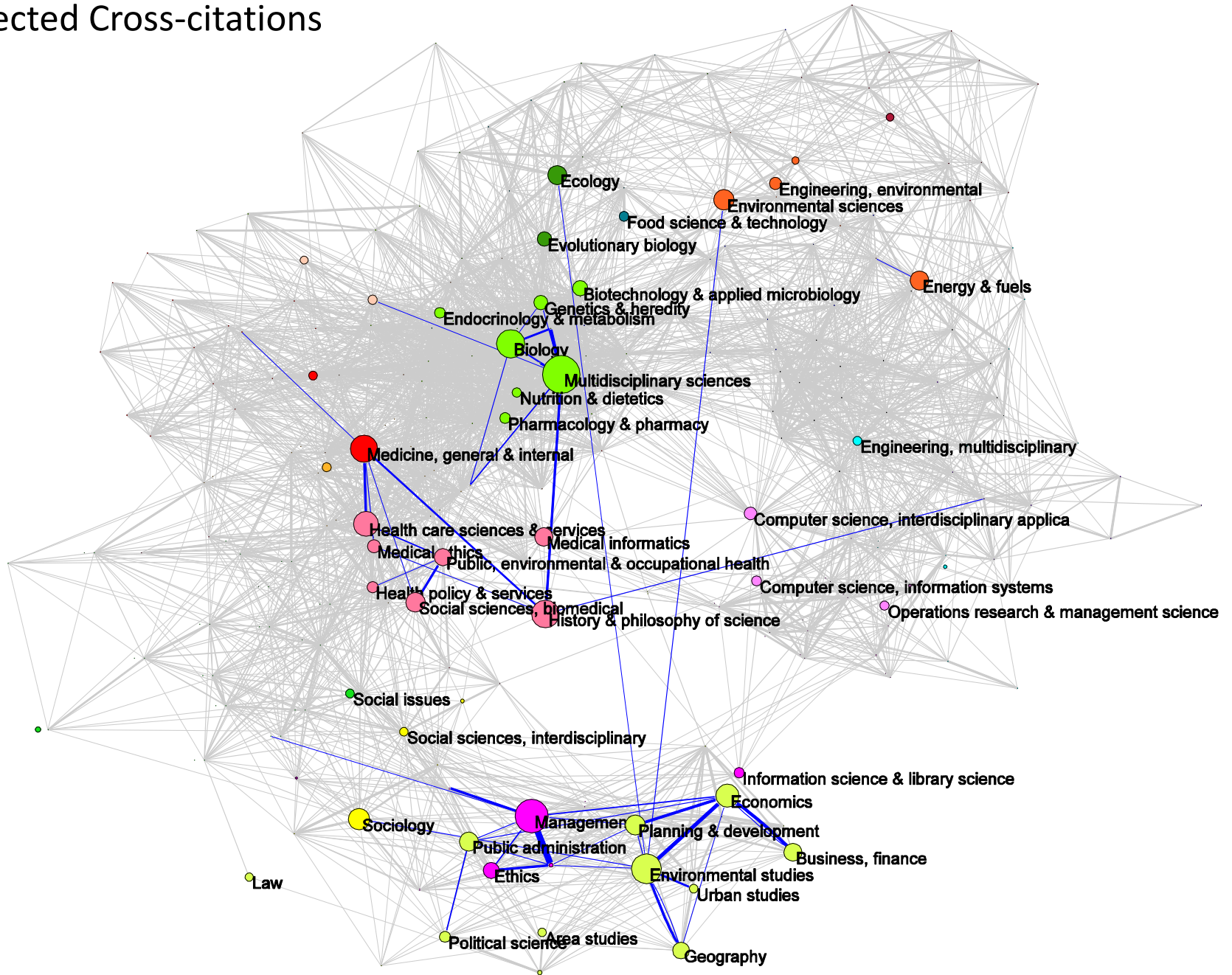
Only Observed/Expected>5 shown

Log-scale

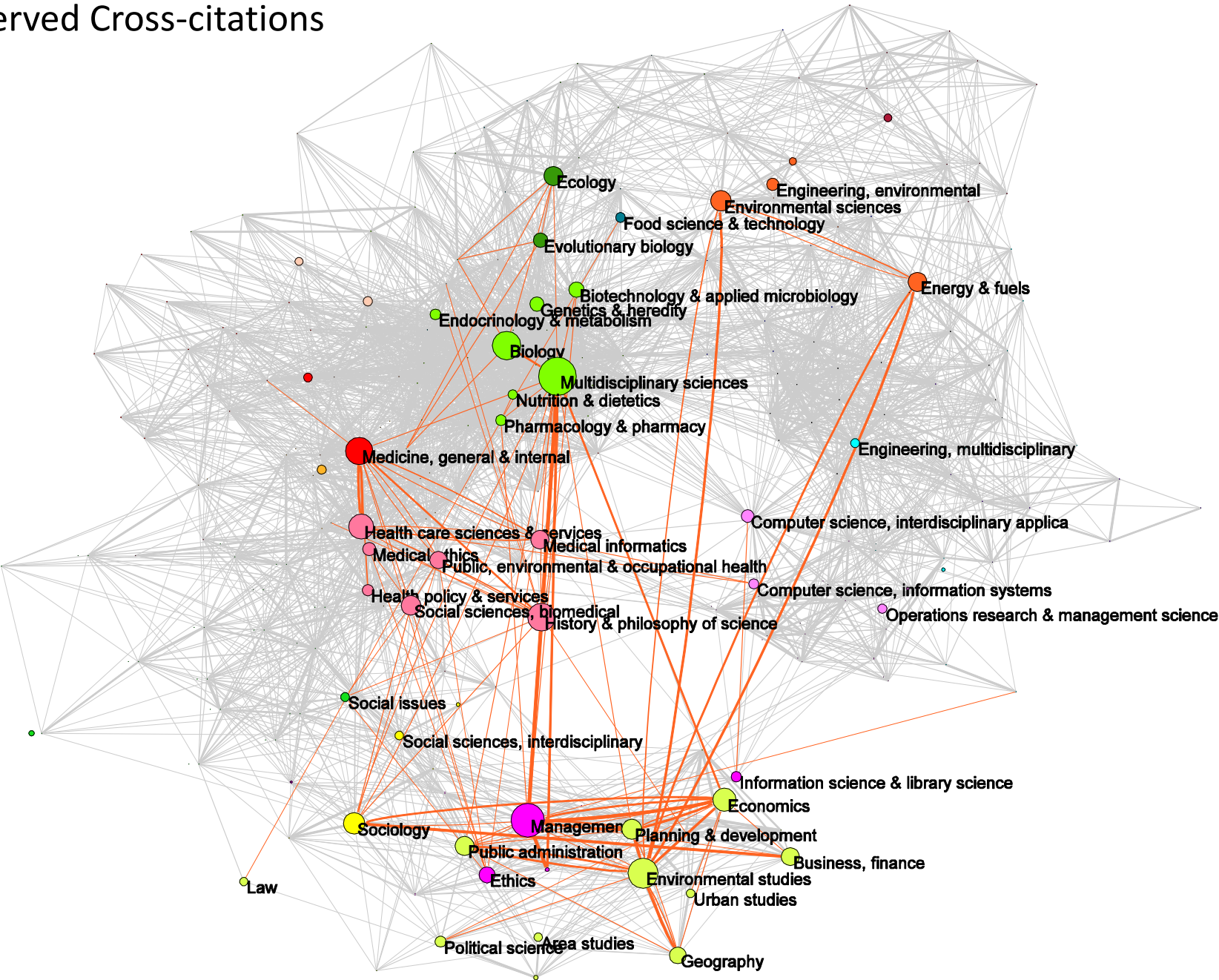


ISSTI Edinburgh

Expected Cross-citations



ISSTI Edinburgh
Observed Cross-citations

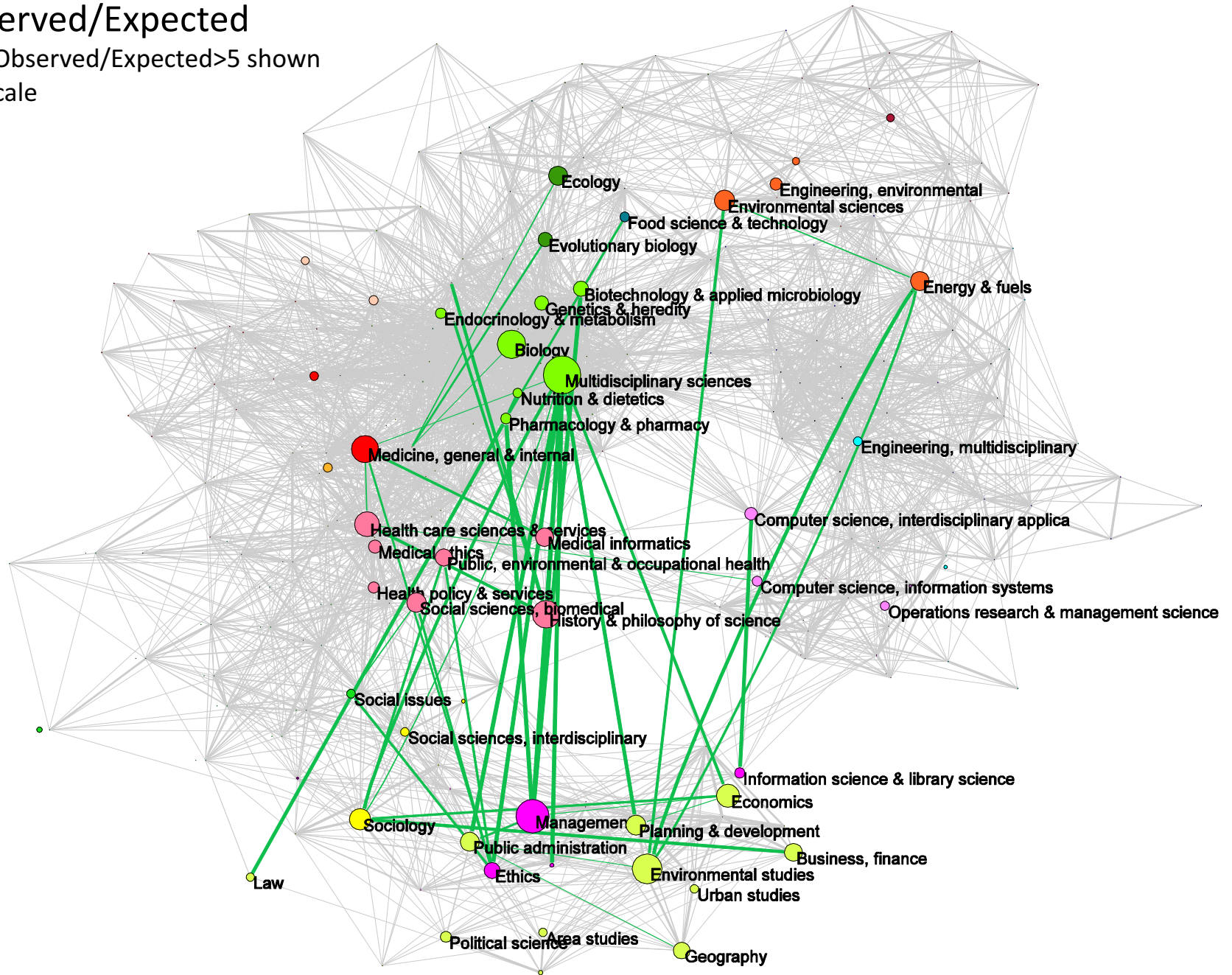


ISSTI Edinburgh

Observed/Expected

Only Observed/Expected>5 shown

Log-scale



Take away points

1. Use of certain STI indicators is associated with certain theoretical assumptions.
 - Indicators are based on conceptual framings
2. Use of indicators is associated with purpose and it has “constitutive” (intended and unintended) effects.
 - Awareness of the effect that our measuring and using measures may cause –e.g. choice over opening up vs. closing down.

Why look at STI indicators?

For example:

US National Science Board:

- **'The ultimate goal ... is a set of indices which could reveal the strengths or weaknesses of US science and technology, in terms of the capacity and performance .. in contributing to national objectives'**

(Science Indicators report of the NSB (1973), cited after Godin 2003, 680)

- **"to measure and to reflect US science, to demonstrate its strengths and weaknesses and to follow its changing character. Indicators such as these, updated regularly , can provide early warnings of events and trends which might impair the capability of science – and its related technology – to meet the ends of the Nation"**

(National Science Board US (NSB), 1975)

Why STI indicators?

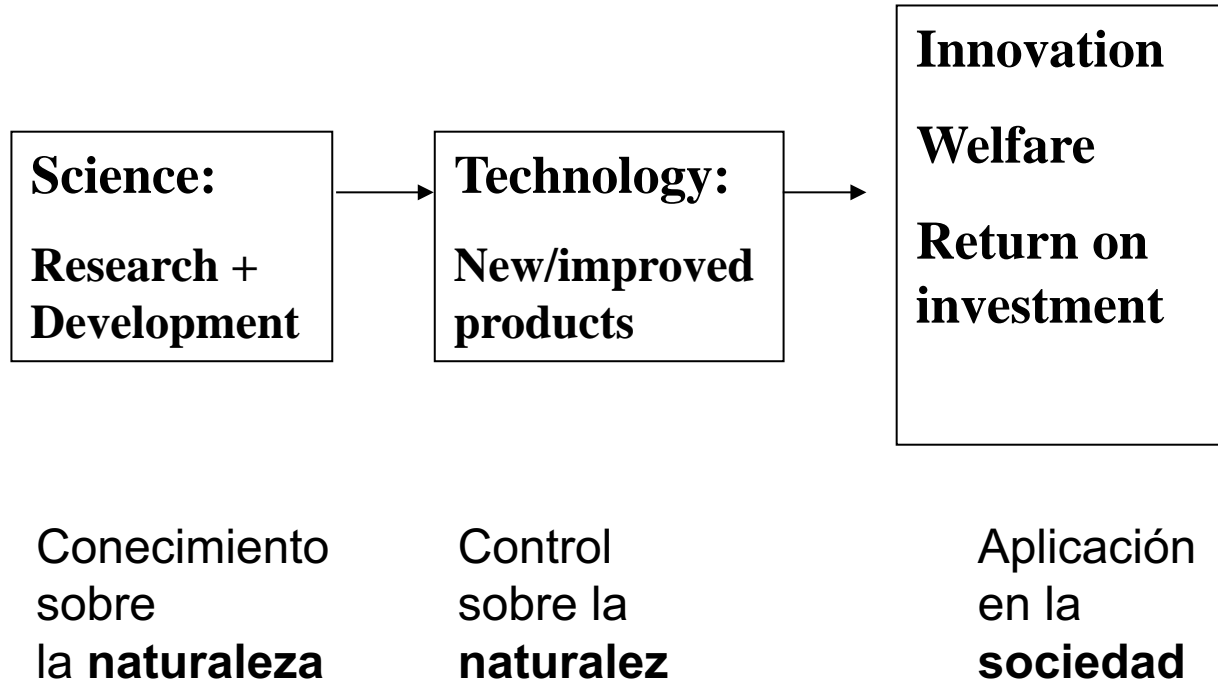
- Growing recognition that knowledge plays a crucial role in social and economic progress
- Input for the study of innovation-related activities
- Input to information R&D managers and policy makers

What can indicators be used for?

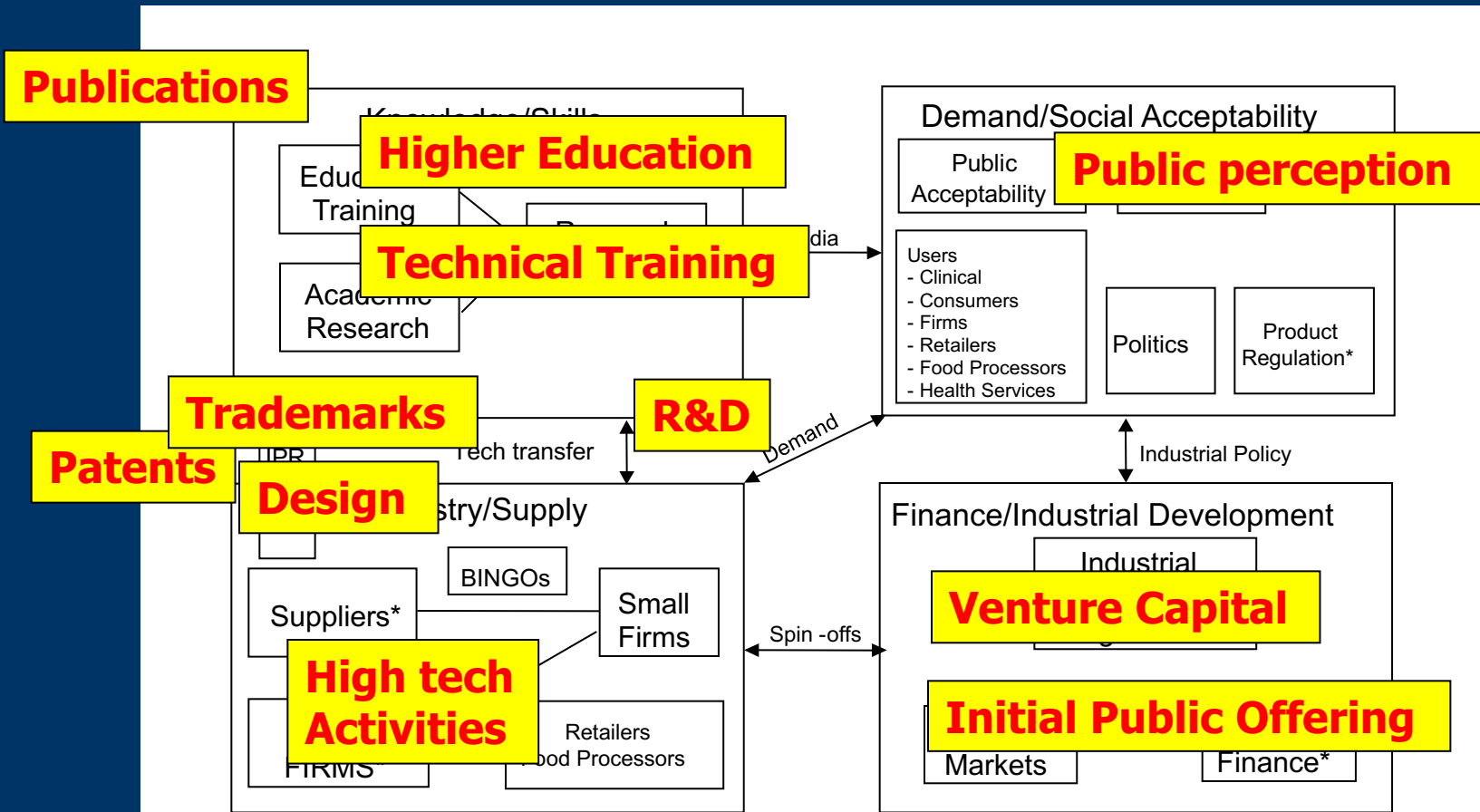
- **Monitoring (be aware of some trends)**
- **Foresight (thinking about future STI)**
- **Compare (benchmark) organisations, countries or other actors**
- **Evaluate ex-post (ex-ante?) STI policies/investments**
- **Support decisions on the allocation of R&D funds**

Understanding phenomena, supporting decision-making

El modelo lineal de innovación



Innovation systems: what should we measure?



*International influence

Source: Lacasa, Reiss & Senker, 'Trends and gaps in biotechnology policies' in *Science and Public Policy* October 2004. p. 388.