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Policy use of bibliometric evaluation and its repercussions on the scientific community

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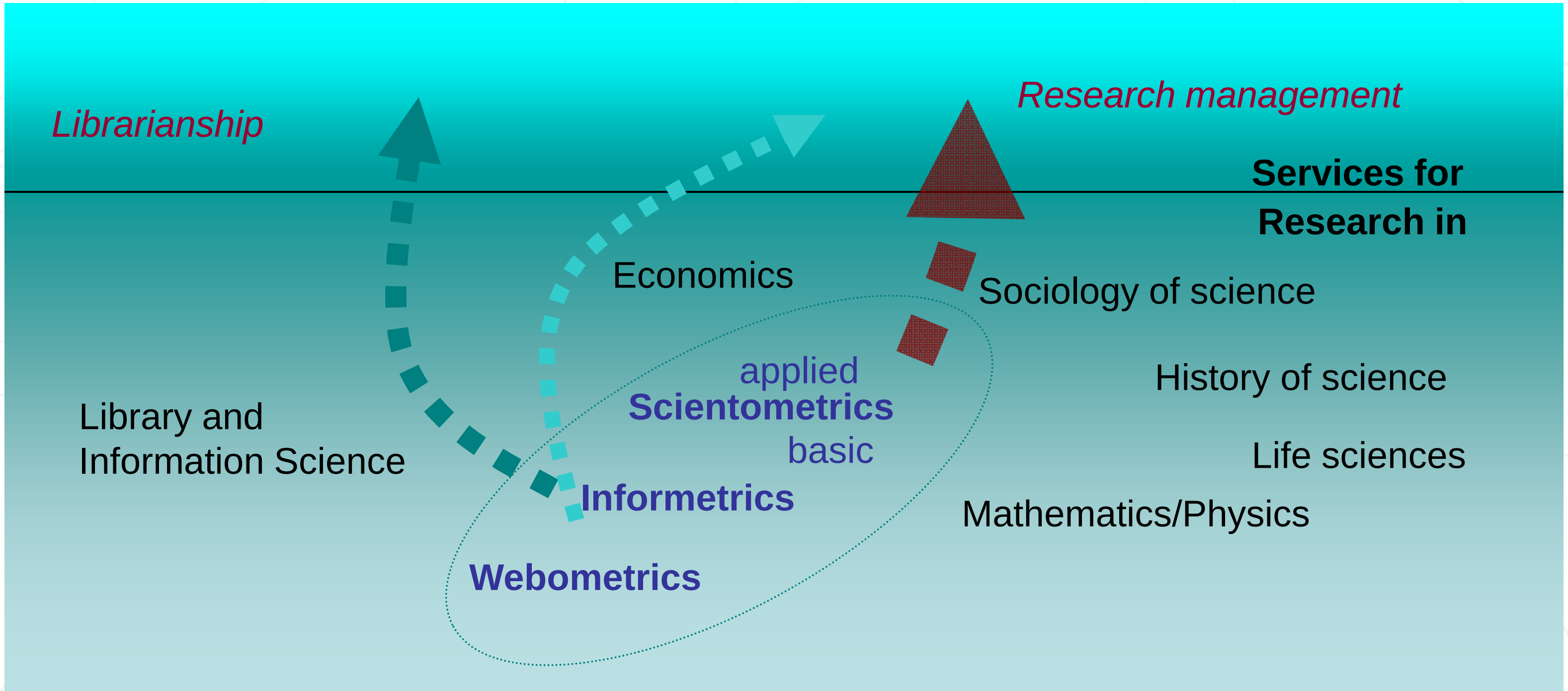
Evaluative science policy
Reflections and issues:

- Approaches in modern evaluative science policy
- The trend towards smart specialization and its repercussions for science policy
- Impact on the scientific community
- Final reflections

XXXmetrics and evaluative science policy

- **“Evaluative scientometrics” --- some contextual reflections:**



A varied data and indicators for evaluative science policy: data, indicators, benchmarks & normalization

- Evaluative scientometrics can rely on a wealth of robust data sources with benchmark potential:
  - WoS & Scopus & …
  - Patent data (USPTO, EPO, PCT, …)
  - CIS & R&D surveys
  - Regionalized data (Eurostat, ECOOM)

Given the growing interest in 3rd stream activities

- Evaluative scientometrics should be clever regarding indicators and methods:
  - Relative and normalized publication and citation indicators (MECR, MOCR, FECR, RCR, NMCR etc.), impact factors
  - Activity index
  - Relative specialisation index (Balassa)
  - Salton cosine measures (Relationship strength)
  - Robust subject classification schemes
  - Combinatorial approaches of the above; involving textmining, clustering, citation … analyses

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Comprehensive data infrastructures are key to evaluative science policy

- **E.g. ECOOM S&T data structures and infrastructures:**

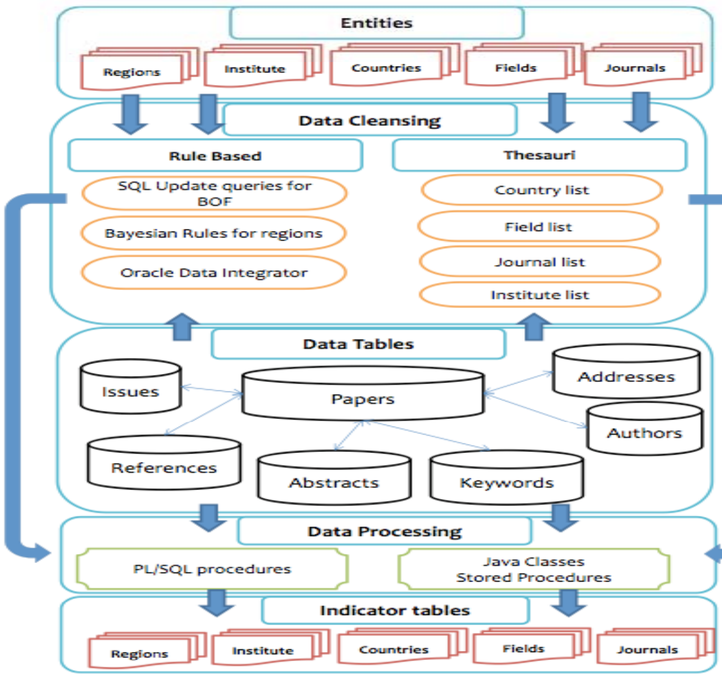
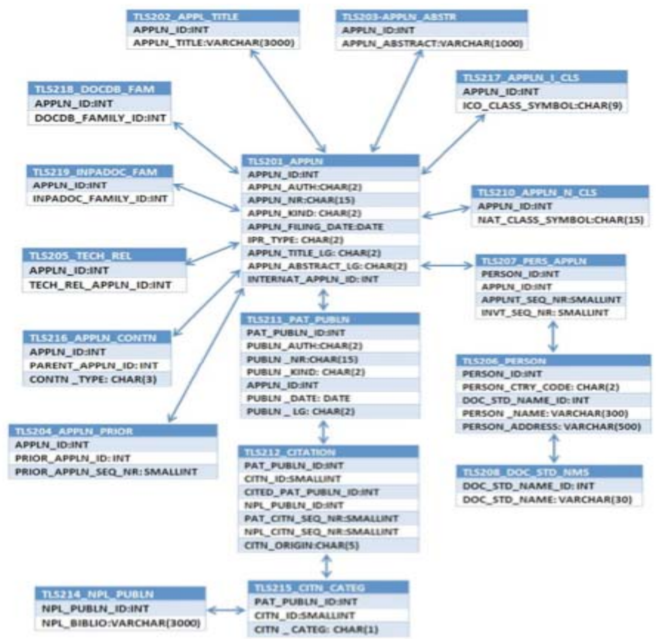


Figure 2: Structure of the relational database created from the abstract and citation databases

Diagram 1: PATSTAT Databank



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Subject classification is a key component of evaluative science policy

- Subject classification for benchmarking (Glänzel & Schubert, 2003)

A AGRICULTURE & ENVIRONMENT
- A1 agricultural science & technology
  - AE AGRICULTURAL ENGINEERING
  - AF AGRICULTURAL ECONOMICS & POLICY
  - AH AGRICULTURE, MULTIDISCIPLINARY
- A2 plant & soil science & technology
  - AM AGRONOMY
  - KA FORESTRY
  - MU HORTICULTURE
  - XE AGRICULTURE, SOIL SCIENCE
- A3 environmental science & technology
  - IH ENGINEERING, ENVIRONMENTAL
  - JA ENVIRONMENTAL SCIENCES
  - JB ENVIRONMENTAL STUDIES
  - ZR WATER RESOURCES
- A4 food & animal science & technology
  - AD AGRICULTURE, DAIRY & ANIMAL SCIENCE
  - JU FISHERIES
  - JY FOOD SCIENCE & TECHNOLOGY

Z BIOLOGY (ORGANISMIC & SUPRAORGANISMIC LEVEL)
- Z1 animal sciences
  - IY ENTOMOLOGY
  - TA ORNITHOLOGY
  - ZM ZOOLOGY
- Z2 aquatic sciences
  - OU LIMNOLOGY
  - PI MARINE & FRESHWATER BIOLOGY
- Z3 microbiology
  - DB BIOTECHNOLOGY & APPLIED MICROBIOLOGY
  - QU MICROBIOLOGY
  - RQ MYCOLOGY
  - TI PARASITOLOGY
  - ZE VIROLOGY
- Z4 plant sciences
  - DE PLANT SCIENCES
- Z5 pure & applied ecology
  - BD BIODIVERSITY CONSERVATION
  - GU ECOLOGY
- Z6 veterinary sciences
  - ZC VETERINARY SCIENCES

B BIOSCIENCES (GENERAL, CELLULAR & SUBCELLULAR BIOLOGY; GENETICS)
- B0 multidisciplinary biology

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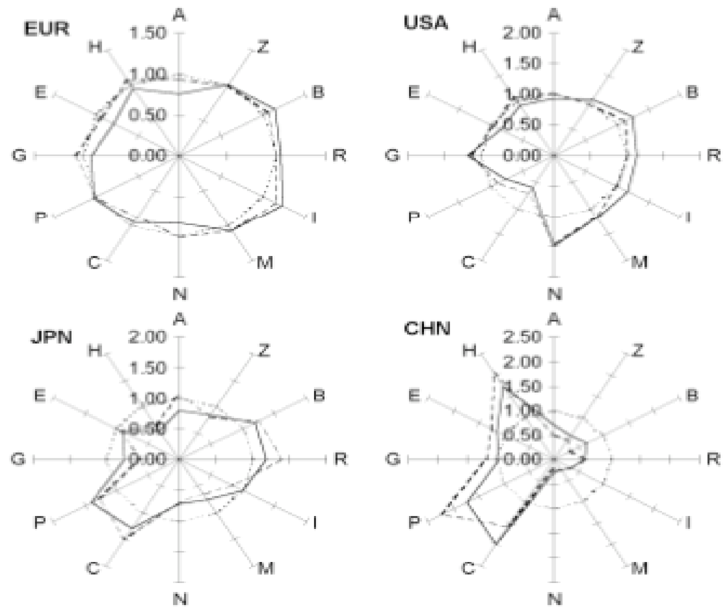
- B0 multidisciplinary biology
  - CU BIOLOGY
  - CX BIOLOGY, MISCELLANEOUS
- B1 biochemistry/biophysics/molecular biology
  - CO BIOCHEMICAL RESEARCH METHODS
  - CQ BIOCHEMISTRY & MOLECULAR BIOLOGY
  - DA BIOPHYSICS
- B2 cell biology
  - DR CELL BIOLOGY
- B3 genetics & developmental biology
  - HT EVOLUTIONARY BIOLOGY
  - HY DEVELOPMENTAL BIOLOGY
  - KM GENETICS & HEREDITY
  - WF REPRODUCTIVE BIOLOGY

...

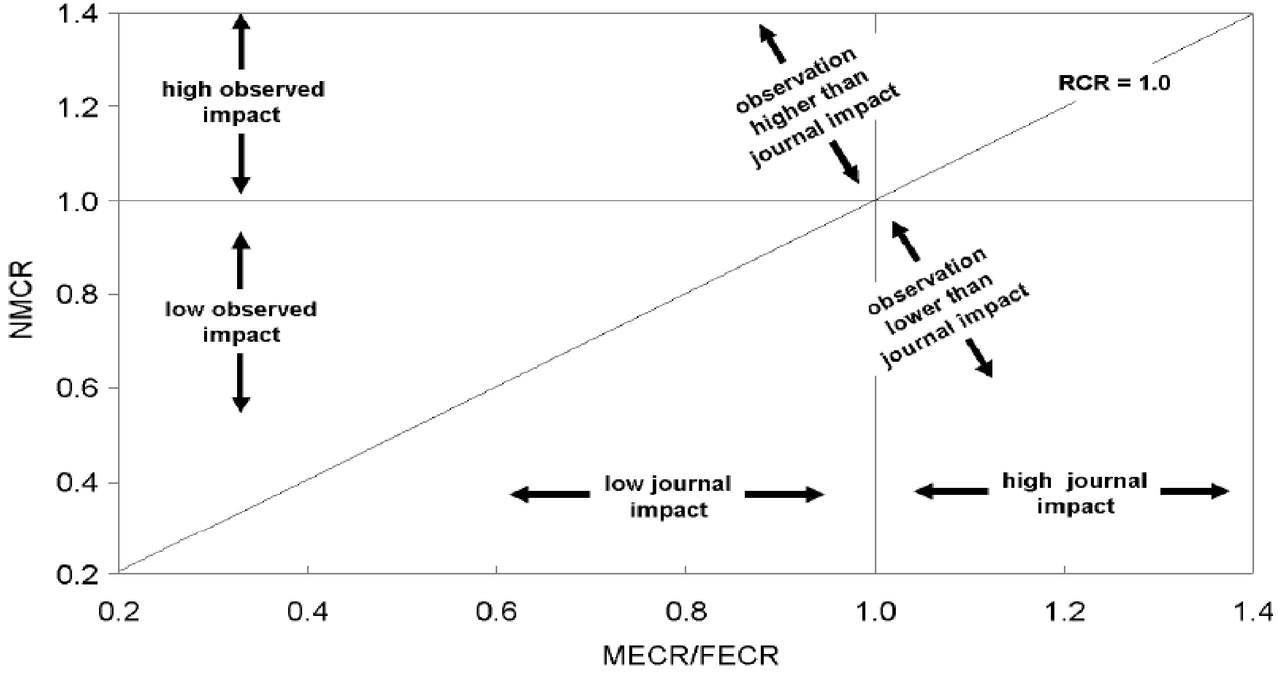
Activity profiling is key to understand institutional heterogeneity relevant to evaluative science policy

- Profiling scientific activity (Glänzel et al., 2008)



Normalization is a prerequisite for reliable benchmarks and hence for evaluative science policy

- The development of valid and robust normalized bibliometric indicator approaches for institutional benchmarking and profiling (Glänzel, Thijs, Schubert, Debackere, 2009)



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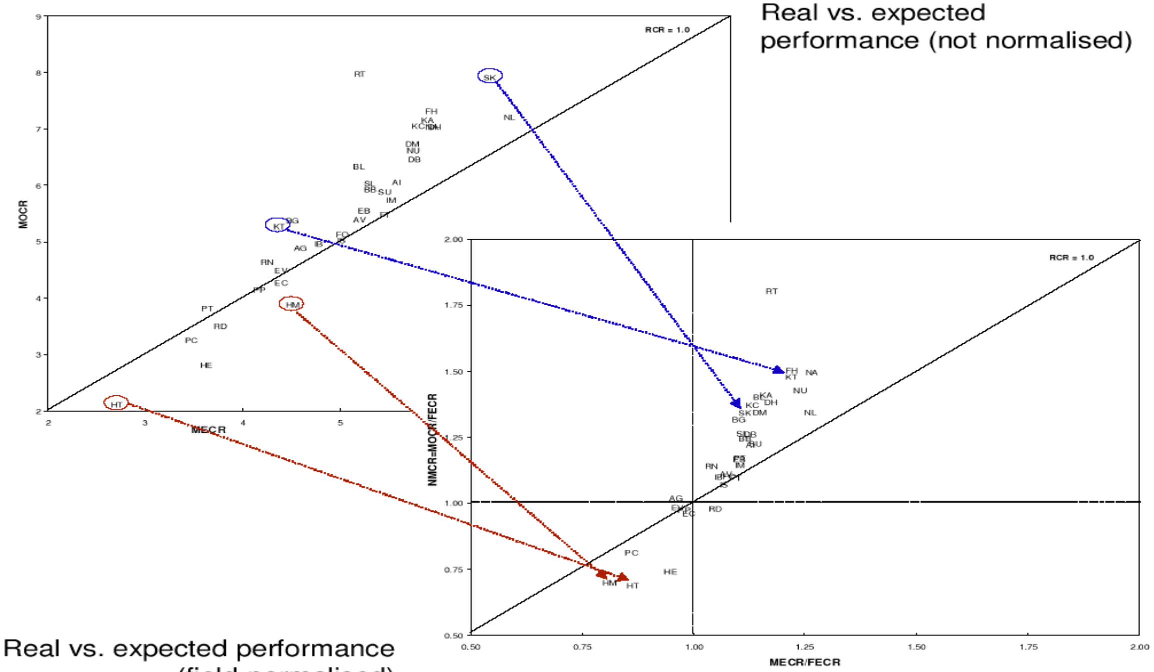
Real vs. expected performance (not normalised)



Real vs. expected performance (field-normalised)

CAVEAT regarding all the above

- Data cleaning (typographical issues, homonyms, synonyms, …) and validation are of tantamount importance before using and applying all of the above indicators, classifications and normalizations
- Evaluative science policy now plays at different levels:
  - Country/region
  - Institution
  - Disciplines
  - Small(er) research groups/projects
  - Individual level

Additional assessment of "content quality" is always needed, though need increases in direction of the arrow!
So, evaluative scientometrics is no substitute for (peer or expert) review!

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The origins of smart specialization policies

- In the wake of Joseph Schumpeter: Robert Solow and the econometric proof of scientific and technological (progress) as the “3rd” production factor ➔ the Solow-residual to explain economic growth beyond labor and capital (*The Review of Economics and Statistics, Vol. 39, No. 3. (1957), pp. 312-320)*:
  - Y=F(K,L) (i.e. Cobb-Douglas $Y = \alpha L^{\beta} K^{\gamma}$)
  - Y=F(K,L).X(T) with X(T) a parameter measuring technical progress (e.g. evolution in R&D expenditures)
  - R^2: ±20% ==> ±80%

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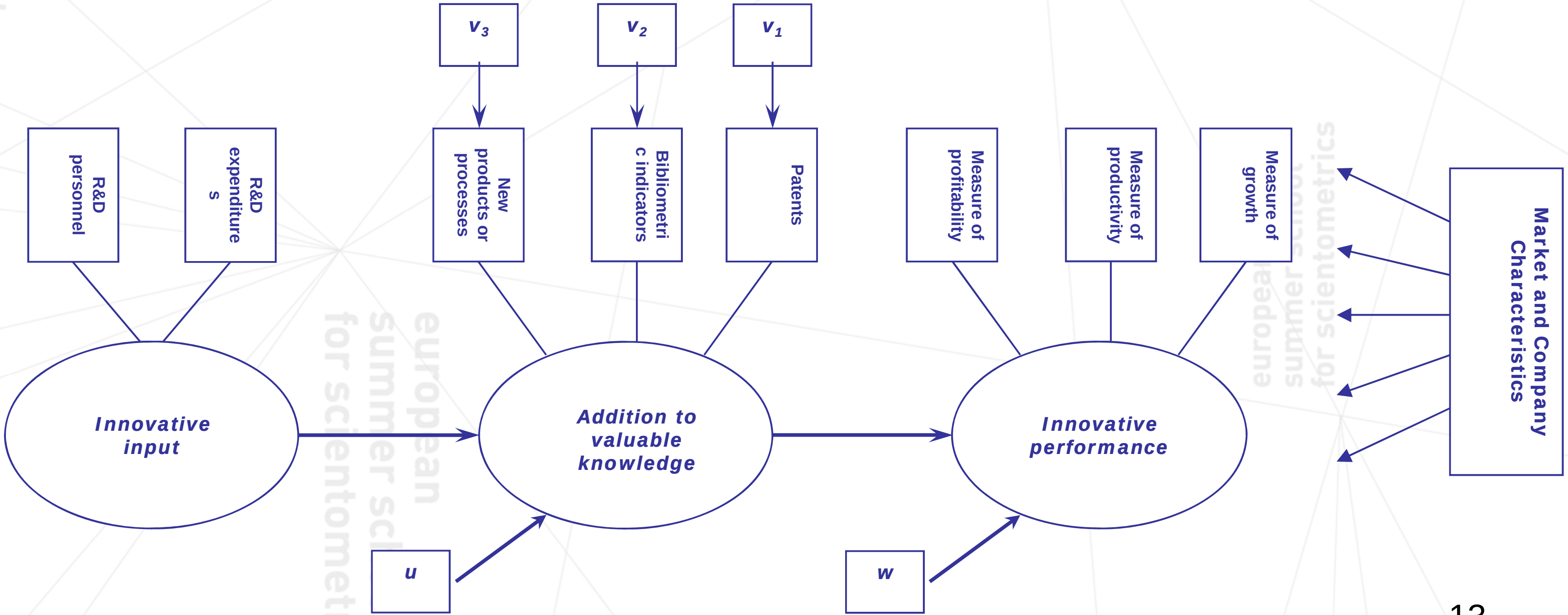
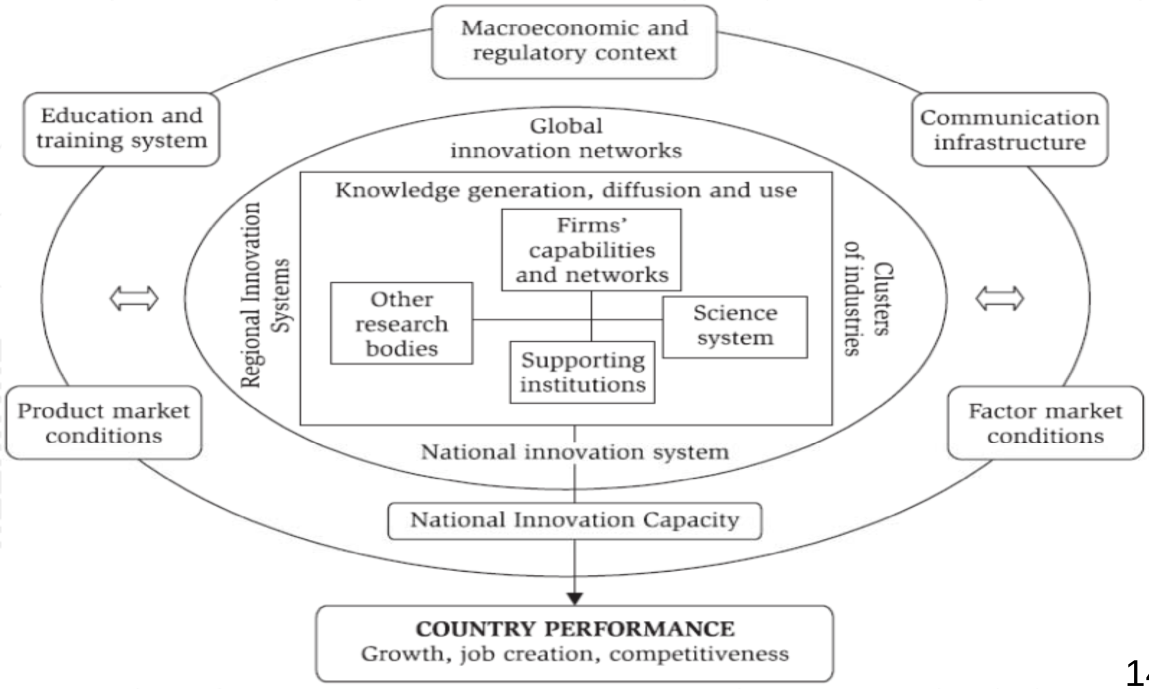
The origins of smart specialization policies

- The advent of the knowledge production function – Zvi Griliches, 1990



The origins of smart specialization policies

- The ‘endogenous’ nature of science and technology development, OECD



The origins of smart specialization policies

- The advent of the Triple Helix --- Etzkowitz & Leydesdorff, 2000

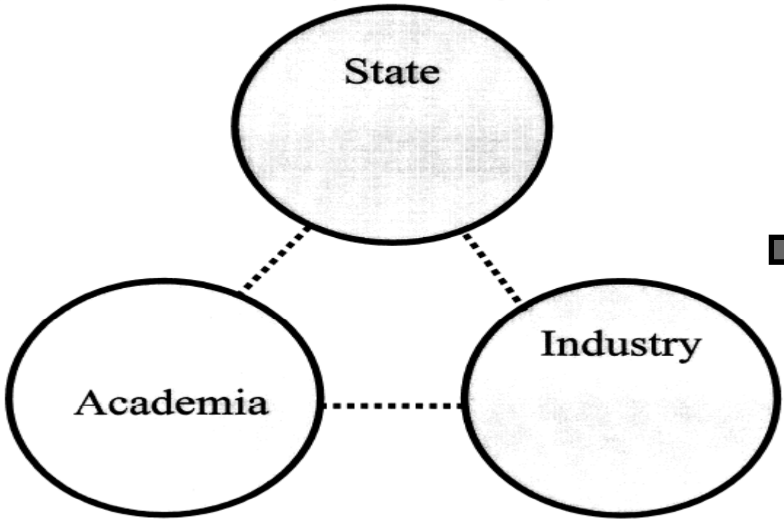


Fig. 2. A ''laissez-faire'' model of university–industry–government relations.

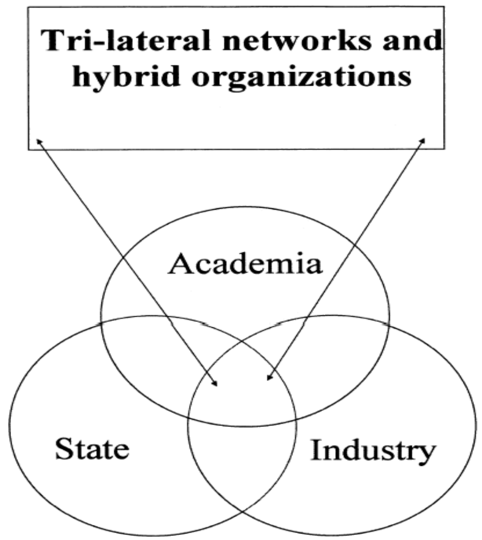


Fig. 3. The Triple Helix Model of University–Industry–Government Relations.

Defining smart specialization

- **Smart Specialization Strategy --- “3S”:**
  - Combining, linking Science & Innovation Policy + New Industry Policy
  - Objective: the knowledge-based transformation of the industrial/business texture of a region or nation
- **What? Choices based on:**
  - Unique knowledge, innovation and economic capabilities present in a region or nation,
  - Clustering of activities on the basis of an entrepreneurial discovery process,
  - Supported by cycles of policy learning in a Triple Helix context and approach.

Defining smart specialization

- **Transition** is one pattern of structural changes that a smart specialization strategy is likely to generate. Transition occurs when a new economic domain emerges from existing industrial commons (a collection of R&D, engineering, and manufacturing capabilities that sustain innovation). *E.g. the development and growth of a sustainable chemistry sector out of the present chemical industrial commons.*
- **Modernization** is another pattern. It is manifest when the development of specific applications of a general-purpose technology produces a significant impact on the efficiency and quality of an existing (often traditional) sector. *E.g. rejuvenating present, traditional manufacturing operations through the introduction of mechatronics' technologies.*
- **Diversification** in a narrow sense is a third pattern. In such cases the discovery concerns potential synergies (economies of scope, spillovers) that are likely to materialize between an existing activity and a new one. *E.g. diversification of traditional textile activities into a high value-added technical textiles industry.*
- A fourth strategic pattern involves the **radical foundation** of an economic activity domain. In this case, the discovery is that R&D and innovation in a certain field has the potential to make some activities progressive and attractive that had not been previously. *E.g. nanotechnologies for health via medical technology applications.*

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Introducing "scientometric" perspectives in 3S

Country	ISI Category (N=29160)					Topic (N=7059)				
	Papers	Share	MOCR	MECR	RCR	Papers	Share	MOCR	MECR	RCR
Belgium	198	0.7%	3.94	3.49	1.13	50	0.7%	4.14	3.82	1.08
Brazil	523	1.8%	3.50	3.82	0.91	140	2.0%	3.71	3.76	0.99
Denmark	318	1.1%	5.00	3.28	1.52	75	1.1%	10.01	3.44	2.91
France	1265	4.3%	3.27	3.23	1.01	328	4.6%	3.80	3.80	1.00
Germany	1294	4.4%	3.35	3.06	1.09	326	4.6%	4.63	3.80	1.22
Greece	462	1.6%	3.38	3.27	1.04	120	1.7%	3.59	3.13	1.15
India	1510	5.2%	4.11	3.97	1.04	421	6.0%	4.53	3.88	1.17
Italy	811	2.8%	3.40	3.44	0.99	223	3.2%	3.89	3.65	1.06
Japan	1524	5.2%	3.52	3.87	0.91	499	7.1%	4.29	4.14	1.04
Netherlands	480	1.6%	3.94	3.44	1.14	94	1.3%	4.65	3.89	1.19
China	3759	12.9%	3.68	3.58	1.03	1218	17.3%	4.12	3.78	1.09
Poland	339	1.2%	2.47	3.12	0.79	97	1.4%	3.66	3.66	1.00
Spain	1120	3.8%	3.51	3.76	0.93	262	3.7%	3.62	3.70	0.98
Sweden	568	1.9%	3.71	3.44	1.08	93	1.3%	3.66	3.64	1.00
UK	1424	4.9%	3.26	3.12	1.05	307	4.3%	3.78	3.09	1.22
USA	5136	17.6%	3.50	3.23	1.08	1036	14.7%	4.11	3.60	1.14
EUR15	7778	26.7%	3.38	3.31	1.02	1806	25.6%	4.02	3.58	1.12

Table 2 Energy & Fuels (biodiesel)
Data sourced from Thomson Reuters Web of Knowledge

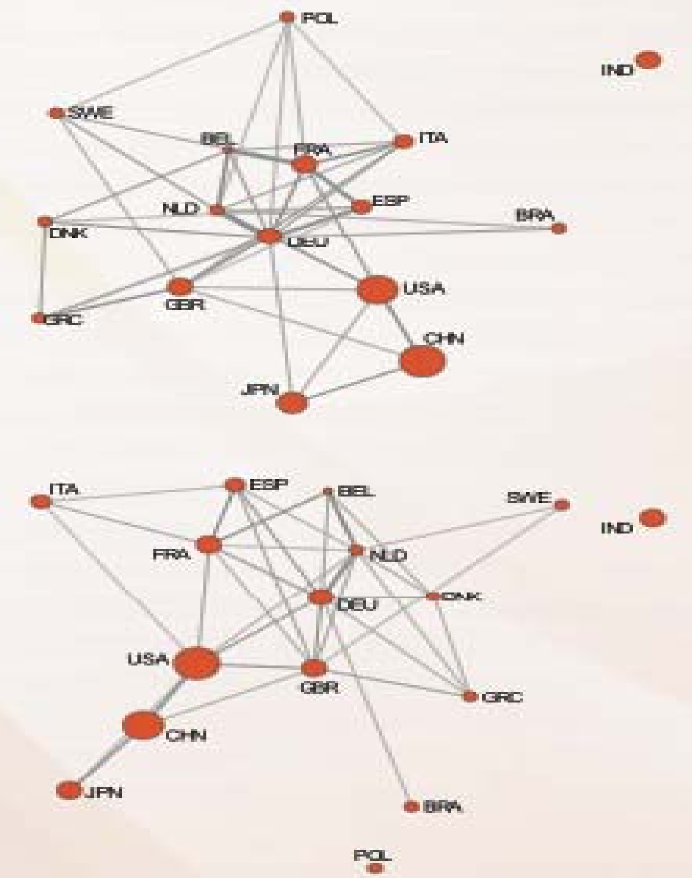

Figure 2 Energy & Fuel
(top: subject category; bottom: emerging topic)
Data sourced from Thomson Reuters Web of Knowledge

Source: ECOOM, Glänzel et al., 2011

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Impact on the scientific community

- (Potential) impact on scientific community is multiple and multifaceted:
  - Research agenda choice and setting (cfr. 3S, Horizon2020, KET's, targeted innovation (and science) policies, etc.) at individual level and at research group level (portfolio's and balances)
  - Interaction with, involvement from and even steering by other institutional stakeholders (& this does not only mean industry, but also government agencies etc.)
  - And of course, all kind of "more" as well as "less" desired behaviors … e.g. impact on collaboration, on interpretation of citations, on information use etc.; see next slides

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Possible positive effects of collaboration

Scientists might recognise that scientific collaboration and publishing in high-impact or even top journals pays. Also their publication activity might be stimulated.

Possible negative effects of collaboration

Exaggerated collaboration, even trends towards hyper-authorship, inflating publication output by splitting up publications to sequences, inflating citation impact by self-citations and forming citation cliques, etc. Trend towards replacing quality and recognition by visibility at any price or towards preferring journals as publication channels in social sciences and humanities might be among these effects.

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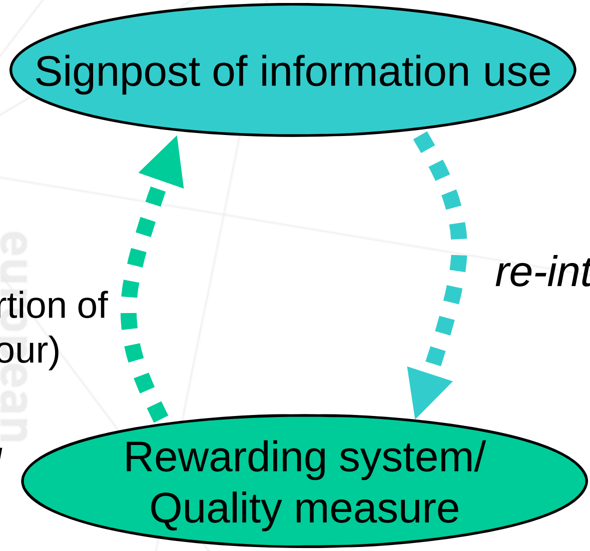
Impact on the scientific community

- Be careful with interpreting and re-interpreting citations:

citation | **interpretation**

Bibliometrics/ Information science



uncitedness: unused information
frequent cite: good reception
self-cite: part of scient. communication

repercussion
(possible distortion of citation behaviour)

re-interpretation

Reasearch evaluation/ Science policy

uncitedness: low quality
frequent cite: high quality
self-cite: manipulation of impact

An issue hence concerns the changes in the publication, citation and collaboration behavior of scientists (both positive and negative) that the consistent policy use of bibliometric indicators might potentially induce.

Studies on the problem choice behaviour of academic scientists have revealed that both cognitive and social influences determine the manner in which scientists go about choosing the problems they work on (Debackere and Rappa 1994). Hence the issue should be raised to what extent the policy use of bibliometrics might or could affect this behaviour.

The problem of inappropriate use ranges from uninformed use, over selecting and collecting ‘most advantageous’ indicators to the obvious and deliberate misuse of data.

Uninformed use and misuse are not always beyond the responsibility of bibliometricians. Unfortunately, bibliometricians do not always resist the temptation to follow popular, even populist trends in order to meet the expectations of the customers.

Clearly, any kind of uninformed use or misuse of bibliometric results involves the danger of bringing bibliometric research itself into disrepute.

Uninformed use of bibliometrics

- incorrect presentation, interpretation of bibliometric indicators or their use in an inappropriate context caused by insufficient knowledge of methodology, background and data sources
- generalisation (*induction*) of special cases or of results obtained at lower levels of aggregation

Misuse of bibliometrics

- intentionally incorrect presentation, interpretation of bibliometric indicators or their deliberate use in inappropriate context
- tendentious application of biases
- tendentious choice of (incompatible) indicators

But even correct use might have undesired consequences. *Example*: Re-interpreting underlying contexts such as the notion of *citation* shows author self-citations in an unfavourable light. Authors might thus be urged avoiding self-citations – a clear intervention into the mechanism of scientific communication.

Less obvious repercussions might be observed when bibliometric tools are used in decision-making in science policy and research management and the scientific community recognises the feedback in terms of their funding.

Butler (2004) has shown on the example of Australia what might happen when funding is linked to publication counts. She found that the publications component of the *Composite Index* has stimulated an increased publication activity in the lower impact journals.

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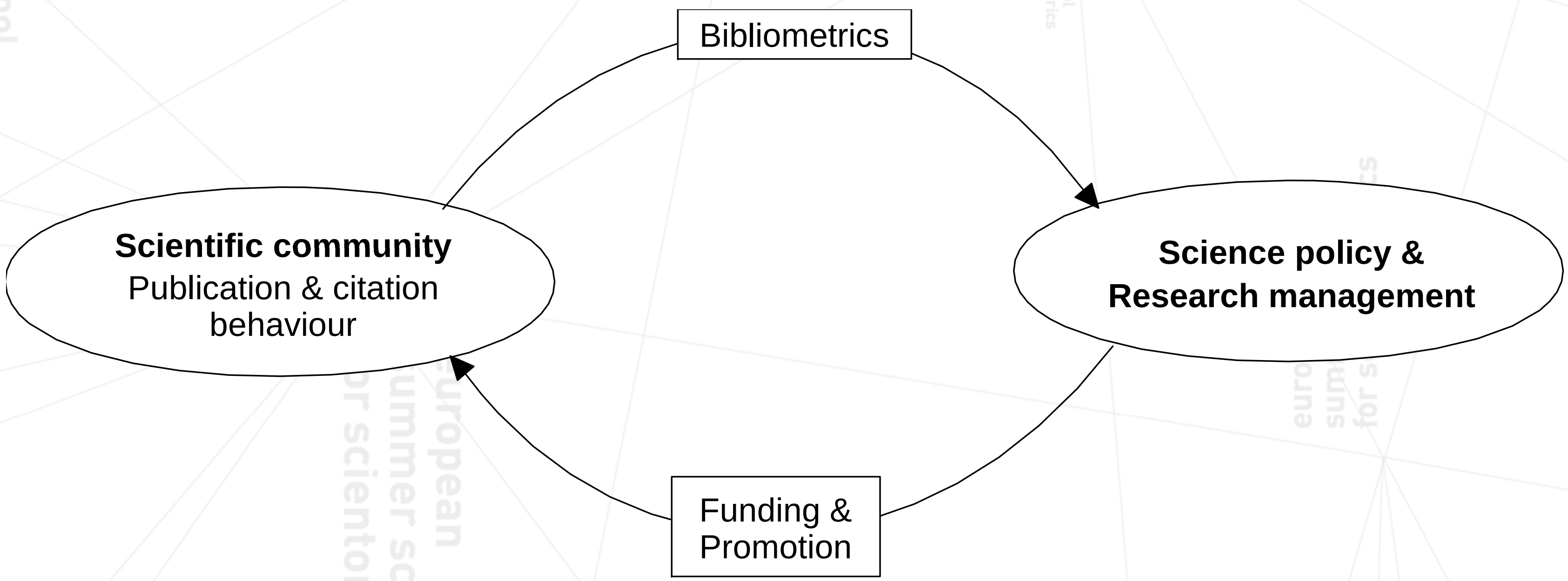
Schematic visualisation of the feedback of policy use of bibliometrics on the scientific community



Impact on the scientific community

- Therefore, an absolute need for:
  - Transparency on data, data methods, data treatment, data analysis, not only at moments of evaluation but also during the monitoring that occurs all along
  - Understanding the pitfalls and the limitations of the use of different indicator and data sources at different levels of analysis serving different evaluative purposes
  - And integrity, as should always be …

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Final reflections

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  - WoS & Scopus & …
  - Patent data (USPTO, EPO, PCT, …)
  - CIS & R&D surveys
  - Regionalized data (Eurostat, ECOOM)
- However, we should always be clever and transparant regarding the specific use of indicators and methods and the context to which they are fitted:
  - Relative and normalized publication and citation indicators, impact factors
  - Activity index
  - Relative specialisation index
  - Salton cosine measures
  - Robust subject classification schemes
  - Combinatorial approaches involving textmining, clustering, citation … analyses

Final reflections

- Complement these indicators and methods with:
  - Intelligent (limited) additional data collection for controls
  - Case studies on institutions & policies
- Practical scientometrics should also understand:
  - The amount of data “work” needed to do robust bibliometric analysis (data cleaning, institutional cleaning, harmonizing data …)
  - The need for appropriate IT-infrastructures and -platforms to support scientific and policy oriented bibliometric analyses
  - The need to be extremely transparant on what data were used in what manner
- The emerging input, output & outcome debates and challenges

THANK YOU

Questions?

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