

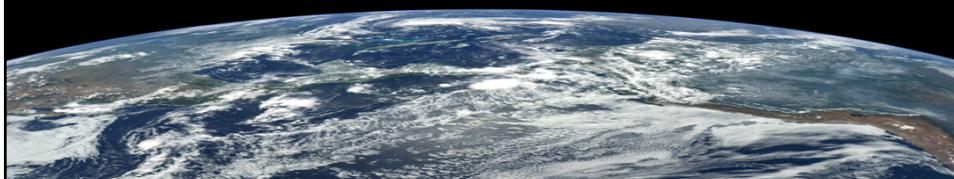
Implications for Future OECD Work

Katy Börner

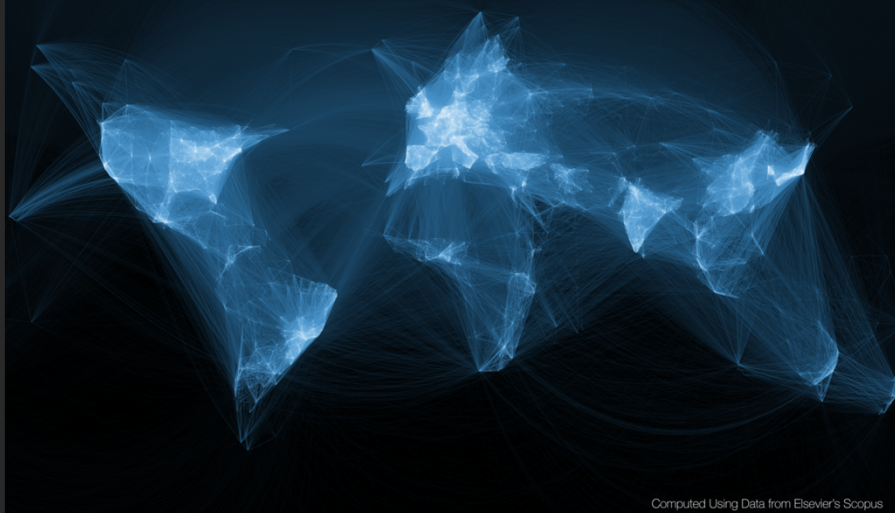
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OECD-Experts Dialogue on Scientometrics
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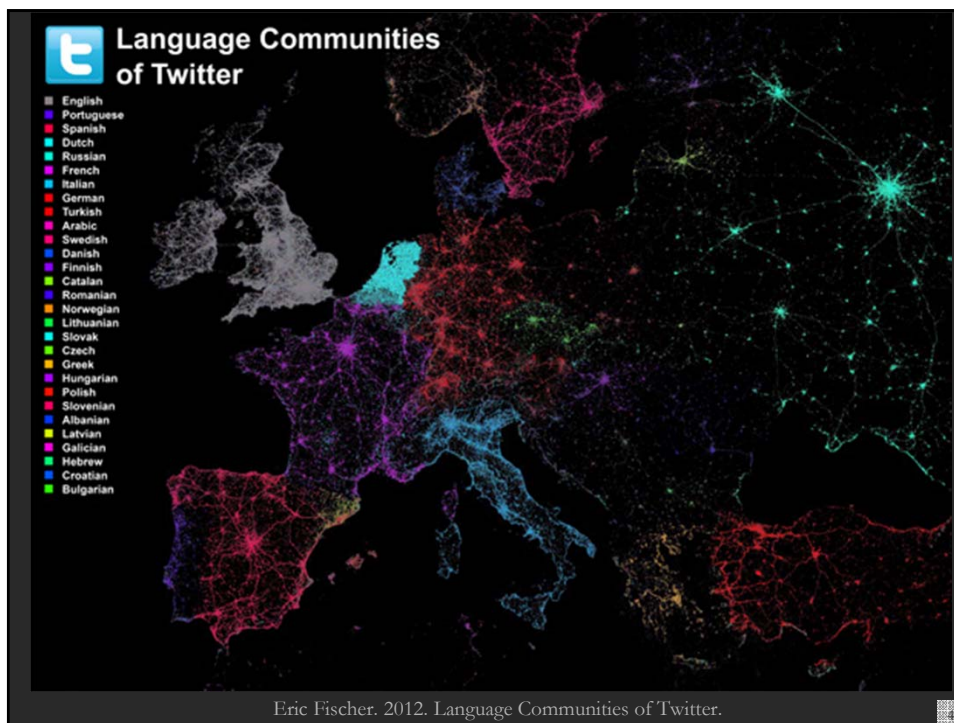
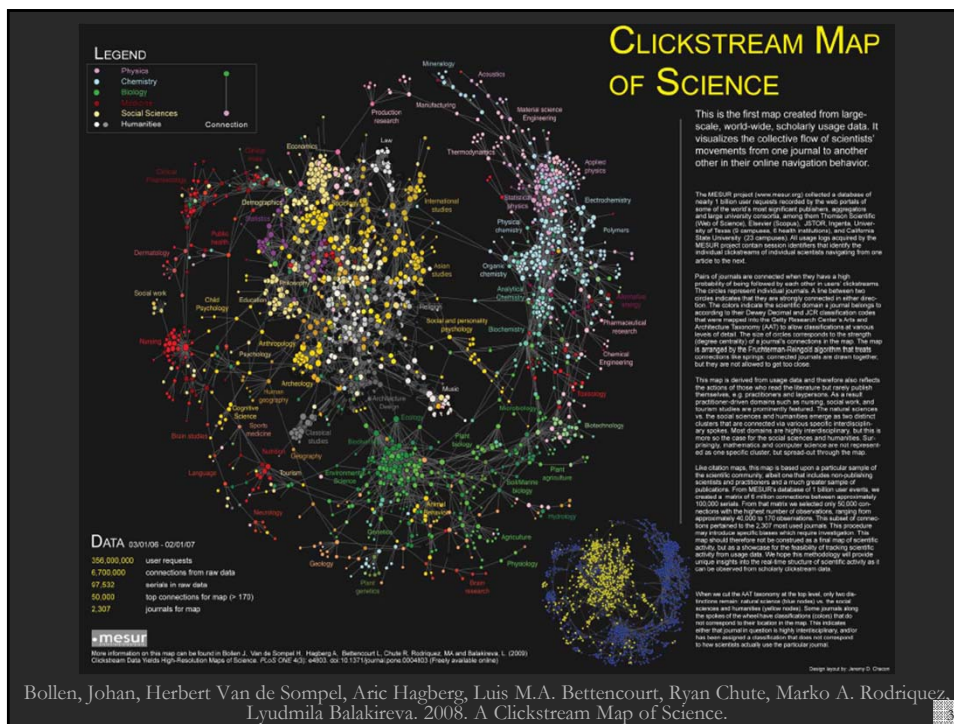
Map of Scientific Collaborations from 2005-2009



Computed Using Data from Elsevier's Scopus

Olivier H. Beauchesne, 2011. Map of Scientific Collaborations from 2005-2009.





INSTITUTE FOR THE FUTURE
Science & Technology Outlook: 2005-2055

2005

2055

MAP THEMES

- 1. Health Care**
Over 20 years of basic research and development at the 100-nanometer scale, the importance of nanotechnology as a source of innovation and new capabilities in everything from medicine to agriculture is already well understood. These trends, however, will define how nanotechnology will be used, and what impacts will have. First, nanotechnology is a single field with universal intellectual programs. It is an open-ended hybrid, brought by a combination of fundamental research, quantum, nanoscale mechanical engineering, and various other capital. Second, nanotechnology moves away from the original vision of small-scale mechanical engineering—which encompasses both mechanical systems from industrial plants—toward one which includes biological and biochemistry contribute essential tools. Such as proteins that build nanoscale. Finally, nanotechnology will also serve as a model for transdisciplinary science. It will support both fundamental research and some-oriented innovation, and it will be conducted not within the boundaries of conventional academic or corporate research departments, but in interdisciplinary centers that address the interface between.
- 2. Environmental Energy**
In the last 10 years, nuclear has gained biology as the grand old baby. Matter has been a traditional hydrogen bomb to read and write the genetic code of life and building up ability to recognize biology from the bottom up. We do not only genetically engineer existing life but actually create new life forms with purpose. Still, we will not be able to realize the potential of the next 50 years of engineering of the smaller scale will be a rich source of inspiration and will be the most important of the next 50 years.
- 3. Cognitive Tech**
In the next 50 years, we will be faced with great opportunities to improve our minds and bodies in profoundly different ways. Advances in biotechnology, brain science, robotics, technology, and robotics will result in an array of methods to dramatically alter, enhance, and expand the mental and physical faculties that nature has dealt us. While relying both on surfaces, humans will begin to desire a variety of diverse "transformational" paths—ways of being being that extend beyond what we today consider natural for our species. In very long term, following these paths could completely redefine an individual's life as humans.
- 4. Mathematical World**
The ability to process, manipulate, and ultimately understand patterns in enormous amounts of data will allow discovery of previously unappreciated processes in everything from biological to social systems. Scientists are learning that at the core of many biological phenomena—regulation, growth, repair, and others—in computational processes that can be devised and automated. Using techniques of computational science to uncover such patterns—whether these are physical, biological, or social—will likely open up an increasing stream of surprising insights in the next 50 years. Such research programs will also come to include advanced computer simulation will be used to try to help make decisions about large complex scientific and social problems but also to help individual make better choices in their daily lives.
- 5. Sensory Transformation**
In the next ten years, physical objects, places, and even humans being themselves will increasingly become embedded with computational devices that can sense, understand, and act upon their environment. They will be able to read to understand about the physical, social, and even emotional state of people and act on their surroundings. As a result, increasing numbers will be placed on our walls, ceilings, and other sensory devices. Information processing will be distributed across humans, animals, machines, and facility environments. This artificial general environment will coincide with major breakthroughs in our understanding of the brain—how we process sensory information and connect various sensory functions.

Science & Technology Outlook: 2005-2055 - Alex Soojung-Kim Pang, David Pescovitz, Marina Gorbis, Jean Hagan - 2006

Chemical Research & Development Powers the U.S. Innovation Engine
Macroeconomic Implications of Public and Private R&D Investments in Chemical Sciences

INVESTMENT IN CHEMICAL SCIENCE R&D

FEDERAL GOVERNMENT
\$1 Billion FEDERAL FUNDING

CHEMICAL INDUSTRY
\$5 Billion INDUSTRY FUNDING

U.S. ECONOMY
\$8 Billion TAXES

\$10 Billion
CHEMICAL INDUSTRY OPERATING INCOME

\$40 Billion
GROWTH IN GNP
+
600,000
JOBS CREATED

TIMELINE FROM CONCEPTION TO COMMERCIALIZATION

4-5 YEARS: ECONOMIC RESEARCH → 0-1 YEARS: APPLIED RESEARCH → 2-5 YEARS: TECHNOLOGY COMMERCIALIZATION

The Council for Chemical Research (CCR) has provided the U.S. Congress and government policy makers with important results regarding the impact of Federal Research & Development (R&D) investments on U.S. innovation and global competitiveness through its commissioned 5-year two phase study. To take full advantage of typically brief access to policy makers, CCR developed the graphic below as a communication tool that distills the complex data produced by these studies in direct, concise and clear terms.

The design shows that an input of \$1B in federal investment, leveraged by \$8B industry investment, brings new technologies to market and results in \$10B of operating income for the chemical industry. \$40B growth in the Gross National Product (GNP) and further impacts the U.S. economy by generating approximately 600,000 jobs, along with a return of \$6B in taxes. Additional details, also reported in the CCR studies, are depicted in the map to the left. This map clearly shows the two R&D investment cycles: the shorter industry investment at the innovation stage to commercialization cycle; and the longer federal investment cycle which begins in basic research and culminates in national economic and job growth along with the increase tax base that in turn is available for investment in basic research.

Council for Chemical Research. 2009. Chemical R&D Powers the U.S. Innovation Engine. Washington, DC. Courtesy of the Council for Chemical Research.

Past Workshops (with links to slides)

- **Bibliometric Standards** 1995 in Chicago, IL
- [Workshop on Scholarly Databases & Data Integration](#) August 30-31, 2006 at CNS, Bloomington, IN
- [NIH Workshop on Identifiers and Disambiguation in Scholarly Work](#) March 18-19, 2010 in Gainesville, FL
- [JSMF Workshop on Standards for Science Metrics, Classifications, and Mapping](#) August 11-12, 2011 at CNS, Bloomington, IN
- [Standards for Science Mapping and Classifications](#) July 15, 2013 at ISSI, Vienna, Austria
- **Standards Workshop** 2013 at STI in Berlin, Germany
- [Science Mapping Standards Workshop](#) Nov. 04-05, 2013 at CNS, Bloomington, IN
- [OECD-experts dialogue on scientometrics: Improving the use of bibliometric indicators and analysis for policy-making](#) March 25, 2014 at OECD, Paris, France

Please send me pointers to others.

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WANTED (1995 Chicago Workshop , W. Glänzel's slides with Katy add-ons)

- Terminology and definitions
- Structure and organization of (micro)data that is interoperable so that global, multi-level S&T studies can be run
- Proper documentation of methods – re-runnable workflows
- Robust but easy to use/understand algorithms and tools
- Replicability and validation of results
- Commensurability and comparability
- Level of aggregation—each level needs own standards, indicators
- Improved communication among experts and with policy makers
- Healthy balance of competition and collaboration
- Training for experts (including publishers) in advanced methods and tools in statistics, economics, social science, scientometrics, etc.
- Training for policy makers on appropriateness of tools and indicators
- Education of the general public on the utility and value of S&T

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WANTED (From 2013 STI Workshop, W. Glänzel's slides)**Data sources**

- Publication and document types
- Data cleaning and processing
- **Subject classification**

Indicators

- Statistical issues
- Time-related issues
- Normalisation

Good practice

- Situations in which the use of bibliometrics is considered appropriate and situations in which it is not (e.g., individual level bibliometrics – ISSI Plenary and STI Special)
- Distorted behaviour based on policy use and misuse of bibliometric data (Repercussions on the community and scientists' behaviour)
- Transparency of bibliometric research evaluation and interaction with users

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Promising Example: Map of Science and Classification System

- Small: 1996 Map of Science [\[6\]](#)
- Boyack and Klavans: The Backbone of Science, the 2002 Base Map, the Paradigm Map, the UCSD Map of Science, see discussion and comparison in [\[4\]](#)
- Leydesdorff and Rafols: Map of Thomson Reuters subject categories and associated journals [\[5\]](#)
- Moya-Anegón et al. at SCImago: Graphic representation of the Spanish Science Research [\[7\]](#)
- Börner, Klavans, ..., Larivière, and Boyack (2012) Design and Update of a Classification System: The UCSD Map of Science. *PLoS ONE* 7(7): e39464. doi:10.1371/journal.pone.0039464, Data is at <http://sci.cns.iu.edu/ucsdmap>
- [SciTech Strategies](#), [OST](#), [CNS](#), CWTS, SciELO are currently collaborating on a paper-based (WoS + proceedings + books, Scopus, SciELO), multi-level map and classification system. This classification system will have concordances to different S&T, engineering and education taxonomies and classifications.

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Possible Roles for OECD (*This list is VERY extensive list. If one or two items could be implemented collectively this would be a major progress.*)

- Invite (edit?) and publish a dictionary of terminology and definitions—in many languages
- Promote open access to (micro)data and validated tools in support of replicability
- Publish existing uniqueX lists of institutions, funding agencies, etc. for different countries.
- Lead (?) development of S&T, engineering and education classifications and cross-walks/concordances.
- Promote and showcase evaluation and validation of metrics, indicators, models
- User-oriented state of the art reports (Henk)
- Publish key meetings, efforts, projects, e.g., listserv, web sites
- Help bridge the gap between those who develop indicators and those who use them
- Facilitate a more continuous, systematic dialogue via a **Scientometrics Task Force** that involves key producers and users of publication and other data.
- Promote Scientometrics at Blue Sky Conference (Alessandra)

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Upcoming Conferences and Workshops (*Possible venues to continue this discussion*)

- March 25, OECD-Experts Dialogue on Scientometrics, OECD, Paris, France.
- April 10-13, International Network of Research Management Societies (INORMS), Washington, DC.
- May 19-21, [6th Annual Research Development Conference](#) (NORDP), Portland, OR.
- June 2-6, International Conference on Network Science, Berkeley, CA.
- June 23-26, Web Science Conference, Bloomington, IN.
- August 6-8, Science of Team Science + VIVO Conference, Austin, TX.
- Sept 3-5, [19th International Conference on Science and Technology Indicators](#) Conference, Leiden, Netherlands.
- Nov 3-4, [Plug-and-Play Macroscopes Workshop](#), CNS, IU.

2015: 15th International Conference of the International Society for Scientometrics and Informetrics, Istanbul, Turkey

2016: OECD Blue Sky Indicators Conference

Please send me pointers to others.

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