

Envisioning Communication and Collaboration

Katy Börner

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School of Informatics and Computing, Indiana University, USA

Rice University, Houston, TX
November 11, 2014

Language Communities of Twitter - Eric Fischer - 2012

Humanexus

[Watch the official trailer »](#)



Producer/Script Writer: Katy Börner, Designer/Artist: Ying-Fang Shen, Sound Artist: Norbert Herber, 2013.

<http://cns.iu.edu/humanexus>



READINGS

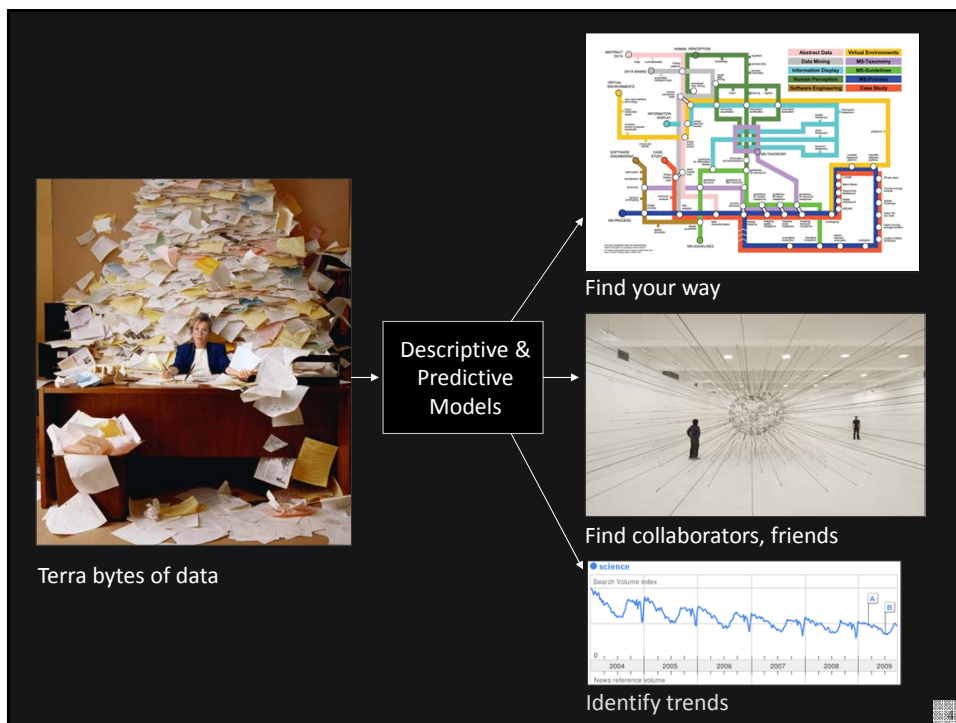
Papers

- Stipelman, Brooke A., Hall, Kara L., Zoss, Angela, Okamoto, Janet, Stokols, Dan, and Börner, Katy (2014) Mapping the Impact of Transdisciplinary Research: A Visual Comparison of Investigator Initiated and Team Based Tobacco Use Research Publications. *The Journal of Translational Medicine and Epidemiology*.
- Bollen, Johan, David Crandall, Damion Junk, Ying Ding, and Katy Börner. 2014. [From funding agencies to scientific agency: Collective allocation of science funding as an alternative to peer review](#). *EMBO Reports* 15 (1): 1-121.
- Mazloumian, Amin, Dirk Helbing, Sergi Lozano, Robert Light, and Katy Börner. 2013. [Global Multi-Level Analysis of the 'Scientific Food Web'](#). *Scientific Reports* 3, 1167.

Books

- Börner, Katy. 2015. *Atlas of Knowledge: Anyone Can Map*. The MIT Press.
- Börner, Katy, and David E. Polley. 2014. *Visual Insights: A Practical Guide to Making Sense of Data*. Cambridge, MA: The MIT Press.
- Scharnhorst, Andrea, Katy Börner, and Peter van den Besselaar, eds. 2012. *Models of Science Dynamics*. Springer Verlag.
- Börner, Katy, Mike Conlon, Jon Corson-Rikert, and Ying Ding, eds. 2012. *VIVO: A Semantic Approach to Scholarly Networking and Discovery*. Morgan & Claypool Publishers LLC.
- Börner, Katy. 2010. *Atlas of Science: Visualizing What We Know*. The MIT Press.

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Descriptive Models

Multiple levels: Micro ... Macro

Answering: When? Where? What? With Whom?



Different Levels of Abstraction/Analysis

Macro/Global
Population Level



Meso/Local
Group Level



Micro
Individual Level

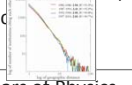





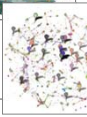


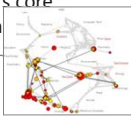


Type of Analysis vs. Level of Analysis

	Micro/Individual (1-100 records)	Meso/Local (101-100,000 records)	Macro/Global (100,000 < records)
Statistical Analysis/Profiling	Individual person and their expertise profiles	Larger labs, centers, universities, research domains, or states	All of NSF, all of USA, all of science.
Temporal Analysis (When?)	Funding portfolio of one individual	Mapping topic bursts in 20-years of PNAS	113 Years of Physics Research
Geospatial Analysis (Where?)	Career trajectory of one individual	Mapping a states intellectual landscape	PNAS publications
Topical Analysis (What?)	Base knowledge from which one grant draws.	Knowledge flows in Chemistry research	VxOrd/Topic maps of NIH funding
Network Analysis (With Whom?)	NSF Co-PI network of one individual	Co-author network	NIH's core competency

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Type of Analysis vs. Level of Analysis

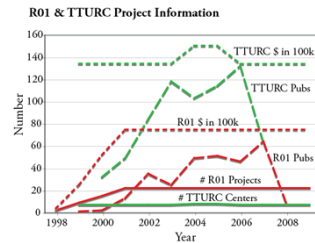
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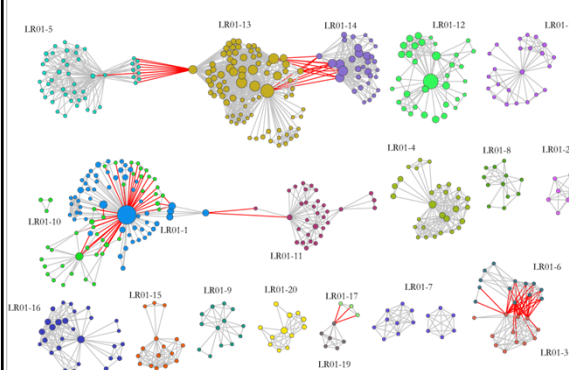
Mapping Transdisciplinary Tobacco Use Research Centers Publications

Compare R01 investigator based funding with TTURC Center awards in terms of number of publications and evolving co-author networks.

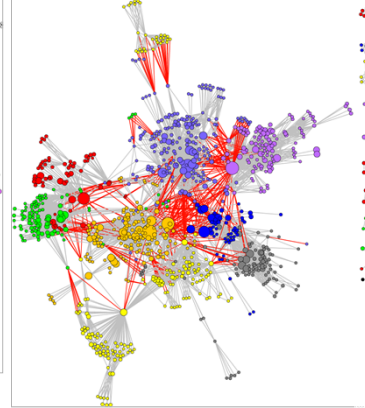
Stipelman, Hall, Zoss, Okamoto, Stokols & Börner, 2014
Supported by NIH/NCI Contract HHSN261200800812



Longitudinal R01 Co-Authorship Network



TTURC Co-Authorship Network



Spatio-Temporal Information Production and Consumption of Major U.S. Research Institutions

Börner, Penumathy, Meiss & Ke (2006) Mapping the Diffusion of Scholarly Knowledge Among Major U.S. Research Institutions. Scientometrics. 68(3), pp. 415-426.

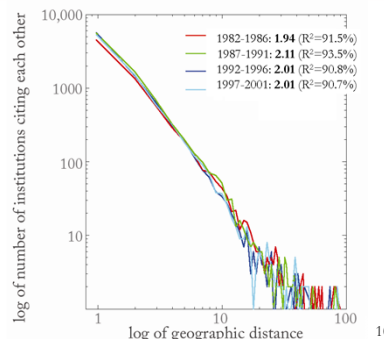
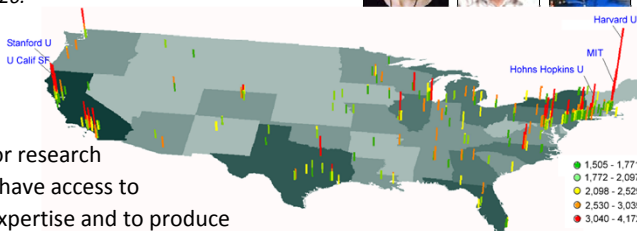


Research questions:

1. Does space still matter in the Internet age?
2. Does one still have to study and work at major research institutions in order to have access to high quality data and expertise and to produce high quality research?
3. Does the Internet lead to more global citation patterns, i.e., more citation links between papers produced at geographically distant research institutions?

Contributions:

- Answer to Qs 1 + 2 is YES.
- Answer to Qs 3 is NO.
- Novel approach to analyzing the dual role of institutions as information producers and consumers and to study and visualize the diffusion of information among them.



The Global 'Scientific Food Web'

Mazloumian, Amin, Dirk Helbing, Sergi Lozano, Robert Light, and Katy Börner. 2013. "Global Multi-Level Analysis of the 'Scientific Food Web'". *Scientific Reports* 3, 1167.

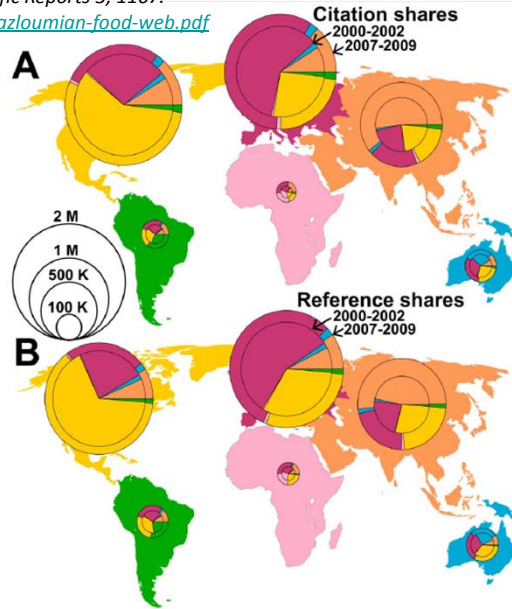
<http://cns.iu.edu/docs/publications/2013-mazloumian-food-web.pdf>

Contributions:

Comprehensive global analysis of scholarly knowledge production and diffusion on the level of continents, countries, and cities.

Quantifying knowledge flows between 2000 and 2009, we identify global sources and sinks of knowledge production. Our knowledge flow index reveals, where ideas are born and consumed, thereby defining a global 'scientific food web'.

While Asia is quickly catching up in terms of publications and citation rates, we find that its dependence on knowledge consumption has further increased.



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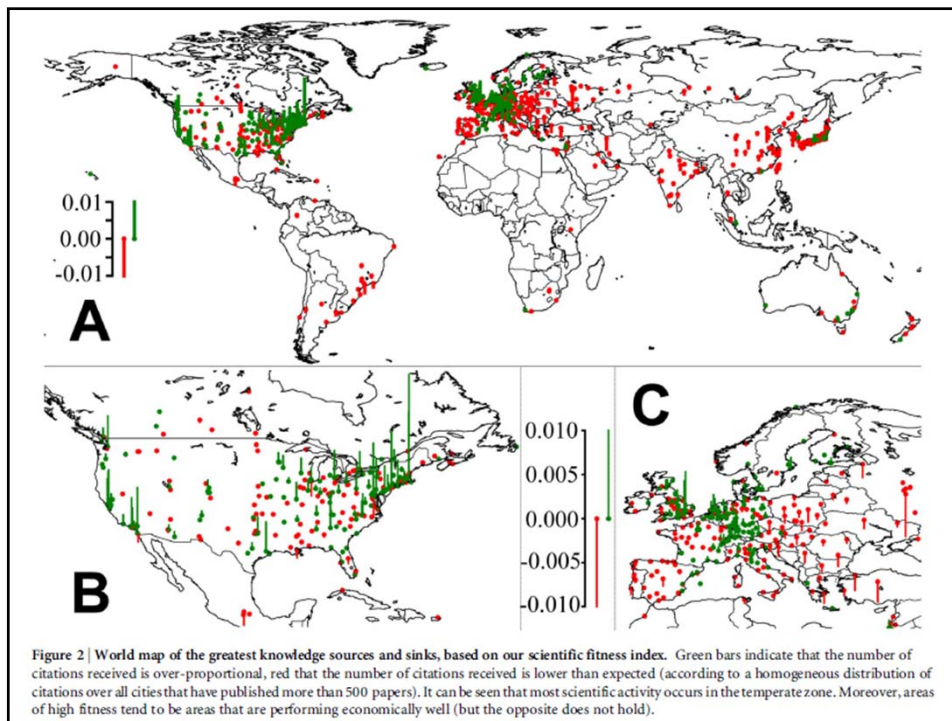


Figure 2 | World map of the greatest knowledge sources and sinks, based on our scientific fitness index. Green bars indicate that the number of citations received is over-proportional, red that the number of citations received is lower than expected (according to a homogeneous distribution of citations over all cities that have published more than 500 papers). It can be seen that most scientific activity occurs in the temperate zone. Moreover, areas of high fitness tend to be areas that are performing economically well (but the opposite does not hold).

Type of Analysis vs. Level of Analysis

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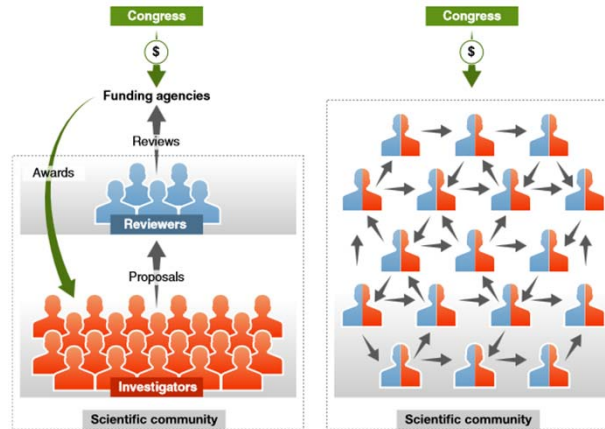
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Predictive Models (Why?)

Example: Collective allocation of science funding as an alternative to peer review

From funding agencies to scientific agency: Collective allocation of science funding as an alternative to peer review

Bollen, Crandall, Junk, Ding & Börner. 2014. *EMBO Reports* 15 (1): 1-121.



Existing (left) and proposed (right) funding systems. Reviewers in blue; investigators in red.

In the proposed system, all scientists are both investigators and reviewers: every scientist receives a fixed amount of funding from the government and discretionary distributions from other scientists, but each is required in turn to redistribute some fraction of the total they received to other investigators.

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From funding agencies to scientific agency: Collective allocation of science funding as an alternative to peer review

Bollen, Johan, David Crandall, Damion Junk, Ying Ding & Katy Börner. 2014. *EMBO Reports* 15 (1): 1-121.

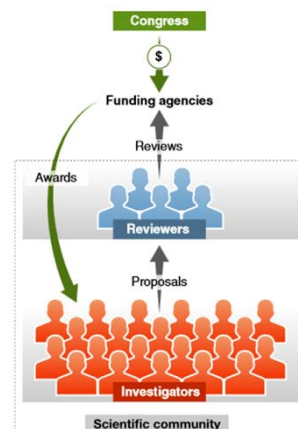
Current Model is Expensive:

If four professors work four weeks full-time on a proposal submission, labor costs are about \$30k [1]. With typical funding rates below 20%, about five submission-review cycles might be needed resulting in a total expected labor cost of **\$150k**. The average NSF grant is **\$128k** per year.

U.S. universities charge about 50% overhead (ca. \$42k), leaving about **\$86k**.

In other words, the four professors lose **\$150k-\$86k= - \$64k** of paid research time by **obtaining** a grant to perform the proposed research.

To add: Time spent by researchers to review proposals. In 2012 alone, NSF convened more than 17,000 scientists to review 53,556 proposals.



[1] Taulbee Survey of Salaries Computer Science ,

<http://cra.org/resources/taulbee>

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From funding agencies to scientific agency: Collective allocation of science funding as an alternative to peer review

Bollen, Crandall, Junk, Ding & Börner. 2014. EMBO Reports 15 (1): 1-121.

Assume

Total funding budget in year y is t_y
 Number of qualified scientists is n

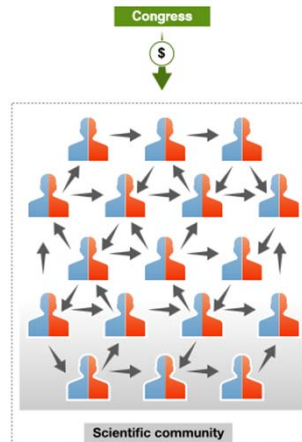
Each year,

the funding agency deposits a fixed amount into each account, equal to the total funding budget divided by the total number of scientists: t_y/n .

Each scientist must distribute a fixed fraction, e.g., 50%, of received funding to other scientists (no self-funding, COIs respected).

Result

Scientists collectively assess each others' merit based on different criteria; they "fund-rank" scientists; highly ranked scientists have to distribute more money.



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From funding agencies to scientific agency: Collective allocation of science funding as an alternative to peer review

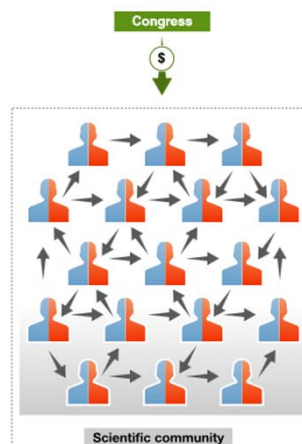
Bollen, Crandall, Junk, Ding & Börner. 2014. EMBO Reports 15 (1): 1-121.

Example:

Total funding budget per year is 2012 NSF budget
 Given the number of NSF funded scientists, each receives a \$100,000 basic grant.
 Fraction is set to 50%

In 2013, scientist S receives a basic grant of \$100,000 plus \$200,000 from her peers, i.e., a total of \$300,000.
 In 2013, S can spend 50% of that total sum, \$150,000, on her own research program, but must donate 50% to other scientists for their 2014 budget.

Rather than submitting and reviewing project proposals, S donates directly to other scientists by logging into a centralized website and entering the names of the scientists to donate to and how much each should receive.



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From funding agencies to scientific agency: Collective allocation of science funding as an alternative to peer review

Bollen, Crandall, Junk, Ding & Börner. 2014. *EMBO Reports* 15 (1): 1-121.

Model Run and Validation:

Model is presented in <http://arxiv.org/abs/1304.1067>

It uses **citations as a proxy** for how each scientist might distribute funds in the proposed system.

Dataset: 37M articles from TR 1992 to 2010 Web of Science (WoS) database with **770M citations** and 4,195,734 unique author names. The **867,872 names** who had authored at least one paper per year in any five years of the period 2000–2010 were used in validation.

For each pair of authors we determined the number of times one had cited the other in each year of our citation data (1992–2010).

NIH and NSF funding records from IU's Scholarly Database provided 347,364 grant amounts for 109,919 unique scientists for that time period.

Simulation run begins in year 2000, in which every scientist was given a fixed budget of $B = \$100k$. In subsequent years, scientists distribute their funding in proportion to their citations over the prior 5 years.

The model yields funding patterns similar to existing NIH and NSF distributions.

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NEWSFOCUS

Making Every Scientist a Research Funder

When it comes to using peer review to distribute research dollars, Johan Bollen favors radical simplicity.

Over the years, many scientists have suggested that the current system could be improved by changing the composition of the review panels, tweaking the interactions among reviewers, or revising how the proposals are scored. But Bollen, a computer scientist at Indiana University, Bloomington, would simply award all eligible researchers a block grant—and then require them to give some of it away to colleagues they judge most deserving.

That radical step, described in a paper Bollen and four Indiana colleagues recently posted on *EMBO Reports*, retains peer review's core concept of tapping into the views of the most knowledgeable researchers. But it would eliminate the huge investment in time and money required to submit proposals and assemble panels to judge them.

Bollen's process would be almost instantaneous: In a version of expert-directed crowdsourcing, scientists would fill out a form once a year listing their favored researchers, and a predetermined portion of their annual grant money—a total of, say, 50%—would then be transferred to their choices.

"So many scientists spend so much time on peer review, and there's a high level of frustration," Bollen explains. "We already know who the best people are. And if you're doing good work, then you deserve to receive support."

Others are skeptical. "I've known Johan for a long time and have the highest regard for his ability as an out-of-the-box thinker," says Stephen Griffin, a retired National Science Foundation (NSF) program manager who's now a visiting professor of information sciences at the University of Pittsburgh in Pennsylvania. "But there are a number of issues he doesn't address."

Those sticking points include the likely mismatch between what researchers need and what their colleagues give them; the absence of any replacement for the overhead payments in today's grants, which support infrastructure at host institutions; and the dearth of public accountability for the billions of dollars that would flow from public coffers to individuals. "Scientists aren't really equipped to be a funding agency," Griffin notes.

Bollen acknowledges that the process would need safeguards to ensure that scientists don't reward their friends or punish their enemies. But his analysis suggests that the U.S. research landscape would not look all that different if his radical proposal were adopted.

Drawing upon citation data in 37 million papers over 20 years, the Indiana researchers conducted a simulation premised on the idea that scientists would reallocate their federal dollars according to how often they cited their peers. The simulation, he says, yielded a funding pattern "similar in shape to the actual distribution" at NSF and the National Institutes of Health for the past decade—at a fraction of the overhead required by the current system.

—JDM

February 7, 2014

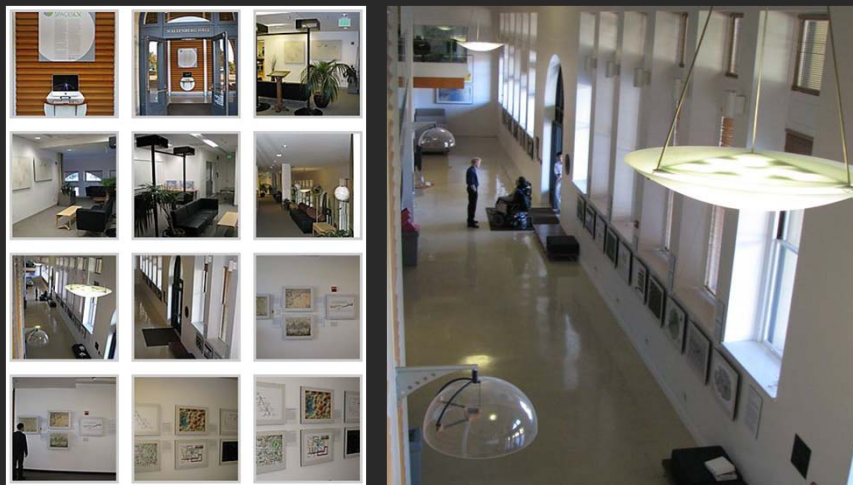
Science 7 February 2014: Vol. 343 no. 6171 p. 598

DOI: 10.1126/science.1234567

<http://www.sciencemag.org/content/343/6171/598.full?sid=4f40a7f0-6ba2-4ad8-a181-7ab394fe2178>

Visualizing STI Model Results

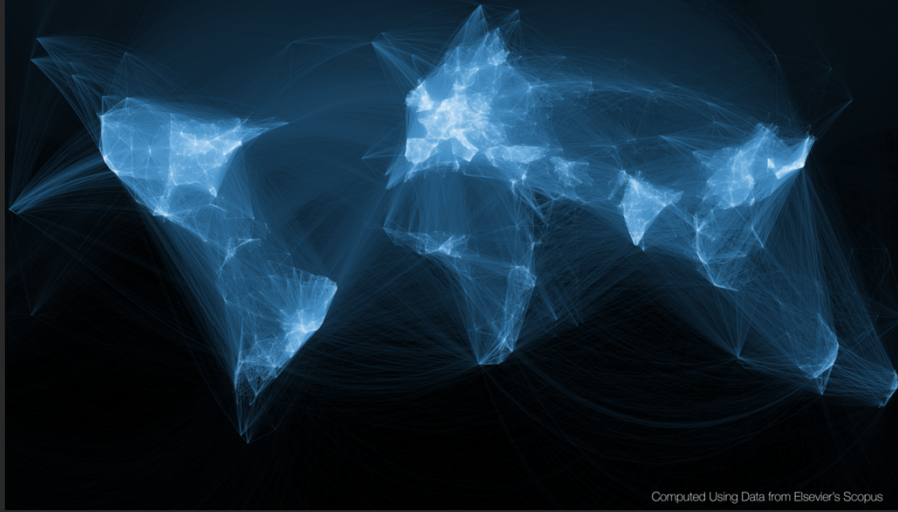
Example: Places & Spaces: Mapping Science Exhibit



Mapping Science Exhibit on display at MEDIA X, Stanford University
<http://mediax.stanford.edu>, <http://scaleindependentthought.typepad.com/photos/scimaps>



Map of Scientific Collaborations from 2005-2009



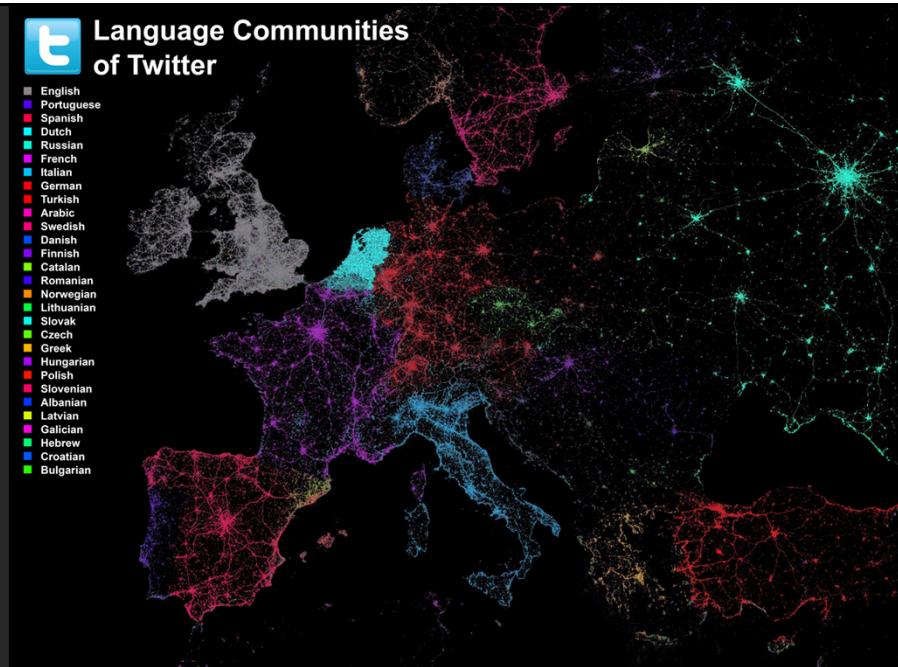
Computed Using Data from Elsevier's Scopus

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



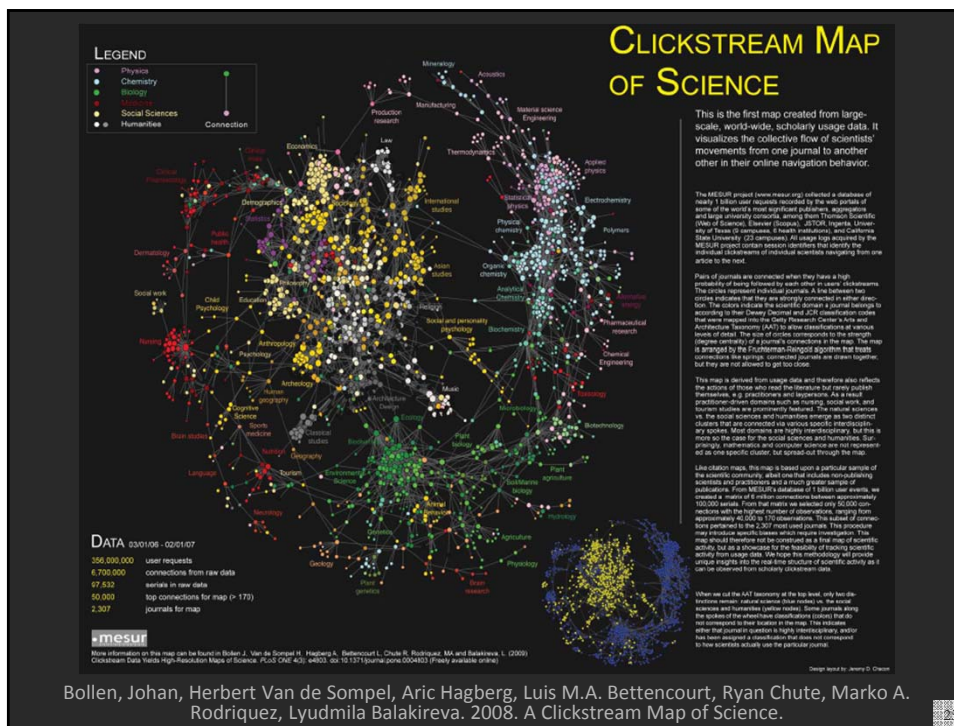
Language Communities of Twitter

- English
- Portuguese
- Spanish
- Dutch
- Russian
- French
- Italian
- German
- Turkish
- Arabic
- Swedish
- Danish
- Finnish
- Catalan
- Romanian
- Norwegian
- Lithuanian
- Slovak
- Czech
- Greek
- Hungarian
- Polish
- Slovenian
- Albanian
- Latvian
- Galician
- Hebrew
- Croatian
- Bulgarian

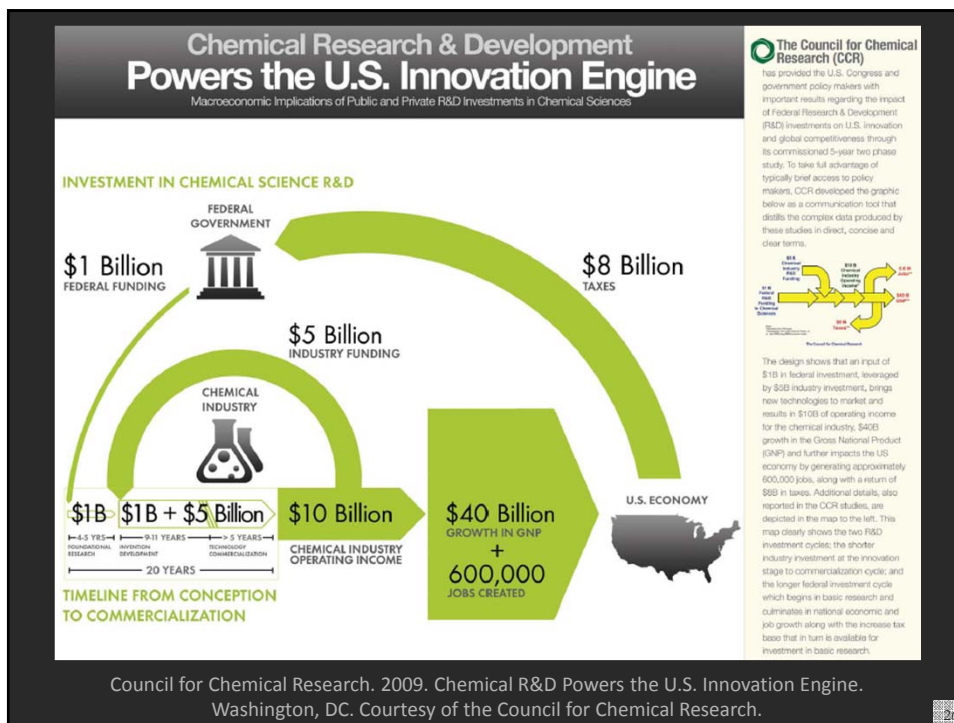


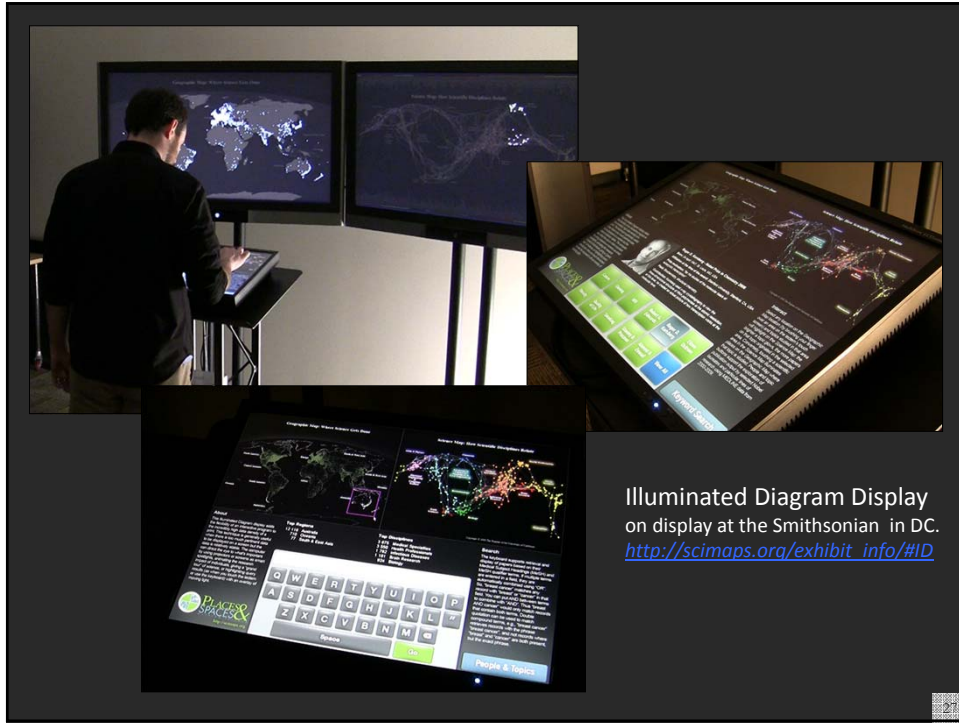
Language Communities of Twitter - Eric Fischer - 2012





Bollen, Johan, Herbert Van de Sompel, Aric Hagberg, Luis M.A. Bettencourt, Ryan Chute, Marko A. Rodriguez, Lyudmila Balakireva. 2008. A Clickstream Map of Science.





Geographic Map: Where Science Gets Done

Science Map: How Scientific Disciplines Relate

Copyright © 2008 The Regents of the University of California

About

This illuminated diagram display adds the flexibility of an interactive program to the incredibly high data density of a print. This technique is generally useful when there is too much pertinent data to be displayed on a screen but the data is relatively stable. The computer can direct the eye to what's important by using projectors or screens as smart spotlights, animating the research impact of individuals, giving a "grand tour" of science, or highlighting query results (as when you touch the lectern or use the keyboard) with an overlay of moving light.

<http://scimaps.org>

Top Five Continents

- North America - 4,000 records
- South & East Asia - 3,589
- Australia - 2,421
- Africa - 2,208
- South America - 1,562

Top Five Scientific Disciplines

- Math & Physics - 4,000 records
- Health Professionals - 3,589
- Social Sciences - 2,431
- Aeronautical, Chemical, Mechanical & Civil Engineering - 2,208
- Humanities - 1,562

Input your search query here.

People & Topics

Search

The keyboard supports retrieval and display of papers based on their Medical Subject Headings (MeSH) and MeSH qualifier terms. If multiple terms are entered in a field, they are automatically combined using "OR". So, "breast cancer" matches any record with "breast" or "cancer" in that field. You can put AND between terms to combine with "AND". Thus "breast AND cancer" would only match records that contain both terms. Double quotation can be used to match compound terms, e.g., "breast cancer" retrieves records with the phrase "breast cancer", and not records where "breast" and "cancer" are both present, but the exact phrase.

Geographic Map: Where Science Gets Done

Regions labeled: North America, Central America, South America, Oceania, Antarctica, Europe, North & West Asia, South & East Asia, Africa, Australia.

Science Map: How Scientific Disciplines Relate

Disciplines shown: Math & Physics, Chemistry, Health, Technology, Agricultural, Chemical, Materials & Civil Engineering, Medical Sciences, Social Sciences, Electrical Engineering & Computer Science, Biotechnology, Brain Research, Infectious Diseases, Earth Sciences, Biology, Humanities.

Copyright © 2008 The Regents of the University of California

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Elinor Ostrom - Nobel Prize in Economic Sciences 2009

Born: 7 August 1933, New York, NY, USA

Affiliation at the time of the award: Indiana University, Bloomington, IN, USA, Arizona State University, Tempe, AZ, USA

Prize motivation: "for her analysis of economic governance, especially the commons"

Field: Economic governance

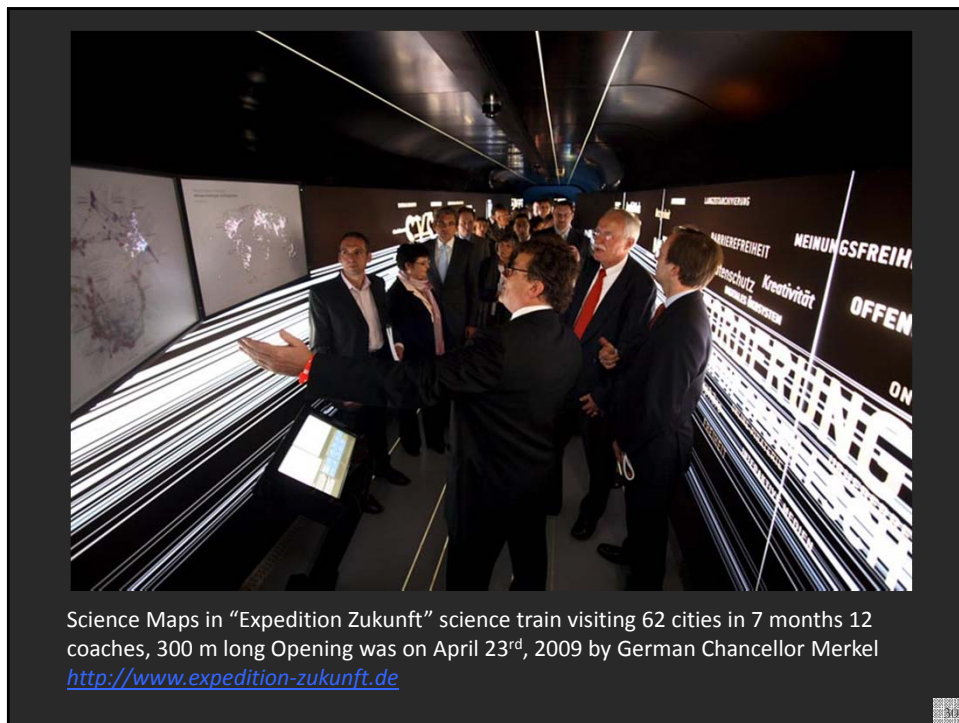
Contribution: Challenged the conventional wisdom by demonstrating how local property can be successfully managed by local commons without any regulation by central authorities or privatization.

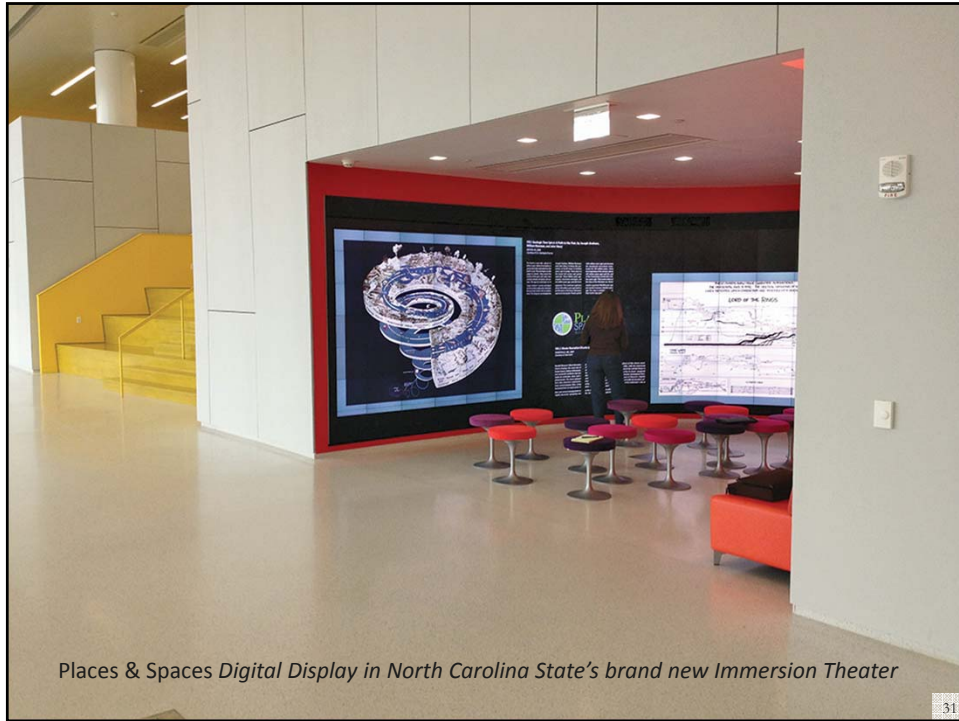
Cancer	Cloning	HIV	Robert G. Edwards	Roger D. Kornberg	Elinor Ostrom
Obesity	Quality of Life	Smoking	Stanley B. Prusiner	Ahmed H. Zewail	View All

Interact

Select any location on the Geographic Map location (by brushing your finger over an area on the lectern's touch screen) and topics studied in that area will highlight on the Science Map: the brighter a topic glows, the more papers on that topic originated in the selected area. Conversely, touching a scientific area in the Science Map illuminates places on the Geographic Map where that topic is studied. People and topic buttons support the exploration of publication output by selected Noble laureates and particular lines of research using MEDLINE data from 2000-2009.

Keyword Search





Places & Spaces: Mapping Science Exhibit

<http://scimaps.org>



Maps are available for sale and the exhibit can be hosted by anyone.



Visualizing STI Model Results

Example: The Information Visualization MOOC

Information Visualization MOOC



Overview

This course provides an overview about the state of the art in information visualization. It teaches the process of producing effective visualizations that take the needs of users into account.

This year, the course can be taken for three Indiana University credits as part of the Online Data Science Program just announced by the School of Informatics and Computing. Students interested in applying to the program can find more information here.

Among other topics, the course covers:

- Data analysis algorithms that enable extraction of patterns and trends in data
- Major temporal, geospatial, topical, and network visualization techniques
- Discussions of systems that drive research and development.

Just like last year, students will have the opportunity to collaborate on real-world projects for a variety of clients. Click here to see this year's list of clients and projects.

Everyone who registers gains free access to the Scholarly Database (26 million paper, patent, and grant records) and the Sci2 Tool (100+ algorithms and tools).

Please watch the introduction video to learn more.

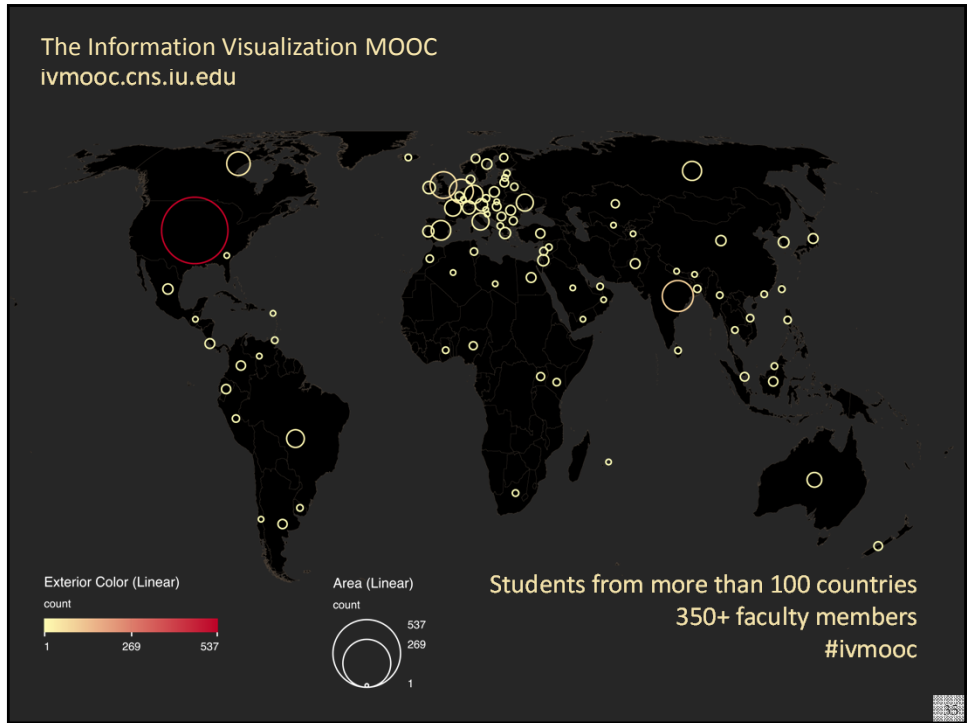


Register for Course

IVMOOC 2014 course materials will be available until end of November 2014. The IVMOOC 2015 will open in January 2015 with new materials and a cloud computing setup.

Register for free at <http://ivmooc.cns.iu.edu>. Class will restart in January 2015.

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Course Schedule

- **Session 1** – Workflow design and visualization framework
- **Session 2** – “When:” Temporal Data
- **Session 3** – “Where:” Geospatial Data
- **Session 4** – “What:” Topical Data

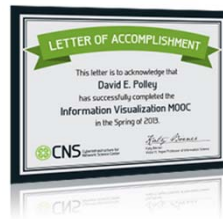
Mid-Term

Students work in teams with clients.

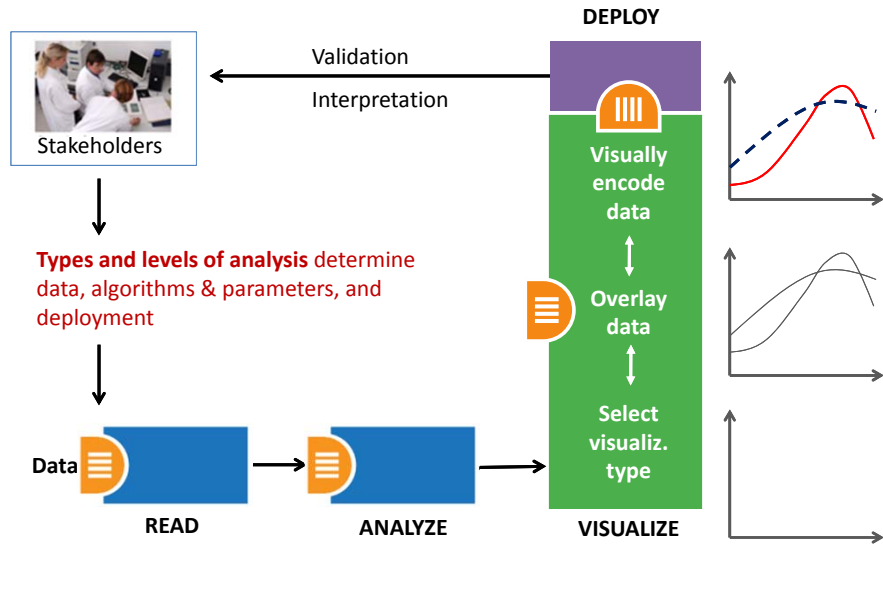
- **Session 5** – “With Whom:” Trees
- **Session 6** – “With Whom:” Networks
- **Session 7** – Dynamic Visualizations and Deployment

Final Exam

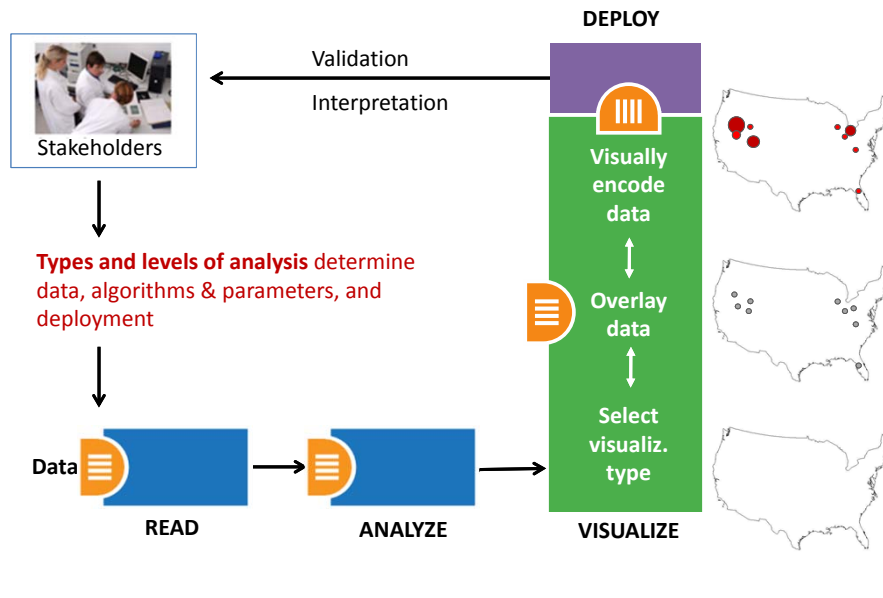
Final grade is based on Midterm (**30%**), Final (**40%**), Client Project (**30%**).



Needs-Driven Workflow Design



Needs-Driven Workflow Design



Clients

Information Visualization MOOC

List of Clients

Project Title: Isis: 100 Years
Client Name: Jay Malone
Project goal/scientific or practical value: A visual representation isis' contributors and locales over the past 100 years. Isis is the journal of the History of Science Society. This representation will provide a dynamic picture of how scholarship in the history of science has shifted over the past century.
Information on dataset(s) to be used: Citation information, author locale, and issue number for Isis publications.
Relevant publications, websites, etc: <http://www.press.uchicago.edu/ucp/journals/journal/isis.html>
Conditions under which students can publish results and/or add project results to their resume: Client would like to approve results.

Project Title: e-Exploration
Client Name: Luyi
Project goal/scientific or practical value: e-Exploration is an agent-based model for the ethnographic observation and the registry, analysis, and interpretation of social practices in virtual communities for intervention in the development of collaboration and cooperation. This project will analyze the interactions between subjects and objects in a platform collaborative community called OYCIB, a project based on e-Exploration (e-crick.net).
Information on dataset(s) to be used: I can provide a data base in .graphml format for the students. The file .graphml contains the interactions between subjects and objects in a platform collaborative community called OYCIB. In the level of practice, it is not necessary that students know agent-based models for using the database. But, in another level, for example: the collaborate level for the OYCIB development, it is necessary to have basic knowledge in AMS or MAS and another competences like PHP and MySQL.
Relevant publications, websites, etc: <http://www.e-crick.net/logs>
Conditions under which students can publish results and/or add project results to their resume: If any person or institution use my dataset or another info about eExploration (e-crick.net, oycib.net), I need to approve the results and appear as co-author.

<http://ivmooc.cns.iu.edu/clients.html>

[Diogo Carmo](#)

Mesothelioma

Main title topics in Medline papers

Mesothelioma (or, more precisely, malignant mesothelioma) is a rare form of cancer that develops from transformed cells originating in the mesothelium, the protective lining that covers many of the internal organs of the body. It is usually caused by exposure to asbestos.

The most common anatomical site for the development of mesothelioma is the pleura (the outer lining of the lungs and internal chest walls), but it can also arise in the peritoneum (the lining of the abdominal cavity) and the pericardium (the sac that surrounds the heart) or the tunica vaginalis (a sac that surrounds the testis).

Most people who develop mesothelioma have worked in jobs where they inhaled asbestos, or were exposed to asbestos dust and fibers in other ways. It has also been suggested that smoking (together with asbestos) may be linked with asbestos, unlike lung cancer, there is no association between mesothelioma and tobacco smoking. Ionizing greatly increases the risk of other asbestos-related cancers. Some people who were exposed to asbestos have collected damages for asbestos-related disease, including mesothelioma. Compensation via asbestos funds or class action lawsuits is an important issue for law practices regarding mesothelioma.

MALIGNANT PLEURAL CYSTIC BENIGN DIAGNOSIS

1982 1987 1992 1997 2002 2007

1932 1937 1942 1947 1952 1957 1962 1967 1972 1977

DIFFUS
PERICARDIUM
PRIMARY
CASE

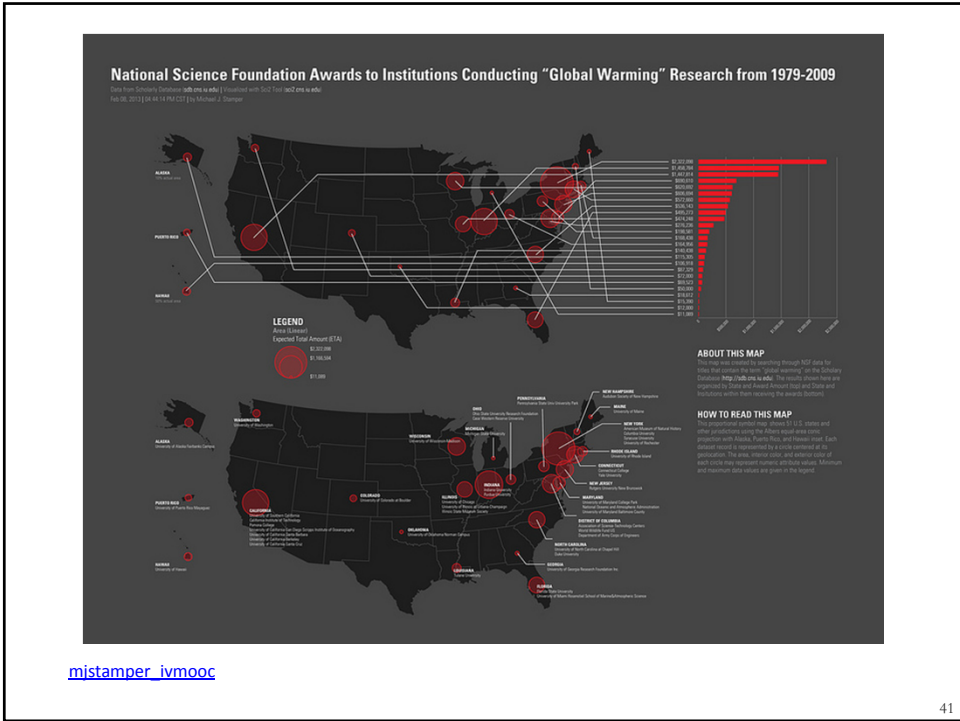
PLEURA

How To Read This Map
 The map for each mesothelioma diagnosis is each record as a horizontal bar with a specific start and end date and a new label on its left side. The area of each bar encodes ranges of interest - and target keywords - in the topic identified in the labels (original words were trimmed).

Author: Diogo Carmo (<http://ivmooc.cns.iu.edu>), Visualization software: Sci2 Team, (2009), Science of Science (Sci2) Team, Indiana University and SciTech Strategies, <http://vis2.cns.iu.edu>, ©Science, Medline Papers, as available in Scholarly Database <http://pubmed.ncbi.nlm.nih.gov/>. Text and images: "Diagnosis of Mesothelioma article, available at <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1500000/> (From: Scamman, by Brent Noring © 2001 - All Rights Reserved. This text format is reformatted and available at <http://vis2.cns.iu.edu>)

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