Mapping Scientific Networks

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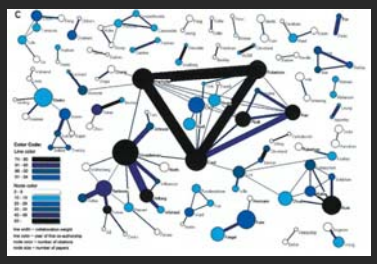
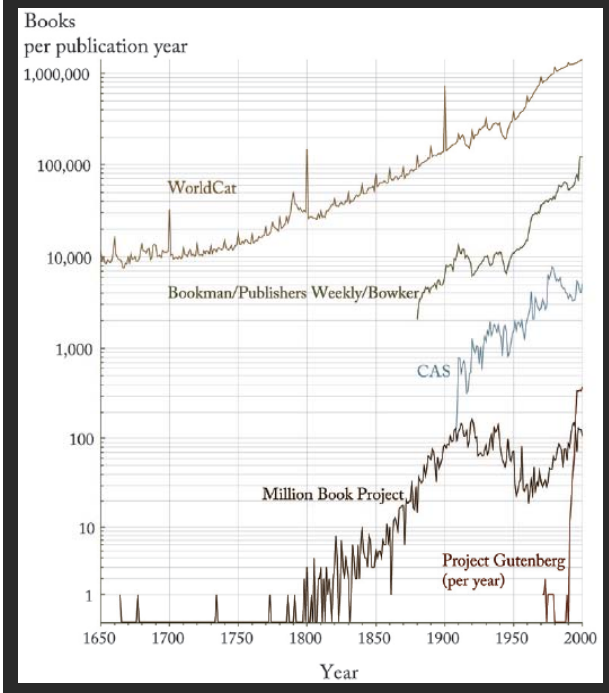
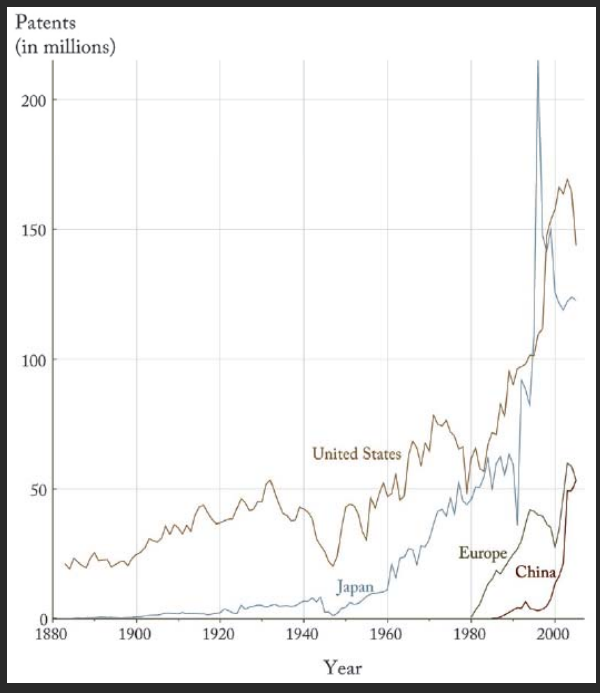


With special thanks to the members at the Cyberinfrastructure for Network Science Center, Mapping Science exhibit map makers and advisory board members, and the VIVO team.

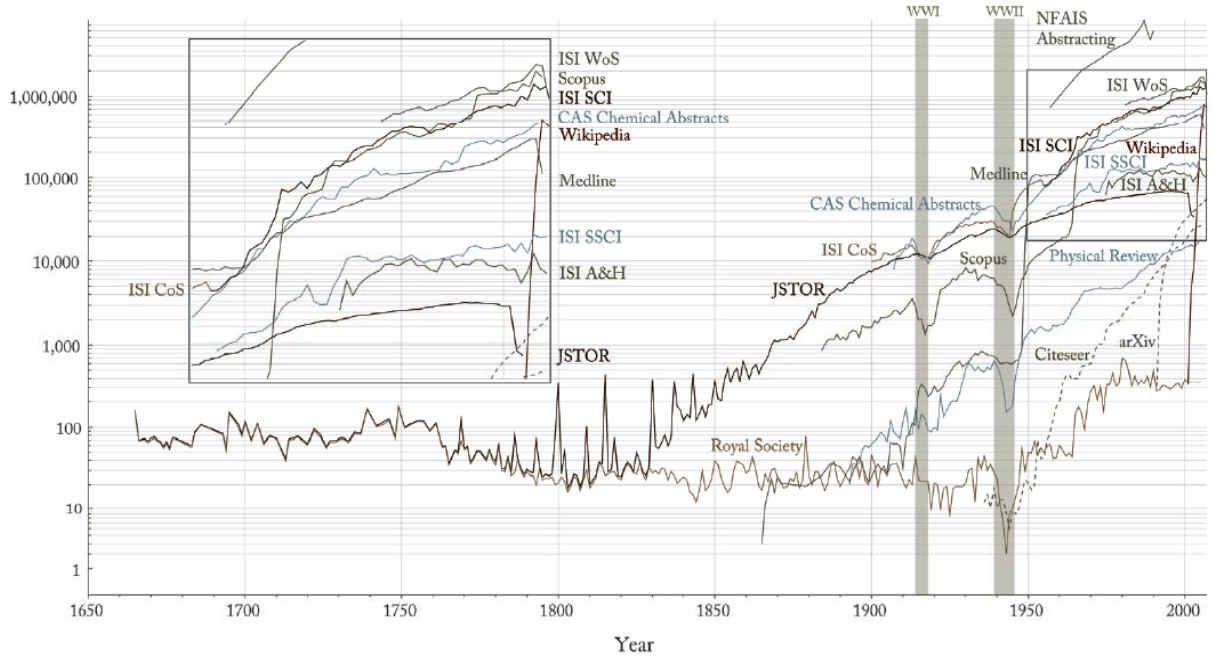
First Annual National VIVO Conference
New York Hall of Science
August 13, 2010





Börner, Katy (2010) Atlas of Science. MIT Press. http://scimaps.org/atlas

Papers & Wikipedia Entries



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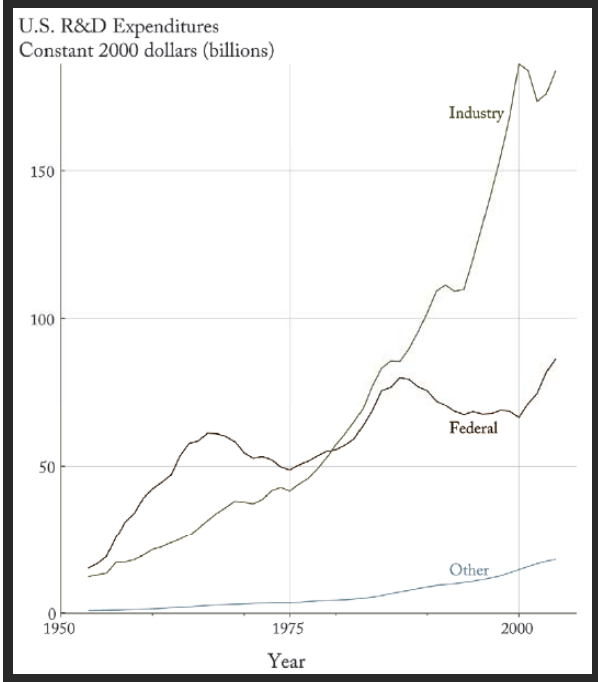
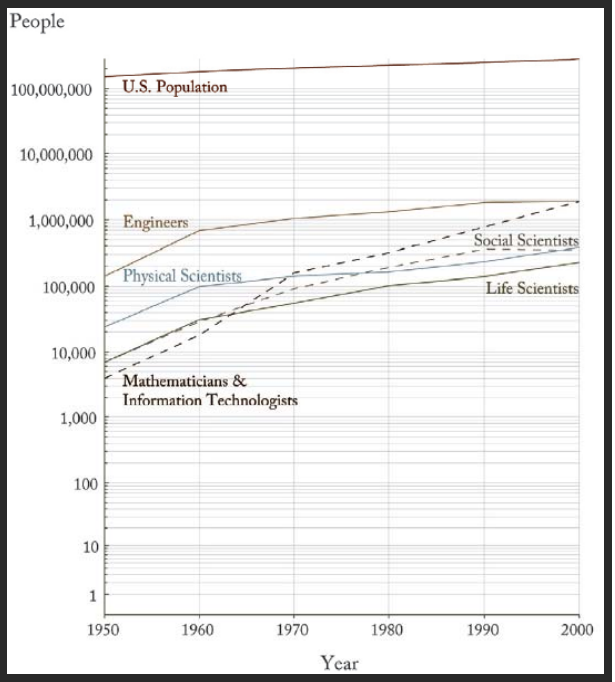
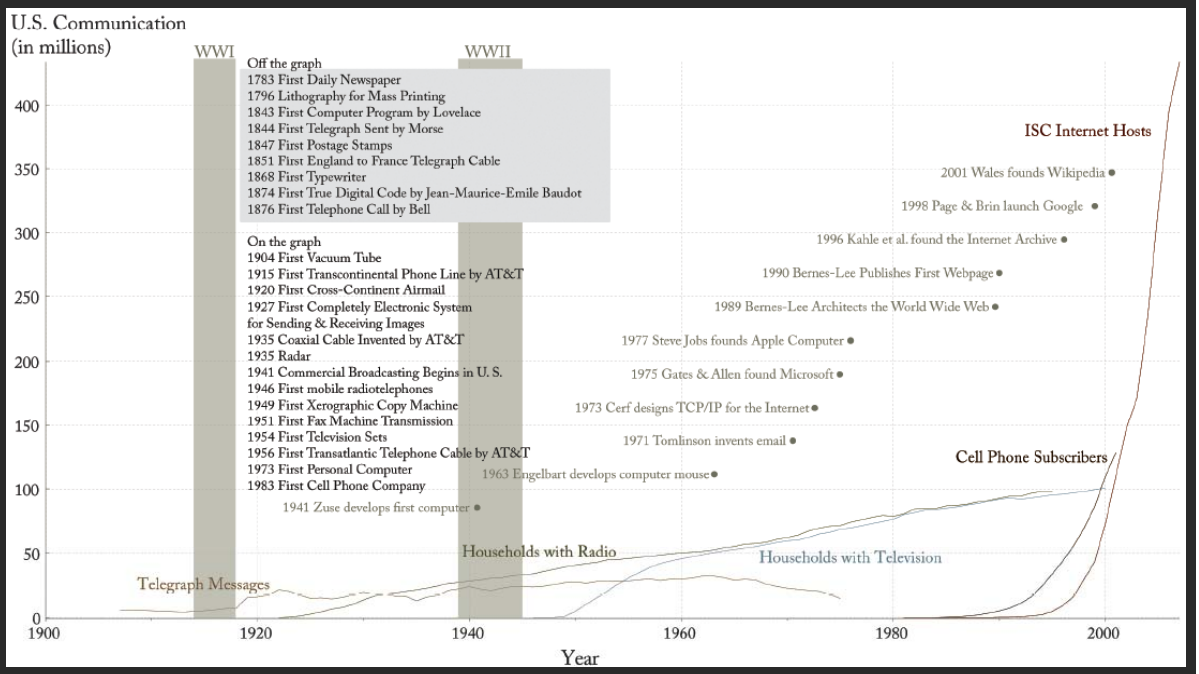




Börner, Katy (2010) Atlas of Science. MIT Press. http://scimaps.org/atlas



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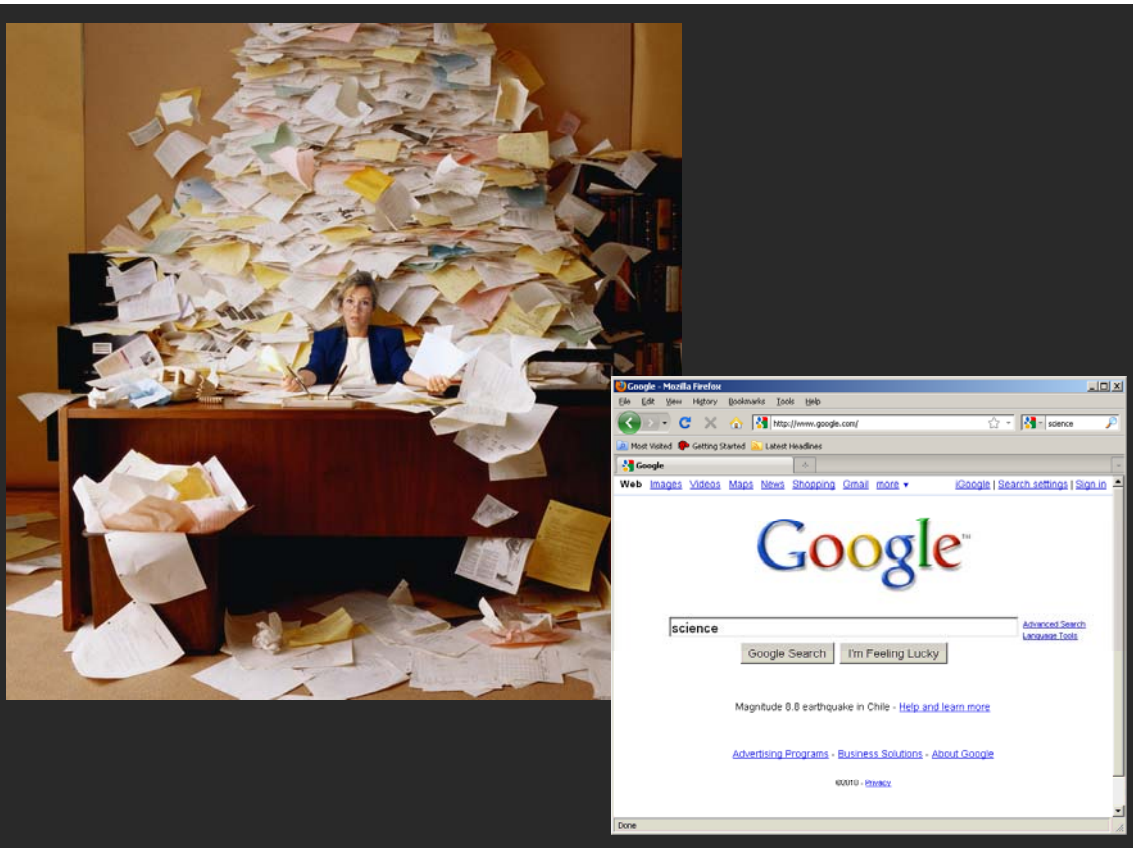
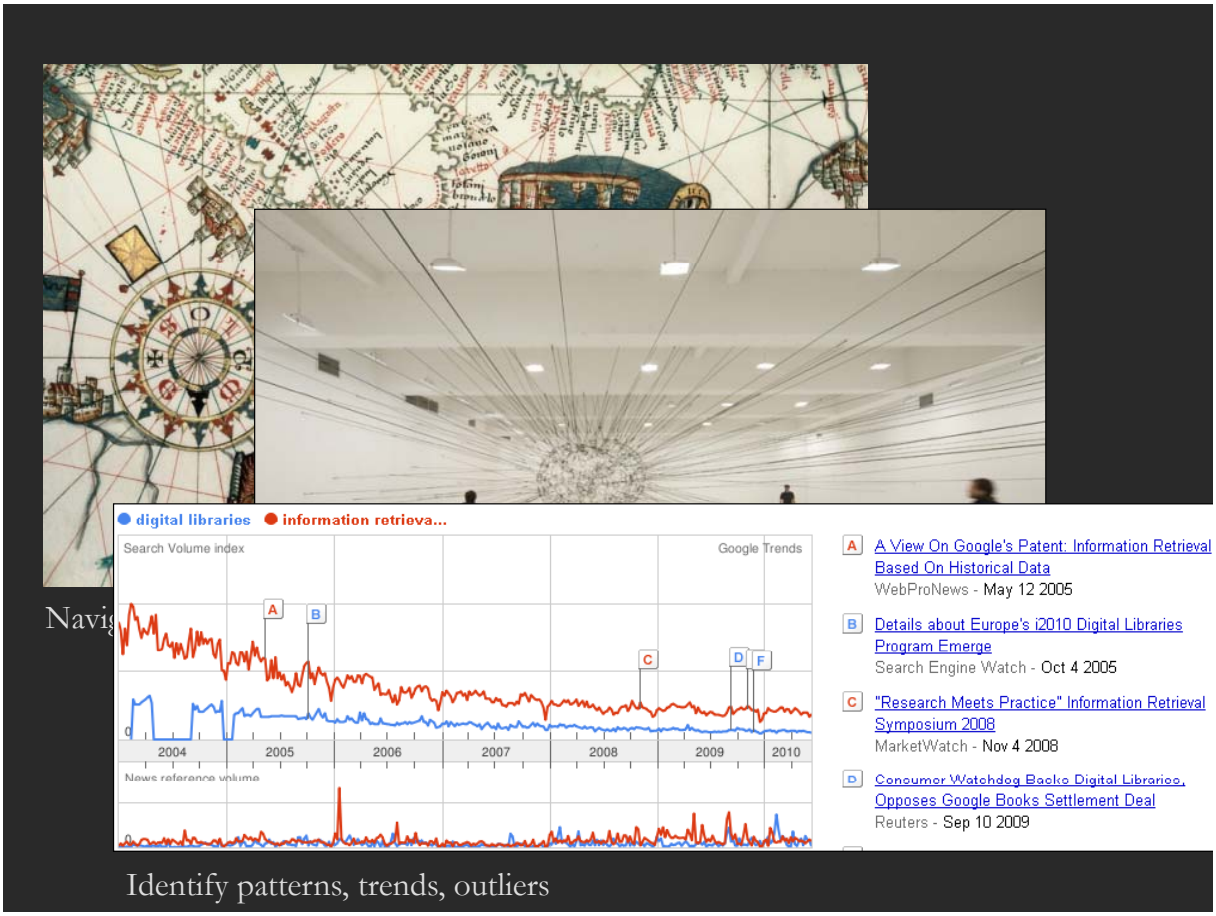




S&T Navigation, Management Tools that Different Stakeholders Want

Funding Agencies

- Need to monitor (long-term) money flow and research developments, identify areas for future development, stimulate new research areas, evaluate funding strategies for different programs, decide on project durations, funding patterns.

Scholars

- Want easy access to research results, relevant funding programs and their success rates, potential collaborators, competitors, related projects/publications **(research push).**

Industry

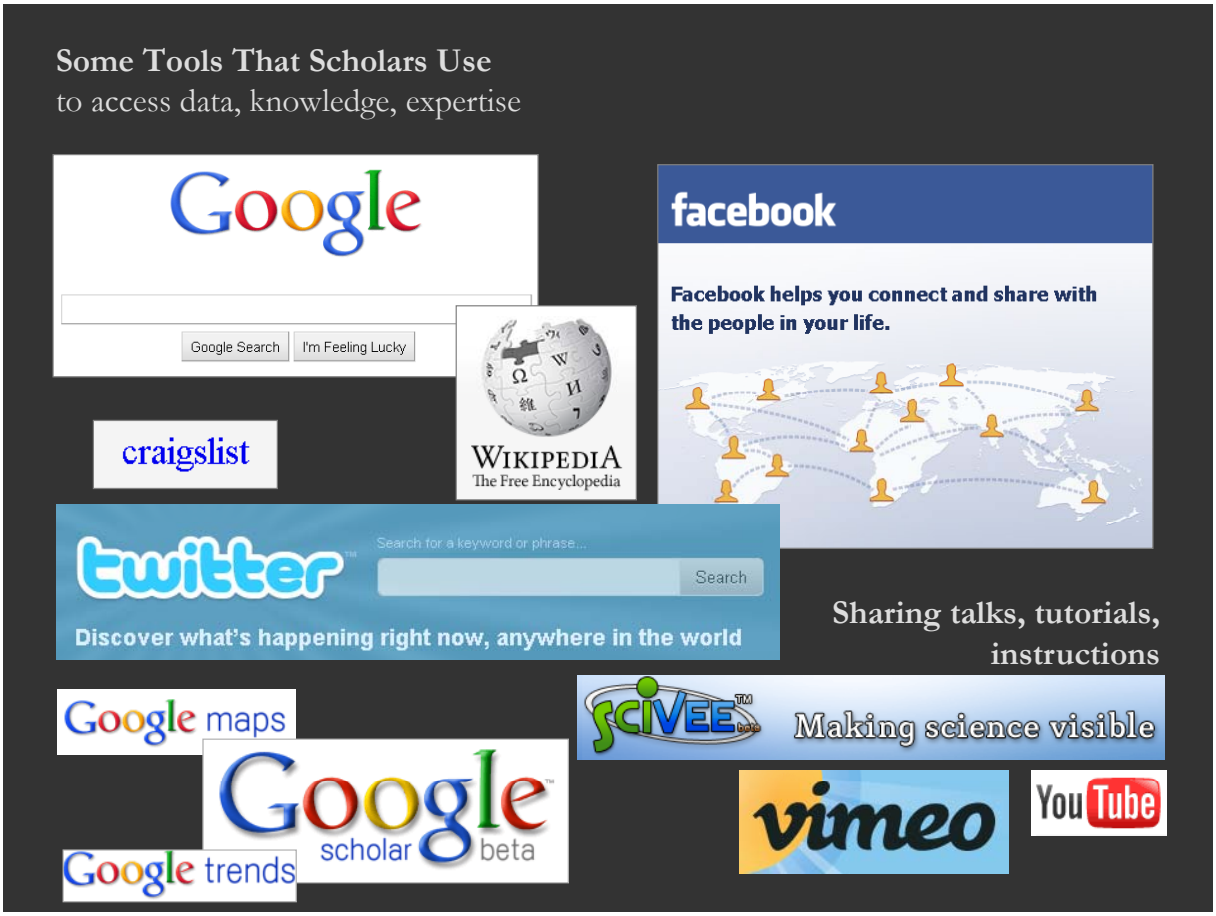
- Is interested in fast and easy access to major results, experts, etc. Influences the direction of research by entering information on needed technologies **(industry-pull)**.

Advantages for Publishers

- Need easy to use interfaces to massive amounts of interlinked data. Need to communicate data provenance, quality, and context.

Society

- Needs easy access to scientific knowledge and expertise.



The Changing Scientific Landscape

Star Scientist -> Research Teams: In former times, science was driven by key scientists. Today, science is driven by effectively collaborating co-author teams often comprising expertise from multiple disciplines and several geospatial locations (Börner, Dall'Asta, Ke, & Vespignani, 2005; Shneiderman, 2008).

Users -> Contributors: Web 2.0 technologies empower anybody to contribute to Wikipedia or to exchange images and videos via Fickr and YouTube. WikiSpecies, WikiProfessionals, or WikiProteins combine wiki and semantic technology in support of real time community annotation of scientific datasets (Mons et al., 2008).

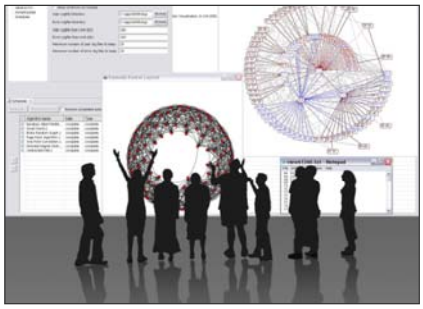
Cross-disciplinary: The best tools frequently borrow and synergistically combine methods and techniques from different disciplines of science and empower interdisciplinary and/or international teams of researchers, practitioners, or educators to fine-tune and interpret results collectively.

One Specimen -> Data Streams: Microscopes and telescopes were originally used to study one specimen at a time. Today, many researchers must make sense of massive streams of multiple types of data with different formats, dynamics, and origin.

Static Instrument -> Evolving Cyberinfrastructure (CI): The importance of hardware instruments that are rather static and expensive decreases relative to software infrastructures that are highly flexible and continuously evolving according to the needs of different sciences. Some of the most successful services and tools are decentralized increasing scalability and fault tolerance.

Microscopes, Telescopes, and Macrocopes





Just as the **microscope** empowered our naked eyes to see cells, microbes, and viruses thereby advancing the progress of biology and medicine or the **telescope** opened our minds to the immensity of the cosmos and has prepared mankind for the conquest of space, **macroscopes** promise to help us cope with another infinite: the infinitely complex. Macroscopes give us a 'vision of the whole' and help us 'synthesize'. They let us detect patterns, trends, outliers, and access details in the landscape of science. Instead of making things larger or smaller, macroscopes let us observe what is at once too great, too slow, or too complex for our eyes.

Desirable Features of a Social Network Studies "Macroscope"

Core Architecture & Plugins/Division of Labor: Computer scientists need to design the standardized, modular, easy to maintain and extend "core architecture". Dataset and algorithm plugins, i.e., the "filling", are provided by those that care and know most about the data and developed the algorithms: the domain experts.

Ease of Use: As most plugin contributions and usage will come from non-computer scientists it must be possible to contribute, share, and use new plugins without writing one line of code. Users need guidance for constructing effective workflows from 100+ continuously changing plugins.

Modularity: The design of software modules with well defined functionality that can be flexibly combined helps reduce costs, makes it possible to have many contribute, and increases flexibility in tool development, augmentation, and customization.

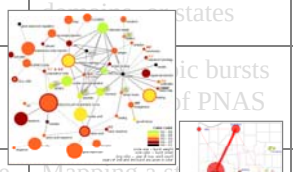
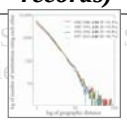
Standardization: Adoption of (industry) standards speeds up development as existing code can be leveraged. It helps pool resources, supports interoperability, but also eases the migration from research code to production code and hence the transfer of research results into industry applications and products.

Open Data and Open Code: Lets anybody check, improve, or repurpose code and eases the replication of scientific studies.

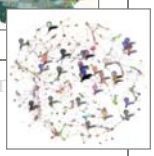
Börner, Katy (in press) Plug-and-Play Macroscopes. Communications of the ACM.

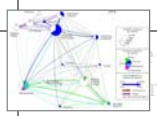
Type of Analysis vs. Scale of Level of Analysis

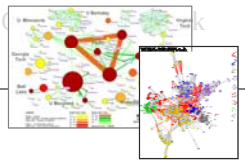
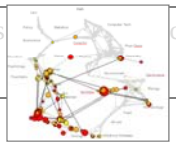
	Micro/Individual ***(1-100 records)***	***Meso/Local*** ***(101–10,000 records)***	***Macro/Global*** ***(10,000 < records)***
Statistical Analysis/Profiling	Individual person and their expertise profiles	Larger labs, centers, universities, research	All of NS SA, all of sci states
Temporal Analysis (When)	Funding portfolio of one individual	ic bursts f PNAS	113 Years of P Research
Geospatial Analysis (Where)	Career trajectory of one individual	Mapping a s intellectual l	PNAS
Topical Analysis (What)	s.	lows in research	VxOrd/Topic NIH funding
Network Analysis (With Whom?)	NSF vork of one	k	NIH's cy







Macroscope for Science of Science Studies

About 5-20 algorithms are involved in one single study/workflow.

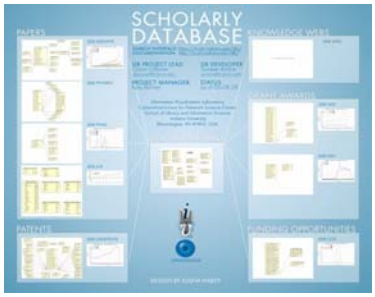
DATA EXTRACTION	UNIT OF ANALYSIS	MEASURES	LAYOUT (often one code does both similarity and ordination steps)		DISPLAY
			SIMILARITY	ORDINATION	
SEARCHES ISI INSPEC Eng Index Medline ResearchIndex Patents etc. BROADENING By citation By terms	COMMON CHOICES Journal Document Author Term	COUNTS/FREQUENCIES Attributes (e.g. terms) Author citations Co-citations By year THRESHOLDS By counts	SCALAR (unit by unit matrix) Direct citation Co-citation Combined linkage Co-word / co-term Co-classification VECTOR (unit by attribute matrix) Vector space model (words/terms) Latent Semantic Analysis (words/terms) incl. Singular Value Decomp (SVD) CORRELATION (if desired) Pearson's R on any of above	DIMENSIONALITY REDUCTION Eigenvector/ Eigenvalue solutions Factor Analysis (FA) and Principal Components Analysis (PCA) Multi-dimensional scaling (MDS) LSA, Topics Pathfinder networks (PFNet) Self-organizing maps (SOM) includes SOM, ET-maps, etc. CLUSTER ANALYSIS SCALAR Triangulation Force-directed placement (FDP)	INTERACTION Browse Pan Zoom Filter Query Detail on demand ANALYSIS

Börner, Katy, Chen, Chaomei, and Boyack, Kevin. (2003) Visualizing Knowledge Domains. ARIST, pp. 179-255.

Domain has about 300 core researchers, 10 key data sources, 20 common tools.

Approaches/algorithms from network science, social science, political science, economics, physics, information science, webometrics, etc. are highly relevant and new ones become available every day.

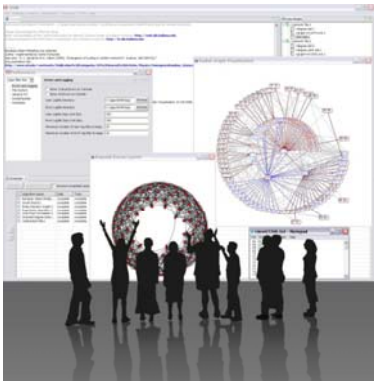
Computational Scientometrics CI



Scholarly Database: 23 million scholarly records
http://sdb.slis.indiana.edu

James S. McDonnell Foundation

VIVO Research Networking
http://vivoweb.org



Information Visualization Cyberinfrastructure
http://iv.slis.indiana.edu

Network Workbench Tool + Community Wiki
http://nwb.slis.indiana.edu

Sci² Tool and Science of Science CI Portal
http://sci.slis.indiana.edu

Epidemics Cyberinfrastructure
http://epic.slis.indiana.edu/

Macroscope Design

Custom Tools for Different Scientific Communities

Information Visualization Cyberinfrastructure
http://iv.slis.indiana.edu

Network Workbench Tool + Community Wiki
http://nwb.slis.indiana.edu

Science of Science (Sci²) Tool and Portal
http://sci.slis.indiana.edu

Epidemics Cyberinfrastructure
http://epic.slis.indiana.edu/

180+ Algorithm Plugins and Branded GUIs
+
Core Architecture

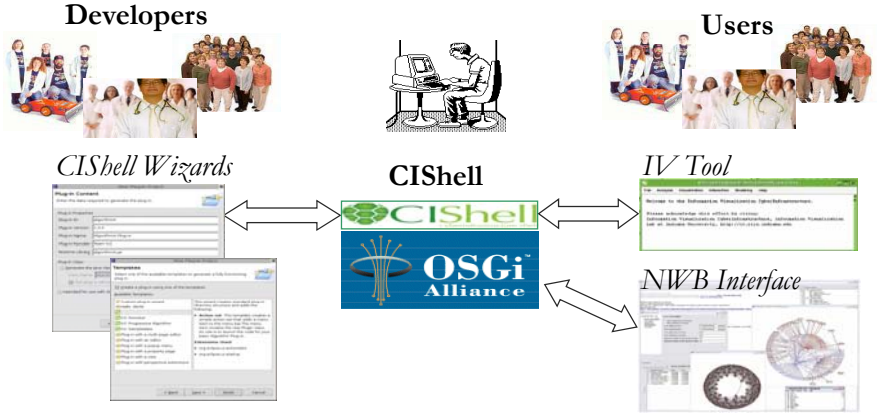
Open Services Gateway Initiative (OSGi) Framework.
http://orgi.org

Cyberinfrastructure Shell (CIShell)
http://cishell.org

Cyberinfrastructure Shell (CIShell)

http://cishell.org

- CIShell is an open source software specification for the integration and utilization of datasets, algorithms, and tools.
- It extends the Open Services Gateway Initiative (OSGi) (http://www.osgi.org), a standardized, component oriented, computing environment for networked services widely used in industry since 10 years.
- Specifically, CIShell provides "sockets" into which existing and new datasets, algorithms, and tools can be plugged using a wizard-driven process.



CIShell – Builds on OSGi Industry Standard

CIShell is built upon the Open Services Gateway Initiative (OSGi) Framework.

OSGi (http://www.osgi.org) is

- A standardized, component oriented, computing environment for networked services.
- Successfully used in the industry from high-end servers to embedded mobile devices since 8 years.
- Alliance members include IBM (Eclipse), Sun, Intel, Oracle, Motorola, NEC and many others.
- Widely adopted in open source realm, especially since Eclipse 3.0 that uses OSGi R4 for its plugin model.

Advantages of Using OSGi

- Any CIShell algorithm is a service that can be used in any OSGi-framework based system.
- Using OSGi, running CIShells/tools can connected via RPC/RMI supporting peer-to-peer sharing of data, algorithms, and computing power.

Ideally, CIShell becomes a standard for creating OSGi Services for algorithms.

Sci² Tool for Science of Science Research and Practice *(http://sci.slis.indiana.edu/sci2)*

Forgot your password?

To recover your account pass

Not registered yet?

Register now

Tutorials

Scott Weingart, Hanning Guc
Biberstine (2010) Science of
Science, Indiana University, I

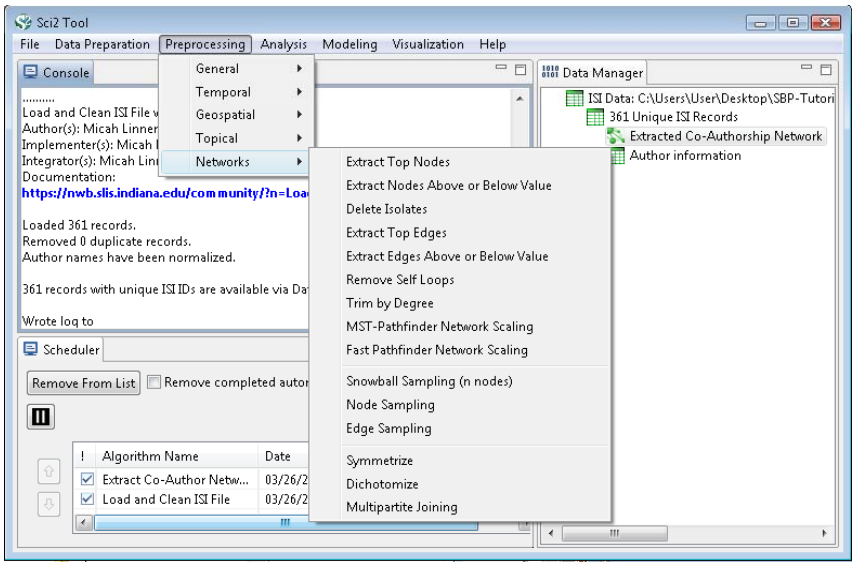
Katy Börner (2010) Science of Science Research and Tools (12 Tutorials). Reporting Branch, Office of Extramural Research/Office of the Director, National Institutes of Health, Bethesda, MD.

- Tutorial #01: Science of Science Research
- Tutorial #02: Network Science / Information Visualization
- Tutorial #03: CIShell Powered Tools: Network Workbench and Science of Science Tool
- Tutorial #04: Temporal Analysis—Burst Detection
- Tutorial #05: Geospatial Analysis and Mapping
- Tutorial #06: Topical Analysis & Mapping
- Tutorial #07: Tree Analysis and Visualization
- Tutorial #08: Network Analysis and Visualization
- Tutorial #09: Large Network Analysis and Visualization.
- Tutorial #10: Using the Scholarly Database at IU
- Tutorial #11: VIVO National Researcher Networking
- Tutorial #12: Future Developments

Geetha Senthil (2010). Multidisciplinary Nature of Work With Reference to PIs and ICs Within a Portfolio. PA Group at NIH.

NIH Office of Extramural Research and Katy Börner (2010) Network Visualizations Using SPIRES Data and the Sci2 Tool. Office of Extramural Research at NIH.

Sci² Tool for Science of Science Research and Practice *(http://sci.slis.indiana.edu/sci2)*



Acknowledgments

This work is supported in part by the Cyberinfrastructure for Network Science center and the School of Library and Information Science at Indiana University, the National Science Foundation under Grant No. SBE-0738111 and IIS-0513650, and the James S. McDonnell Foundation.

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James S. McDonnell Foundation

Sci² Tool for Science of Science Research and Practice *(http://sci.slis.indiana.edu/sci2)*

Supported Input file formats:

- GraphML (*.xml or *.graphml)
- XGMML (*.xml)
- Pajek .NET (*.net) & Pajek .Matrix (*.mat)
- NWB (*.nwb)
- TreeML (*.xml)
- Edge list (*.edge)
- **CSV (*.csv)**
- **ISI (*.isi)**
- **Scopus (*.scopus)**
- **NSF (*.nsf)**
- **Bibtex (*.bib)**
- **Endnote (*.enw)**

Output file formats:

GraphML (*.xml or *.graphml)
Pajek .MAT (*.mat)
Pajek .NET (*.net)
NWB (*.nwb)
XGMML (*.xml)
CSV (*.csv)

Ducu: https://nwb.slis.indiana.edu/community/?n=DataFormats.HomePage.

Mapping the Field of RNAi Research (SDB Data)

(section 5.2.7)

RNAi	
Time frame:	1865-2008
Region(s):	Miscellaneous
Topical Area(s):	RNAi
Analysis Type(s):	Co-Author Network, Patent-Citation Network, Burst Detection

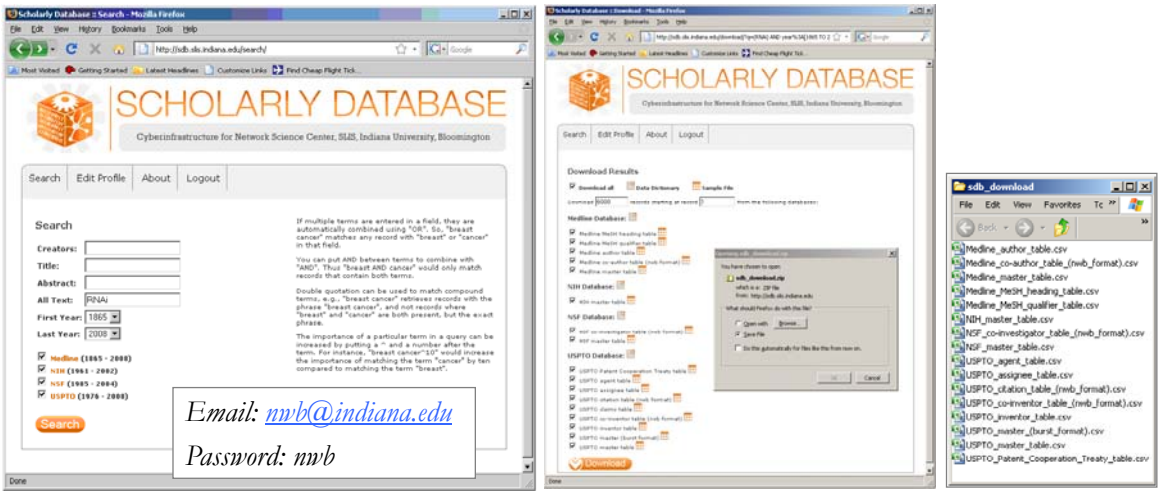
How many papers, patents, and funding awards exist on a specific topic?

Here we selected research on RNA interference (RNAi) is a system within living cells that helps to control which genes are active and how active they are.

The data for this analysis comes from a search of the Scholarly Database (SDB) (http://sdb.slis.indiana.edu/) for "RNAi" in "All Text" from MEDLINE, NSF, NIH and USPTO. A copy of this data is available in '**yoursci2directory*/sampledata/scientometrics/sdb/RNAi*'. The default export format is .csv, which can be loaded in the Sci2 Tool directly.

Mapping the Field of RNAi Research (SDB Data)

(section 5.2.7)



The **Scholarly Database** at Indiana University provides free access to 23,000,000 papers, patents, and grants. Since March 2009, users can also download networks, e .g., co-author, co-investigator, co-inventor, patent citation, and tables for burst analysis. For more information and to register, visit http://sdb.slis.indiana.edu.

Scholarly Database: # Records, Years Covered

Datasets available via the Scholarly Database (* internally)

Dataset	# Records	Years Covered	Updated	Restricted Access
Medline	17,764,826	1898-2008	Yes	
PhysRev	398,005	1893-2006		Yes
PNAS	16,167	1997-2002		Yes
JCR	59,078	1974, 1979, 1984, 1989 1994-2004		Yes
USPTO	3, 875,694	1976-2008	Yes*	
NSF	174,835	1985-2004	Yes*	
NIH	1,043,804	1961-2002	Yes*	
Total	**23,167,642**	**1893-2006**	**4**	**3**

Aim for comprehensive time, geospatial, and topic coverage.

Mapping the Field of RNAi Research (SDB Data)
(section 5.2.7)

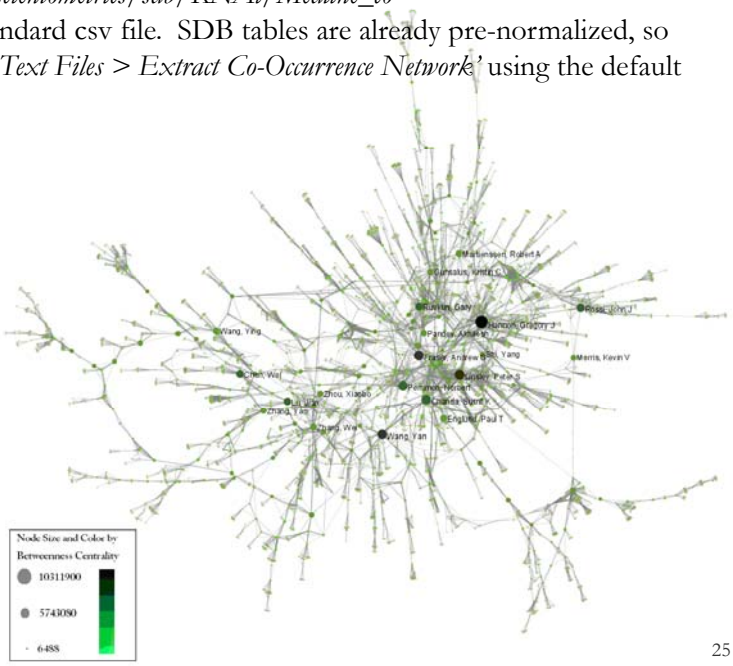
Co-Author Network

Load '**yoursci2directory*/sampledata/scientometrics/sdb/RNAi/Medline_co-author_table_(nwb_format).csv'* as a standard csv file. SDB tables are already pre-normalized, so now simply run '*Data Preparation > Text Files > Extract Co-Occurrence Network'* using the default parameters.

Network Analysis Toolkit (NAT):
21,578 nodes with 131 isolates,
77,739 edges.

Extract only the largest component by running '*Analysis > Networks > Unweighted and Undirected > Weak Component Clustering.'*

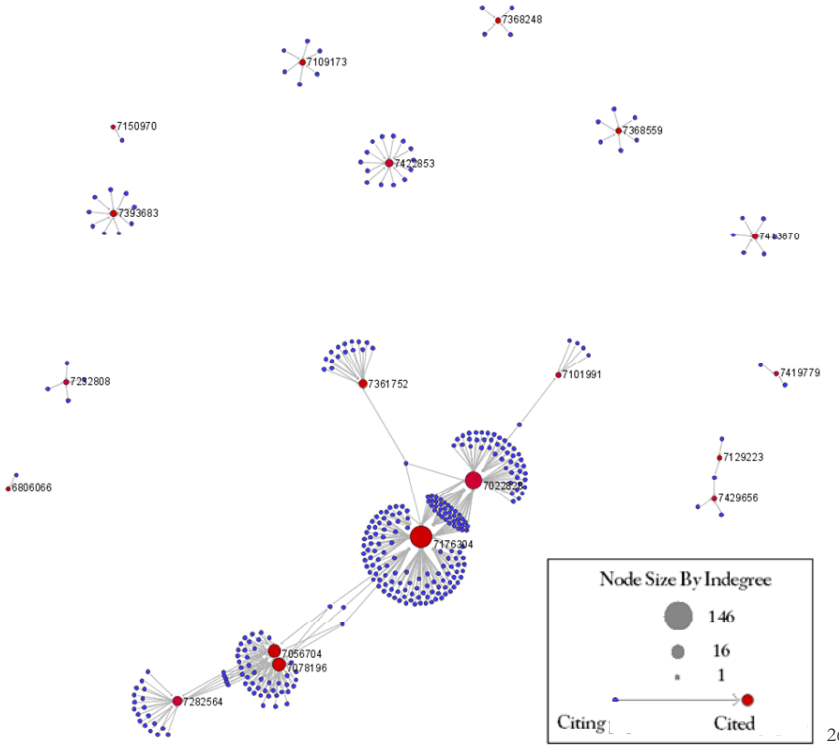
Visualize with *GUESS* using '*Layout > GEM'*.
Use a custom python script to color and size the network.



Mapping the Field of RNAi Research (SDB Data)
(section 5.2.7)

Patent Citation Network

To visualize the citation patterns of patents on RNAi, load '**yoursci2directory*/sampledata/scientometrics/sdb/RNAi/USPTO_citation_table_(nwb_format).csv'* as a standard csv file and follow the instructions in the tutorial.



Biomedical Funding Profile of NSF (NSF Data)

(section 5.2.4)

MedicalAndHealth.nsf	
Time frame:	2003-2010
Region(s):	Miscellaneous
Topical Area(s):	Biomedical
Analysis Type(s):	NSF Organization-Program Network

What organizations and programs at the National Science Foundation support projects that deal with medical and health related topics? Data was downloaded from the NSF Awards Search SIRE (http://www.nsf.gov/awardsearch) on Nov 23rd, 2009, using the query "medical AND health" in the title, abstract, and awards field, with "Active awards only" checked (see section 4.2.2.1 NSF Award Search for data retrieval details).

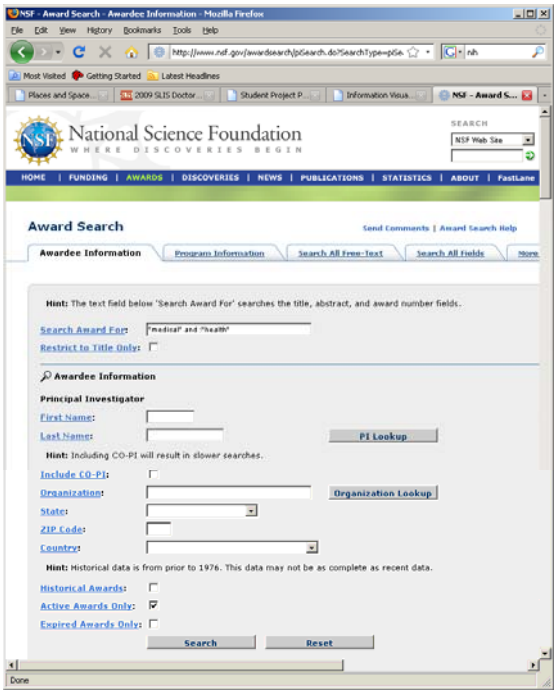
Biomedical Funding Profile of NSF (NSF Data)

(section 5.2.4)

Using NSF Awards Search:
http://www.nsf.gov/awardsearch
download relevant NSF awards that have "medical" AND "health" in title, abstract, and awards.
Active awards only.

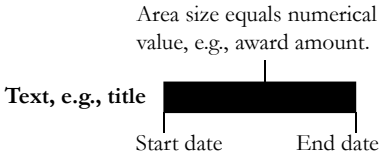
Number of awards: 283 awards
Total awarded amount to date: $152,015,288

Retrieved on Oct 18, 2009



Biomedical Funding Profile
(section 5.2.4)

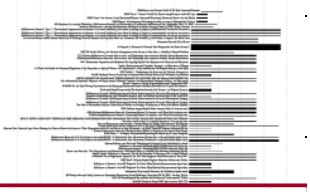
Horizontal Bargraph

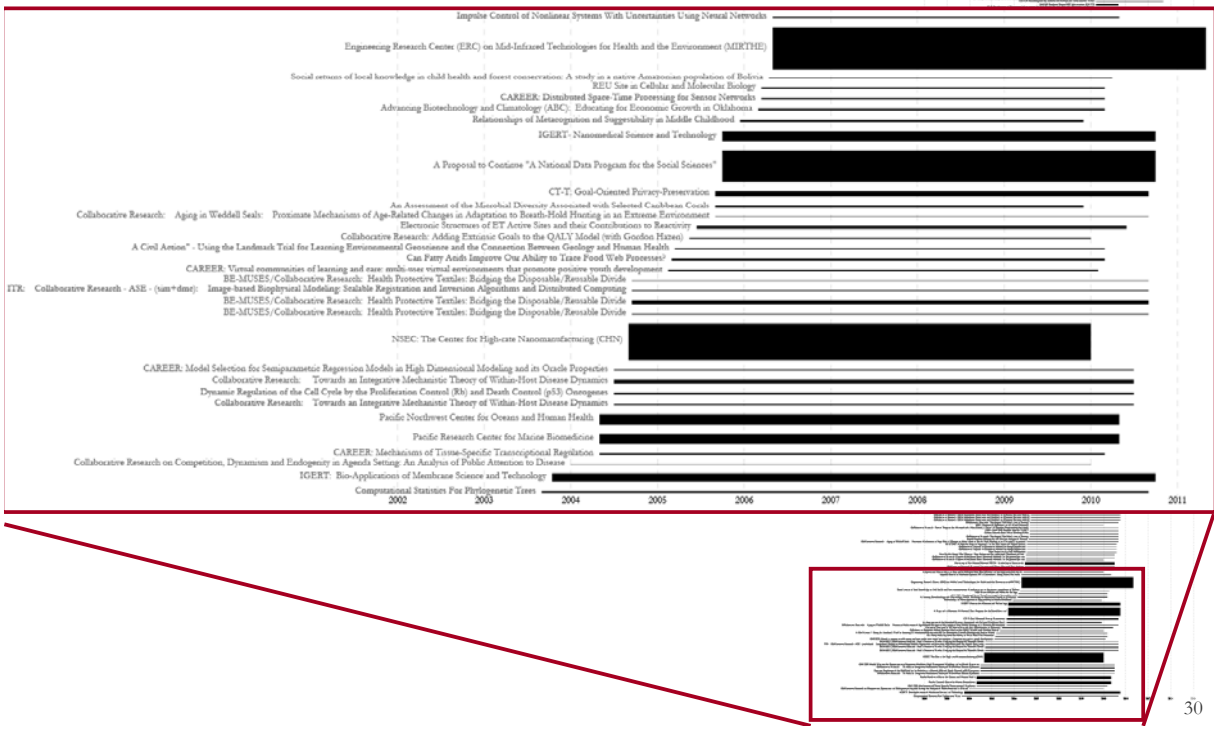


Top-10 grants with highest $Awarded to Date:

Title	NSF Org.	Program(s)	PI	State	Organization	$ Awarded to Date
University of NewMexico/Harvard PREM: Leadership in Bi	DMR	PREM|MATERIAL	Lopez, Gabriel	NM	University of New Mexico	2,037,500
TC: Large: Trustworthy Information Systems for Healthcare	CNS	TRUSTWORTHY C	Kotz, David	NH	Dartmouth College	2,999,999
IGERT- Nanomedical Science and Technology	DGE	||||||IGERT FULL PF	Sridhar, Srinivas	MA	Northeastern University	3,323,891
IGERT: Bio-Applications of Membrane Science and Techr	DGE	HUMAN RESOURI	Fried, Joel	OH	University of Cincinnati Main Campu	3,644,410
Pacific Research Center for Marine Biomedicine	OCE	CHEMICAL OCEA	Laws, Edward	HI	University of Hawaii	3,816,943
Pacific Northwest Center for Oceans and Human Health	OCE	CHEMICAL OCEA	Faustman, Elaine	WA	University of Washington	4,026,968
A Proposal to Continue 'A National Data Program for the S	SES	|SCIENCE & ENG	Smith, Tom	IL	National Opinion Research Center	5,835,140
A Proposal to Continue "A National Data Program for the S	SES	|||SCIENCE & EN(	Davis, James	IL	National Opinion Research Center	10,053,668
NSEC: The Center for High-rate Nanomanufacturing (CHN)	EEC	Studies of Policy S	Busnaina, Ahmed	MA	Northeastern University	13,047,758
Engineering Research Center (ERC) on Mid-Infrared Techn	EEC	COLLABORATIVE	Gmachl, Claire	NJ	Princeton University	13,681,994

Biomedical Funding Profile
(section 5.2.4)





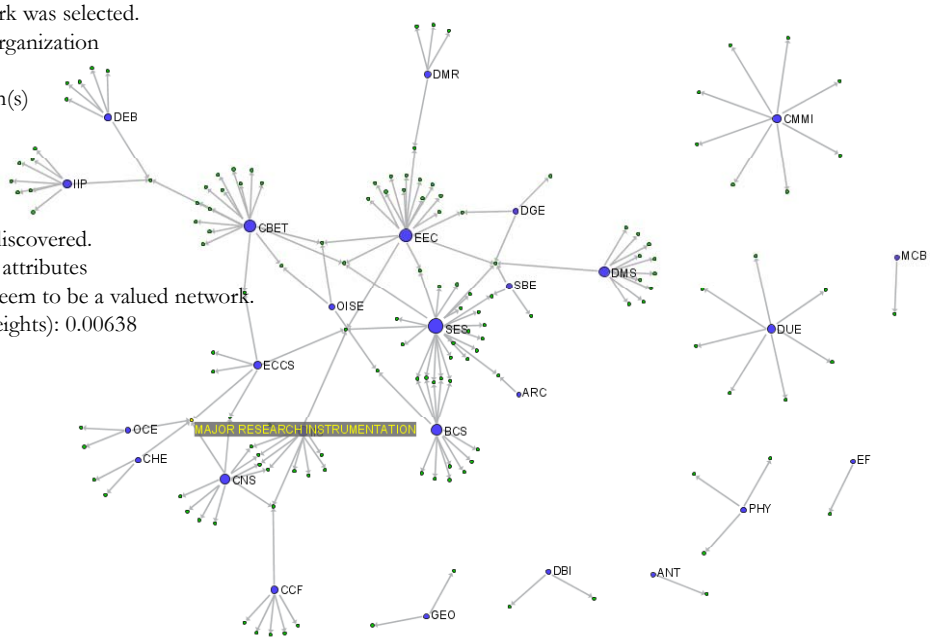
Biomedical Funding Profile of NSF (NSF Data)

(section 5.2.4)

Bimodal Network of NSF Organization to Program(s)

Extract Directed Network was selected.
Source Column: NSF Organization
Text Delimiter: |
Target Column: Program(s)

Nodes: 167
Isolated nodes: 0
Edges: 177
No parallel edges were discovered.
Did not detect any edge attributes
This network does not seem to be a valued network.
Density (disregarding weights): 0.00638



Mapping CTSA Centers (NIH RePORTER Data)

(section 5.2.3)

CTSA2005-2009.xls	
Time frame:	2005-2009
Region(s):	Miscellaneous
Topical Area(s):	Clinical and Translational Science
Analysis Type(s):	PI-Institution Network, Co-Authorship Network

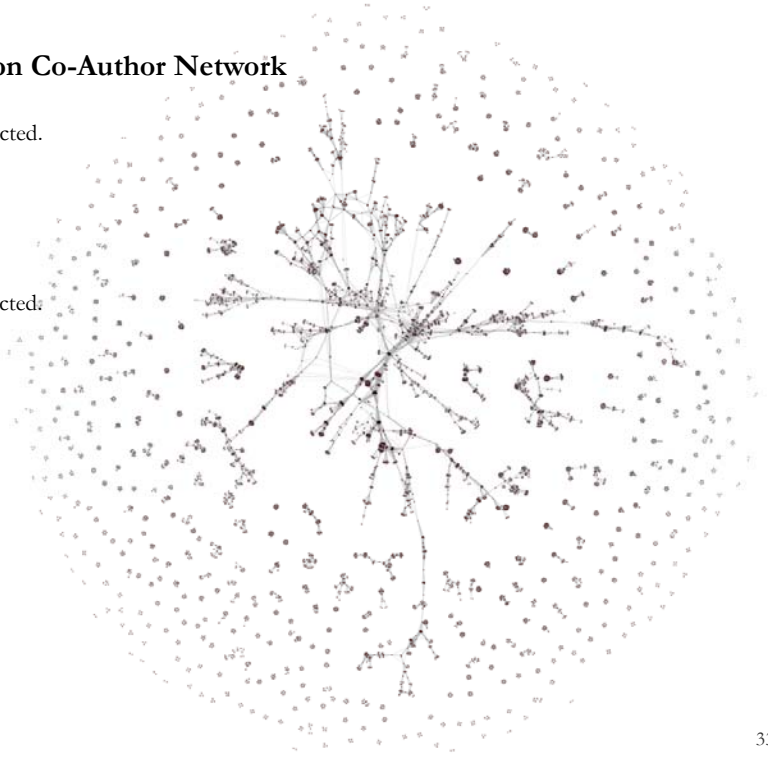
A study of all NIH Clinical and Translational Science Awards (CTSA) awards and resulting publications from 2005-2009, requires advanced data acquisition and manipulation to prepare the required data. Data comes from the union of NIH RePORTER downloads (see Section 4.2.2.2 NIH RePORTER) and NIH ExPORTER data dumps (http://projectreporter.nih.gov/exporter/). CTSA Center grants were identified first and then matched with resulting publications using a project-specific ID. The result file is available as an Excel file in '**yoursci2directory*/sampledata/scientometrics/nih'*. The file contains two spreadsheets, one with publication data and one with grant data. Save each spreadsheet out as *grants.csv* and *publications.csv*.

Mapping CTSA Centers (NIH RePORTER Data)

(section 5.2.3)

NIH CTSA Grants: Publication Co-Author Network

Extract Co-Occurrence Network was selected.
Input Parameters:
Text Delimiter: ;
Column Name: Authors
.....
Network Analysis Toolkit (NAT) was selected.
Nodes: 8680
Isolated nodes: 27
Edges: 50160

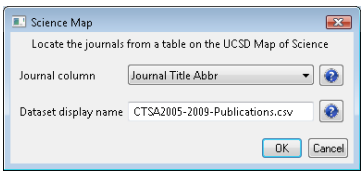


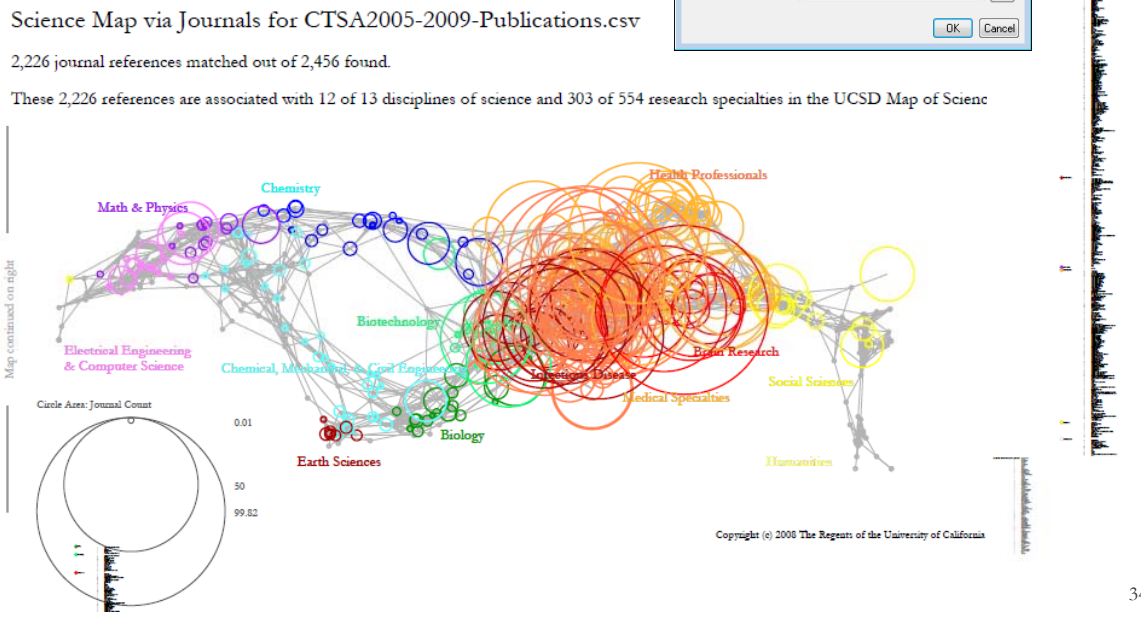
Mapping CTSA Centers (NIH RePORTER Data)

(section 5.2.3)

Topic Coverage of Publications

Visualization > Topical > Science Map via Journals'





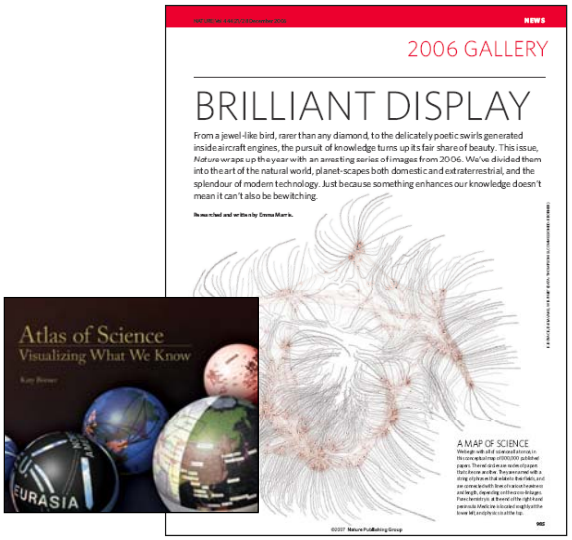
Computational Scientometrics References

Börner, Katy, Chen, Chaomei, and Boyack, Kevin. (2003). **Visualizing Knowledge Domains.** In Blaise Cronin (Ed.), *ARIST*, Medford, NJ: Information Today, Inc./American Society for Information Science and Technology, Volume 37, Chapter 5, pp. 179-255. http://ivl.slis.indiana.edu/km/pub/2003-borner-arist.pdf

Shiffrin, Richard M. and Börner, Katy (Eds.) (2004). **Mapping Knowledge Domains**. *Proceedings of the National Academy of Sciences of the United States of America*, 101(Suppl_1). http://www.pnas.org/content/vol101/suppl_1/

Börner, Katy, Sanyal, Soma and Vespignani, Alessandro (2007). **Network Science.** In Blaise Cronin (Ed.), *ARIST*, Information Today, Inc./American Society for Information Science and Technology, Medford, NJ, Volume 41, Chapter 12, pp. 537-607. http://ivl.slis.indiana.edu/km/pub/2007-borner-arist.pdf

Börner, Katy (2010) Atlas of Science. MIT Press. http://scimaps.org/atlas

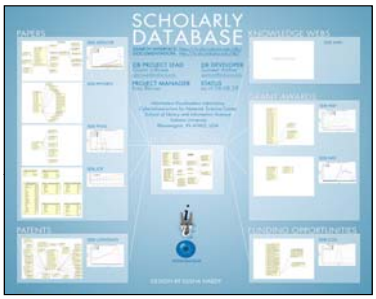


Computational Scientometrics Cyberinfrastructures

Scholarly Database: 23 million scholarly records
http://sdb.slis.indiana.edu

James S. McDonnell Foundation

VIVO Research Networking
http://vivoweb.org



Information Visualization Cyberinfrastructure
http://iv.slis.indiana.edu

Network Workbench Tool & Community Wiki
http://nwb.slis.indiana.edu

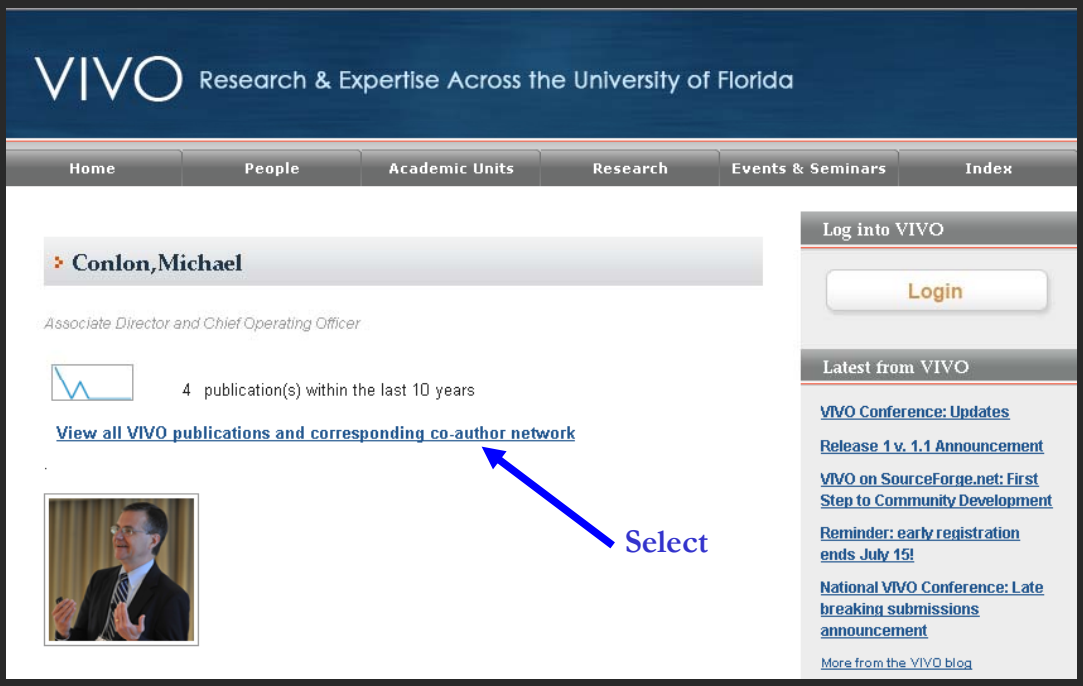
Science of Science (Sci²) Tool and CI Portal
http://sci.slis.indiana.edu

Epidemics Cyberinfrastructure
http://epic.slis.indiana.edu/

OSGi Alliance

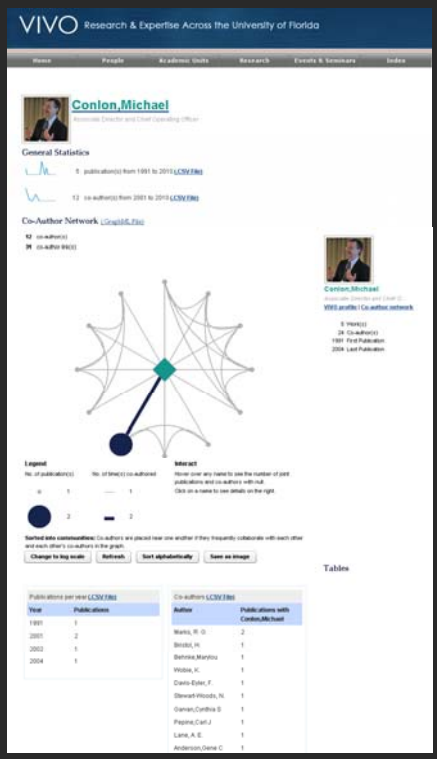
CIShell cyberinfrastructure shell

VIVO Release 1 v. 1.1: Individual Level Co-Author Visualization



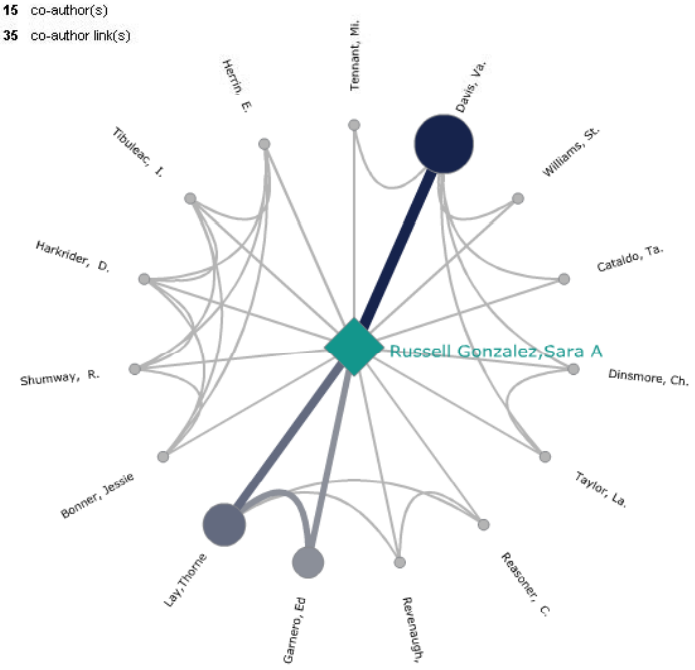
http://vivo.ufl.edu/display/n2556

VIVO Release 1 v. 1.1: Individual Level Co-Author Visualization



Co-Author Network (GraphML File)

15 co-author(s)
35 co-author link(s)



Russell Gonzalez,Sara A

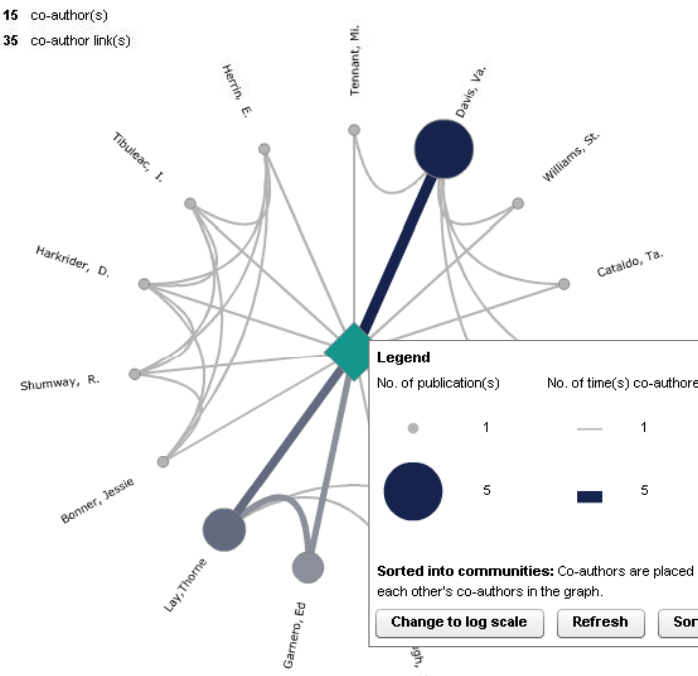
Physical Sciences Librarian

VIVO profile | Co-author network

9 Publication(s)
15 Co-author(s)
1998 First Publication
2010 Last Publication

Co-Author Network (GraphML File)

15 co-author(s)
35 co-author link(s)



Russell Gonzalez,Sara A

Physical Sciences Librarian

VIVO profile | Co-author network

9 Publication(s)
15 Co-author(s)
1998 First Publication
2010 Last Publication

Legend

No. of publication(s) — 1, 5

No. of time(s) co-authored — 1, 5

Interact

Hover over any name to see the number of joint publications and co-authors with Russell Gonzalez,Sara A.

Click on a name to see details on the right.

Thresholding

Only people that co-authored more than 0 paper(s) with Russell Gonzalez,Sara A are shown.

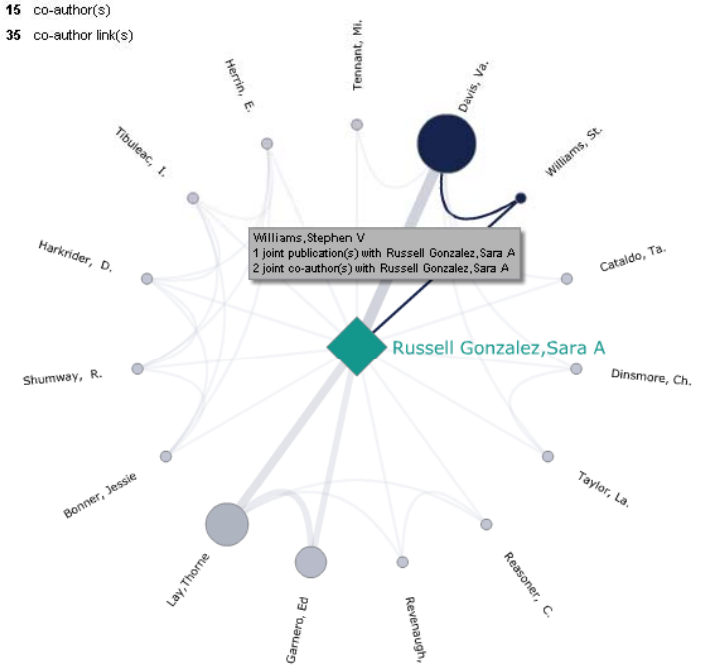
0 out of 0 co-author(s) are shown.

Sorted into communities: Co-authors are placed near one another if they frequently collaborate with each other and each other's co-authors in the graph.

Change to log scale | Refresh | Sort alphabetically | Save as image

Co-Author Network (GraphML File)

15 co-author(s)
35 co-author link(s)



Williams,Stephen V

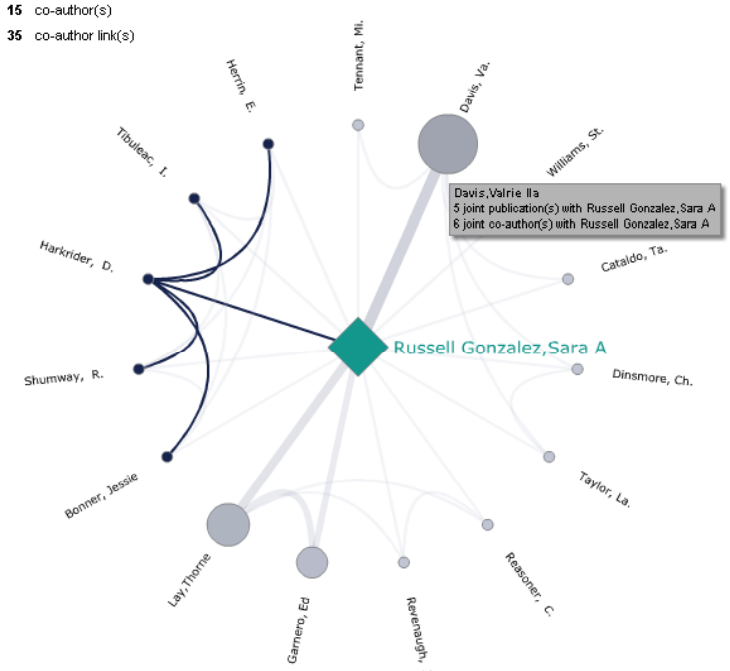
Software Engineer

VIVO profile | Co-author network

1 Joint Publication(s)
2 Joint Co-author(s)
2010 First Publication
2010 Last Publication

Co-Author Network (GraphML File)

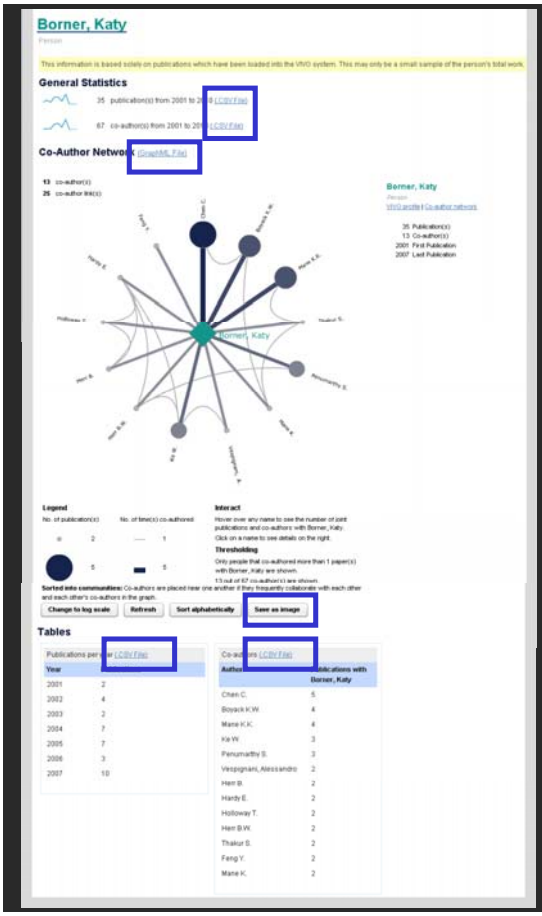
15 co-author(s)
35 co-author link(s)



Harkrider, David G.

VIVO profile | Co-author network

1 Joint Publication(s)
5 Joint Co-author(s)
2003 First Publication
2003 Last Publication



Download Data

General Statistics

- 36 publication(s) from 2001 to 2010 (.CSV File)
- 80 co-author(s) from 2001 to 2010 (.CSV File)

Co-Author Network

(GraphML File)

Save as Image (.PNG file)

Tables

- Publications per year (.CSV File)
- Co-authors (.CSV File)

http://vivo-vis.slis.indiana.edu/vivo1/visualization?uri=http%3A%2F%2Fvivoweb.org%2Fontology%2Fcore%2FPerson72e&vis=person_level&render_mode=standalone

36 publication(s) from 2001 to 2010 (.CSV File)

Year	Publications
2001	2
2002	4
2003	2
2004	7
2005	7
2006	3
2007	10
2010	1

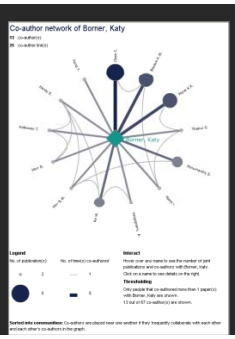
80 co-author(s) from 2001 to 2010 (.CSV File)

Year	Count	Co-Author(s)
2001	1	Chen C.
2002	3	Chen C.; McMahon T.; Feng Y.
2003	2	Chen C.; Boyack K.W.
2004	17	Sengupta A.; Penumarthy S.; Thakur S.; Sooriamurthi R.; Maru J.T.; Shiffrin R.M.; Mane K.; Moor K.A.;

Co-author network (GraphML File)

```
<?xml version="1.0" encoding="UTF-8"?>
   <graphml xmlns="http://graphml.graphdrawing.org/xmlns"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://graphml.graphdrawing.org/xmlns
  http://graphml.graphdrawing.org/xmlns/1.0/graphml.xsd">
<key id="label" for="node" attr.name="label" attr.type="string" />
<key id="number_of_authored_works" for="node" attr.name="number_of_authored_works" attr.type="int" />
<key id="num_unknown_publication" for="node" attr.name="num_unknown_publication" attr.type="int" />
<key id="num_latest_publication" for="node" attr.name="num_latest_publication" attr.type="int" />
<key id="latest_publication" for="node" attr.name="latest_publication" attr.type="int" />
<key id="profile_url" for="node" attr.name="profile_url" attr.type="string" />
```

Save as Image (.PNG file)

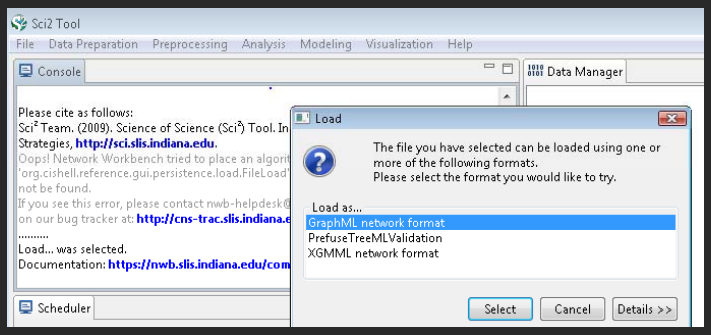


Publications per year (.CSV File), see top file.

Co-authors (.CSV File)

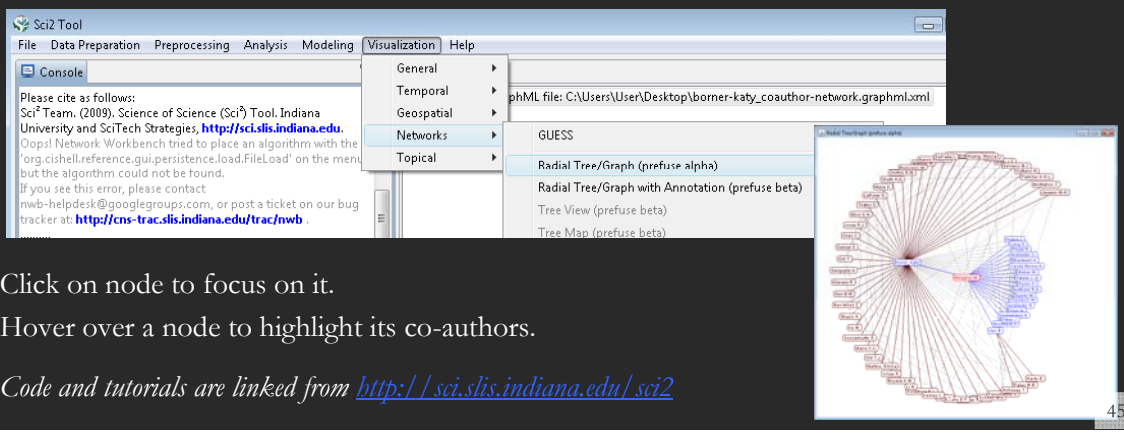
Co-Author	Count
Andrienko G.	1
Andrienko N.	1
Ben-Miled Z.	1
Blackwell A.	1
Boyack K.W.	4
Bozicevic M.	1
Brodbeck D.	1
Burkhard R.A.	1
Chen C.	5

Run Sci2 Tool and Load Co-Author Network (GraphML File)



Network Analysis Toolkit
Nodes: 81
Edges: 390

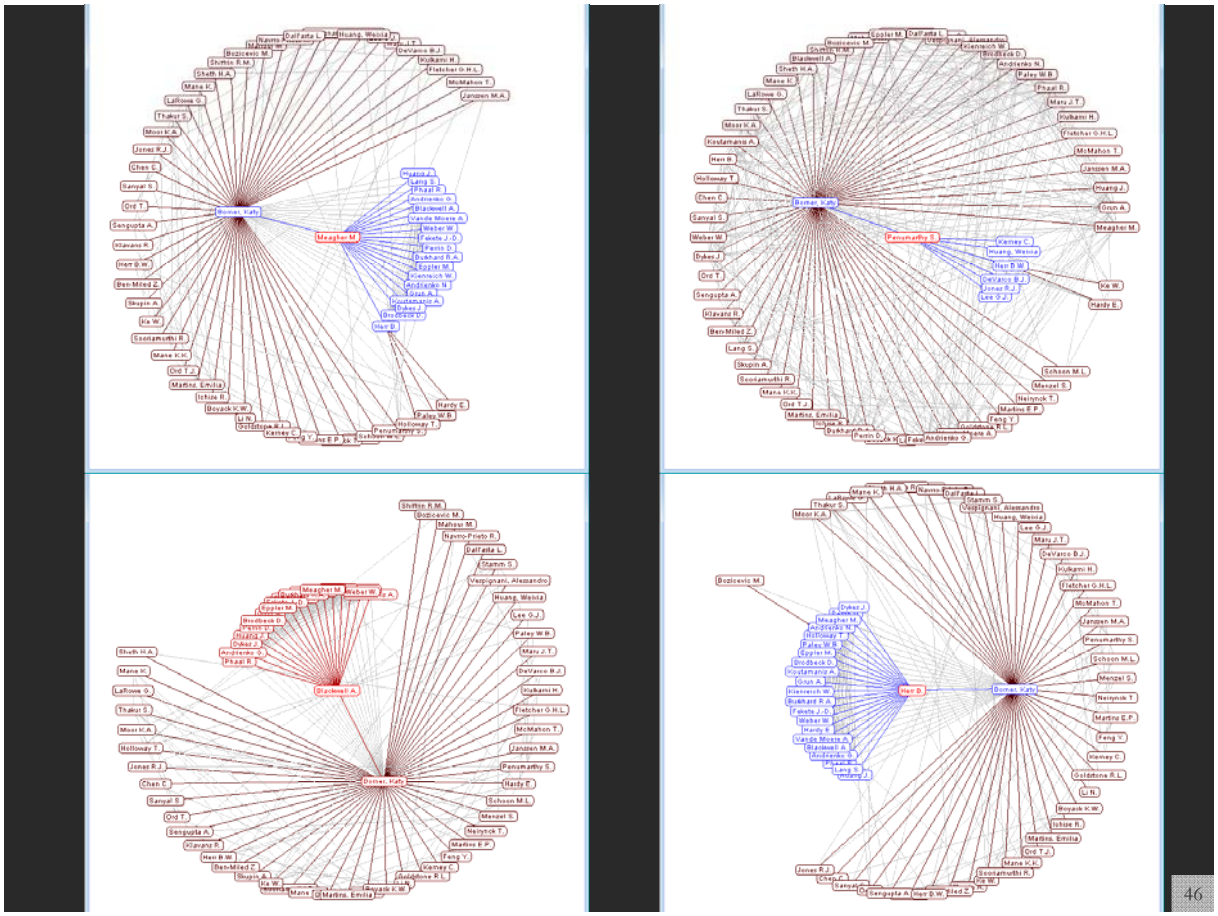
Visualize the file using Radial Graph layout.

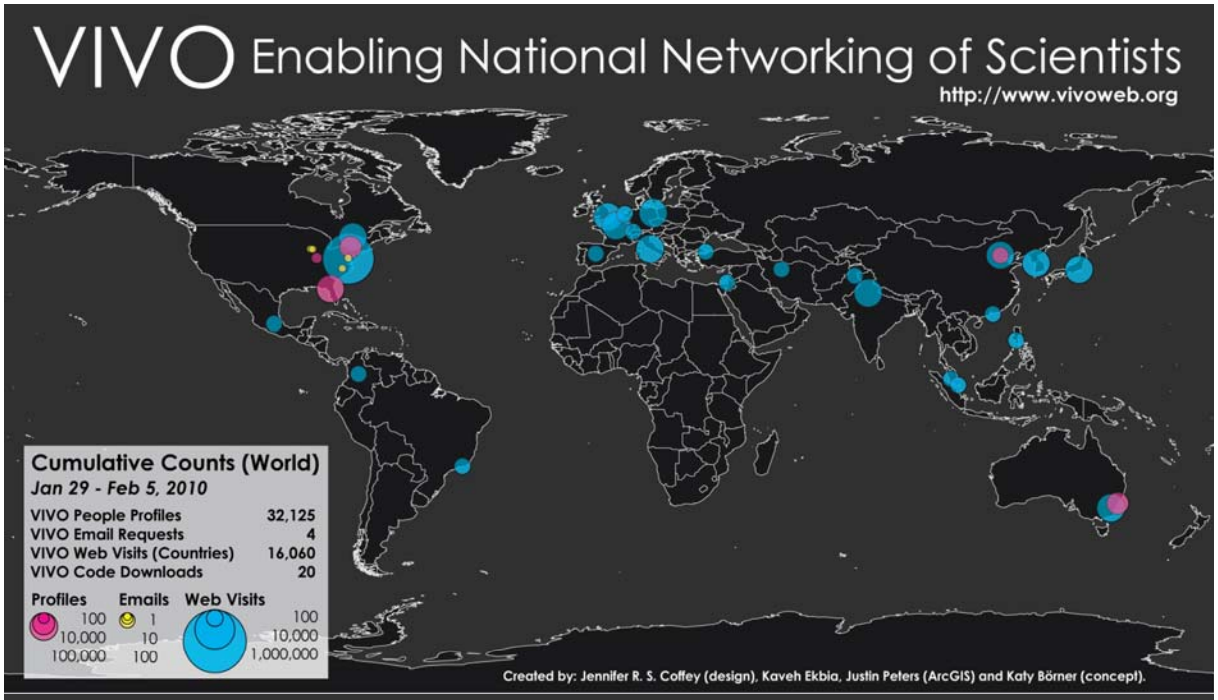


Click on node to focus on it.

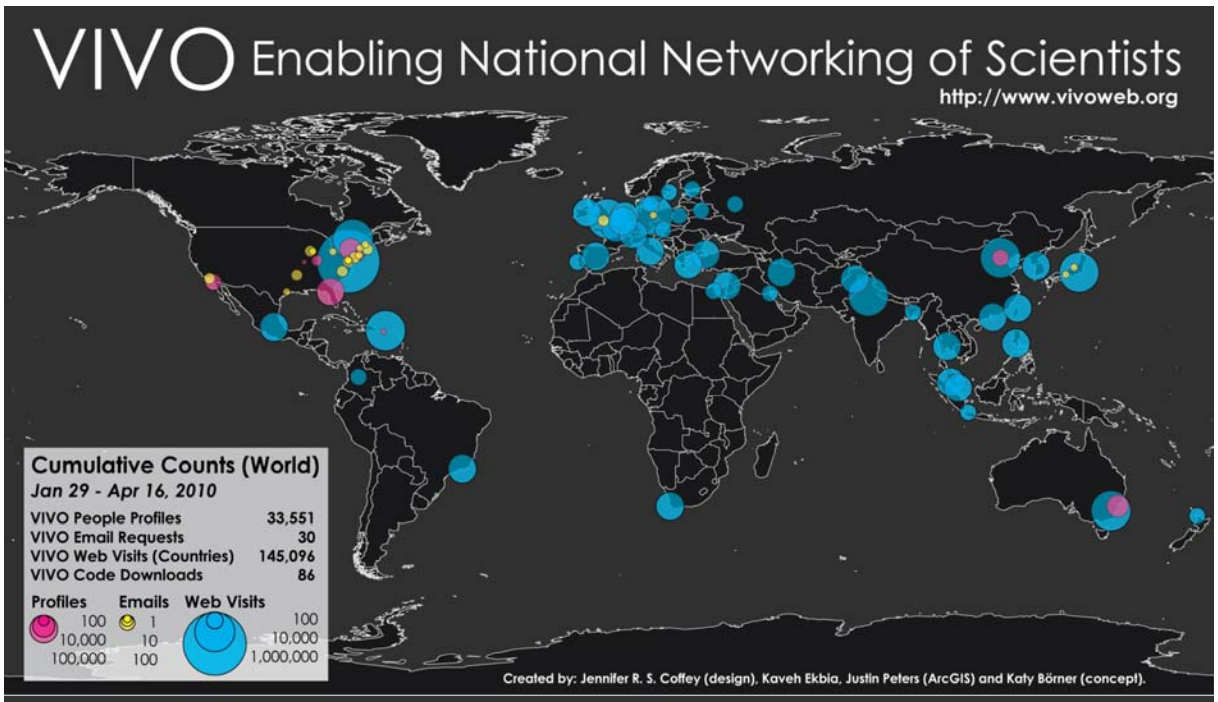
Hover over a node to highlight its co-authors.

Code and tutorials are linked from http://sci.slis.indiana.edu/sci2



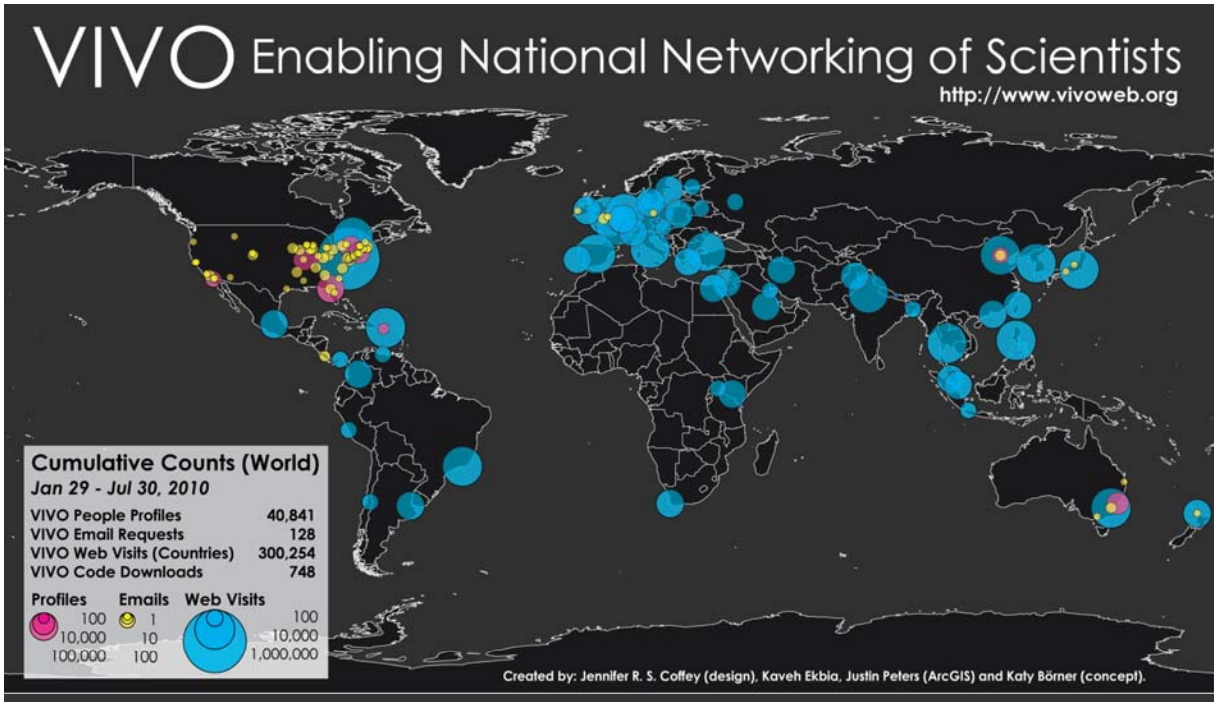


Science is global. World view of VIVO activity.
Web site visits are aggregated at the country level.

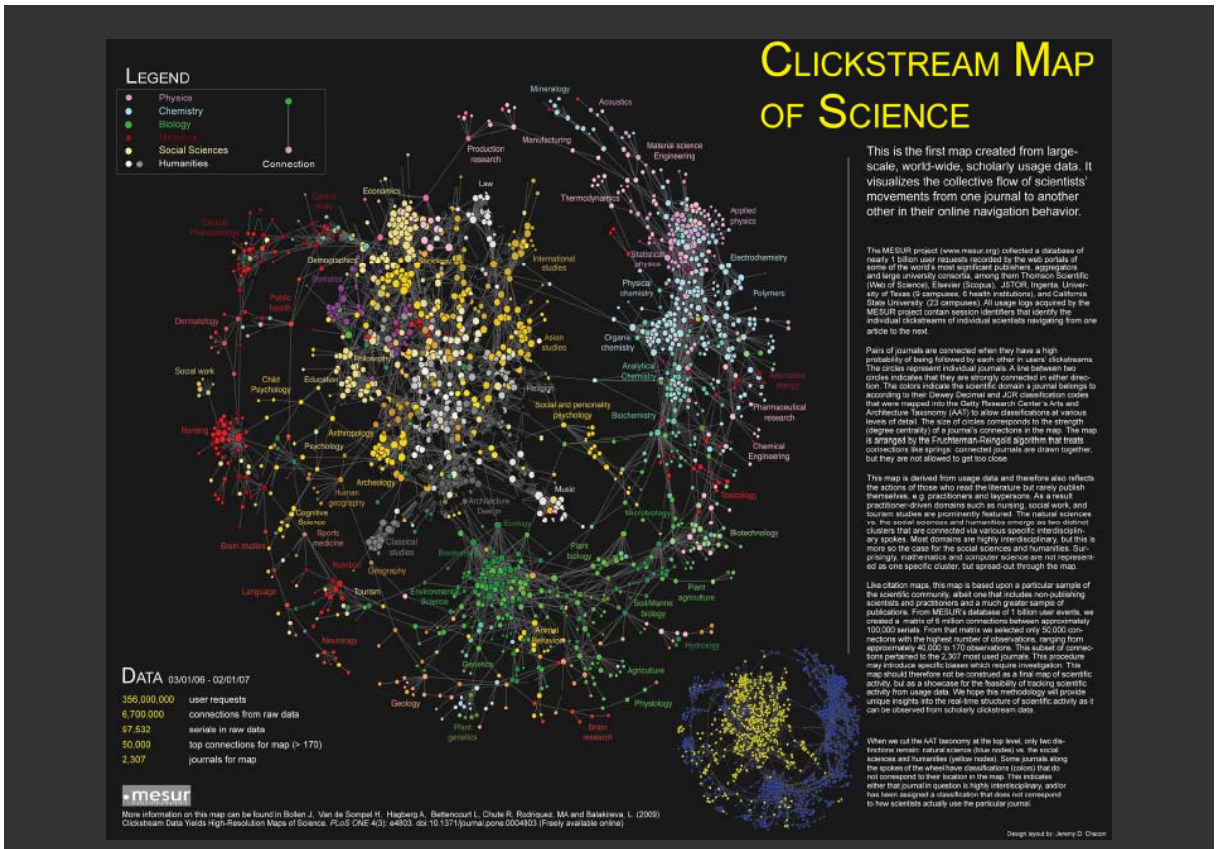


Shown are the
- Number of people profiles in the 7 different VIVO installation sites plus CAS and U Melbourne.
- Email contacts by data and service providers as well as institutions interested to adopt VIVO.
- The number of visitors on http://vivoweb.org

Circles are area size coded using a logarithmic scale.



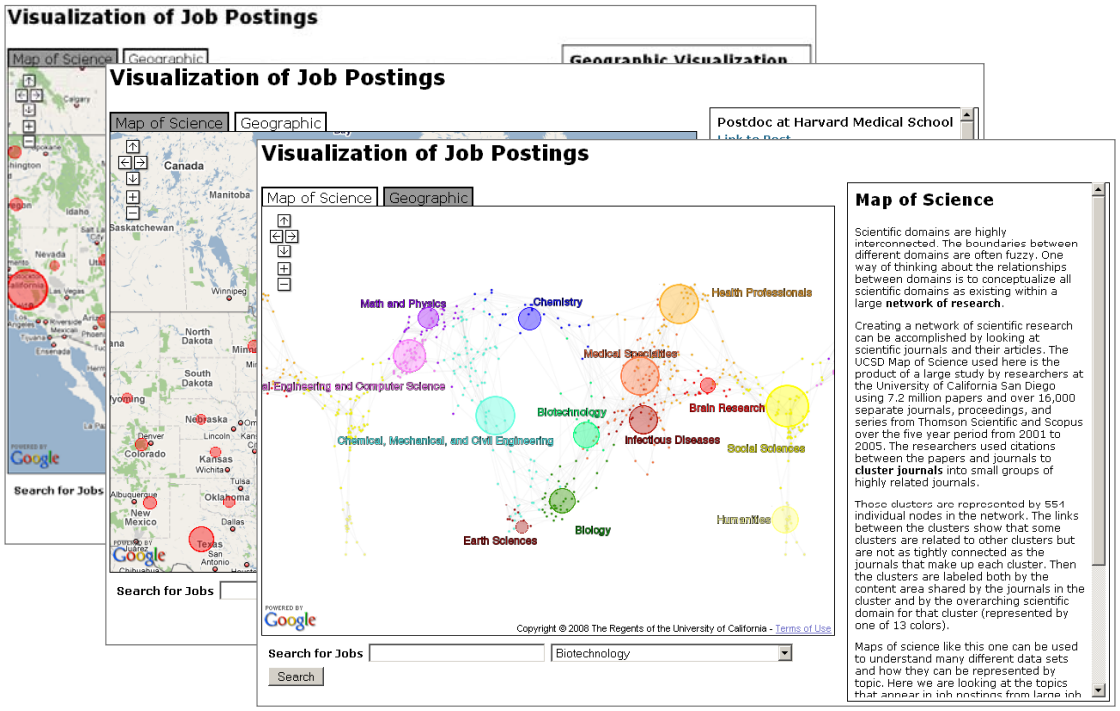
VIVO 1.0 source code was publicly released on April 14, 2010
87 downloads by June 11, 2010.
The more institutions adopt VIVO, the more high quality data will be available to understand, navigate, manage, utilize, and communicate progress in science and technology.



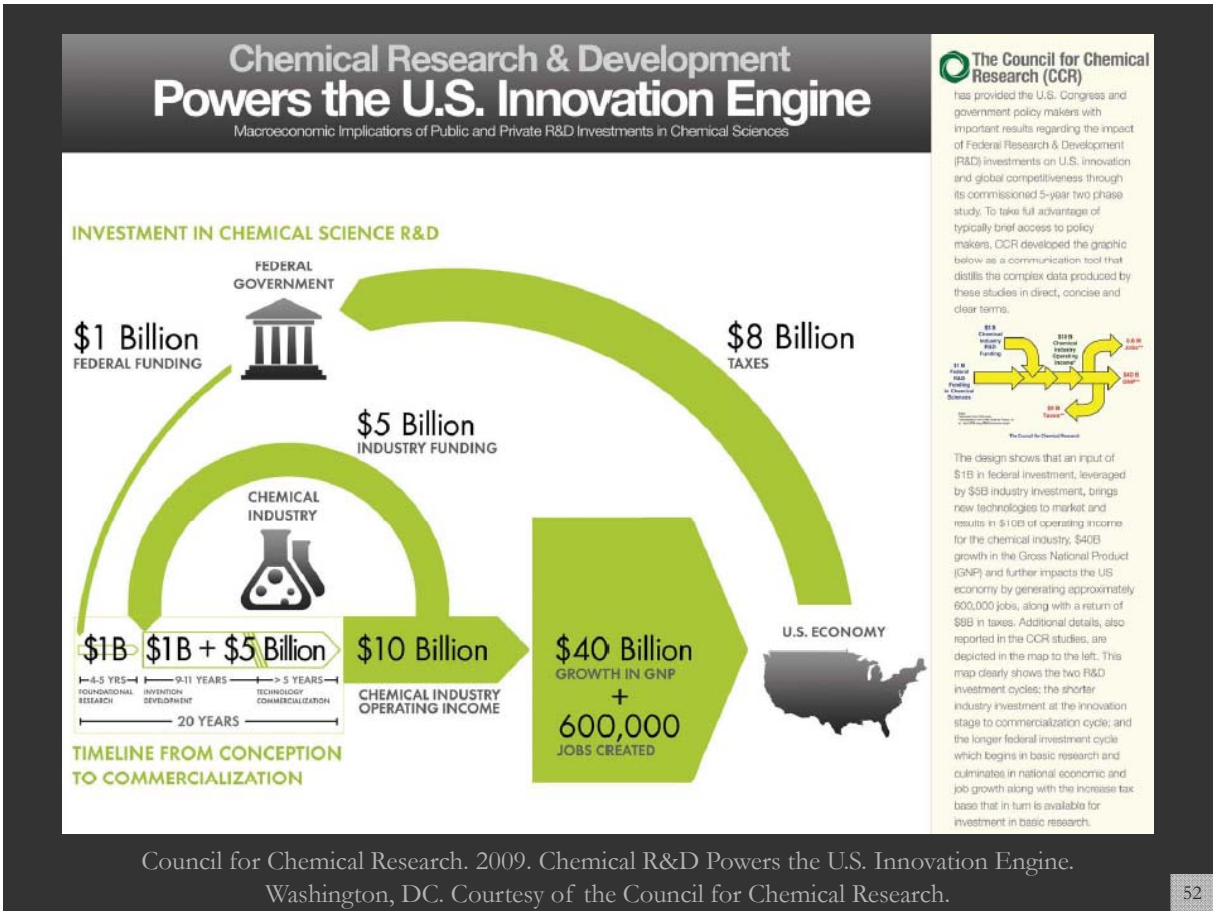
Bollen, Johan, Herbert Van de Sompel, Aric Hagberg, Luis M.A. Bettencourt, Ryan Chute, Marko A. Rodriquez, Lyudmila Balakireva. 2008. A Clickstream Map of Science.

Where Are the Academic Jobs? Interactive Exploration of Job Advertisements in Geospatial and Topical Space

Angela Zoss, Michael Connover, Katy Börner (2010)



http://cns-nd3.slis.indiana.edu/mapjobs/geo

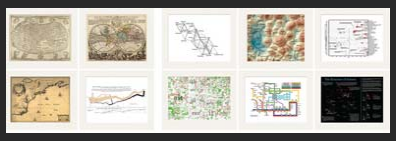


Council for Chemical Research. 2009. Chemical R&D Powers the U.S. Innovation Engine. Washington, DC. Courtesy of the Council for Chemical Research.

Mapping Science Exhibit – 10 Iterations in 10 years

http://scimaps.org

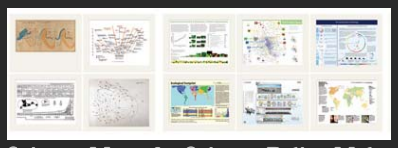
The Power of Maps (2005)



The Power of Reference Systems (2006)

The Power of Forecasts (2007)

Science Maps for Economic Decision Makers (2008)



Science Maps for Science Policy Makers (2009)

Science Maps for Scholars (2010)
Science Maps as Visual Interfaces to Digital Libraries (2011)
Science Maps for Kids (2012)
Science Forecasts (2013)
How to Lie with Science Maps (2014)

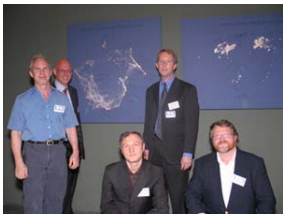
Exhibit has been shown in 72 venues on four continents. Currently at
- NSF, 10th Floor, 4201 Wilson Boulevard, Arlington, VA
- Marston Science Library, University of Florida, Gainesville, FL
- Center of Advanced European Studies and Research, Bonn, Germany
- Science Train, Germany.

ORDER MAPS

Debut of 5th Iteration of Mapping Science Exhibit at MEDIA X was on May 18, 2009 at Wallenberg Hall, Stanford University, http://mediax.stanford.edu, http://scaleindependentthought.typepad.com/photos/scimaps

Illuminated Diagram Display

W. Bradford Paley, Kevin W. Boyack, Richard Kalvans, and Katy Börner (2007) Mapping, Illuminating, and Interacting with Science. SIGGRAPH 2007.



Large-scale, high resolution prints illuminated via projector or screen.

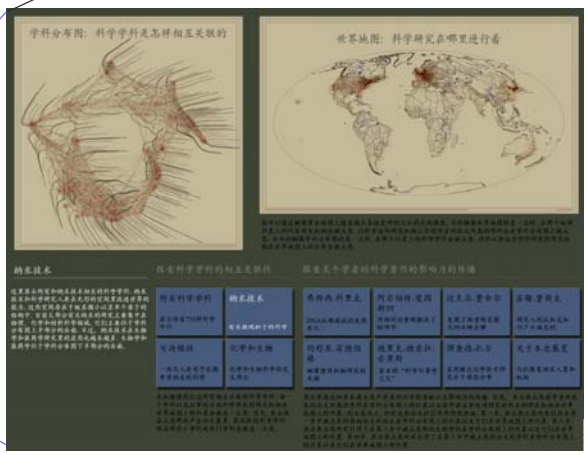
Questions:

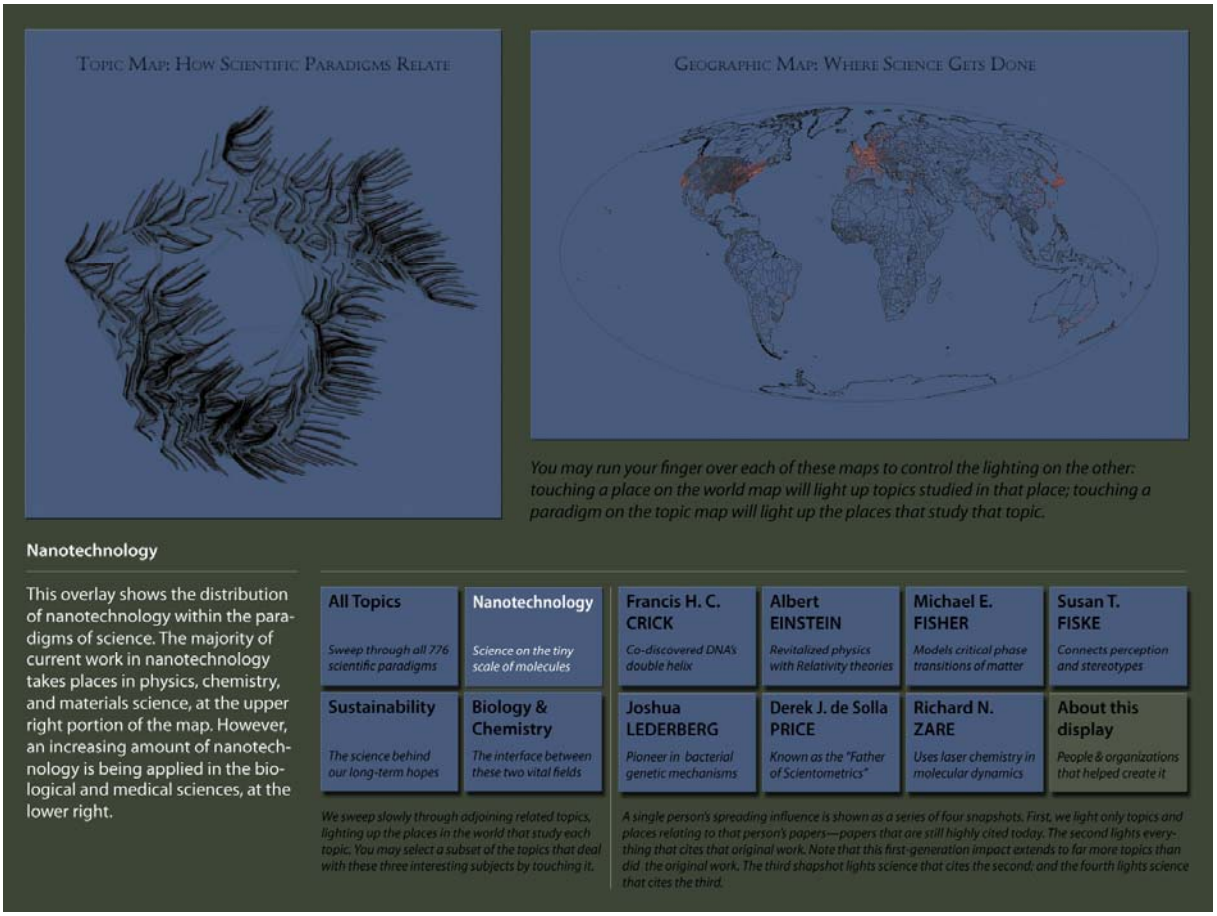
- Who is doing research on what topic and where?
- What is the 'footprint' of interdisciplinary research fields?
- What impact have scientists?

Interactive touch panel.

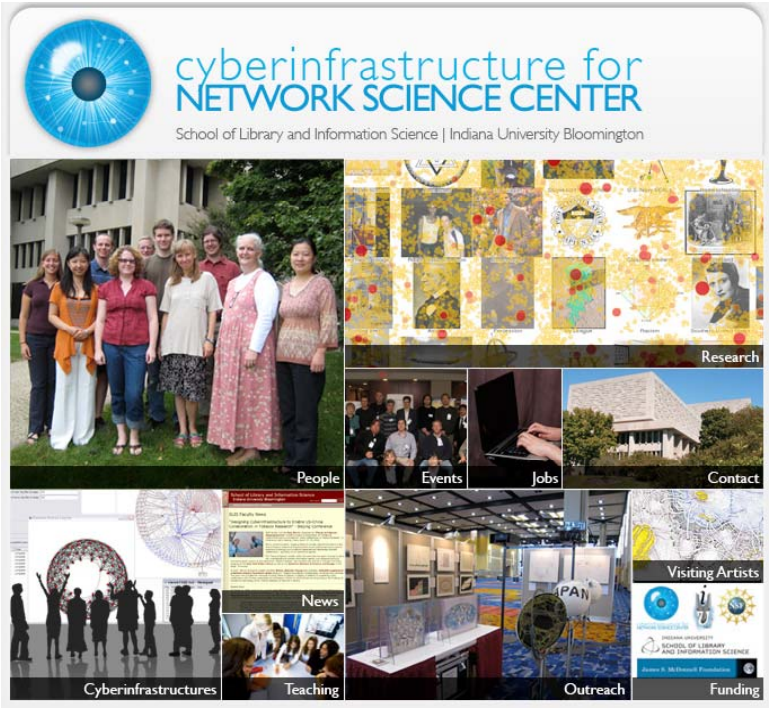
Contributions:

- Interactive, high resolution interface to access and make sense of data about scholarly activity.





Science Maps in "Expedition Zukunft" science train visiting 62 cities in 7 months
12 coaches, 300 m long
Opening was on April 23rd, 2009 by German Chancellor Merkel
http://www.expedition-zukunft.de



All papers, maps, cyberinfrastructures, talks, press are linked from http://cns.slis.indiana.edu