Supporting International Research Networking

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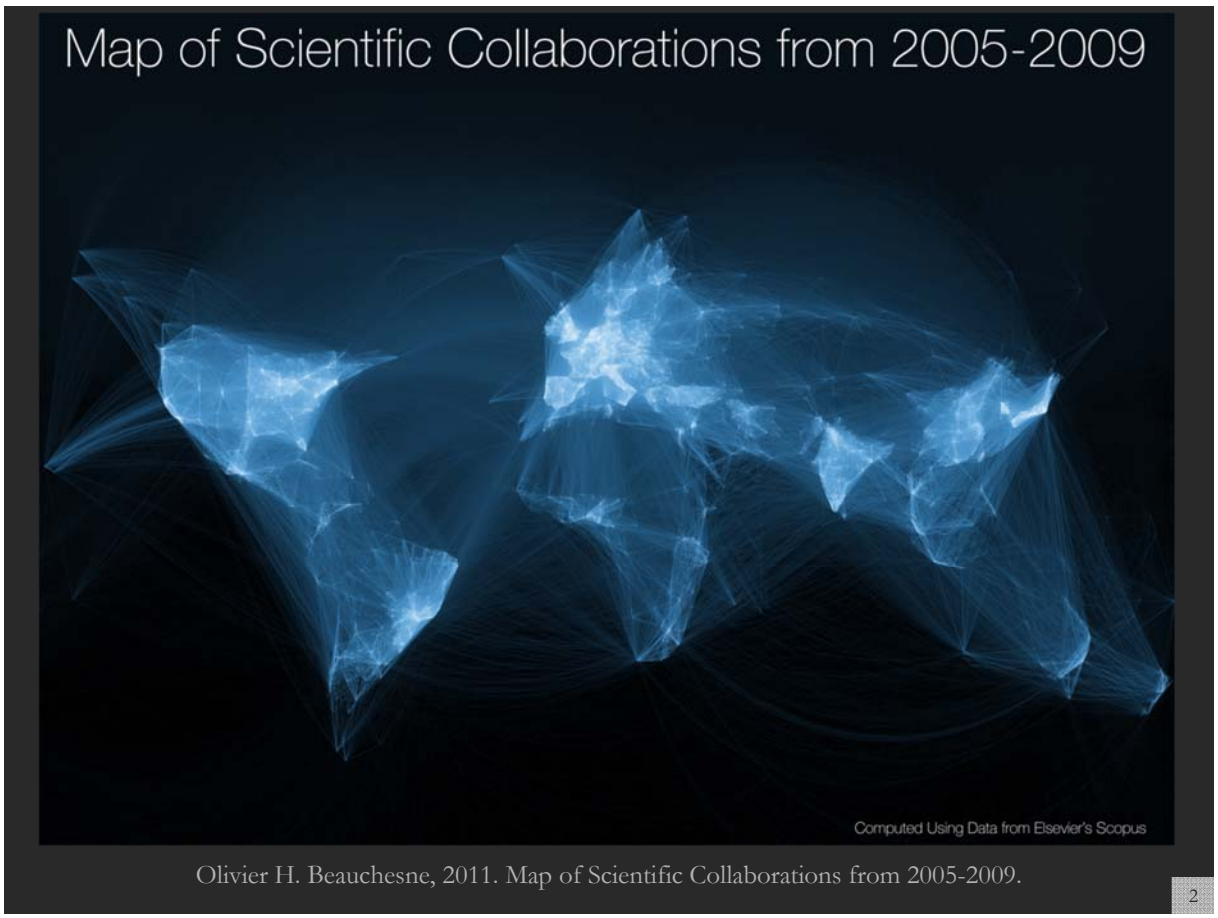
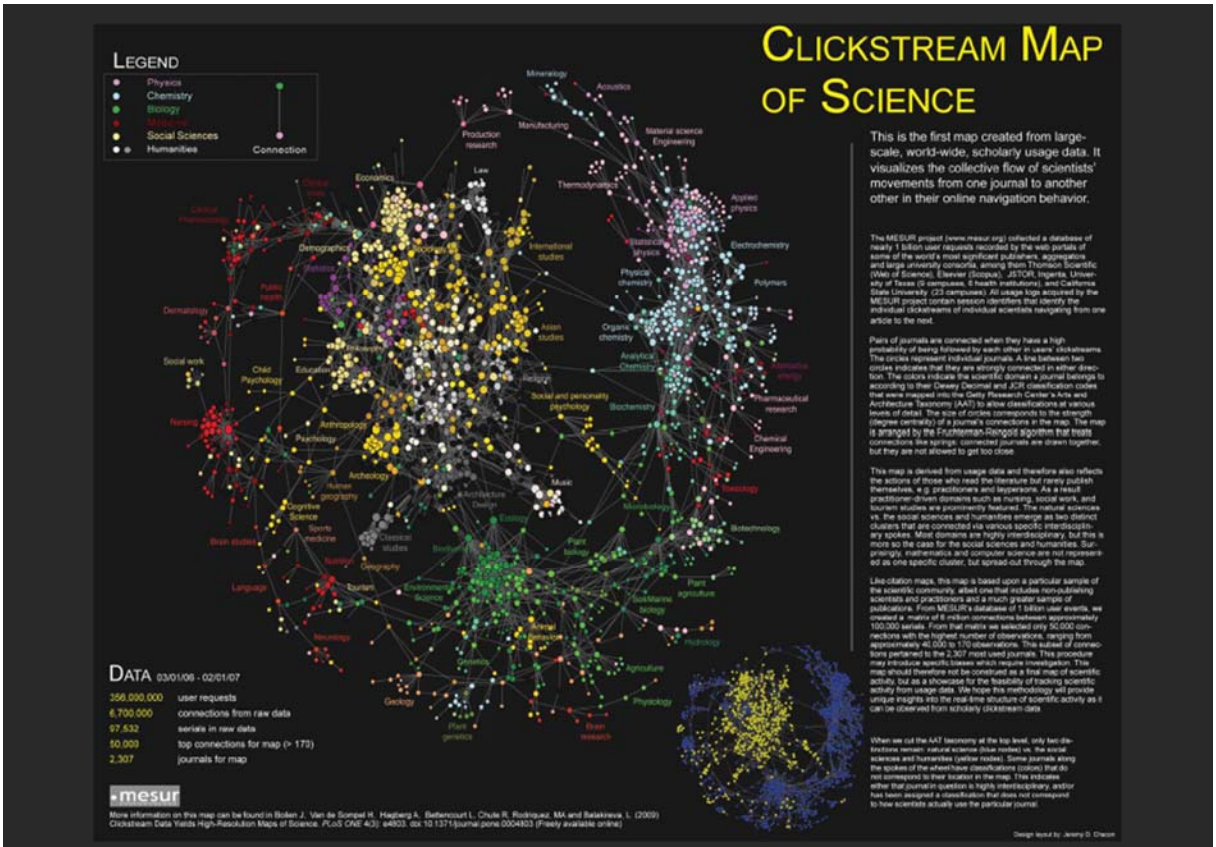
Indiana University, USA

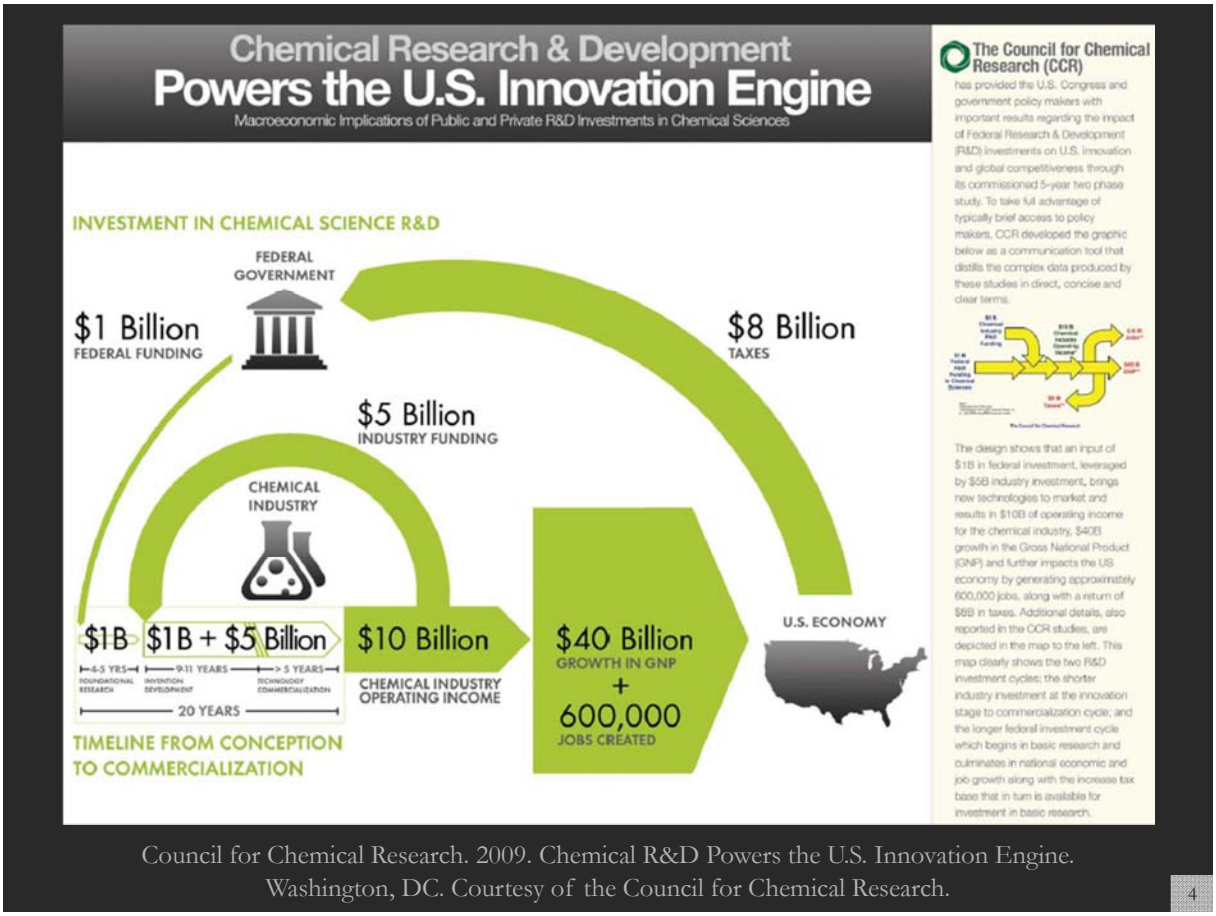
October 24, 2013



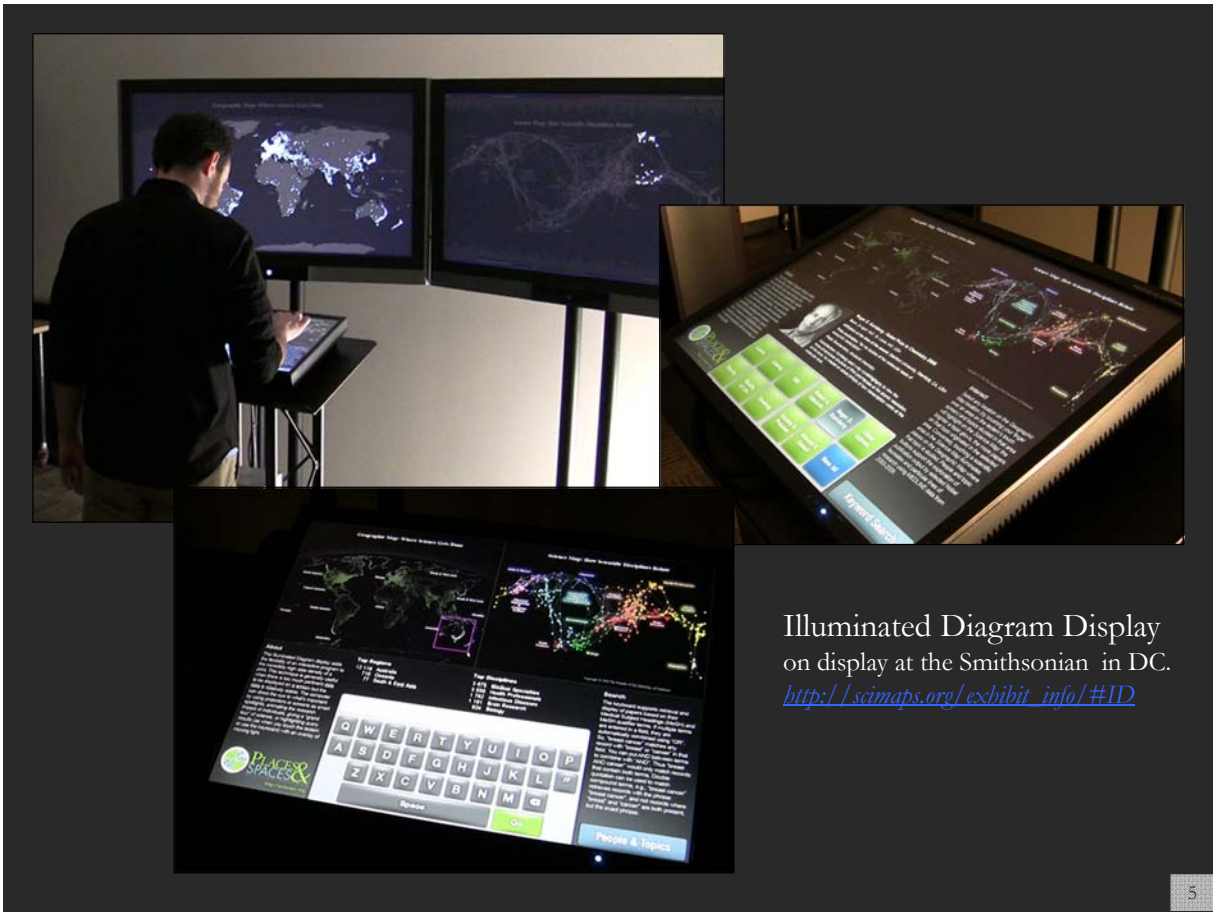
Olivier H. Beauchesne, 2011. Map of Scientific Collaborations from 2005-2009.



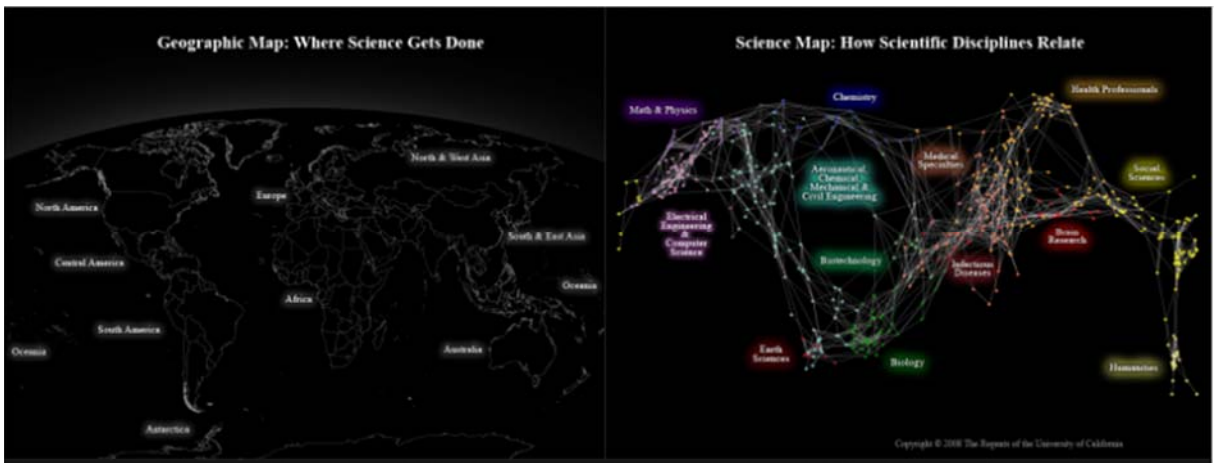
Bollen, Johan, Herbert Van de Sompel, Aric Hagberg, Luis M.A. Bettencourt, Ryan Chute, Marko A. Rodriquez, Lyudmila Balakireva. 2008. A Clickstream Map of Science.



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



Illuminated Diagram Display
on display at the Smithsonian in DC.
http://scimaps.org/exhibit_info/#ID



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.

PLACES & SPACES
http://scimaps.org

Top Five Continents

North America - 4,000 records
South & East Asia - 3,589
Australia - 2,431
Africa - 2,208
South America - 1,582

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 - 1,582

Input your search query here.

Q W E R T Y U I O P
A S D F G H J K L "
Z X C V B N M ⌫
Space Go

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.

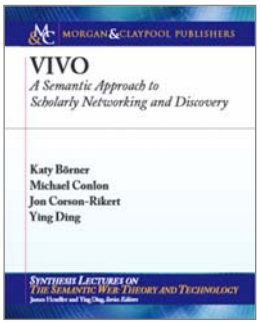
People & Topics

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

Interested to host the exhibit?
scimaps.org/contact

Overview

1. **Research Networking Services** that aim to support collaborations, research management, and the flow of knowledge/expertise.
2. **VIVO Approach and Visualizations** that help answer When, Where, What, With Whom questions.
3. **Outlook** how to scale and commoditize data mining and visualizations of research networking data.



CNS CyberInfrastructure for Network Science Center

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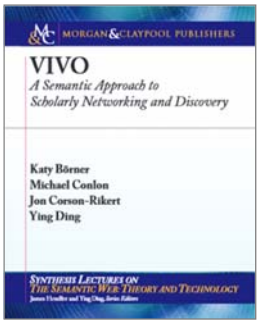
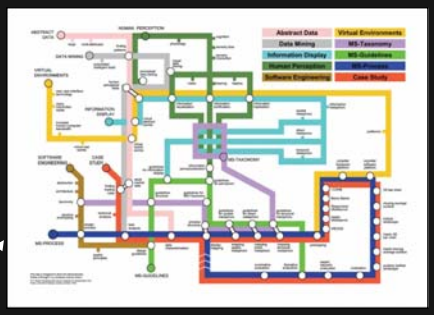


CNS CyberInfrastructure for Network Science Center

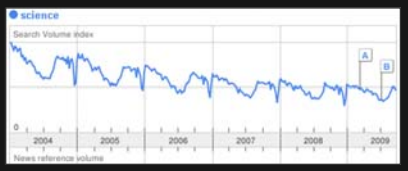
Terra bytes of data

Information Technology



Find your way

Find collaborators, friends

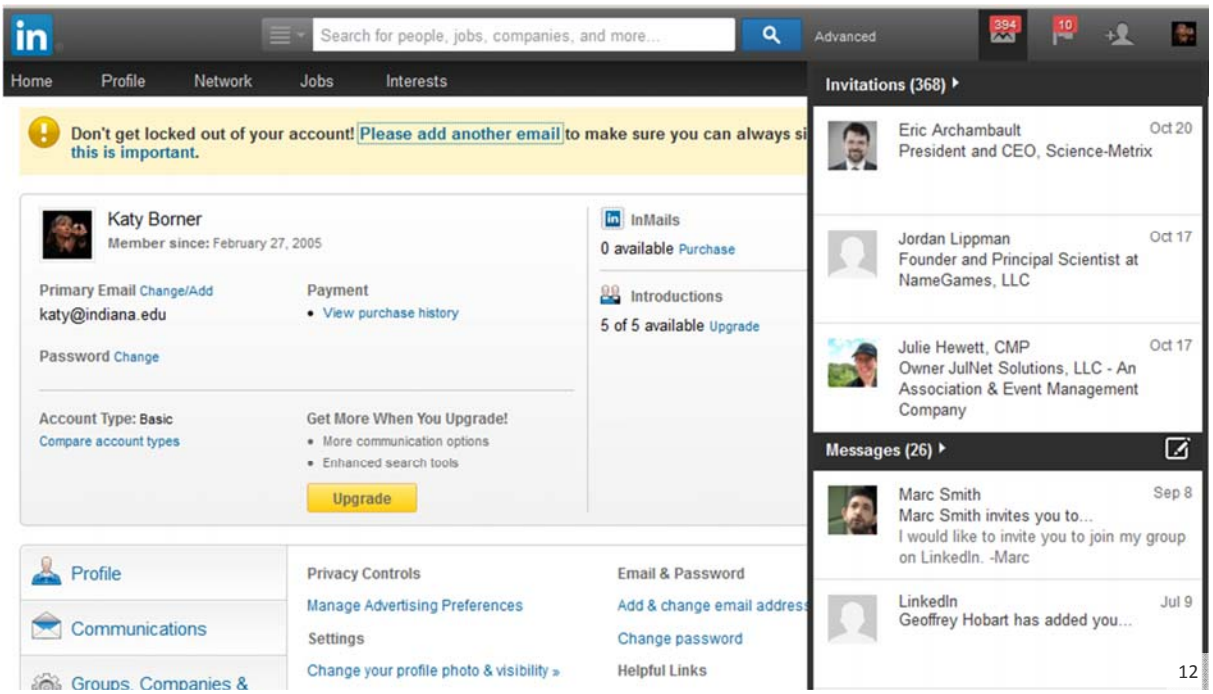


Identify trends

LinkedIn: World's Largest Professional Network

https://www.linkedin.com

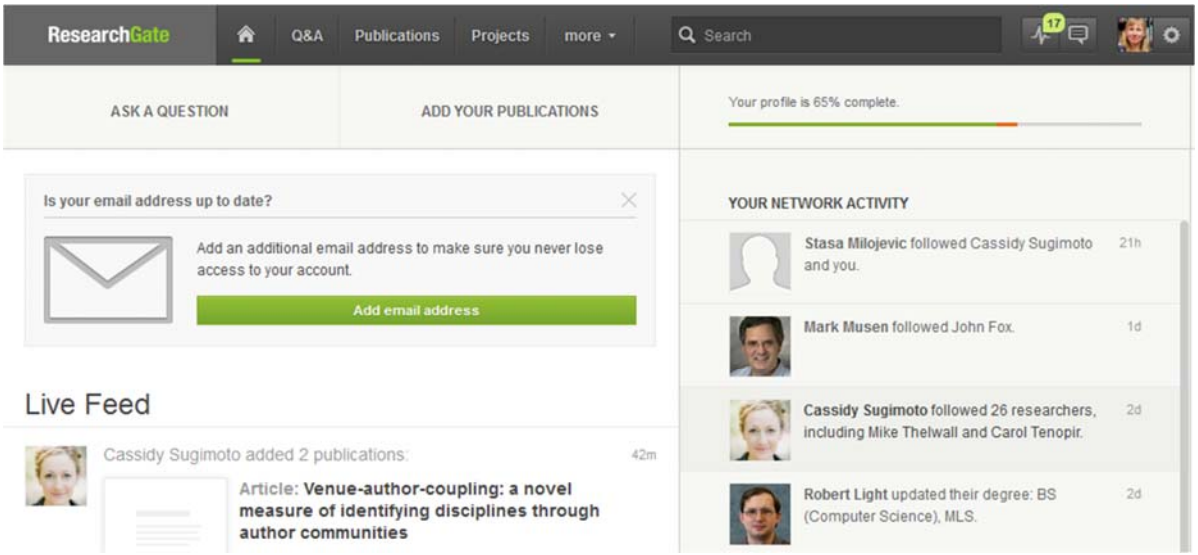
Founded in December 2002 and launched on May 5, 2003.



ResearchGate GmbH

https://www.researchgate.net

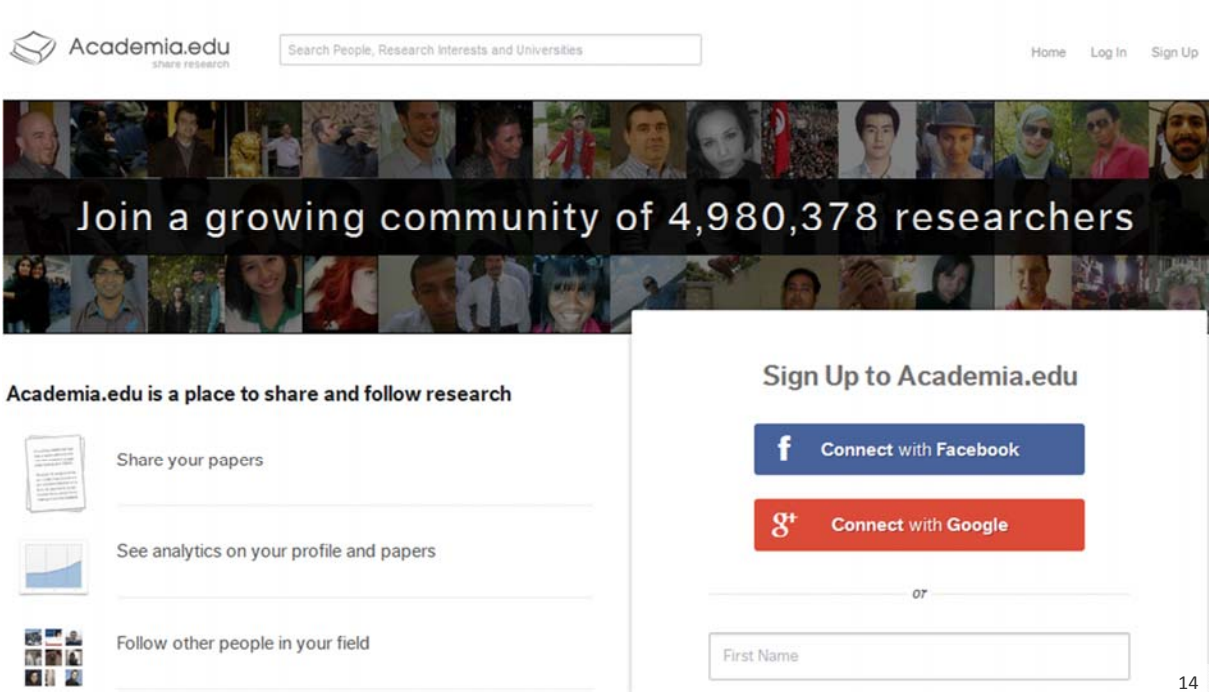
Launched in May 2008, has a user base of 2.3 million scientists worldwide in Aug .2013



Academia.edu—Share Research

http://www.academia.edu

Launched in Nov 2010.



Networking Services—60 More

This table provides general information for each tool: name, developing institution, external links to information, whether the code is Open Source and known adopters of the software.

Research Networking Tool	Link to Product Page	Developer/Owner	Open Source	Adopters
Activity Insight	Activity Insight	Digital Measures	No	USC Marshall School of Business
C-IKNOW[5][6]	C-IKNOW	Science of Networks in Communities (SONIC) - Northwestern University	Yes	National Cancer Institute, National Science Foundation
Collaborative Partnership / Profile System	Collaborative Partnership and Research Expertise at UT Arlington	University of Texas at Arlington	Yes	UT Arlington, UT Pan American, University of North Texas Health Science Center, UT El Paso, UT San Antonio, UT Tyler, UT Health Science Center, University of North Texas, UT Dallas, UT Health Center at Tyler, Texas Christian University, (plans to add Gulf Coast Consortia: Rice University, Baylor College of Medicine)
Community Academic Profiles - CAP	Community Academic Profiles	Stanford University	No	Stanford University
Curvita™ Profile Manager	Curvita Profile Manager	SciMed Solutions	No	University of North Carolina
CUSP - Columbia University Scientific Profiles	CUSP	Columbia University	No	Columbia University
Digital Vita	DigitalVita	Center for Dental Informatics - University of Pittsburgh	Yes	University of Pittsburgh, Pitt Health Sciences Center
Elsevier's SciVal Experts (formerly Collexis Expert Profiling)	SciVal Experts	Elsevier	No	45+ implementations worldwide containing profiles for researchers at 65+ institutions. Customers include Johns Hopkins University, Memorial Sloan-Kettering, Northwestern University, REACH NC, University of Michigan, University of Texas MD Anderson Cancer Center, and several institutions in Asia-Pacific, Europe and Latin America. See SciVal

http://en.wikipedia.org/wiki/Comparison_of_Research_Networking_Tools_and_Research_Profiling_Systems

Direct2Experts –Federated Network of Biomedical Research Expertise

http://direct2experts.org

Participants

The institutions currently participating in DIRECT2Experts are listed below. Note that institutions can participate in different ways, and not all have research networking tools connected to DIRECT2Experts yet.

1.Albert Einstein College of Medicine - SciVal Experts
2.Arizona State University - SciVal Experts
3.Baylor College of Medicine - Profiles RNS
4.Boston University - Profiles RNS
5.Case Western Reserve University - SciVal Experts
6.Cornell University - VIVO
7.CTSI at Children's National - SciVal Experts
8.David Geffen School of Medicine at UCLA - UCLA CTSI
9.Georgia Regents University - SciVal Experts
10.Harvard University - Profiles RNS
11.Indiana CTSI - CTSI HUB
12.Indiana University School of Medicine - SciVal Experts
13.Instituto Politecnico Nacional - SciVal Experts
14.John Hopkins University - SciVal Experts
15.Kanazawa University - SciVal Experts
16.MD Anderson - SciVal Experts
17.MEHARRY Medical Collage - SciVal Experts
18.Memorial Sloan-Kettering Cancer Center - SciVal Experts
19.Michigan Alliance for Clinical and Translational Science - SciVal Experts
20.Michigan State University - SciVal Experts
21.National Institute of Immunology (India) - SciVal Experts
22.Northwestern University - SciVal Experts
23.Northwestern University Feinberg School of Medicine - LatticeGrid
24.Ohio State University Health Sciences - SciVal Experts
25.Oregon Health & Science University - SciVal Experts
26.Pennsylvania State University - Profiles RNS
27.Ponce School of Medicine - VIVO
28.Qatar University - SciVal Experts
29.RTRN (18 RCMI Institutions) - Profiles RNS
30.Shibaura Institute of Technology - SciVal Experts
31.South Carolina (HSSC/SCTR) - Profiles RNS
32.Stanford University School of Medicine - CAP
33.Temple University Center for Clinical & Transl. Science - SciVal Experts
34.The Scripps Research Institute – VIVO
35.The University of Alabama at Birmingham - SciVal Experts
36.UAE University - SciVal Experts
37.UC Davis Health System - SciVal Experts
38.Universidad Autonoma de Queretaro - SciVal Experts
39.Universidad de Santiago de Chile - SciVal Experts
40.Universitat Autònoma de Barcelona Campus of International Excellence - SciVal Experts
41.Universiti Kebangsaan Malaysia - SciVal Experts
42.University of California, San Francisco - Profiles RNS
43.University of Colorado Profiles - Profiles RNS
44.University of Connecticut Health Center - Profiles RNS
45.University of Florida - VIVO
46.University of Illinois at Chicago - SciVal Experts
47.University of Iowa - Loki
48.University of Maryland - SciVal Experts
49.University of Massachusetts - Profiles RNS
50.University of Miami - SciVal Experts
51.University of Michigan - SciVal Experts
52.University of Minnesota - Academic Health Center - Profiles RNS
53.University of Minnesota - Twin Cities Campus - SciVal Experts
54.University of Nebraska - SciVal Experts
55.University of Pittsburgh - Digital Vita
56.University of Porto - SciVal Experts
57.University of Rochester Medical Center - Profiles RNS
58.University of Southern California - Profiles RNS
59.University of Texas Health Science Center at Houston (UTHealth) - SciVal Experts
60.University of Washington - SciVal Experts
61.UT Health Northeast/UTHSC Tyler - SciVal Experts
62.UT Health Science Center - SciVal Experts
63.UT Medical Branch at Galveston - SciVal Experts
64.UT Southwestern Medical Center - SciVal Experts
65.Wake Forest Baptist Medical Center - Profiles RNS
66.Washington State University - SciVal Experts
67.Washington University in St. Louis - VIVO
68.Wayne State University - SciVal Experts
69.Weill Cornell Medical College - VIVO

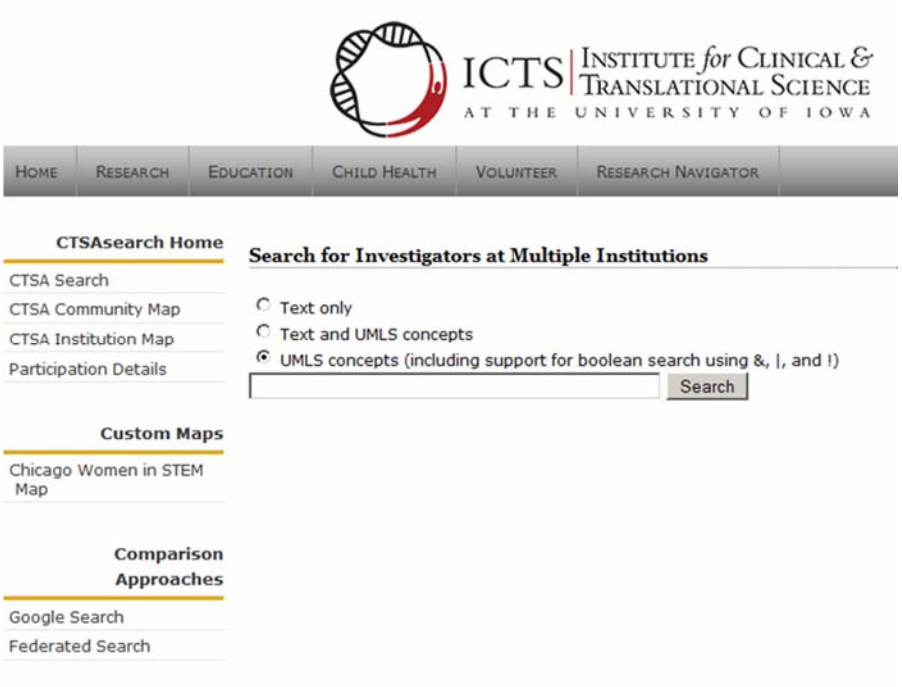
CTSAConnect—A Linked Open Data approach to represent clinical and research expertise, activities, and resources

http://www.ctsaconnect.org

CTSASearch

http://research.icts.uiowa.edu/polyglot/ctsaSearch.jsp

118,000 profiles from 14 institutions –VIVO, Profiles, SciVal Experts, and Loki, plus custom harvests.



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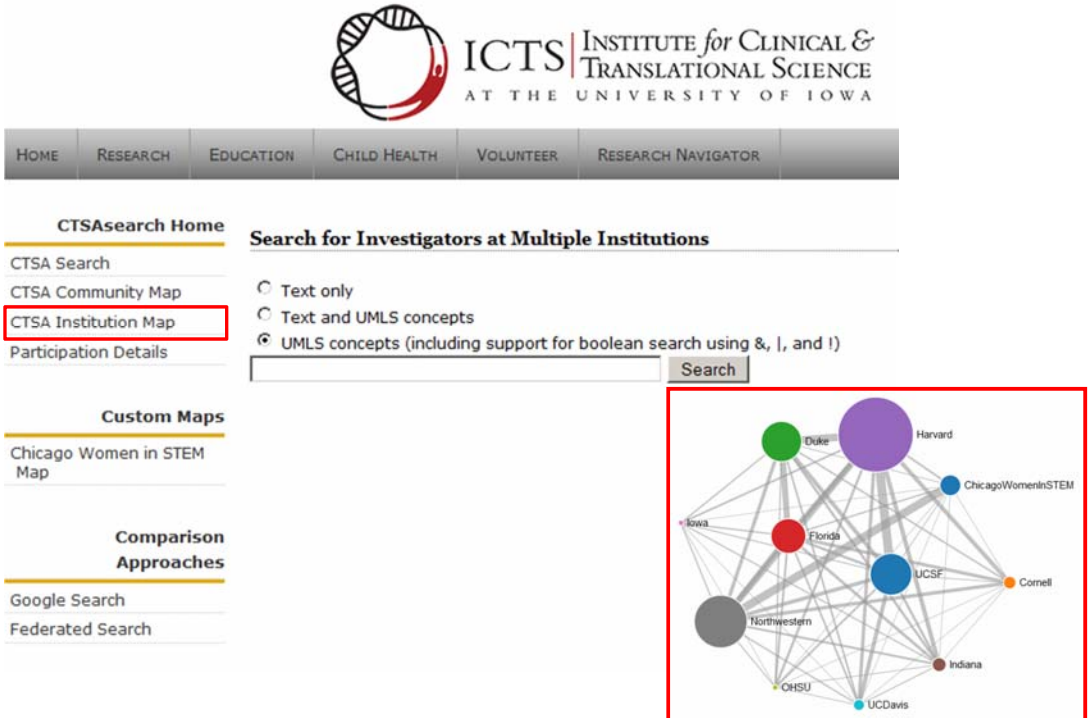
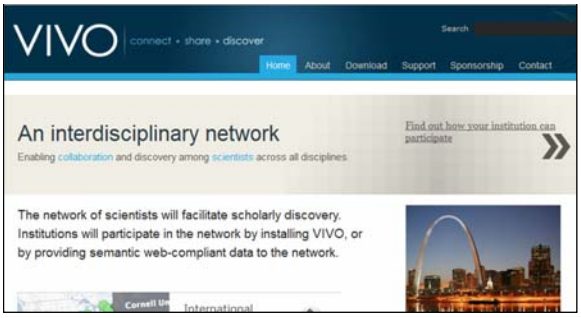


VIVO Updates

http://vivoweb.org



- Align with **international standards**: Significant partners include CASRAI (Consortium Advancing Standards in Research Administration Information), EuroCRIS (Current Research Information Systems) and the ORCID (Open Researcher and Contributor ID) Initiative.
- **Adopters** of the VIVO platform include: the U.S. Department of Agriculture, the U.S. Environmental Protection Agency, the American Psychological Association and the Publish Trust Project, the Australian-based ANDS VIVO project, and a growing number of universities around the world. Producers of VIVO-compliant data also include: Clinical and Translational Science Award (CTSA) Consortium institutions, Harvard Profiles, Elements from Symplectic Limited, and Elsevier's SciVal Experts.
- Cornell pulls data from **Activity Insight,** a widely-adopted faculty reporting system from Digital Measures, and code can be shared.

Thanks go to Jon Corson-Rikert, Cornell University.

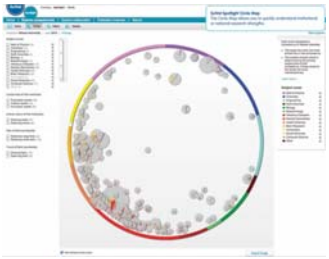
Harvard Profiles

http://profiles.catalyst.harvard.edu/

- UCSF released an update of Profiles RNS that includes **OpenSocial** support—the same front-end gadgets can now run on VIVO or Profiles RNS.
- **Scopus** data can be purchased through Elsevier's SciVal Author Profile Refinement Services and loaded into Profiles RNS.
- Boston University has developed a tool to **create ORCID IDs for their faculty** and synch publication data between ORCID and Profiles RNS. They plan to release it as open source code soon.
- Profiles RNS sites are part of Direct2Experts, CTSAConnect, and VIVOSearch.

Thanks go to Griffin Weber, Harvard University.

SciVal Experts by Elsevier



http://www.elsevier.com/elsevier-products/scival

- Supports **group profiles** (e.g., schools, divisions, departments OR institutes, centers, and programs OR graduate programs) but also multi-institutional instances [e.g., Solar Fuels Institute (SOFI) and Chicago Collaboration for Women in STEM sites.
- Experts can pull data from some **annual reporting/faculty information systems**, such as FASIS at Northwestern.
- **De-duplication** feature allows for the reconciliation of multiple versions of, say publication data, ingested from multiple data sources (e.g., WoS, Scopus, CrossRef, and PubMed.
- Supports **reporting**, e.g., multiple biosketch and CV templates.
- Committed to interoperability, e.g., with SciENcv.
- **ORCID IDs** are incorporated into the Scopus DB in support of author and institution refinement.

Thanks go to Holly J Falk-Krzesinski, Vice President Global Academic & Research Relations, Elsevier

SciENcv

Federal-Wide Researcher Profile Project

RBM Home

Background

Executive Committee

Federal-Wide Researcher Profile Project

A-21 Task Force

Federal Register Notices

Toolkit

Archive

SciENcv
Science Experts Network Curriculum Vitae
Mission:
Create a researcher profile system for all individuals who apply for, receive or are associated with research investments from federal agencies, in order to:

- Eliminate the need to repeatedly enter biosketch information and therefore reduce the administrative burden associated with federal grant submission and reporting requirements
- Provide access to a researcher-claimed data repository with information on expertise, employment, education, and professional accomplishments
- Allow researchers to describe their scientific contributions in their own language.

Who We Are:
The Federal Demonstration Partnership (FDP), an association of academic research institutions and federal agencies, is developing the requirements for theSciENcv platform in concert with an Interagency Workgroup that operates under the NSTC's Research Business Models and Science of Science Policy Committees. The SciENcv project is closely connected to the STAR METRICS program. The underlying data model is being built by the National Center of Biotechnology Information (NCBI) at the National Institutes of Health (NIH) in collaboration with FDP and the Department of Defense, the Department of Energy, the Environmental Protection Agency, the National Science Foundation and the United States Department of Agriculture.

http://rbm.nih.gov/profile_project.htm

http://nrn.cns.iu.edu

Light, Robert, Chin Hua Kong, and Katy Börner. 2013. "An Automated System for Tracking the Growth of Expert Profiling Systems". Joint Conference on Digital Libraries (JCDL).

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Expert Networking Services

Desirable Properties

- Open data
- Open code
- Easy harvesting and ingest of major publication datasets, e.g., MEDLINE, Elsevier, Reuters, SciELO, others.
- Inter-platform compatibility—VIVO, Profiles, SciVal Experts, Loki, etc.
- Part of federated search tools, Direct2Experts, CTSAconnect, and SciVal Community, etc.
- Supports/uses DOIs, author identifiers, e.g., ORCID
- Sustainable

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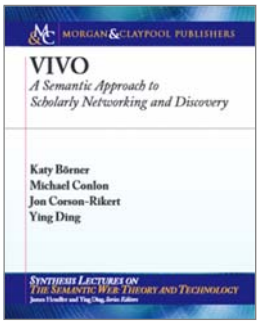
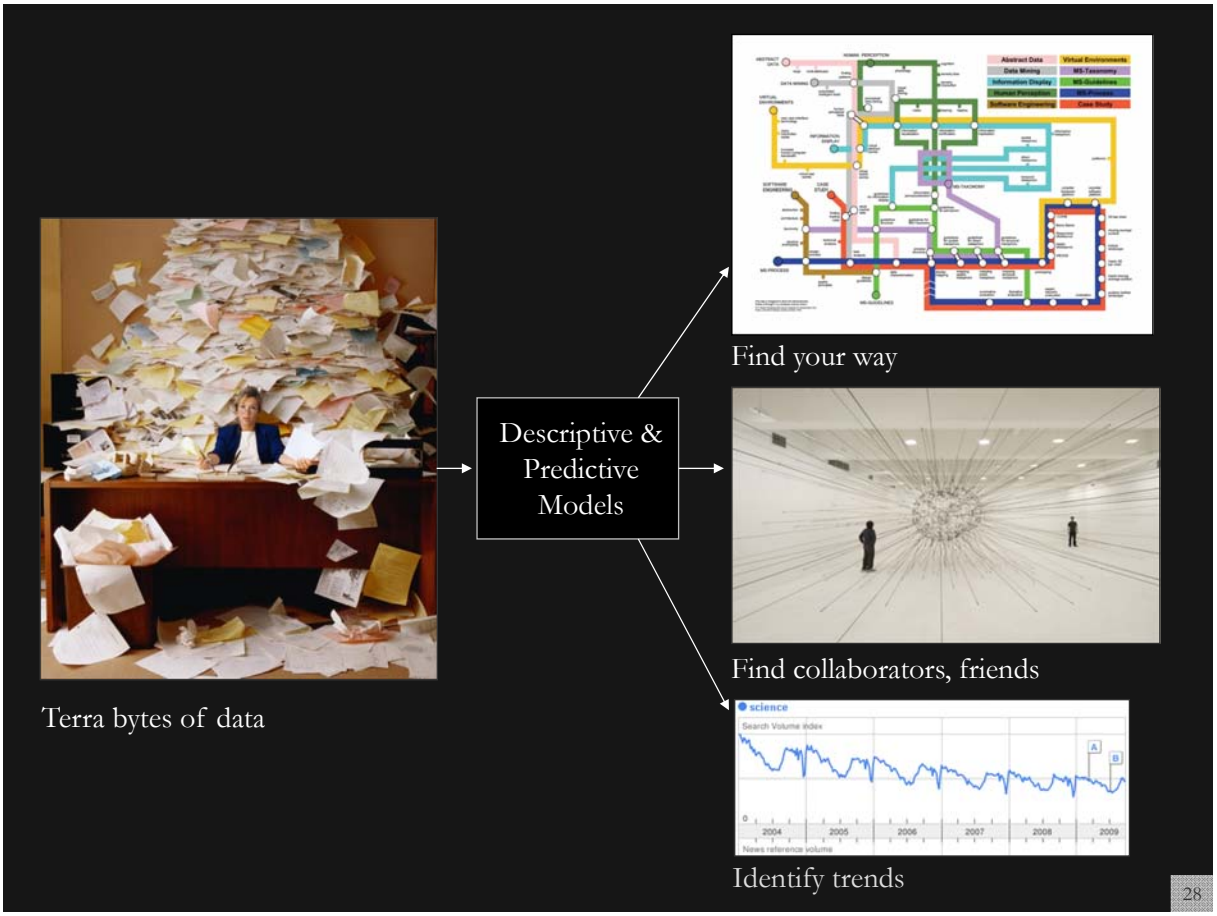


CNS CyberInfrastructure for Network Science Center



Type of Analysis vs. 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 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 state's 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	NSF's core competency

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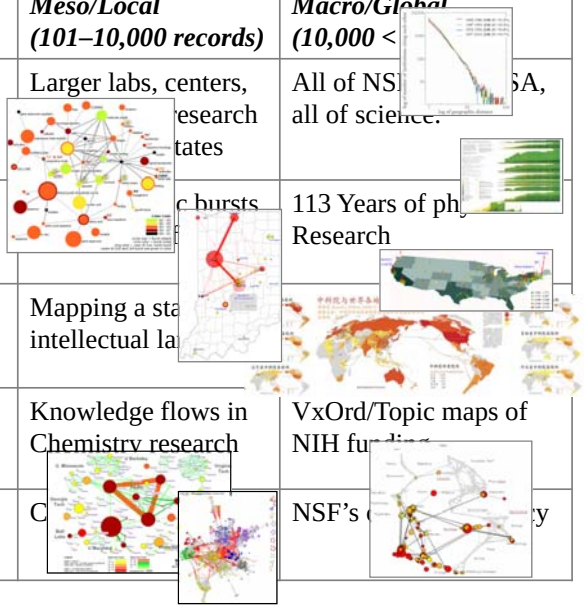
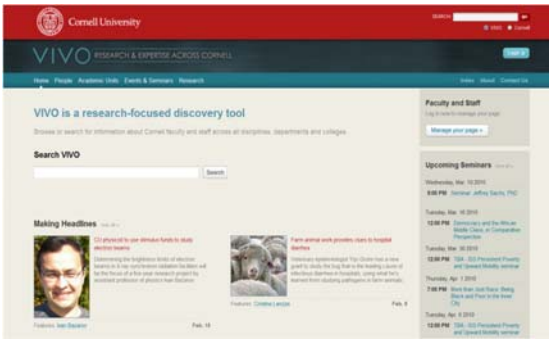


VIVO: A Semantic Approach to Creating a National Network of Researchers (http://vivoweb.org)

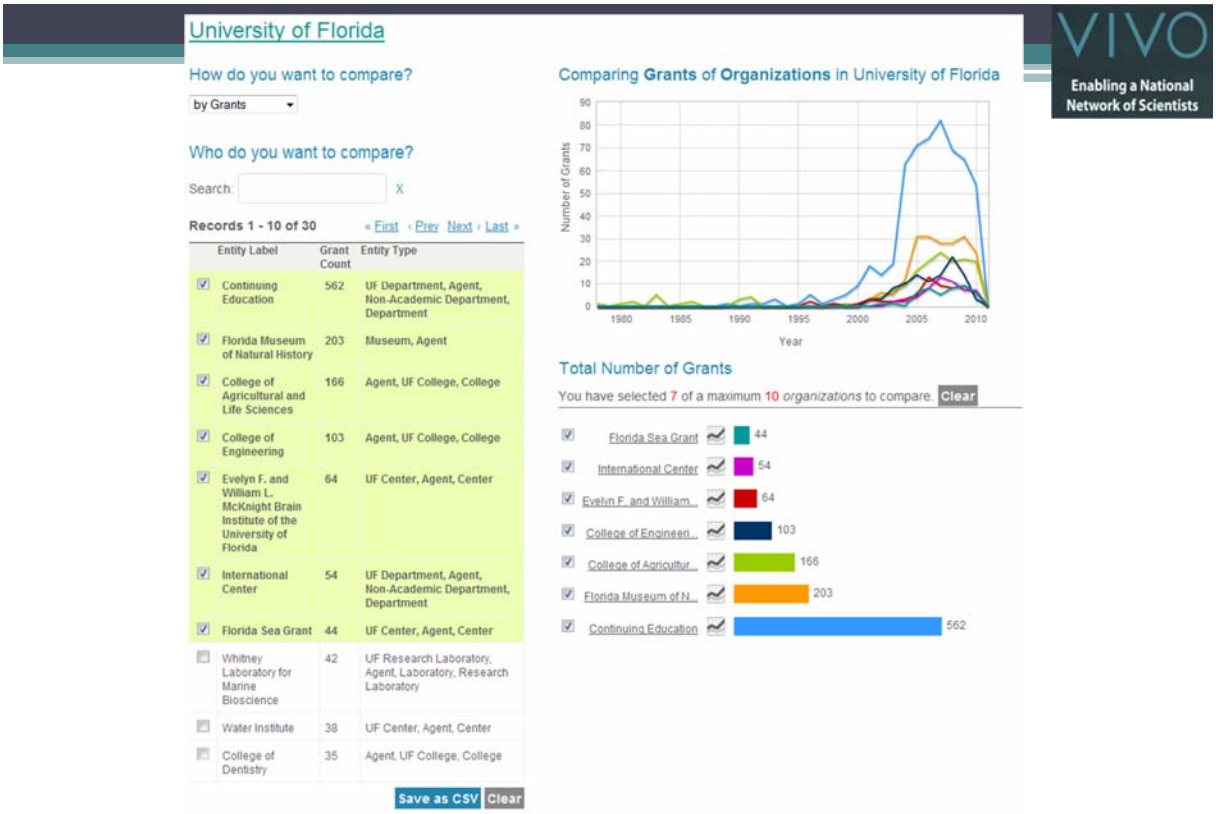
- Semantic web application and ontology editor originally developed at Cornell U.
- Integrates research and scholarship info from systems of record across institution(s).
- Facilitates research discovery and cross-disciplinary collaboration.
- Simplify reporting tasks, e.g., generate biosketch, department report.



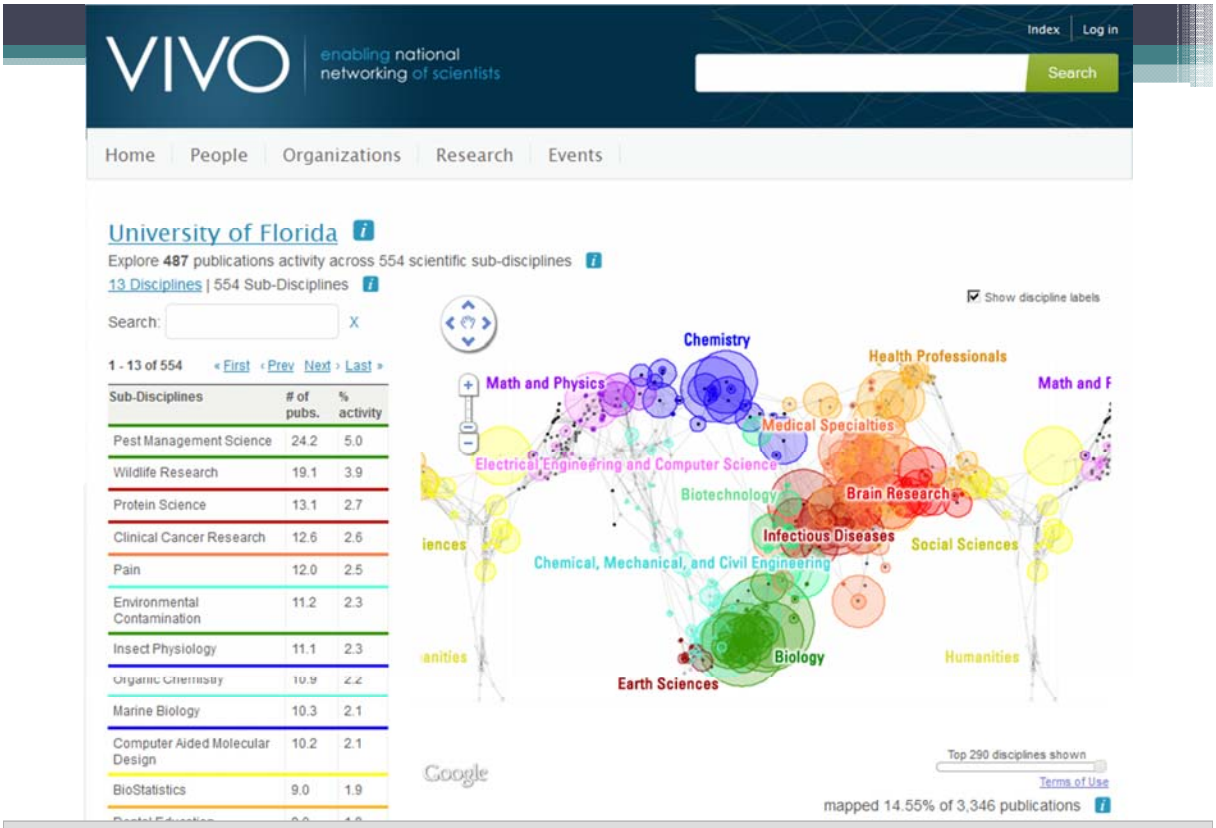
Funded by $12 million NIH award.

Cornell University: Dean Krafft (Cornell PI), Manolo Bevia, Jim Blake, Nick Cappadona, Brian Caruso, Jon Corson-Rikert, Elly Cramer, Medha Devare, John Fereira, Brian Lowe, Stella Mitchell, Holly Mistlebauer, Anup Sawant, Christopher Westling, Rebecca Younes. **University of Florida:** Mike Conlon (VIVO and UF PI), Cecilia Botero, Kerry Britt, Erin Brooks, Amy Buhler, Ellie Bushhousen, Chris Case, Valrie Davis, Nita Ferree, Chris Haines, Rae Jesano, Margeaux Johnson, Sara Kreinest, Yang Li, Paula Markes, Sara Russell Gonzalez, Alexander Rockwell, Nancy Schaefer, Michele R. Tennant, George Hack, Chris Barnes, Narayan Raum, Brenda Stevens, Alicia Turner, Stephen Williams. **Indiana University**: Katy Borner (IU PI), William Barnett, Shanshan Chen, Ying Ding, Russell Duhon, Jon Dunn, Micah Linnemeier, Nianli Ma, Robert McDonald, Barbara Ann O'Leary, Mark Price, Yuyin Sun, Alan Walsh, Brian Wheeler, Angela Zoss. **Ponce School of Medicine:** Richard Noel (Ponce PI), Ricardo Espada, Damaris Torres. **The Scripps Research Institute:** Gerald Joyce (Scripps PI), Greg Dunlap, Catherine Dunn, Brant Kelley, Paula King, Angela Murrell, Barbara Noble, Cary Thomas, Michaeleen Trimarchi. **Washington University, St. Louis**: Rakesh Nagarajan (WUSTL PI), Kristi L. Holmes, Sunita B. Koul, Leslie D. McIntosh. **Weill Cornell Medical College:** Curtis Cole (Weill PI), Paul Albert, Victor Brodsky, Adam Cheriff, Oscar Cruz, Dan Dickinson, Chris Huang, Itay Klaz, Peter Michelini, Grace Migliorisi, John Ruffing, Jason Specland, Tru Tran, Jesse Turner, Vinay Varughese.

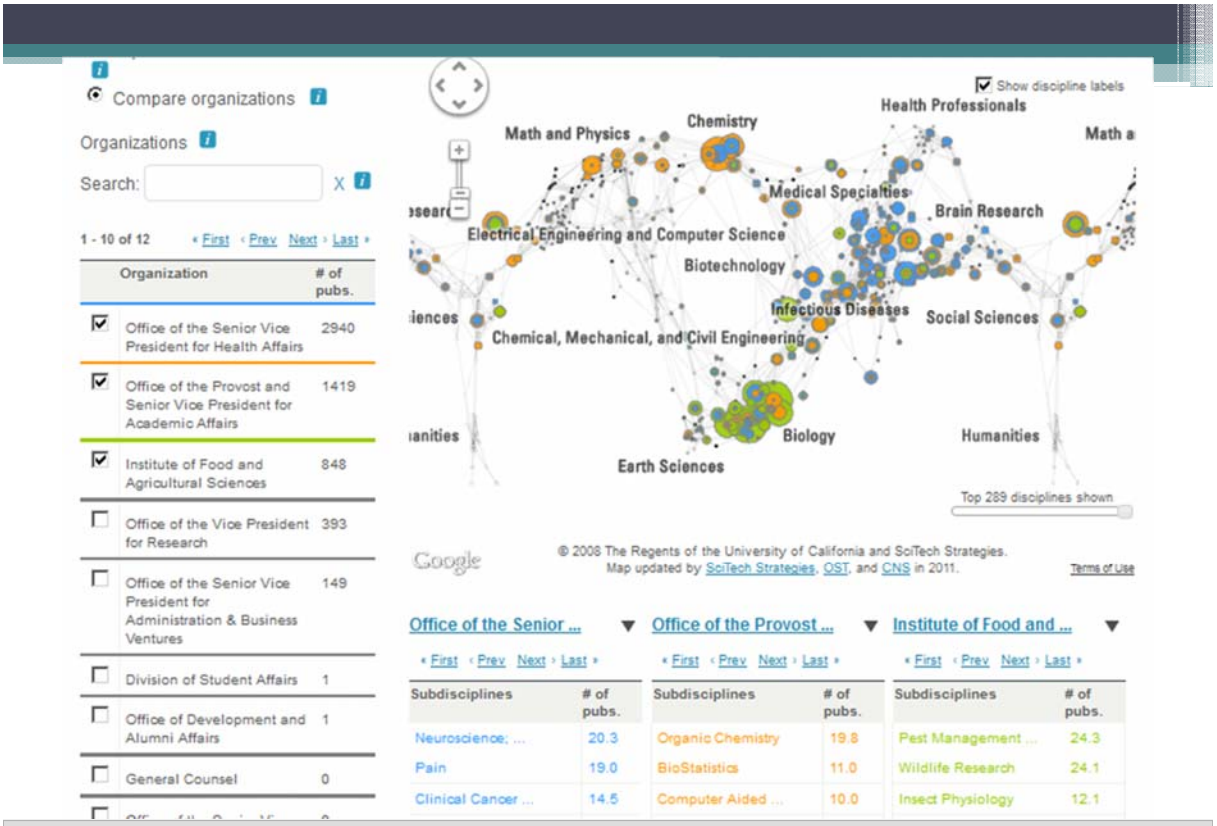
UF Clinical and Translational Science Institute
UNIVERSITY of FLORIDA



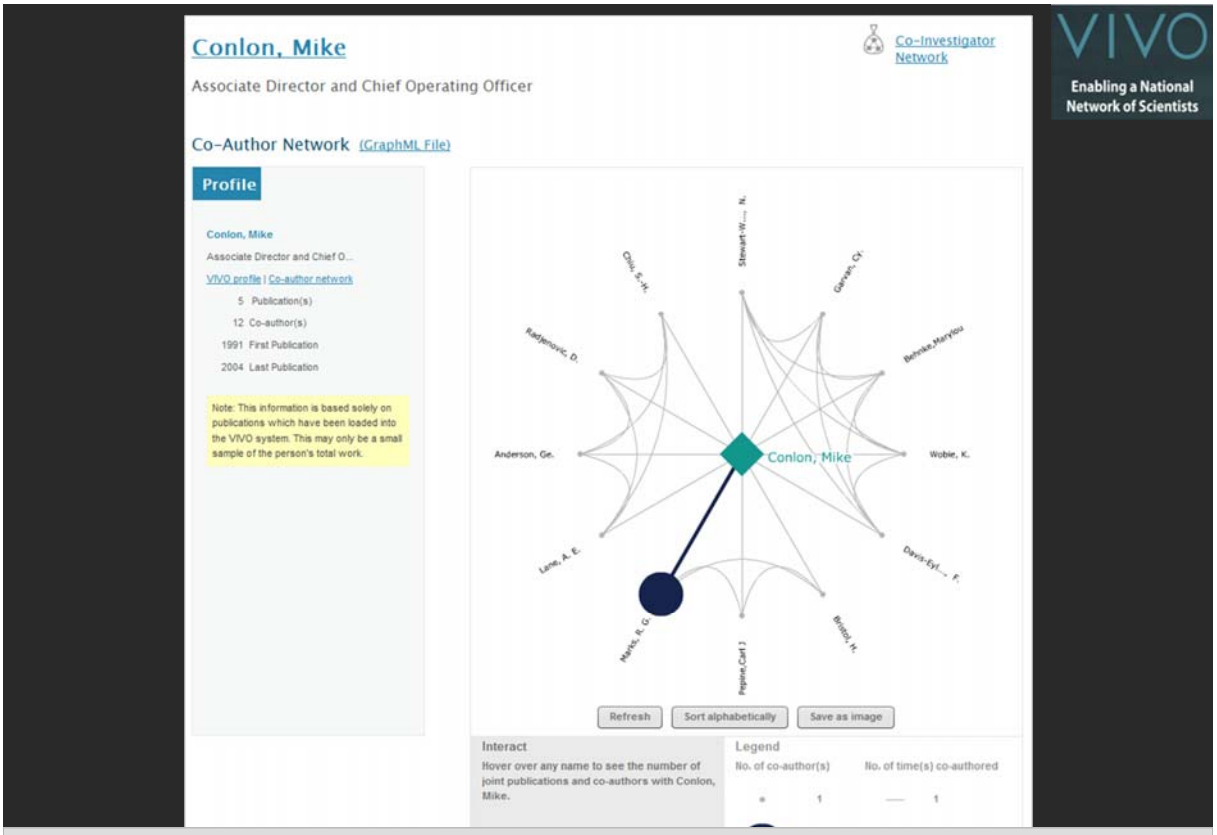
Temporal Analysis (When) Temporal visualizations of the number of papers/funding awarded at the institution, school, department, and people level



Topical Analysis (What) Science map overlays will show where a person, department, or university publishes most in the world of science. (in work)



Topical Analysis (What) Science map overlays will show where a person, department, or university publishes most in the world of science. (in work)



Network Analysis (With Whom?) Who is co-authoring, co-investigating, co-inventing with whom? What teams are most productive in what projects?

VIVO On-The-Go

Overview, Interactivity, Details on Demand
come to commonly used devices and environments

VIVO: A Semantic Approach to Scholarly Networking and Discovery

Katy Börner[1], Michael Conlon[2], Jon Corson-Rikert[3], and Ying Ding[1]
Indiana University[1], University of Florida[2], and Cornell University[3]

Series: *Synthesis Lectures on the Semantic Web: Theory and Technology*
Series Editors: James Hendler, *Rensselaer Polytechnic Institute*
Ying Ding, *Indiana University*

The world of scholarship is changing rapidly. Increasing demands on scholars, the growing size and complexity of questions and problems to be addressed, and advances in sophistication of data collection, analysis, and presentation require new approaches to scholarship. A ubiquitous, open information infrastructure for scholarship, consisting of linked open data, open-source software tools, and a community committed to sustainability are emerging to meet the needs of scholars today.

This book provides an introduction to VIVO, http://vivoweb.org/, a tool for representing information about research and researchers—their scholarly works, research interests, and organizational relationships. VIVO provides an expressive ontology, tools for managing the ontology, and a platform for using the ontology to create and manage linked open data for scholarship and discovery. Begun as a project at Cornell and further developed by an NIH funded consortium, VIVO is now being established as an open-source project with community participation from around the world. By the end of 2012, over twenty countries and fifty organizations will provide information in VIVO format on more than one million researchers and research staff, including publications, research resources, events, funding, courses taught, and other scholarly activity.

The rapid growth of VIVO and of VIVO-compatible data sources speaks to the fundamental need to transform scholarship for the twenty-first century.

http://www.morganclaypool.com/toc/wbe.1/1/1

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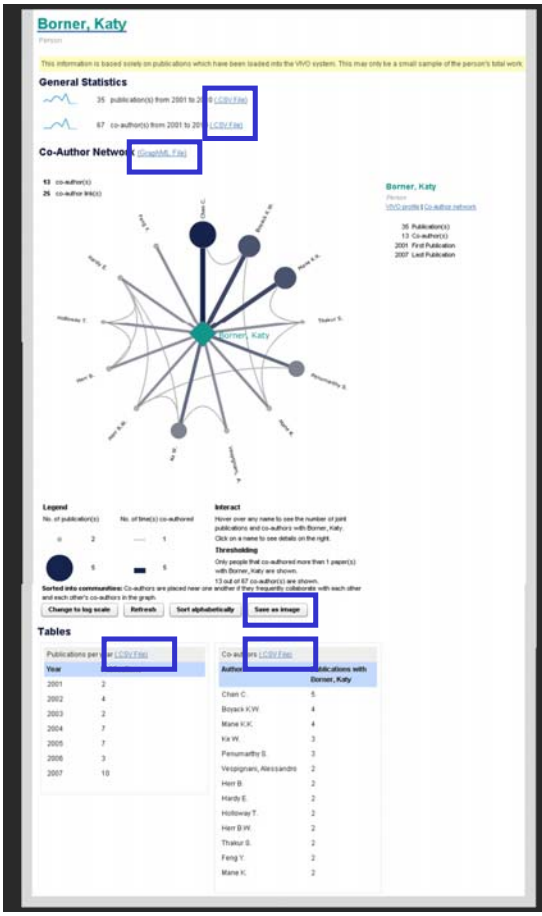
CHAPTER 7

Analyzing and Visualizing VIVO Data

Chintan Tank, *Indiana University and General Sentiment*
Micah Linnemeier, *Indiana University and University of Michigan*
Chin Hua Kong and Katy Börner, *Indiana University*



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

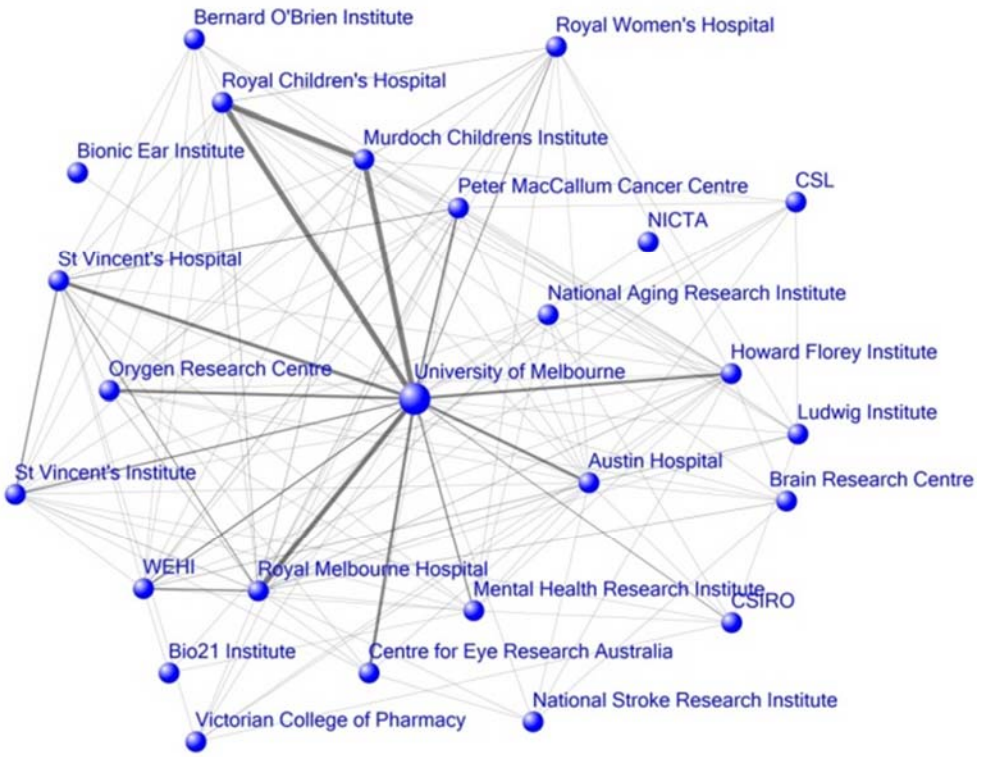
(GraphML File)

Save as Image (.PNG file)

Tables

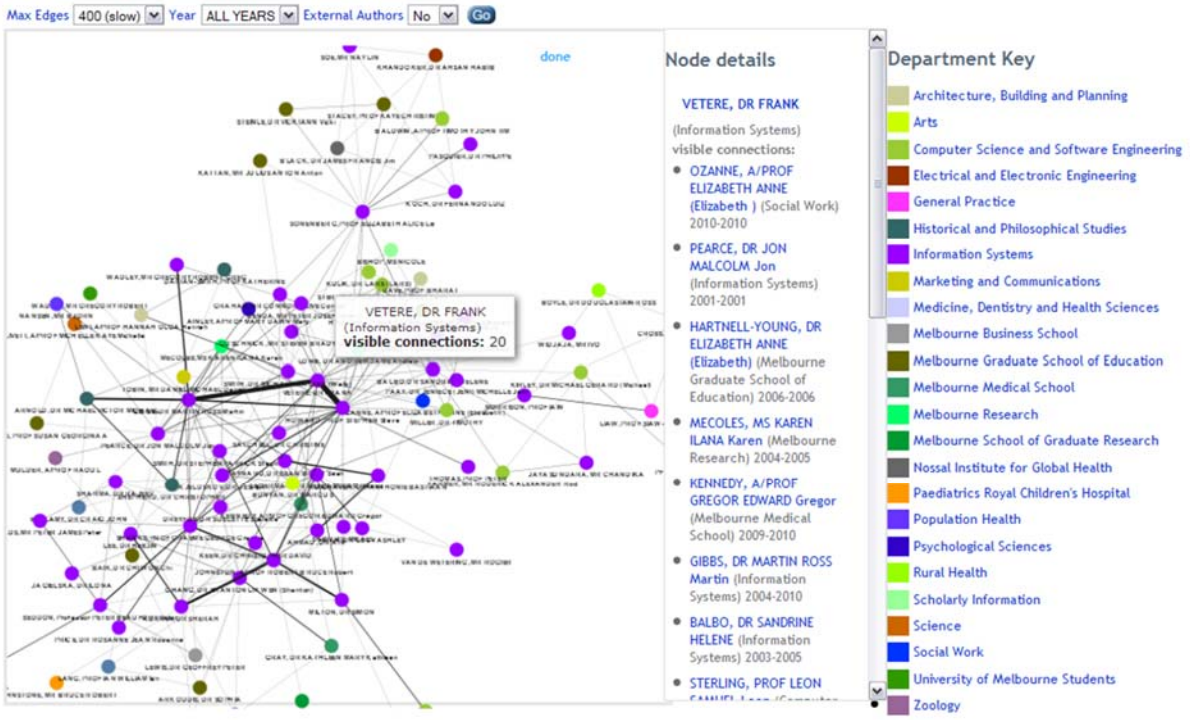
- Publications per year (.CSV File)
- Co-authors (.CSV File)

http://vivo.iu.edu/vis/author-network/person25557



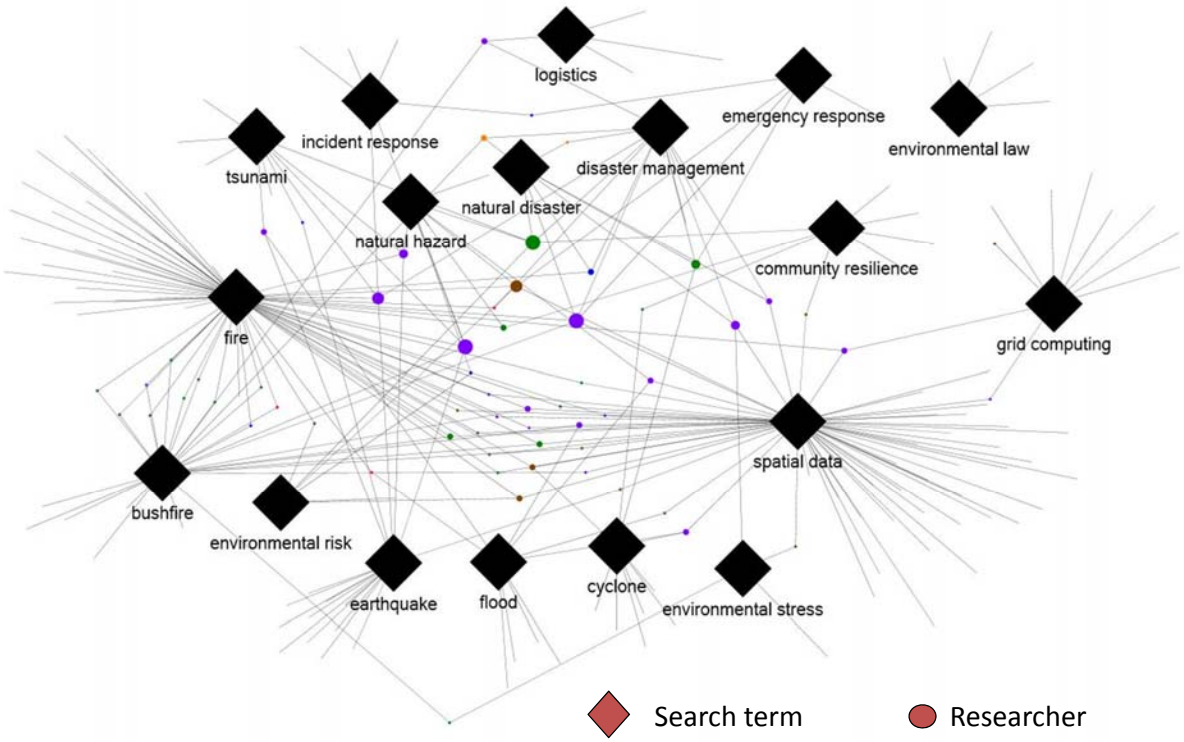
2008 collaboration patterns for medical institutions located close to Melbourne University

Source: Web of Science co authorship information. Compiled by Simon Porter



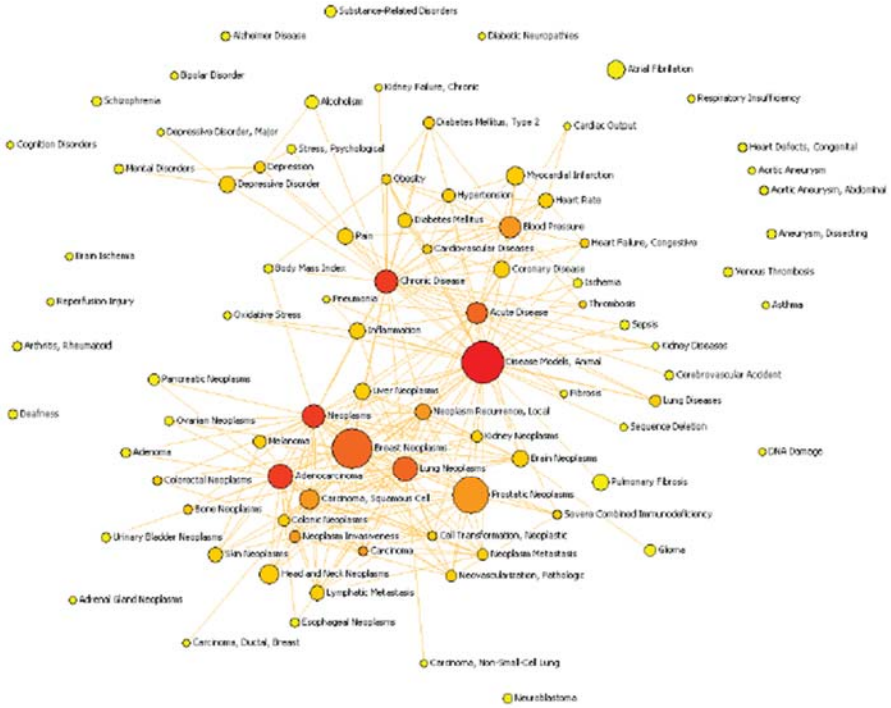
Co-authorship network for the department of Information Systems

Source: Melbourne Research Windows. Contact Simon Porter simon.porter@unimelb.edu.au



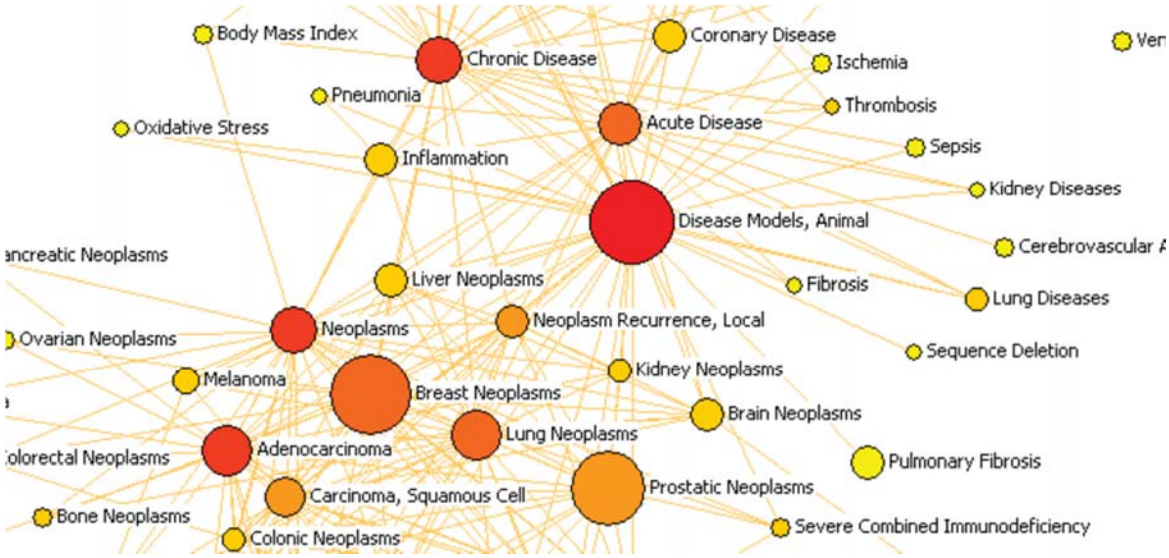
Bimodal network of search terms and researchers extracted from research profile search results to show the **University's capability in Disaster Management** to the Government

Contact: simon.porter@unimelb.edu.au



Top MeSH Disease Concepts Appearing in PubMed Publications by the University of Michigan Medical School. Links connect concepts where 100+ authors published about both concepts within the span of their careers.

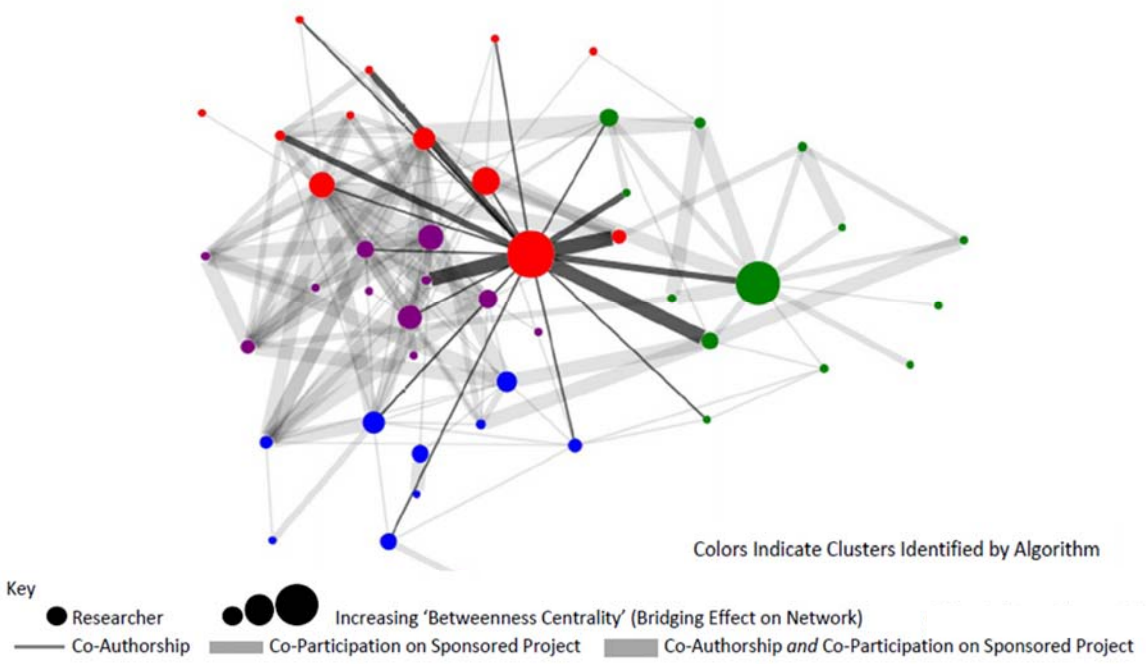
Contact: Jeffrey Horon, J.Horon@elsevier.com



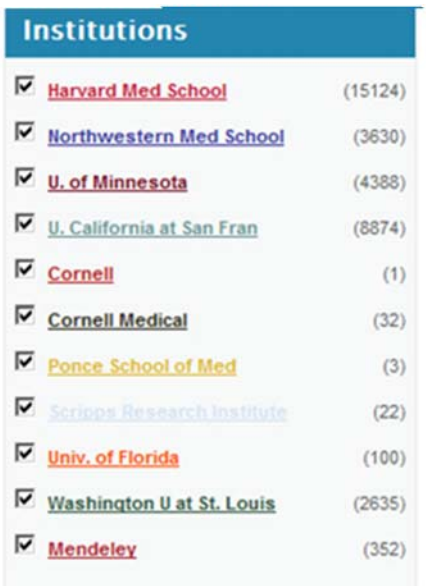
Top MeSH Disease Concepts Appearing in PubMed Publications by the University of Michigan Medical School. Links connect concepts where 100+ authors published about both concepts within the span of their careers.

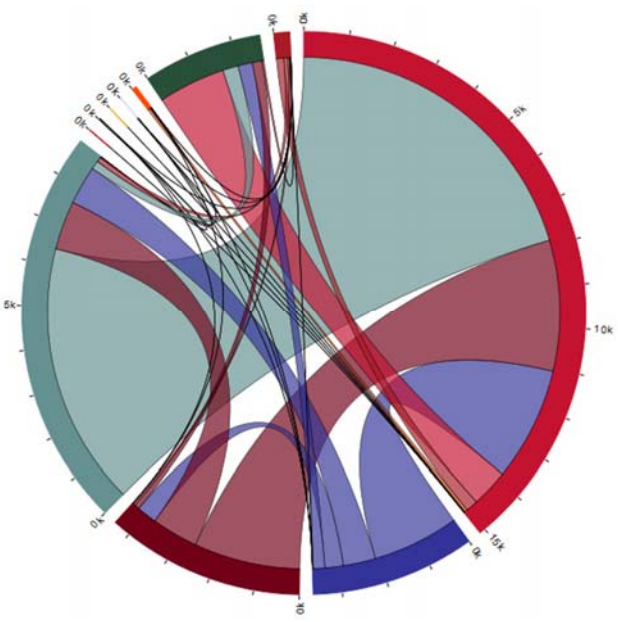
This visualization revealed that animal disease models were central to disease research at U-M whiich encouraged additional thought and attention to animal husbandry, animal expenses, and core/shared services overall.

Contact: Jeffrey Horon, J.Horon@elsevier.com



P30 Member Collaborations – Sponsored Project Co-Participation and Co-Authorship Network. Used in **successful! P30** funding application. Shows the PI's relationships with various P30 members, conveying that the PI was not only the formal center of the group but also the informal center and the person who exhibited the highest betweenness centrality. *Contact: Jeffrey Horon, J.Horon@elsevier.com*





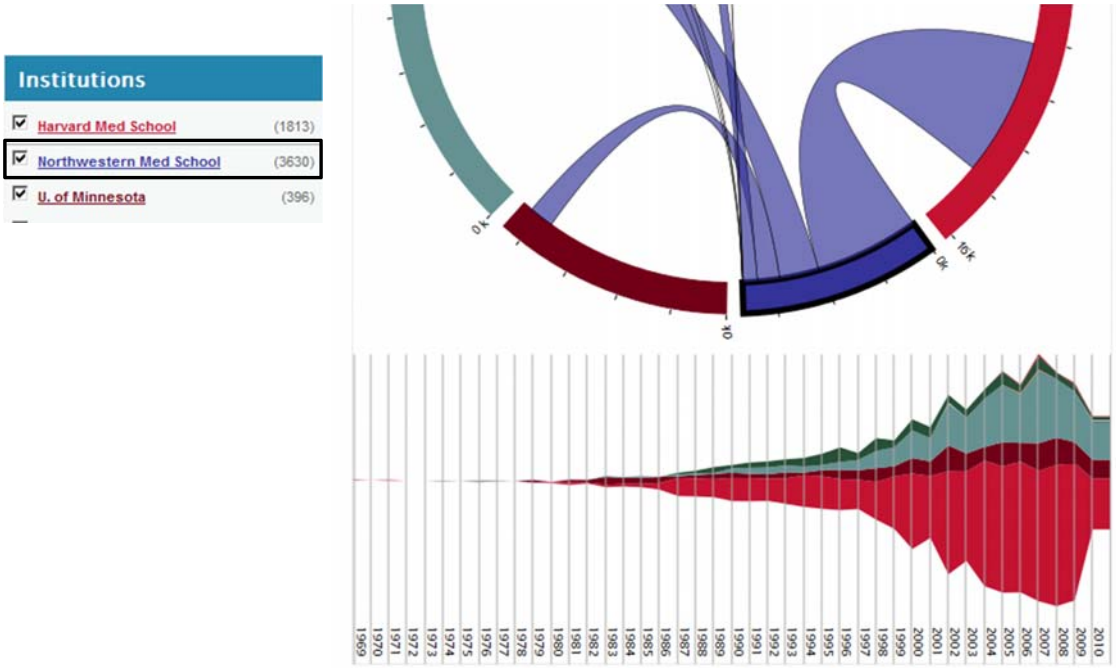
Inter-Institutional Collaboration Explorer

This visualization shows information about "collaborative publications" found at 2 or more Researcher Networking websites.

The idea that institutions don't work together and that biomedical research is conducted in silos is not true. Researchers, even when separated by great distances, are in fact willing to work together, and this visualization demonstrates that they often do.

Contact: Nick Benik (nbenik@gmail.com), Harvard Medical School, Boston, MA.

URL: http://xcite.hackerceo.org/VIVOviz

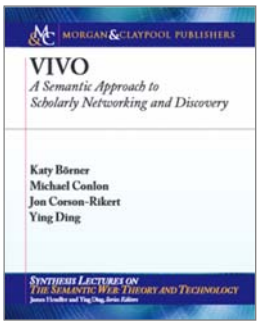


Inter-Institutional Collaboration Explorer

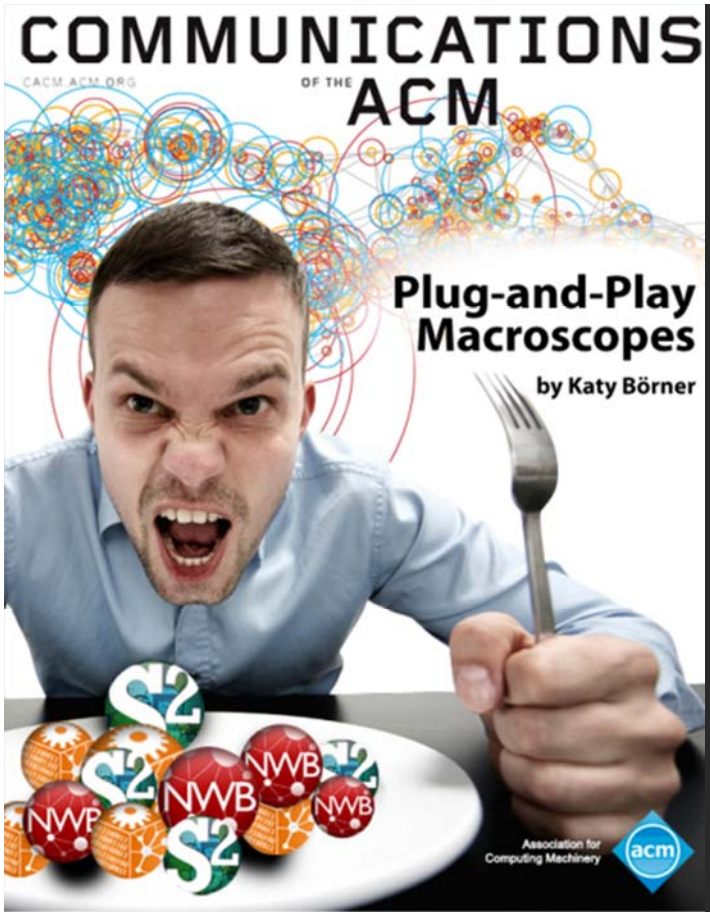
The outer solid colored arcs represent the 11 institutions. The size of the arc is proportional to the number of collaborative publications found on the site. The inner colored bands represent the number of collaborative publications found between the two institutions that each band connects. Clicking an institution's arc will hide any bands not connected to that institution and will display a timeline of when that institution's collaborative publications were written.

Overview

1. **Research Networking Services** that aim to support collaborations, research management, and the flow of knowledge/expertise.
2. **VIVO Approach and Visualizations** that help answer When, Where, What, With Whom questions.
3. **Outlook** how to scale and commoditize data mining and visualizations of research networking data.



CNS CyberInfrastructure for Network Science Center

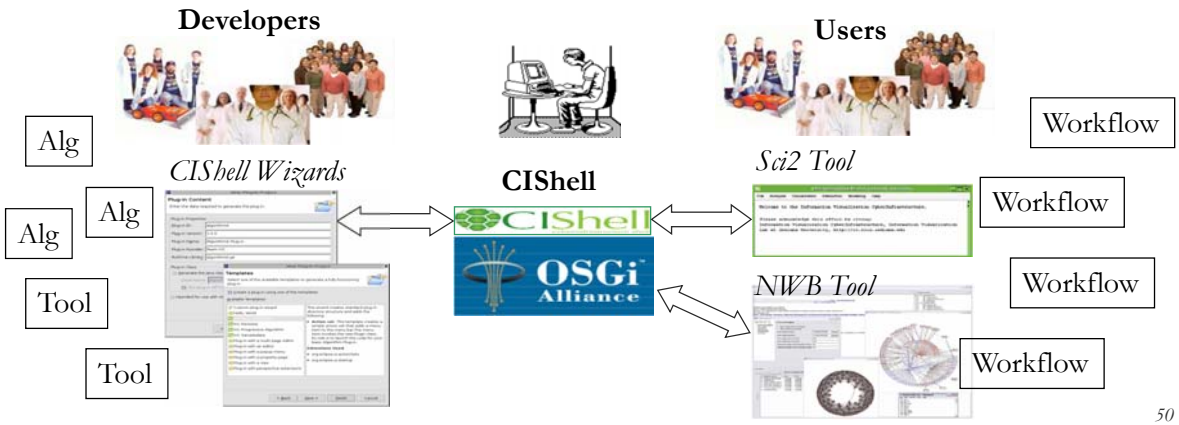


Börner, Katy. (March 2011). Plug-and-Play Macroscopes. *Communications of the ACM, 54(3), 60-69.*

Video and paper are at
http://www.scivee.tv/node/27704

OSGi & CIShell

- CIShell (http://cishell.org) 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://osgi.org), a standardized, component oriented, computing environment for networked services widely used in industry since more than 10 years.
- Specifically, CIShell provides "sockets" into which existing and new datasets, algorithms, and tools can be plugged using a wizard-driven process.

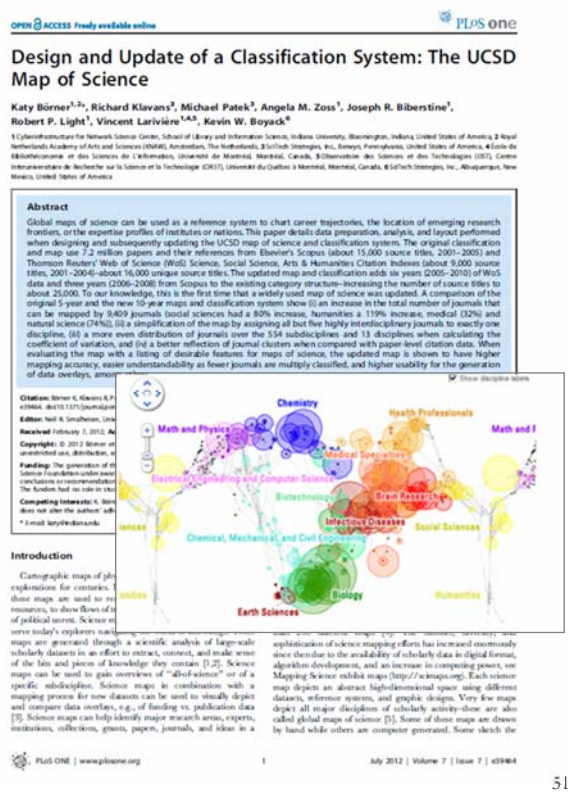


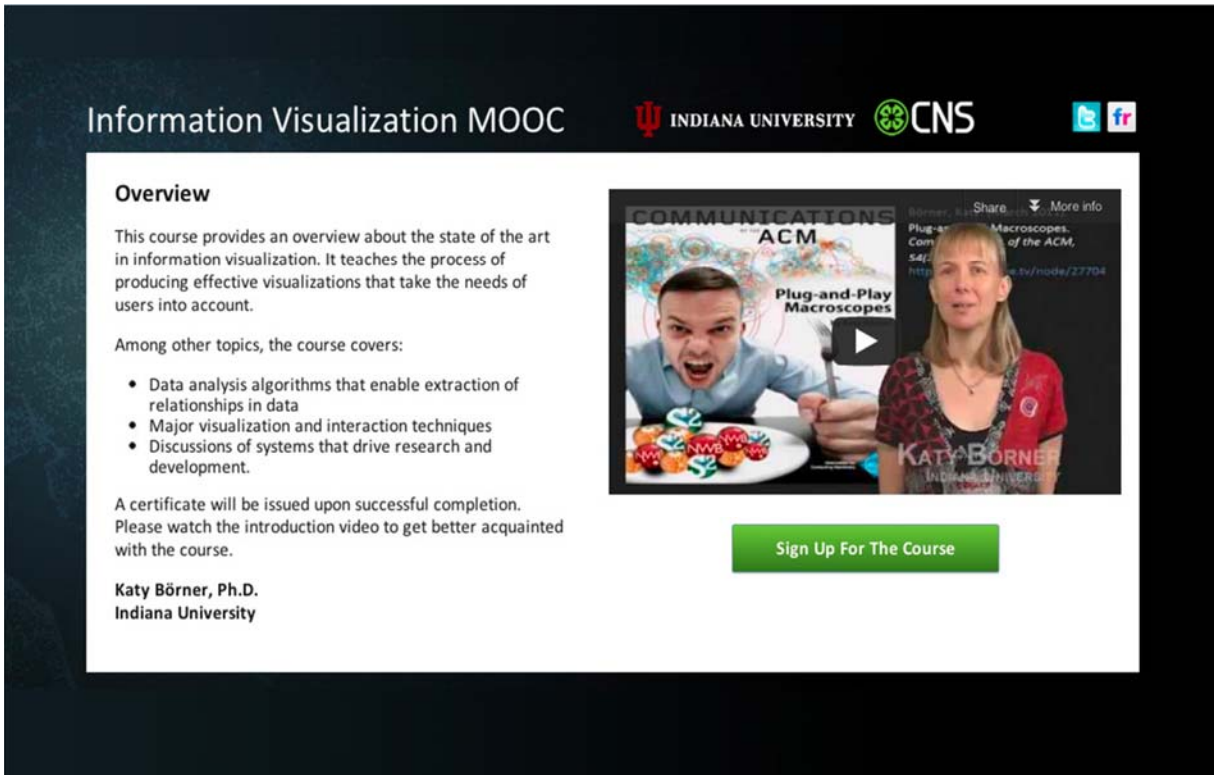
Design and Update of a Classification System: The UCSD Map of Science

Nov. 04-05, 2013 **Science Mapping Standards Workshop** at Indiana University will bring together leading researchers and data providers to

- Update UCSD science map– adding recent publication data by Scopus and Web of Science as well as **Chinese data** and data from **SciELO**.
- Discuss scientifically sound standards for aligning existing science maps to each other and to major classification systems.

Börner, Katy, Richard Klavans, Michael Patek, Angela Zoss, Joseph R. Biberstine, Robert Light, Vincent Larivière, and Kevin W. Boyack. 2012. "Design and Update of a Classification System: The UCSD Map of Science." *PLoS One* 7 (7): e39464.





Register for free at http://ivmooc.cns.iu.edu. Class restarts on Jan 28, 2014.

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Börner, Katy, Chen, Chaomei, and Boyack, Kevin. (2003). **Visualizing Knowledge Domains.** In Blaise Cronin (Ed.), *ARIST*, Medford, NJ: Information Today, 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., Volume 41, Chapter 12, pp. 537-607.
http://ivl.slis.indiana.edu/km/pub/2007-borner-arist.pdf

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Katy Börner, Michael Conlon, Jon Corson-Rikert, Cornell, Ying Ding (2012) **VIVO: A Semantic Approach to Scholarly Networking and Discovery**. Morgan & Claypool.

Katy Börner and David E Polley (2014) **Visual Insights: A Practical Guide to Making Sense of Data**. MIT Press.

All papers, maps, tools, talks, press are linked from http://cns.iu.edu

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Mapping Science Exhibit Facebook: http://www.facebook.com/mappingscience