

Can Network Measures Serve as Indicators of Knowledge Creation and Flow?

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NSF Workshop

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Big Qs:

- Can network measures serve as indicators of knowledge creation and flow?
- Which measures come closest to being an 'indicator'?
- Where is the data, and is it reliable?
- What tools are available to conduct analysis and what are benefits to one over another?

Web of Science as a Research Dataset

Date:

November 14-15, 2016

<http://cns.iu.edu/workshops/event/161114.html>

Meeting Place:

Social Science Research Commons (SSRC),
Woodburn Hall, Room 200
1100 East Seventh Street
Bloomington, IN 47405

Web [Indiana University Campus Map](#) »

Organizers:



Katy Börner

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James Pringle

Head of Industry Development & Innovation at Thomson Reuters IP & Science

Workshop Goals

This practical workshop brings together data scientists and data stewards from research centers that are using the Web of Science™ at scale. We will explore WoS from the perspective of a research dataset and work together on practical ways to better support our research in the future. While the main focus will be on the Web of Science, the results should be extensible to all similar metadata aggregations. This unique focus—bringing data stewards and data scientists from these centers together to work on shared needs in tandem with the Web of Science team—will enable us to redefine and fully repurpose WoS to fit our research goals. We intend to launch an ongoing community in which we will learn techniques and develop tools to improve the data that underlies our research.

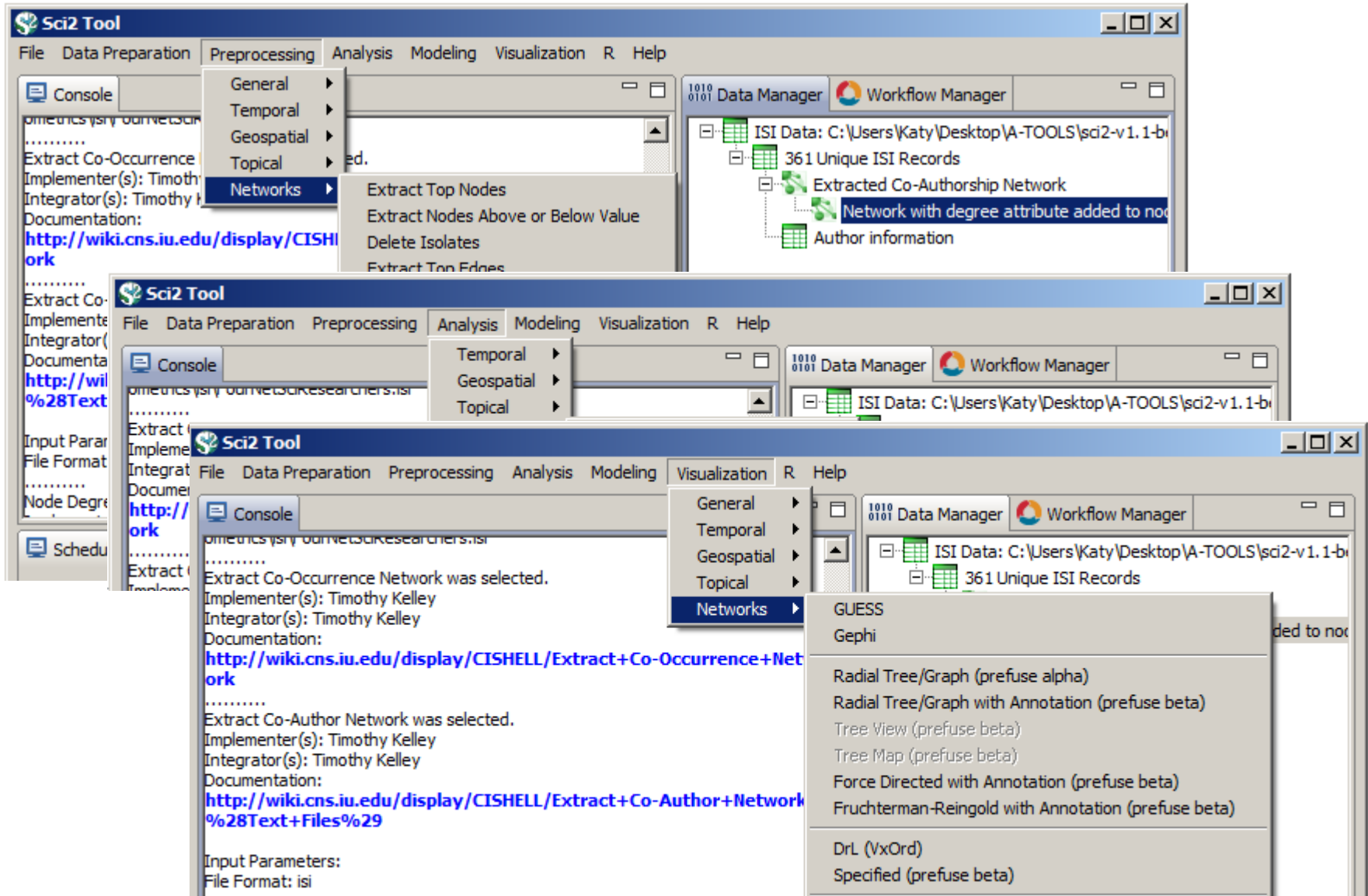
Advance Preparations

- Data stewards will provide a short profile of how WoS as a dataset is being implemented in the context of their research center/university and the technical, content, and other challenges they are facing.
- Researcher data scientists will prepare a short profile of current research projects leveraging the WoS dataset, focusing on key challenges such as linking, disambiguating, mining, etc. that, if solved, would offer greater research opportunities.

Sci2 Tool

Download tool for free at <http://sci2.cns.iu.edu>

Learn to use it in IVMOOC at <http://ivmooc.cns.iu.edu>



Network Science

Börner, Katy, Soma Sanyal, and Alessandro Vespignani. 2007. "[Network Science](#)". *Annual Review of Information Science & Technology* 41: 537-607.

Paper reviews network science by

- Introducing a theoretical and practical framework for the scientific study of networks.
- Defining key measures at the micro, meso, global levels.
- Covering dynamics.

Aiming to unify work developed in many different disciplines.

It also reviews computational, generative network models.

Given the complexity of networks and the obtained results, the application of visualization techniques for the communication and interpretation of results is important.

Interpretation frequently results in the further refinement (for example, selection of different parameter values or algorithms) and re-run of sampling, modeling, measurement and visualization stages.

The Global 'Scientific Food Web'

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

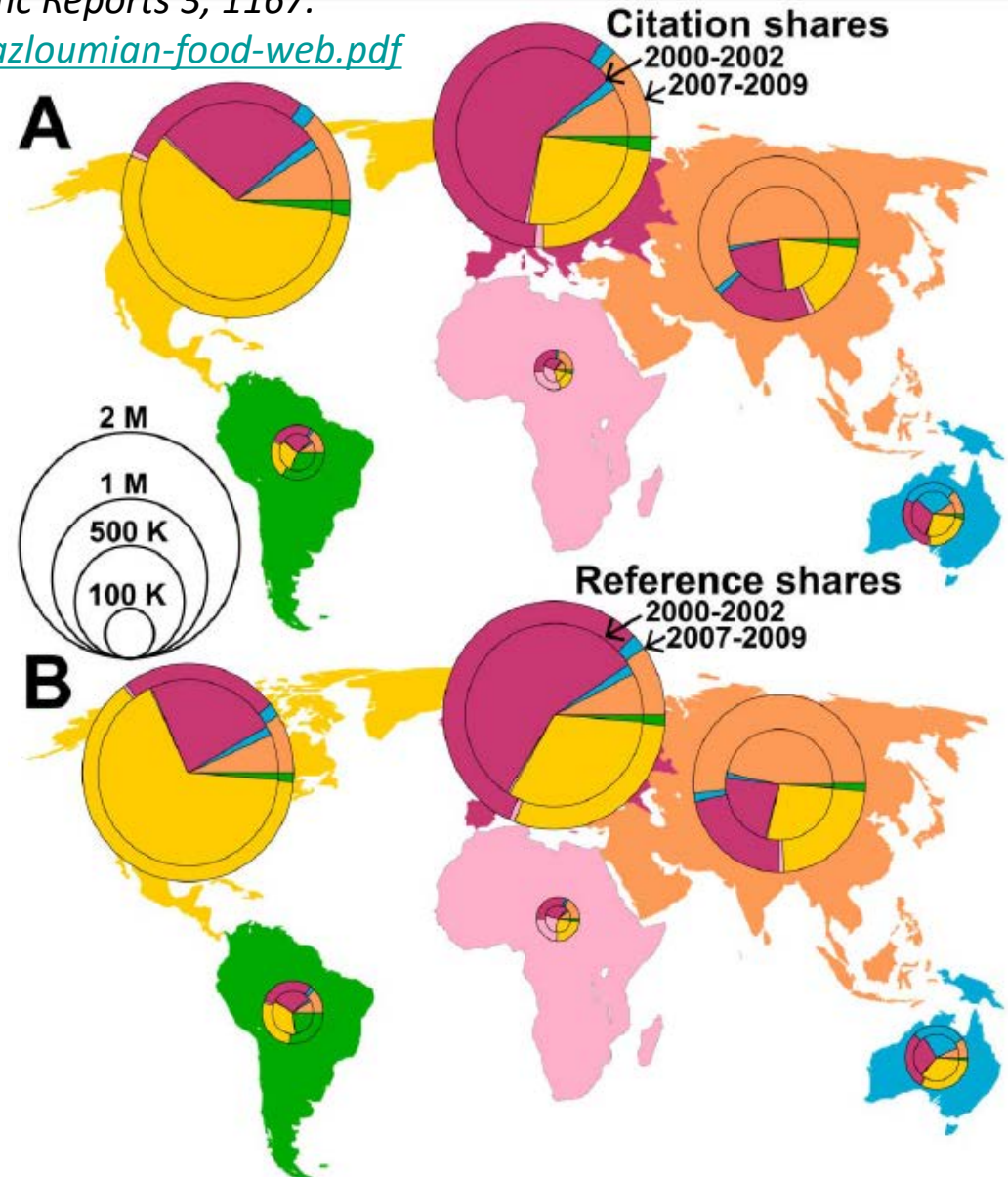
<http://cns.iu.edu/docs/publications/2013-mazlounian-food-web.pdf>

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.

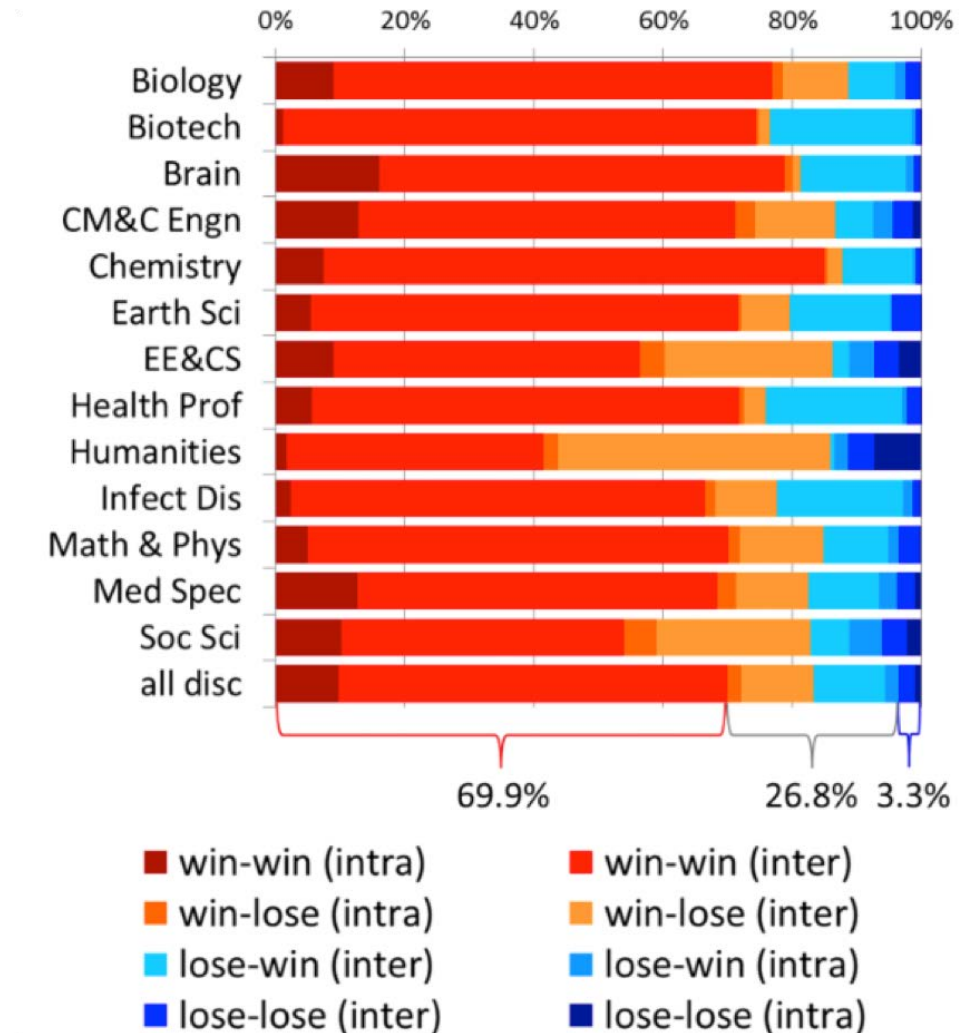


Long-Distance Interdisciplinarity Leads to Higher Scientific Impact

Larivière, Vincent, Stefanie Haustein, and Katy Börner. 2015. PLOS ONE DOI: 10.1371.

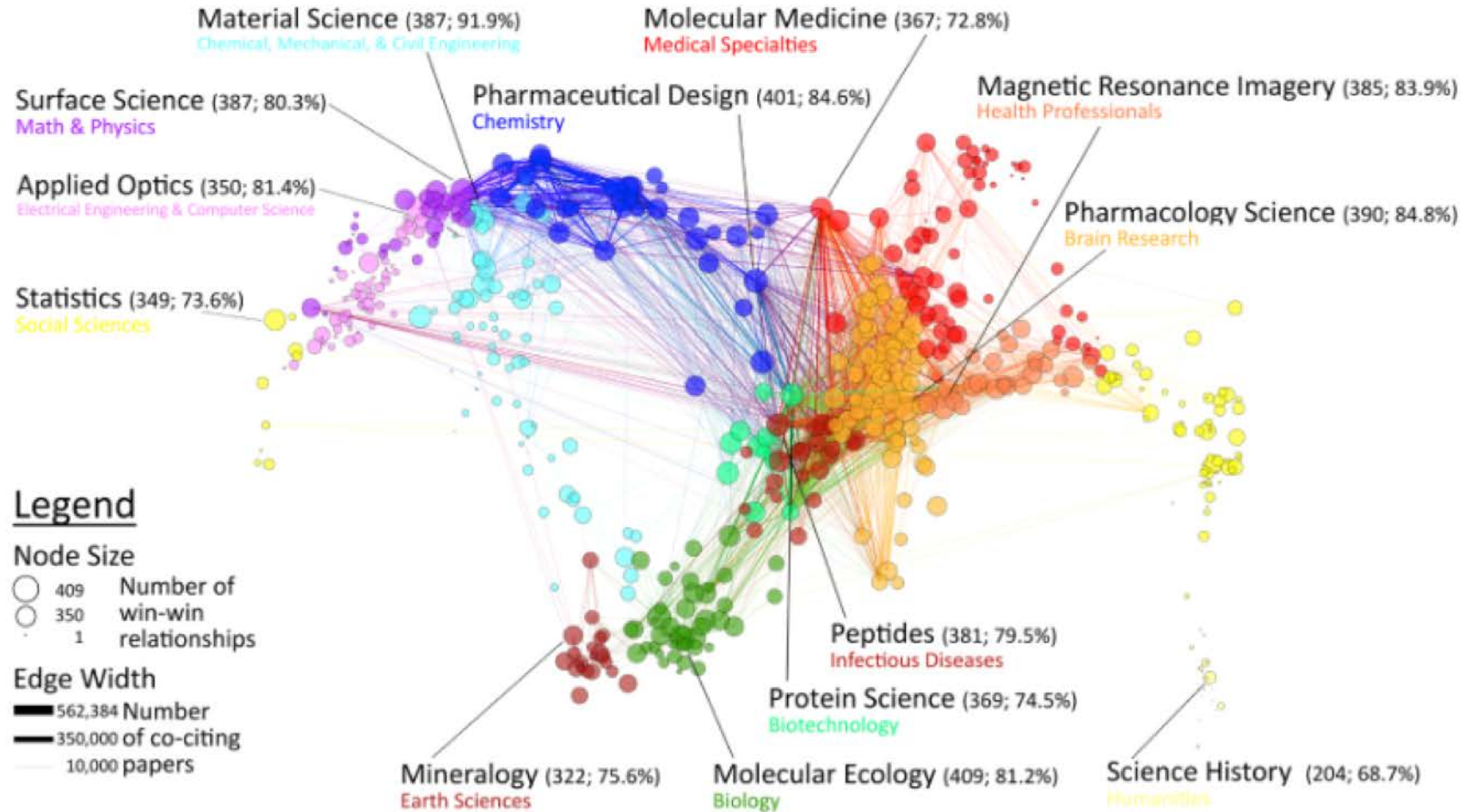
Data: 9.2 million interdisciplinary research papers published between 2000 and 2012.

Results: majority (69.9%) of co-cited interdisciplinary pairs are “win-win” relationships, i.e., papers that cite them have higher citation impact and there are as few as 3.3% “lose-lose” relationships. UCSD map of science is used to compute “distance.”



A1 Number of papers citing win-win relationships ($\geq 10,000$ citing papers)

citing papers



2,940 (5.19%) of 56,614 win-win edges

node color: discipline | edge color: mix of adjacent nodes | labels: subdiscipline with highest number of win-win relationships (number and percentage of win-win relationships)

Visua

Insight Need Types page 26

- categorize/cluster
- order/rank/sort
- distributions (also outliers, gaps)
- comparisons
- trends (process and time)
- geospatial
- compositions (also of text)
- correlations/relations

Kapitalverflechtungen in Deutschland



This network visualization by Lothar Krempel of the Max Planck Society in Germany shows the evolving network of leading companies in Germany. Yellow nodes signify banking and insurance companies; red nodes signify industrial companies (e.g., airline, automotive, and manufacturing firms). Node size denotes the volume of shared linkages. Yellow lines are used to link financial companies; red lines, industrial firms; and orange lines, financial companies to industrial firms. It reveals how during that time frame a drastic reduction was observed in the number and volume of linkages.

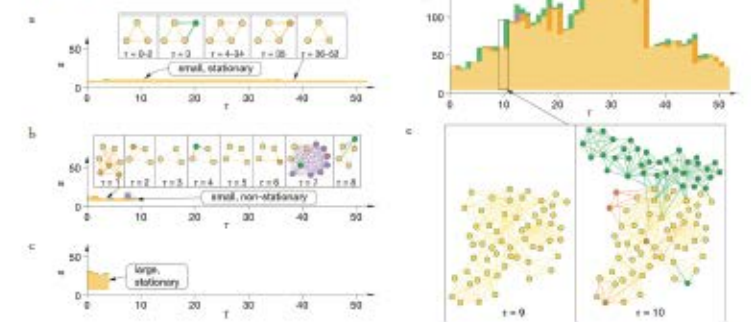


Quantifying Social Group Evolution

Gergely Palla and colleagues studied coauthor and phone-call "collaboration events." Shown are coauthorship events extracted from publications in the arXiv e-Print condensed matter archive, published over 142 months by over 30,000 authors. The stacked bar graphs show community composition per time step. Four types of author nodes are distinguished: those who joined in a previous time step (yellow), current newcomers (green), those who joined previously but will leave in the next time step (orange), and those who joined for this one time step only (purple). Collectively, the number of all nodes is represented by bar height.

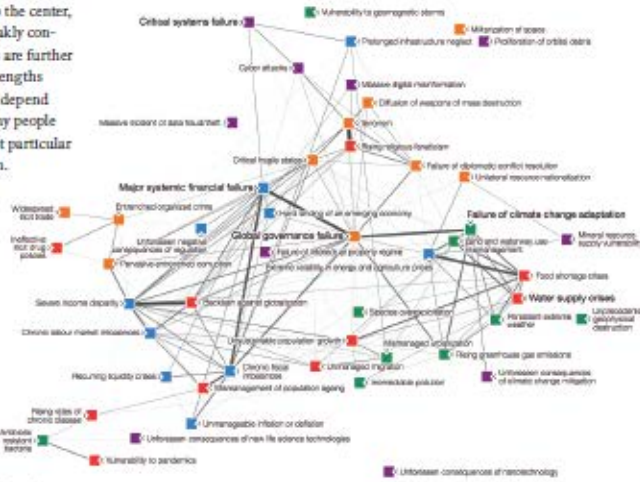
Shown at left is the evolution of three communities:

(a) small and stationary; (b) small and nonstationary; and (c) large and stationary. Shown at right is (d) a large, nonstationary community and (e) network structures for two time steps.



The Risk Interconnection Map, 2013

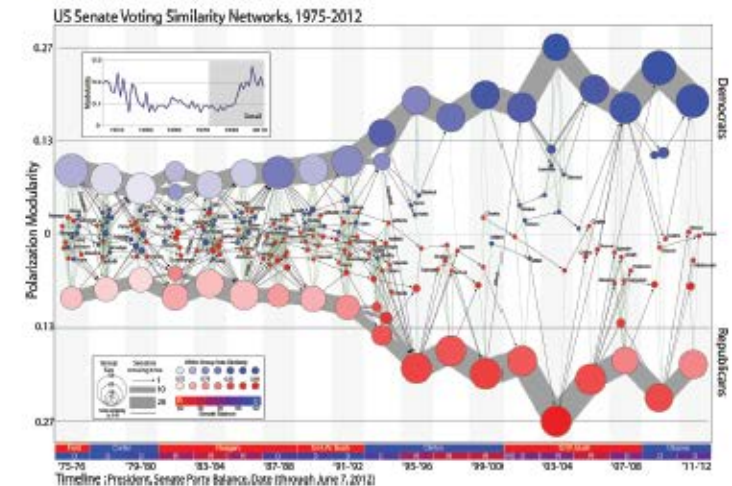
The World Economic Forum conducted a survey that asked experts to identify a minimum of three and a maximum of ten connections between major risks. The resulting network includes 529 paired connections. More connected risks are closer to the center, whereas weakly connected risks are further out. The strengths of the lines depend on how many people selected that particular combination.



Source: World Economic Forum

U.S. Senate Voting Similarity Networks, 1975–2012

Using U.S. Senate voting data from 1975 to 2012, this timeline by James Moody and Peter Mucha shows the increasing political polarization in America. Over time, fewer and fewer senators occupy a middle ground outside of their party's camp.



Atlas Trilogy

Börner, Katy (2010) **Atlas of Science: Visualizing What We Know**. The MIT Press.

<http://scimaps.org/atlas>

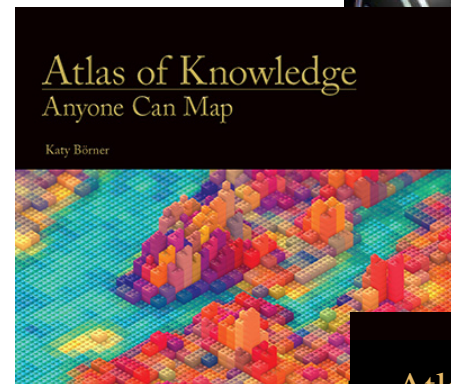
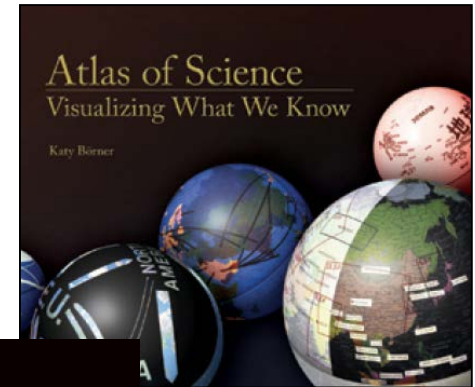
Börner, Katy (2015) **Atlas of Knowledge: Anyone Can Map**. The MIT Press.

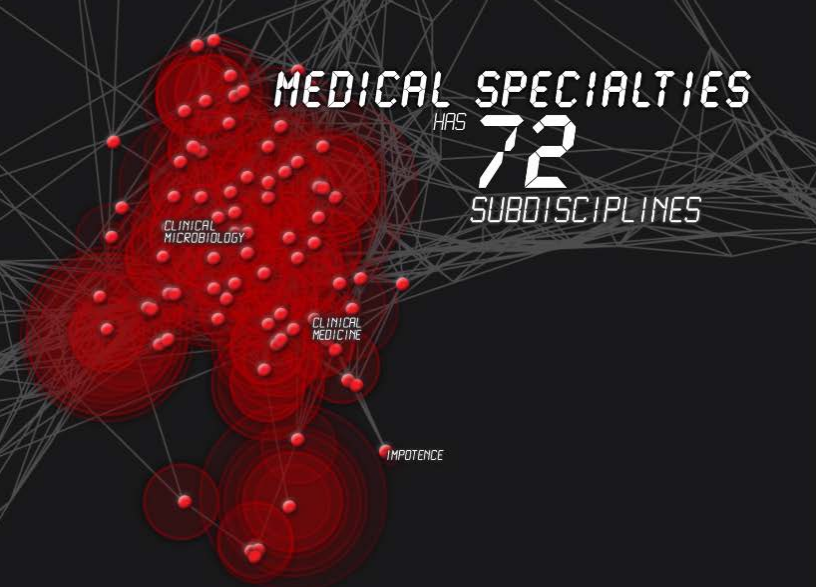
<http://scimaps.org/atlas2>

Börner, Katy (2020) **Atlas of Forecasts: Predicting and Broadcasting Science, Technology, and Innovation**. The MIT Press.

ModSTI Conference slides, recordings, and report are at <http://modsti.cns.iu.edu/report>

Upcoming Sackler Colloquium on "**Modelling and Visualizing Science and Technology Developments**" will take place in December 2017 at the Beckman Center, Irvine, CA.





Science Forecast S1:E1, 2015



Dr. Johan Bollen