

Literature Reviews and Selling Ideas

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The CMU centers for:

Informed DEMocracy And Social cyber-security

Computational Analysis of Social and Organizational Systems



Carnegie Mellon University



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1

Literature Review for a Scientific Paper

- ☐ Sets the ground work for what is critical and new in presenting your new scientific work.
- ☐ This is typically short 2-4 pages
- ☐ In CS often have 10 or so studies, many more in some fields
- ☐ But literature is used throughout paper

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2



Importance of Lit Review in Paper

- ☐ Demonstrates your understanding/mastery
 - ☐ Outlines important research trends
 - ☐ Assesses the strengths and weaknesses of existing research
 - ☐ Identifies potential gaps in knowledge
- ☐ Establishes a need for current and/or future research projects
- ☐ Locates your work or agenda within the literature

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Importance of Citing Others Outside of Lit Review

- ☐ INTRO
 - ☐ Establishes potential impact of this research
 - ☐ Why is this important to the general public
- ☐ DATA or METHODS
 - ☐ Gives credit to others for data, algorithms, theory
 - ☐ Comparison with your data or algorithm
- ☐ Summary or Future Directions
 - ☐ Why your work confirms x's work
 - ☐ Confirmation that next step is critical

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High Level Guide

- ☐ Introduce the literature review by describing the major research topic
- ☐ Identify the broad problem area in a meaningful way (not too broad, not too specific)
- ☐ Describe why audience should care about this topic
- ☐ Don't try to cover everything written on your topic
- ☐ Select the research most relevant to the topic of the paper
- ☐ You will use the studies in your literature review as "evidence" that your research is important and your findings relevant

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The Scientific Paper (home for the lit review)

- ☐ Closes gaps in the research;
 - ☐ Tests an aspect of a theory;
 - ☐ Replicates an important study;
 - ☐ Retests a hypothesis with a new or improved methodology;
 - ☐ Resolves conflicts in the field;
 - ☐ Creates original research (this is rare).
-
- ☐ Your lit review should be oriented to support the type of paper

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Core Idea

- ☐ Core statement goes here.
- ☐ Describe the area that your project is addressing.
 - ☐ Briefly describe the connection to improving an area
 - ☐ Briefly describe what is not known – the open question that needs resolving.

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Core Idea Cont.

- ☐ Core Statement Example: “We will put a man on the moon and return him safely by the end of the decade”
 - ☐ This may be the hardest part of this briefing
 - ☐ Keep this to one or two sentences as illustrated by the example above (perhaps with a graphic).
 - ☐ Straightforward and simple
 - ☐ Concrete: actions, behaviors, artifacts
 - ☐ Self testing
 - ☐ Tell a story
 - ☐ Recommended reading: “Made to Stick: Why Some Ideas Survive and Others Die” by Chip Heath & Dan Heath

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Describe the Area

- ☐ Describing the area – what is the newness of your approach
- ☐ Whether you are discovering new information or developing a new widget, it needs to be improving how some operation is done today.
 - ☐ Here is where you get to introduce that connection.
 - ☐ Use single short narrative statements.

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What are you trying to improve

- ☐ How does the operational or institutional element that you are addressing get it done today?
- ☐ Who does it?
- ☐ What are the limitations & problems of the present approaches?
- ☐ This is further setup for describing the newness of your approach and is key to evaluation by reviewers

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What is new

- ☐ What recent changes in the scientific or technological environment are enabling the field to successfully address this problem now?
- ☐ How has the field advantage of that recently developed information, technology, theory, integration to address the limitations and problems of the present approaches?
- ☐ Upon whose shoulders are you and the field standing? What is enabling the field to move to the next level?

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Novelty Claims example

- ☐ Example:
 - ☐ Recent advances in agent-based models will allow us to model known individual cognitive processes into software agents.
 - ☐ Executing these agents in a simulation model will generate more realistic group behavior
 - ☐ This will allow us to forecast group behavior more accurately in response to an influence message.
 - ☐ A wide range of messages can be tested against a wide range of plausible agent characteristics

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Evidence that concepts have been appropriately synthesized

- ☐ Major theoretical concept underlying this review
 - ☐ A plain language description of the theoretical concept
 - ☐ Reference refereed publications of concept
 - ☐ Concrete example(s) of how you have implemented this construct in your model or process
- ☐ Next major theoretical concept ...

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Evidence that concepts and constructs are appropriately applied to a domain

- ☐ What are is the field trying to model or process?
- ☐ Concrete examples of how real world information, entities, actions are being translated into computational parameters and values {Subject Matter Experts, Statistics, other ...}
 - ☐ How is a translation being verified
- ☐ Concrete examples of how results from the model or process will affect outcomes or analysis procedures

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Gaps

- ☐ When all is said and done
 - ☐ What is critical that has not been done
 - ☐ Why should this be done? What are the payoffs
- ☐ 5/10 year plan
 - ☐ What is likely or should happen in next few years

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Literature Reviews are Arguments

- ☐ All sources cited in the literature review should be listed in the references
- ☐ A literature review should include introduction, summary and critique of journal articles and books, justifications for your research project and the hypothesis for your research project
- ☐ After reviewing the literature, summarize what has been done, what has not been done, and what needs to be done
- ☐ Remember you are arguing why your study is important!
- ☐ Note: any formal research question or hypothesis needs to be clearly linked to your literature review

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Do Literature Reviews with A Purpose

- ☐ Start with a good outline.
- ☐ Have at least
 - ☐ An introduction that establishes the importance of the topic, the scope of the review, and the organization of the paper;
 - ☐ The major section headers and sub-sections that follow the same organization as the organization established in the introduction;
 - ☐ Summary of findings, implications of findings, and discussion.

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How Far Back to Search

- ☐ Depends on field
- ☐ Depends on type of review – type 1 more recent articles, type 2 include more historical articles
- ☐ For articles found consider
 - ☐ Is it current?
 - ☐ Have the claims, evidence, or arguments been superseded
 - ☐ Is it a citation classic or critical for historical background

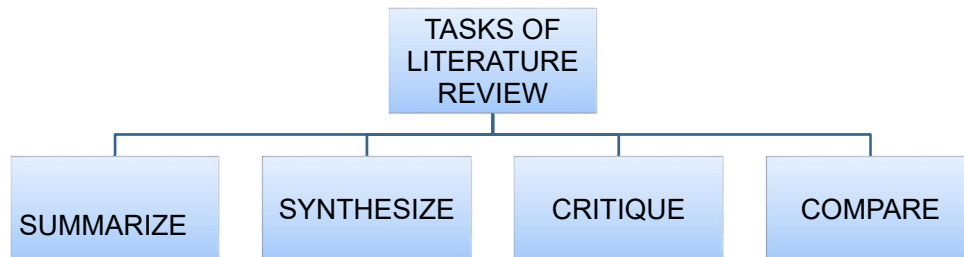
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18

Four Analysis Tasks in the Literature Review



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From Matt Weiss at PSU



Summarize & Synthesize

In your own words, summarize and/or synthesize the key findings relevant to your study.

- ☐ What do we know about the immediate area?
- ☐ What are the key arguments, key characteristics, key concepts or key figures?
- ☐ What are the existing debates/theories?
- ☐ What common methodologies are used?
- ☐ What are common assumptions about data? Model parameters? ...

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Illustrative phrases

- ☐ has demonstrated, failed to demonstrate
- ☐ is concerned with, deals with, describes
- ☐ compared to, contrasting
- ☐ the first one to
- ☐ later approach, extended, altered, changed, revised

neutral	implies	argues	disagrees	agrees
Comment	Analyze	Contend	Bemoans	Admit
Describe	Assess	Defend	Complains	Approve
Illustrate	Conclude	Holds	Ignores	Concede
Note	Find	Maintains	Deplores	Concur
Observe	Discover	Insists	Laments	Grant that
Point Out	Predict	Disputes	Warns	States

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Compare & Critique

- ☐ Evaluates the strength and weaknesses of the work:
 - ☐ What specific claims are made?
 - ☐ **What specific conclusions are drawn?**
 - ☐ Are they warranted by the evidence?
 - ☐ **How does this article, argument, theory, etc., relate to other work?**
 - ☐ Are they stated clearly?
 - ☐ What support is given for those claims?
 - ☐ What evidence, and what type is offered?
 - ☐ Is the evidence relevant? Sufficient?
 - ☐ **What is the source of the evidence or other information?**
 - ☐ The author's own experiments, surveys, etc.? Government documents?
 - ☐ How reliable are the sources?

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Compare & Critique Cont.

- ☐ What arguments are given?
 - ☐ Does the author take into account contrary or conflicting evidence and arguments?
 - ☐ How does the author address disagreements with other researchers?
- ☐ What assumptions are made and are they warranted?
- ☐ How do the different studies relate? What is new, different, or controversial?
- ☐ What views need further testing?
- ☐ What evidence is lacking, inconclusive, contradicting, or too limited?
- ☐ What research designs or methods seem unsatisfactory?

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Adjectives to use in Comparison and Critique

- | | |
|---|-------------------------------------|
| ☐ Unusual | ☐ Complex |
| ☐ Small, Large | ☐ Competent |
| ☐ Simple | ☐ Important |
| ☐ Exploratory, Comprehensive | ☐ Innovative |
| ☐ Limited | ☐ Impressive |
| ☐ Restricted | ☐ Useful |
| ☐ Flawed | ☐ Careful |

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Analysis

- ☐ Consider whether the literature:
 - ☐ Demonstrate the topic's chronological development.
 - ☐ Show different approaches to the problem.
 - ☐ Show an ongoing debate.
 - ☐ Center on a "seminal" study or studies.
 - ☐ Demonstrate a "paradigm shift."

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Analysis

- ☐ By the end of the review you should be able to answer
 - ☐ What do we know
 - ☐ What do we not know
 - ☐ What needs to be done
 - ☐ How your research will contribute

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Common Errors

- ☐ Not logically organized
- ☐ Not focused on most important facets of the study
- ☐ Doesn't relate literature to the study
- ☐ Too few references or outdated references cited
- ☐ Recent references are omitted
- ☐ Leaves out a major author or paper
- ☐ Doesn't demonstrate why this topic fits in this venue
- ☐ Not written in author's own words and style
- ☐ Reads like a series of disjointed summaries
- ☐ Doesn't argue a point

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Extended Literature Reviews

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Practicum

The CMU centers for:

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Computational Analysis of Social and Organizational Systems



Carnegie Mellon University

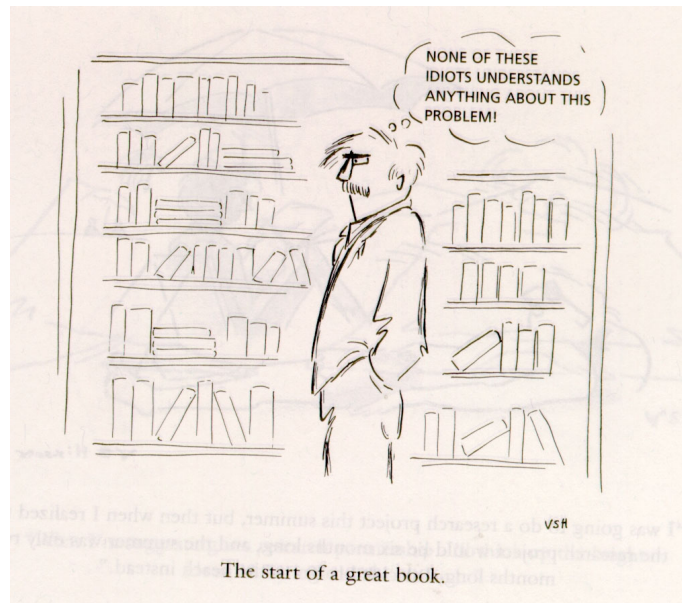


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28

Science as Collaborative ?



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29

The Invisible College

- ❑ The invisible college is a small group that controls the perspective on the issue
 - ❑ What constitutes good work
 - ❑ What the challenges are
- ❑ The members of the invisible college
 - ❑ may not agree with each other
 - ❑ collectively recognize each other's expertise
 - ❑ Using their knowledge you can
 - ❑ identify the central members of the group
 - ❑ Identify the knowledge boundaries of the problem

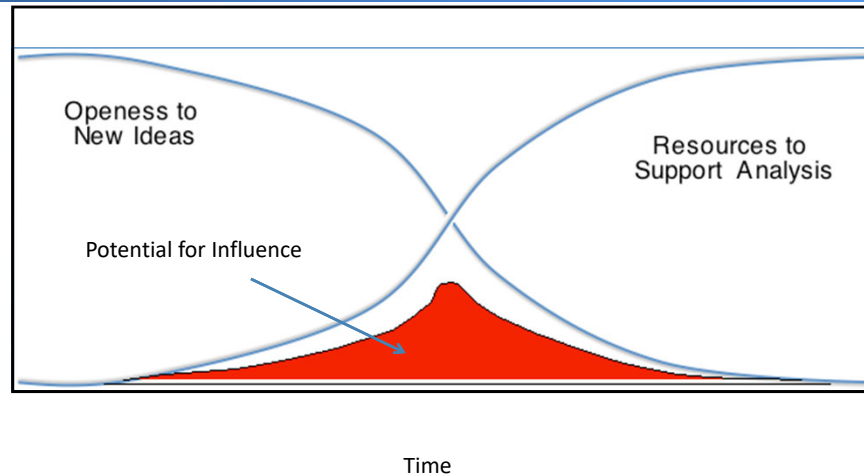
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30

The Window of Influence



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Dennis Meadows
Kathleen M. Carley

31



Disciplinary Coherence

- ☐ The extent to which science is “carved up into a host of detailed studies that have no link with one another” is a question of network cohesion.
 - ☐ A fractured discipline will be dominated by tight clusters based on specific research problems
 - ☐ An integrated discipline will have strong connections bridging research problems

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Understanding Scientific Coherence

- ❑ Normal Science, accumulation & revolution
 - ❑ Science is problem driven & evidence based
 - ❑ Consensus emerges through a competition of ideas against data
 - ❑ (though lab ethnography repeatedly shows that consensus is often more socially constructed than evidentiary)
 - ❑ Scientific “Star” systems reward prior success, and stars shape research agendas
- ❑ Boundary Specification & Science as a profession
 - ❑ -Motivated by prestige & competition for resources
 - ❑ -Competition will lead to both vanquishing and niche filling
 - ❑ Disciplinary identity & coherence become a key issue
 - ❑ Contested fields lead to “chaotic” outcomes (Abbott 2001)
- ❑ Invisible Colleges
 - ❑ Informal communities create acceptable scientific standards
 - ❑ Boundaries are defined socially through interaction
- ❑ Scientific (social) Movements
 - ❑ Combination of many of these ideas under a social movement frame
 - ❑ Coherence becomes a framing & “grievance” issue used to shape resource allocation

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Methods to Understanding Scientific Coherence

Networks of Interest:

- ❑ Citation networks – a direct trace of scientific recognition & production
- ❑ Topic networks – clusters of scientific products speaking about the same subject
- ❑ Collaboration networks – “invisible communities” of social interaction that produces scientific products
- ❑ Research Communities – People linked through common research topics (merger of 2 & 3)

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Types of Links

- ☐ Type
 - ☐ Direct
 - ☐ A cites B
 - ☐ Co-occurrence
 - ☐ A and B co-author
 - ☐ Bibliographic coupling
 - ☐ Co-citation
 - ☐ B & C both cited by A
- ☐ Level
 - ☐ Document
 - ☐ Author
 - ☐ Journal

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Co-Citation

- ☐ Co-Citation is a similarity measure used to establish a subject similarity between two items
- ☐ If A and B are both cited by C, they may be said to be related to one another, even though they don't directly reference each other
 - ☐ If A and B are both cited by many other items, they have a stronger relationship
 - ☐ The more items they are cited by, the stronger their relationship is
 - ☐ Undirected, Unweighted
- ☐ Proposed in the fields of citation analysis and bibliometrics as a fundamental metric to characterize the similarity between documents

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36

Co-Citation

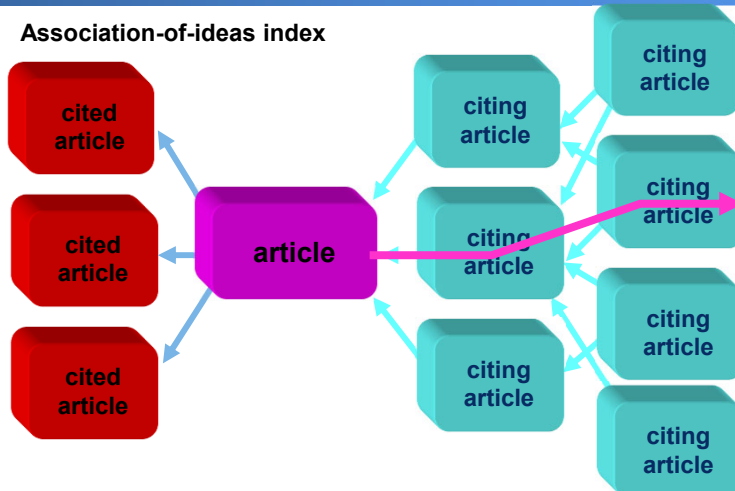
- ❑ Document Co-Citation Network (DCA)
 - ❑ DCA introduced by Small and Marshakova in 1973 (Marshakova, 1973; Small, 1973; Small & Greenlee, 1986).
 - ❑ Logical opposite of bibliographic coupling
 - ❑ The co-citation frequency equals the number of times two papers are cited together, i.e., appear together in a reference list
- ❑ Author Co-Citation Network (ACA)
 - ❑ Authors of works that repeatedly appear together in lists of references are assumed to be related.
 - ❑ Clusters in ACA networks often reveal shared schools of thought or methodology, common subjects of study, collaborative and student-mentor relationships, ties of nationality, etc.
 - ❑ Scientific areas differ in the density of the ACA
- ❑ Journal Co-Citation Network (JCA)
 - ❑ JCA networks offer wide-angle views of scholarly disciplines
 - ❑ Over time analysis reveals the evolution of disciplinary similarity.

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Science Citation Index



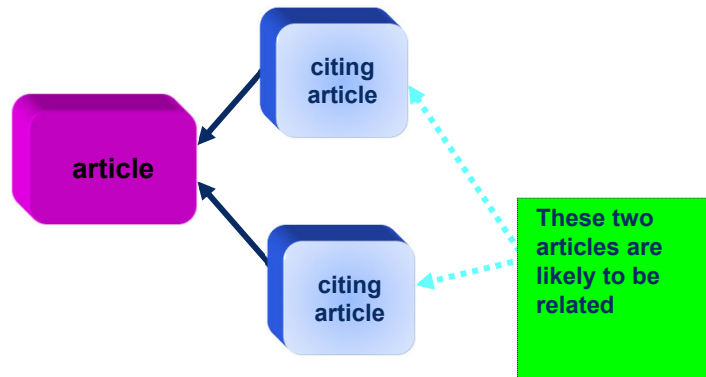
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Co-citation analysis

Articles that cite the same article are likely to both be of interest to the reader of the cited article



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39



Co-citation Philosophy



all articles published between 1993 and 2013 in *Nous*, the *Journal of Philosophy*, the *Philosophical Review*, and *Mind*.

chosen because they are high-impact, high-prestige, and self-consciously "generalist" journals.

Articles 2,262

Citations 34,000

520 most cited items (as at 500 not natural break).

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40



Collaboration Network

- ❑ Girvin-Newman Algorithm was applied to a collaboration network of scientists at the Santa Fe Institute
 - ❑ an interdisciplinary research center
 - ❑ The 271 nodes in this network represent scientists during the calendar year 1999 or 2000 and their collaborators
- ❑ An edge is drawn between a pair of scientists if they coauthored one or more articles during the same time period
- ❑ The network includes all journal and book publications, papers by the scientists involved

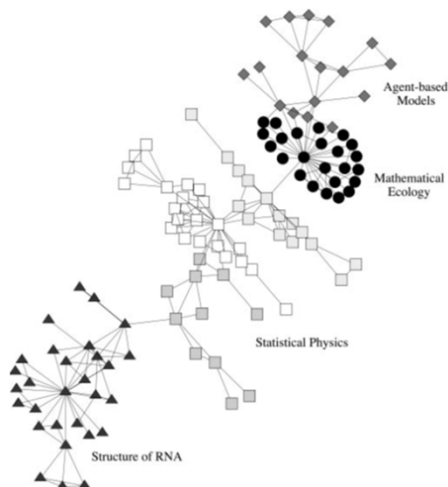
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Scientist Collaboration Diagram



- ❑ Largest component of the Santa Fe Institute collaboration network, with the primary divisions detected by Girvin-Newman algorithm indicated by different node shapes

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N. Girvan & M. Newman



42

Issue	Cyber Security	Social Cyber Security
Core Disciplines	Electrical Engineering, Software Engineering, Computer Science	Computational Social Science, Societal Computing, Policy
Illustrative problems	Encryption, Malware Detection. Denial of Service Attack Protection	Spread of disinformation, spam, altering who appears influential, creating echo-chambers
Core Methods	Cryptography, Software Engineering, Computer Forensics, Biometrics	Network Science/Social Networks, Language Technologies, Social Media Analytics
Data Level	Packets	Social media post
Insider Threat Focus	Encryption to prevent ease of reading. Software to prevent or detect illicit data sharing. Firewalls.	Social engineering to seduce insider to share information. Information leakage in social media.
Spreading Malware images Focus	How malware is embedded and detected.	Use of bots to promote message sharing. What groups are at risk to download.
Illustrative Tools	SysInternals, Windows GodMode, Microsoft EMET, Secure@Source, Q-Radar, ArcSight	ORA-PRO, Maltego, TalkWalker, Scraawl, Pulse, TweetTracker, BlogTracker
National Infrastructure Support	US-CERT – United States Computer Emergency Readiness Team	Nothing comparable – emergent self management by social media providers

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Key Challenges

❑ Rate of Change:

- ❑ cyber-technologies, legal and policy constraints, and global information flow

❑ Technical, policy and economic issues impact

- ❑ what science can be done,
- ❑ what science needs to be done,
- ❑ how science can be done,
- ❑ what is required for those who can do that science

Data Control & Management

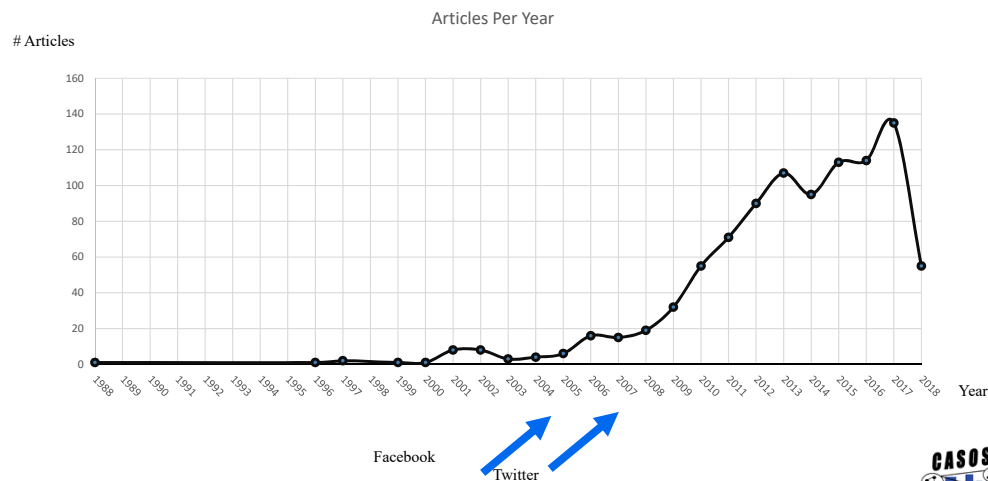
- ❑ Data is often only a sample
 - ❑ Biases are often not known nor accounted for
- ❑ Data is not free and open
 - ❑ Providers dictate who can do what kind of science
- ❑ Data is not necessarily preserved
 - ❑ Replication is difficult if not impossible
- ❑ Policies are out-of-sync with technology & science
 - ❑ Often not possible to collect the data needed to answer the policy question

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Social Cyber-Security – Time Line

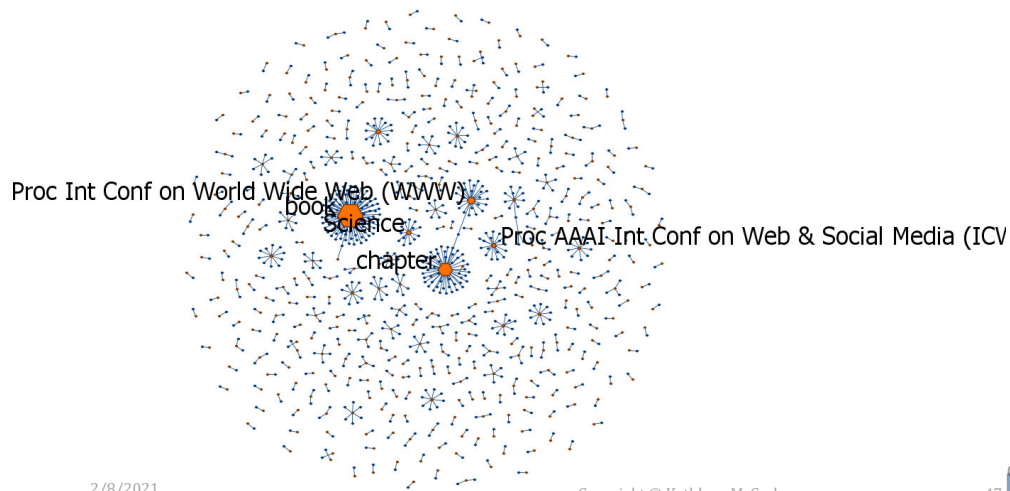


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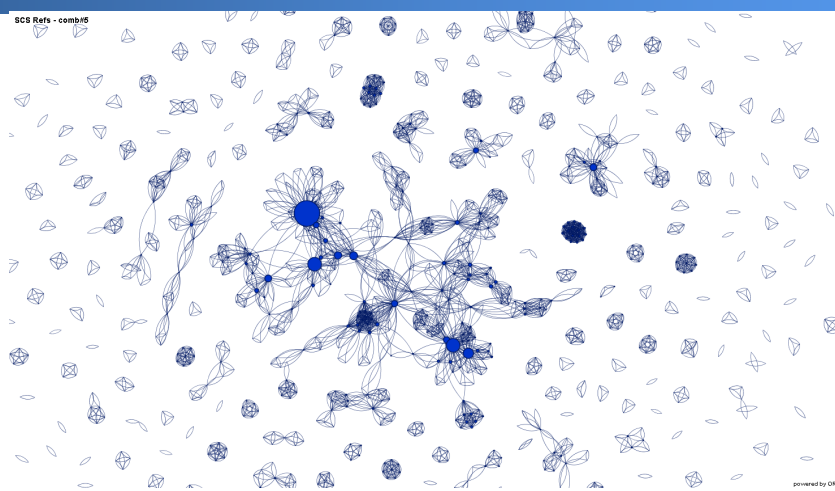
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Why the Disconnect?



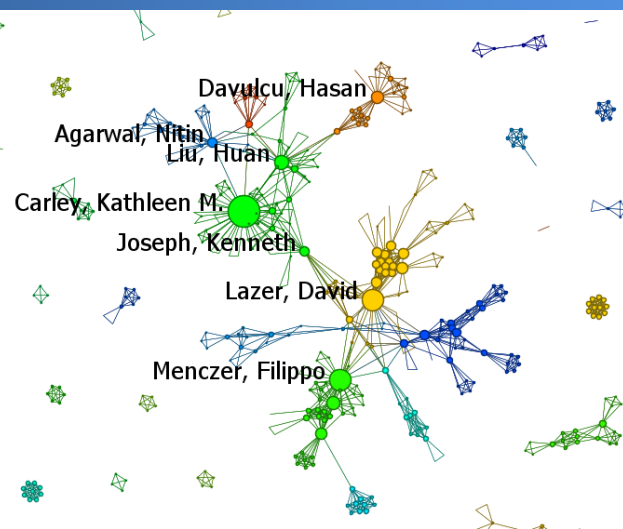
Co-Authorship Network of Social Cyber-Security



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Central Core of Social Cyber-Security



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2020

SCS Refs - 2019 v9



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Recommended Reading

- ❑ Crane Diana (1972) 'Invisible colleges. Diffusion of knowledge in scientific communities.' The University of Chicago Press: Chicago and London.
- ❑ Wagner, Caroline S. (2008) 'The New Invisible College: Science for Development.' Brooking Press: Washington DC.
- ❑ Derek J. de Solla Price, (1963) *Little Science, Big Science*, New York: [Columbia University Press](#) (1963)
- ❑ Derek J. de Solla Price, (1965) "[Networks of Scientific Papers](#)", in *Science* **149** (3683):510-515 (1965)
- ❑ Derek J. de Solla Price, (1976) "[A general theory of bibliometric and other cumulative advantage processes](#)", in *Journal of the American Society for Information Science* **27**:292-306

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51



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- ❑ CASOS website - <http://www.casos.cs.cmu.edu/>
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52

