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Bibliographic Coupling *as a* Sleeping Beauty: *a* Historiography

Nordic Workshop on Bibliometrics

Göthenburg


Bibliographic Coupling, a fundamental concept in bibliometrics, was ignored for decades only to be re-discovered by another field circa 2017.
Let's see what happened…

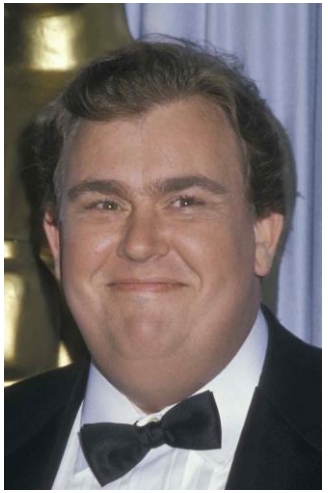
Outline

- McMaster University – *where?*
  - *Scotland?*
- Bibliographic Coupling – *brief intro*
- Sleeping Beauty citation pattern -
  - Reveals *“Paradigm Shift”*
  - *“Seismograph”* for science
- HistCite
  - “Microscope” for citations
- Patterns have a story to tell
  - *Narratives, not numbers!*

McMaster University

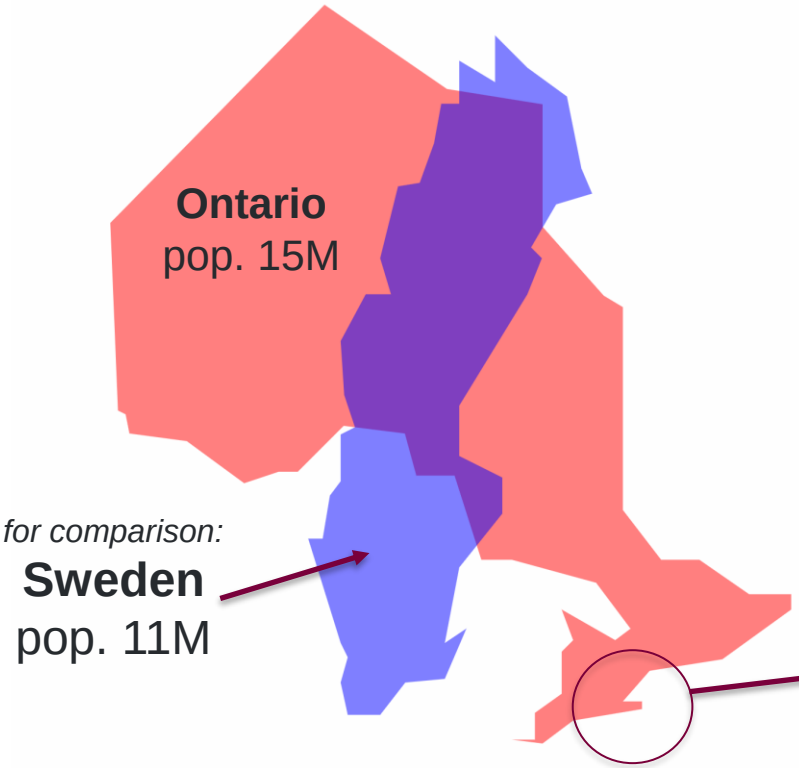
- Founded in 1887
- 29,000 undergraduate students
- 1,000 full-time faculty
- THE ranking = **80th**
- World-renowned **medical school**
  - “**Problem-based learning**”
- **Nuclear reactor** on campus (5MW)
- **Hamilton**
- *Not in Scotland*

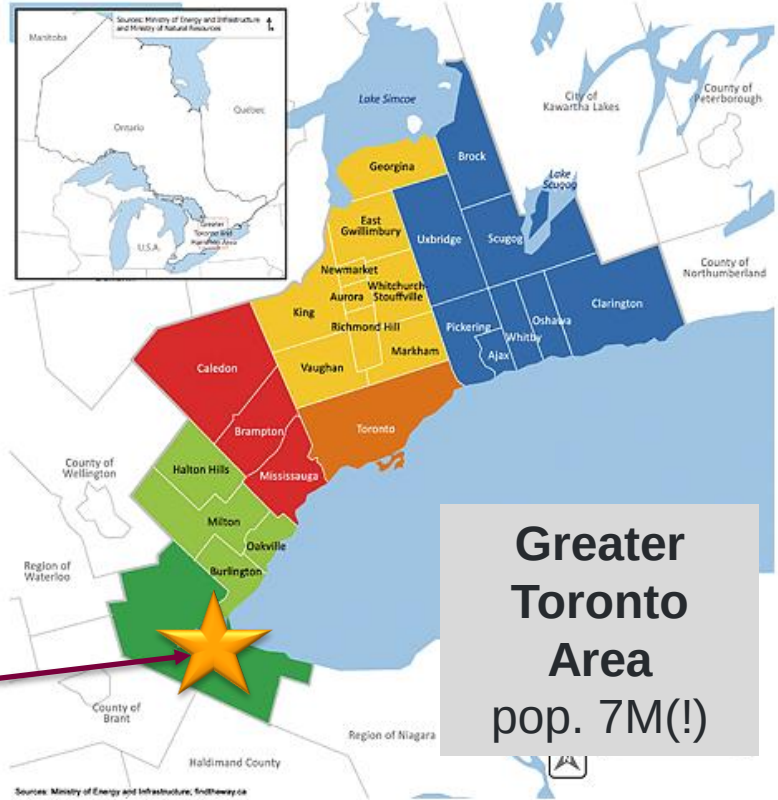
Dr. Roberta Bondar



Donna Strickland (*Nobel 2018*)

Where is McMaster?





Greater Toronto Area
pop. 7M(!)

Sweden is **0.42 times** as big as Ontario (Canada)

McMaster University

Patterns & Techniques

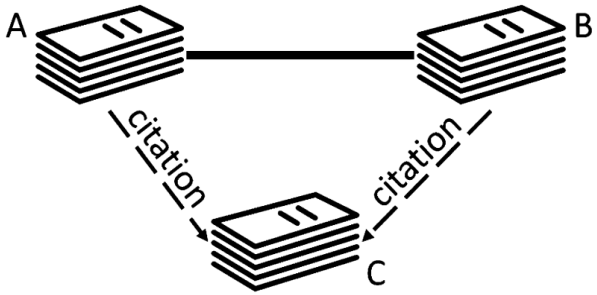
Two citation patterns:

- **micro** = Bibliographic Coupling (*M.M. Kessler, 1963*)
- **macro** = Sleeping Beauty (*Anthony van Raan, 2006*)

Two techniques:

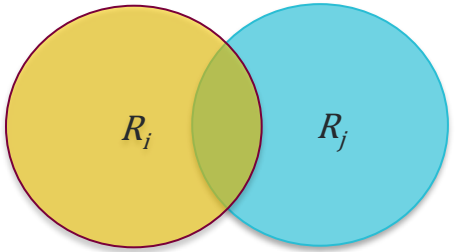
- **macro** = Listen for **Sleeping Beauties**
  - Acts as a *seismograph*
  - 4 reasons for an SB
  - Easy to do in WoS
- **micro** = Observe structure of citations at “pivot”.
  - **Historiograph** acts as a *microscope*

Bibliographic Coupling



Two articles are coupled if they each cite another article in common.

R_i = List of references in article "*i*"
R_i = List of references in article "*j*"

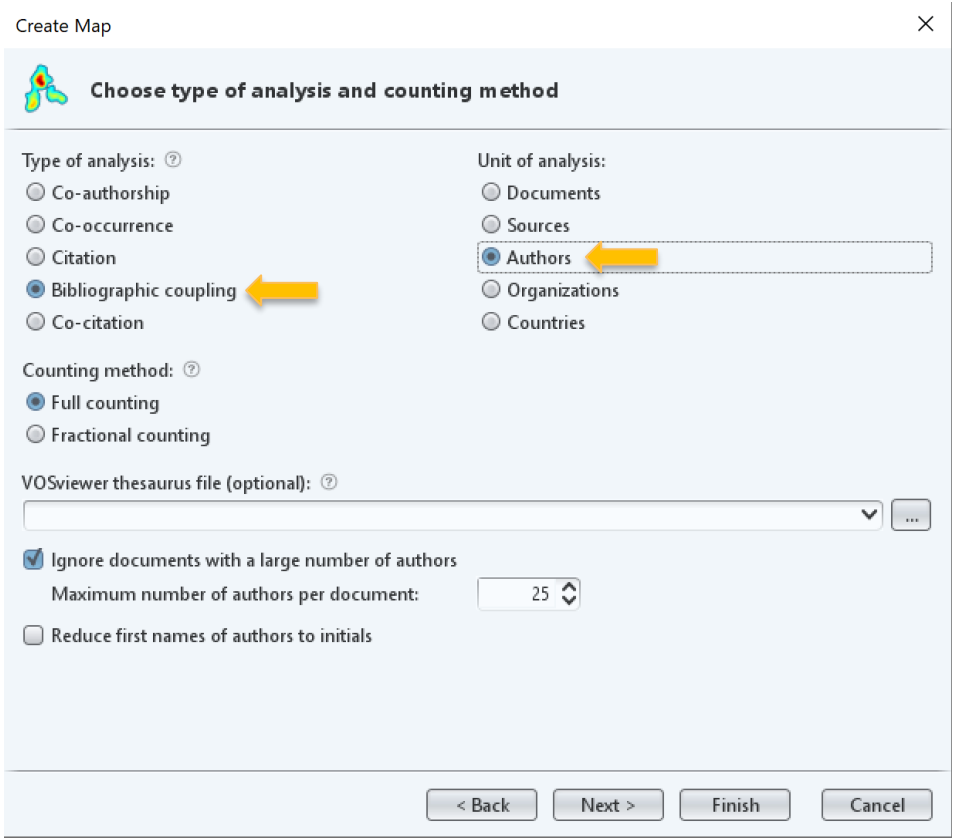
Bibliographic Coupling strength *Kessler 1963*	$R_i \cap R_j$	**Integer** count (1, 2, 3, 4,…)	
Relative BC strength Jaccard index *"Jaccard similarity coefficient"* *Sen & Gan 1983*	$\frac{\lvert R_i \cap R_j \rvert}{\lvert R_i \cup R_j \rvert}$	**Proportion** of items in common to total items. [0→ 1]	
Coupling angle Salton's cosine, Salton's index *"Cosine similarity"* *Sen & Gan 1983*	$\frac{R_i \bullet R_j}{\sqrt{(R^2_i)(R^2_j)}}$	Salton's cosine similarity calculated for Boolean arrays R_i and R_j. [0→ 1]	
Refined BC strength Jaccard index with TF/IDF *Shen, Zhu, Rousseau, Su, Wang 2019*	$\frac{R_s(A) \bullet R_s(B)}{\lVert R_s(A) \rVert \,.\, \lVert R_s(B) \rVert}$	Coupling angle of the relative weights (non-binary) of references. [0→ 1]	

	r_1	r_2	r_3	r_4	r_5	r_n
I	1	0	1	1	0	0
J	0	1	1	0	0	1

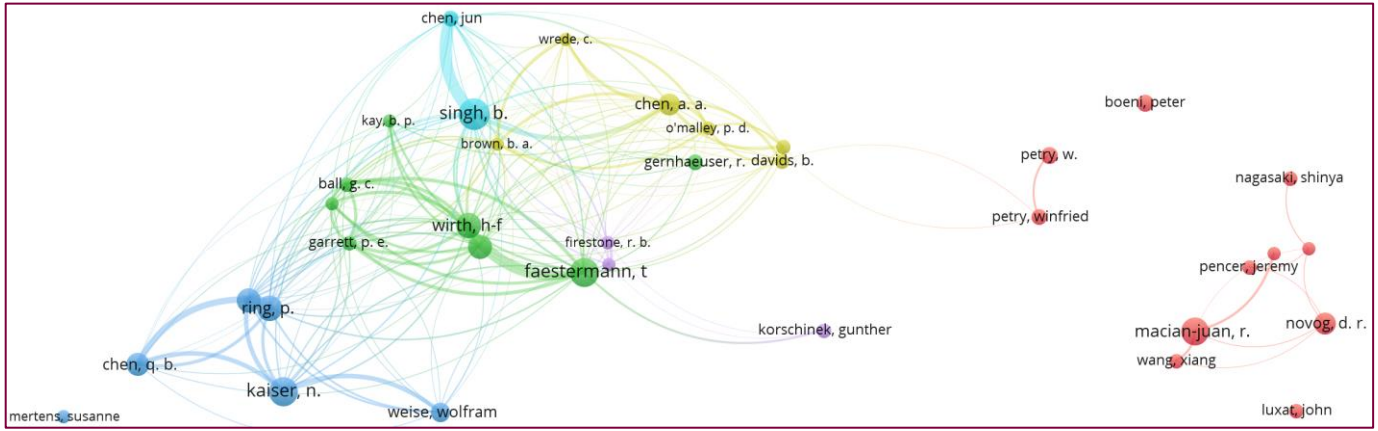
	r_1	r_2	r_3	r_4	r_5	r_n
A	1	0.22	0	0.75	0.13	0.2
B	0	0.65	0.39	0.83	0	0.6

Commonly found in bibliometric tools

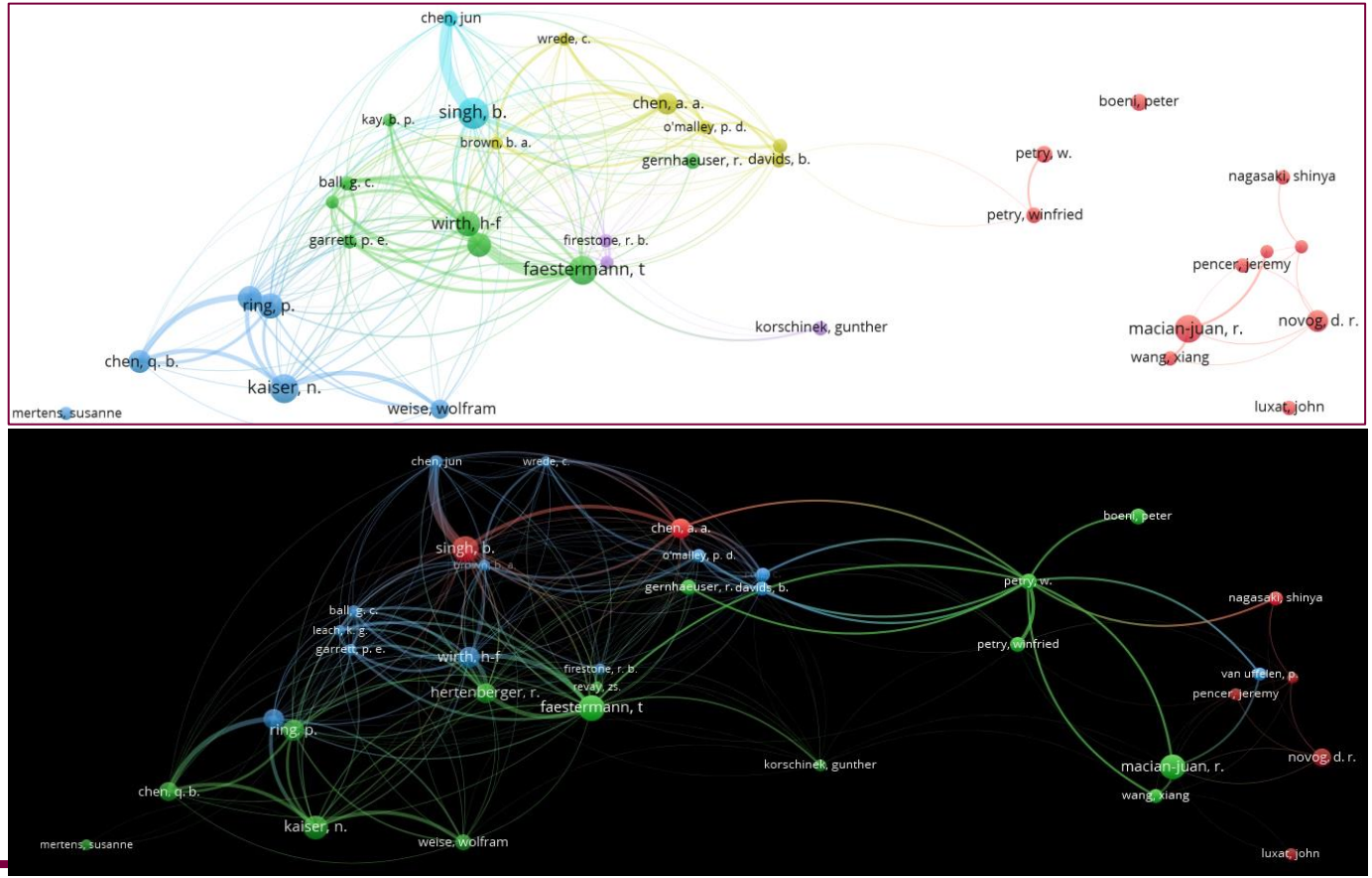
- Built-in to VOSviewer



Topic Map of Science



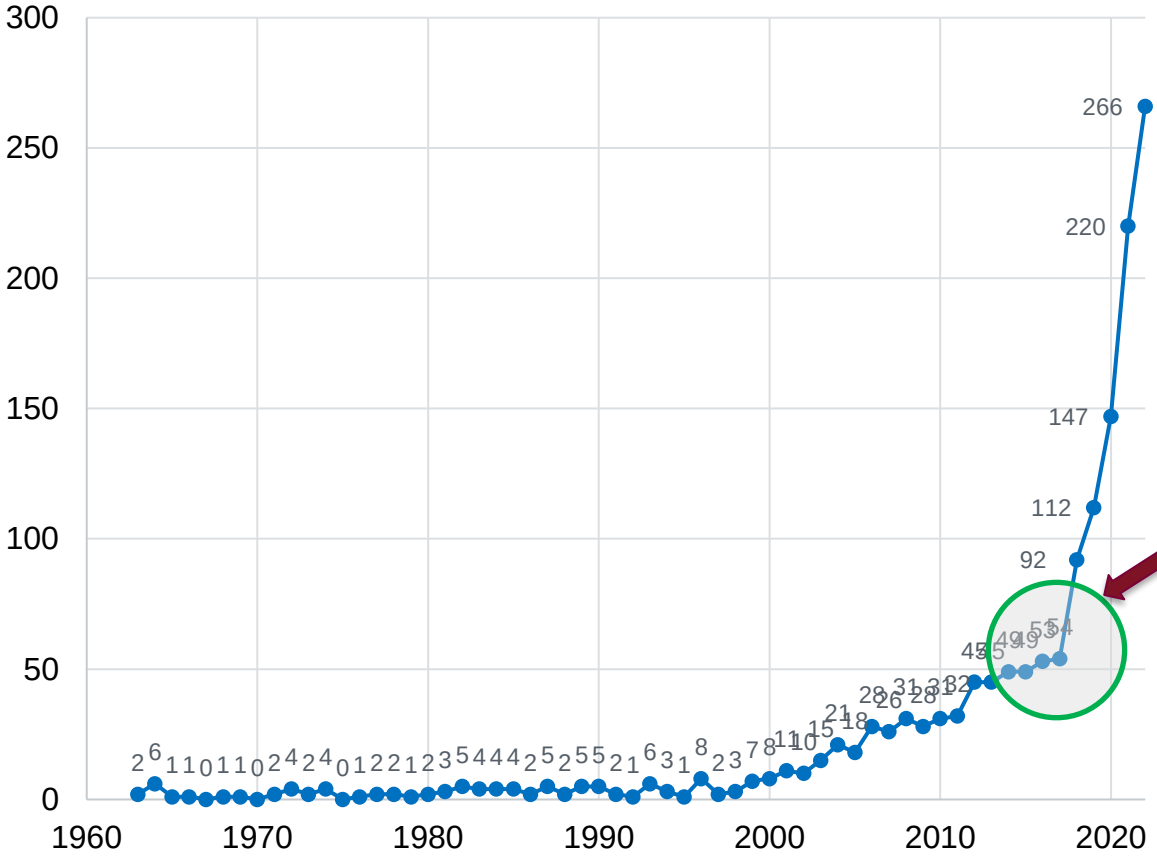
Topic Map of Science + cluster by affiliation



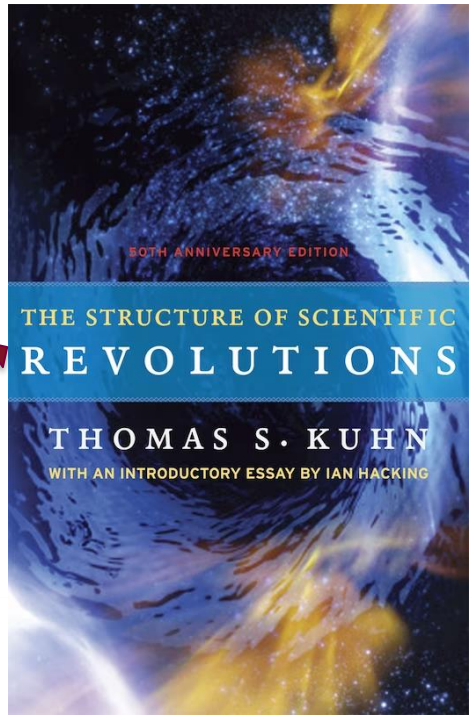
McMaster University

Citations of: **Kessler (1963) "*Bibliographic coupling between scientific papers*"**

This is a *Sleeping Beauty* pattern!



"Paradigm Shift"



What causes a Sleeping Beauty?

1. Ideas ahead of their time: the field is just not ready.
2. Technological limitations. Nice idea, but no way to test it.
3. Jumps from “home field” (where it was ignored) to a new area (gains traction).
4. Referenced in a top journal, gains wider visibility.

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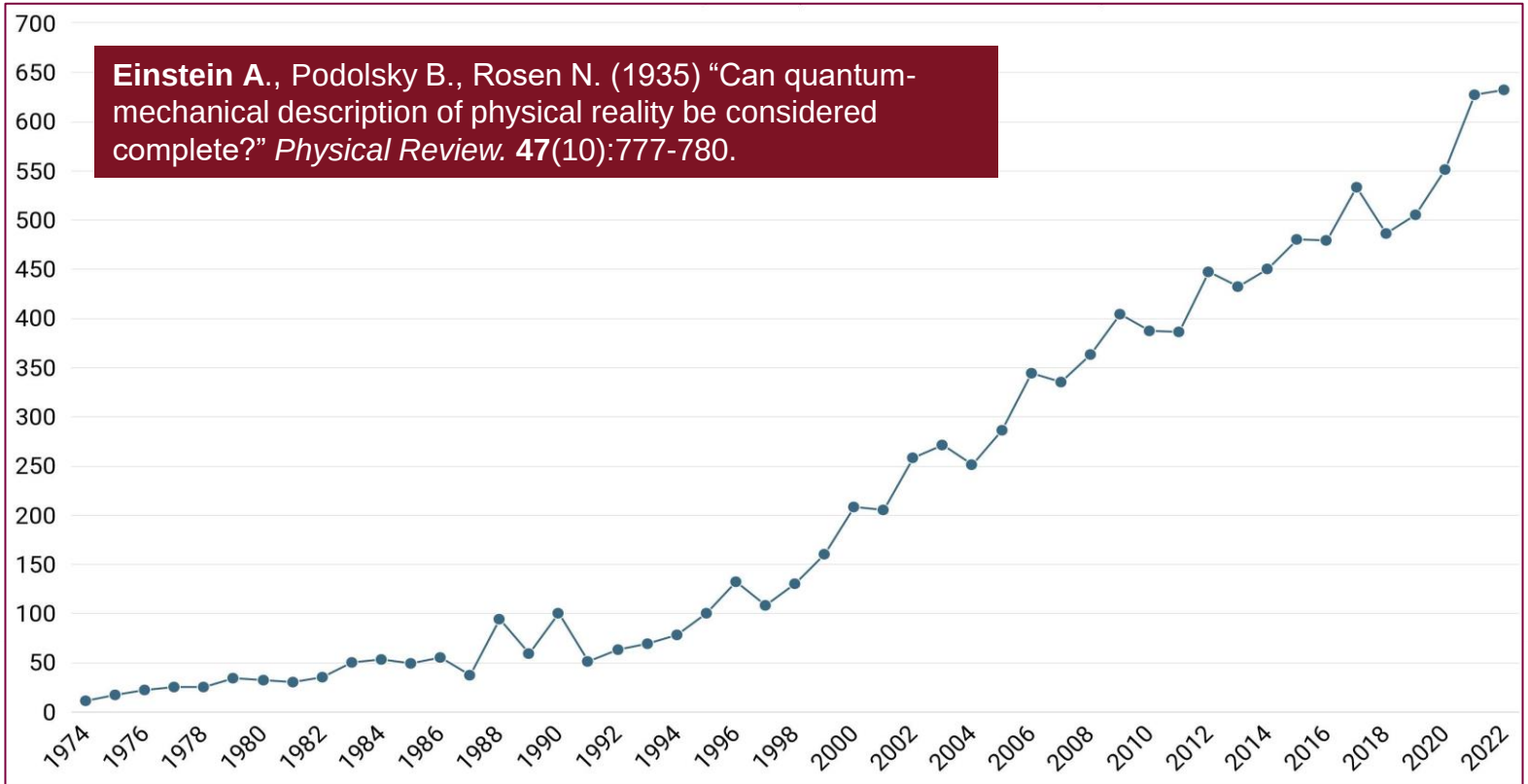


Quantifying the Sleeping Beauty effect

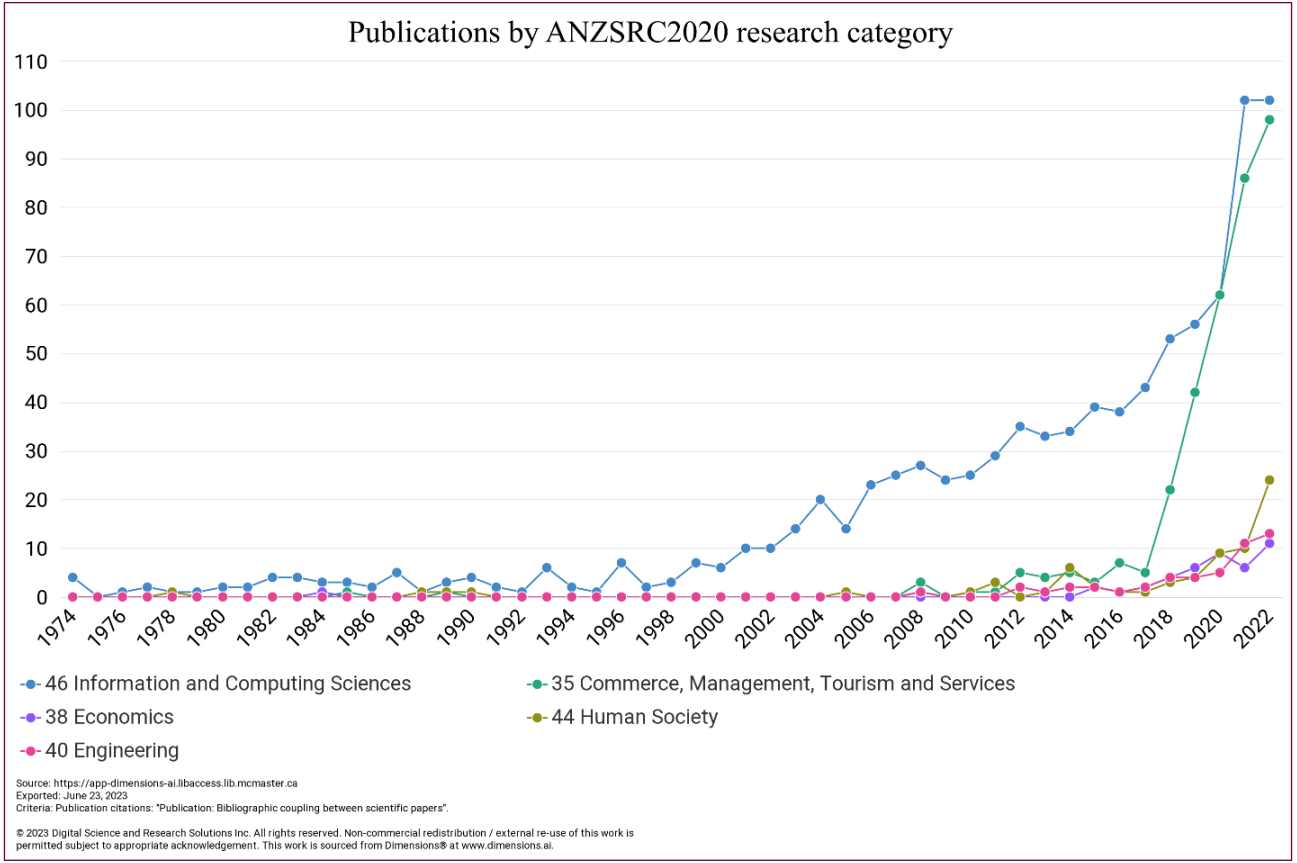
- How "***surprising***" is the increase in citations?
- **Beauty Coefficient:**

$$B = \sum_{t=0}^{t_m} \frac{\frac{c_{t_m} - c_0}{t_m} \cdot t + c_0 - c_t}{\max\{1, c_t\}}$$

- Einstein, Podolsky, Rosen (1935): $B = 2{,}333$
- Kessler (1963): $B = 1{,}474$

Ke, Q. *et al.* (2015) "Defining and identifying Sleeping Beauties in science.", *Proceedings of the National Academy of Sciences of the United States of America*, **112**(24), pp. 7426–31. https://doi.org/10.1073/pnas.1424329112.

Research Areas citing Kessler



McMaster University

HistCite

- Developed by ***Eugene Garfield***
  - "Vintage" software
  - No longer supported
- Use **CitNetExplorer** instead!
  - **www.citnetexplorer.nl**

Methodology:

- Download 829 records from WoS
  - Plus *Merigo (2015)*
- Top 25 Locally cited
  - 2015 forwards
- Top 25 local references
  - 2023 backwards

http://127.0.0.1:1925/ - HistCite - HistCite export file_Historiograph 50.hci - Internet Explorer

File Analyses View Tools Help HistCite™

Untitled Collection

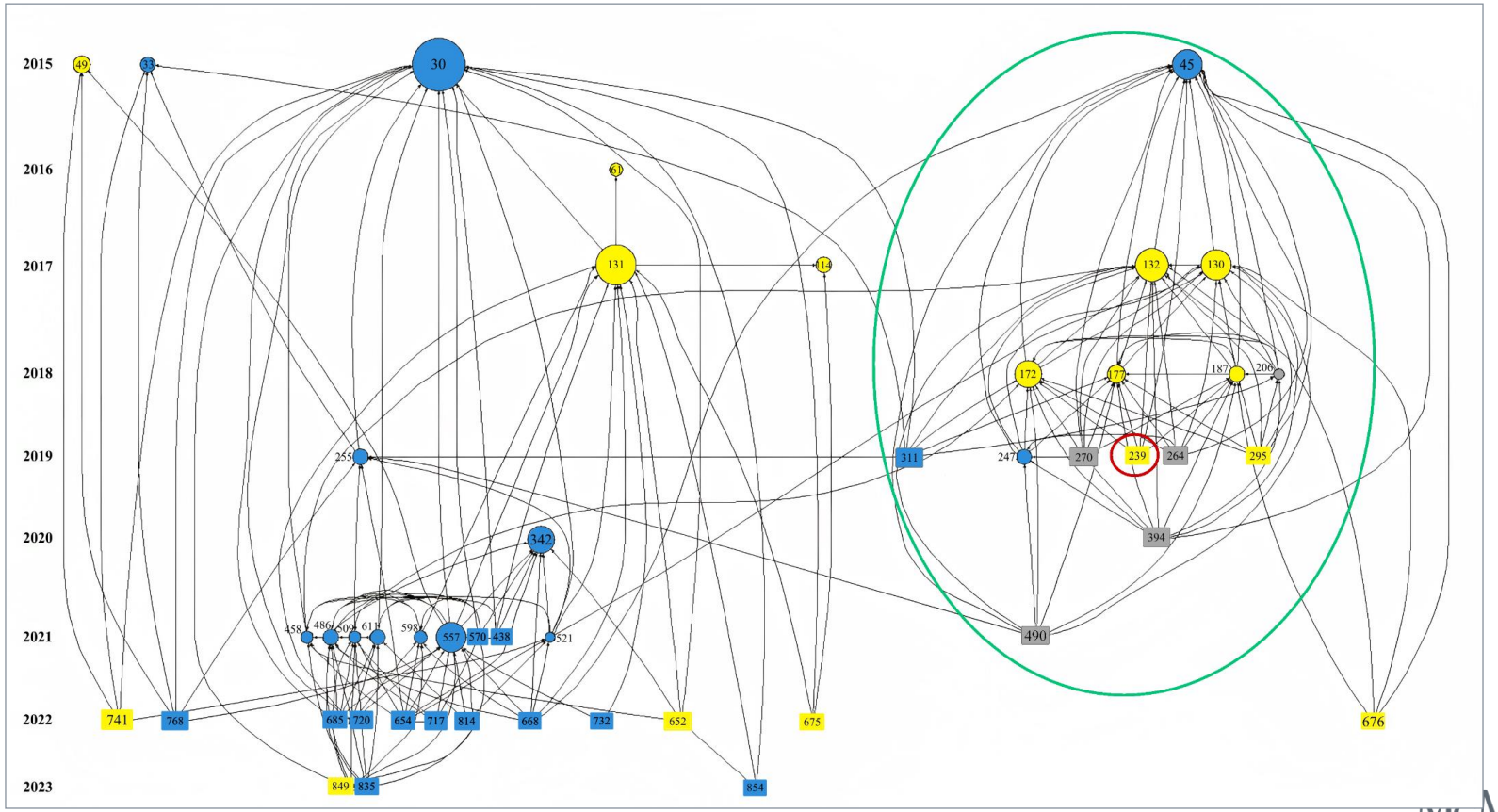
List of All Records

Grand Totals: LCS 188, GCS 8195, CR 3846
Collection span: 2015 - 2023

Records: 50, Authors: 124, Journals: 41, Cited References: 2683, Words: 186
Yearly output | Document Type | Language | Institution | Institution with Subdivision | Country

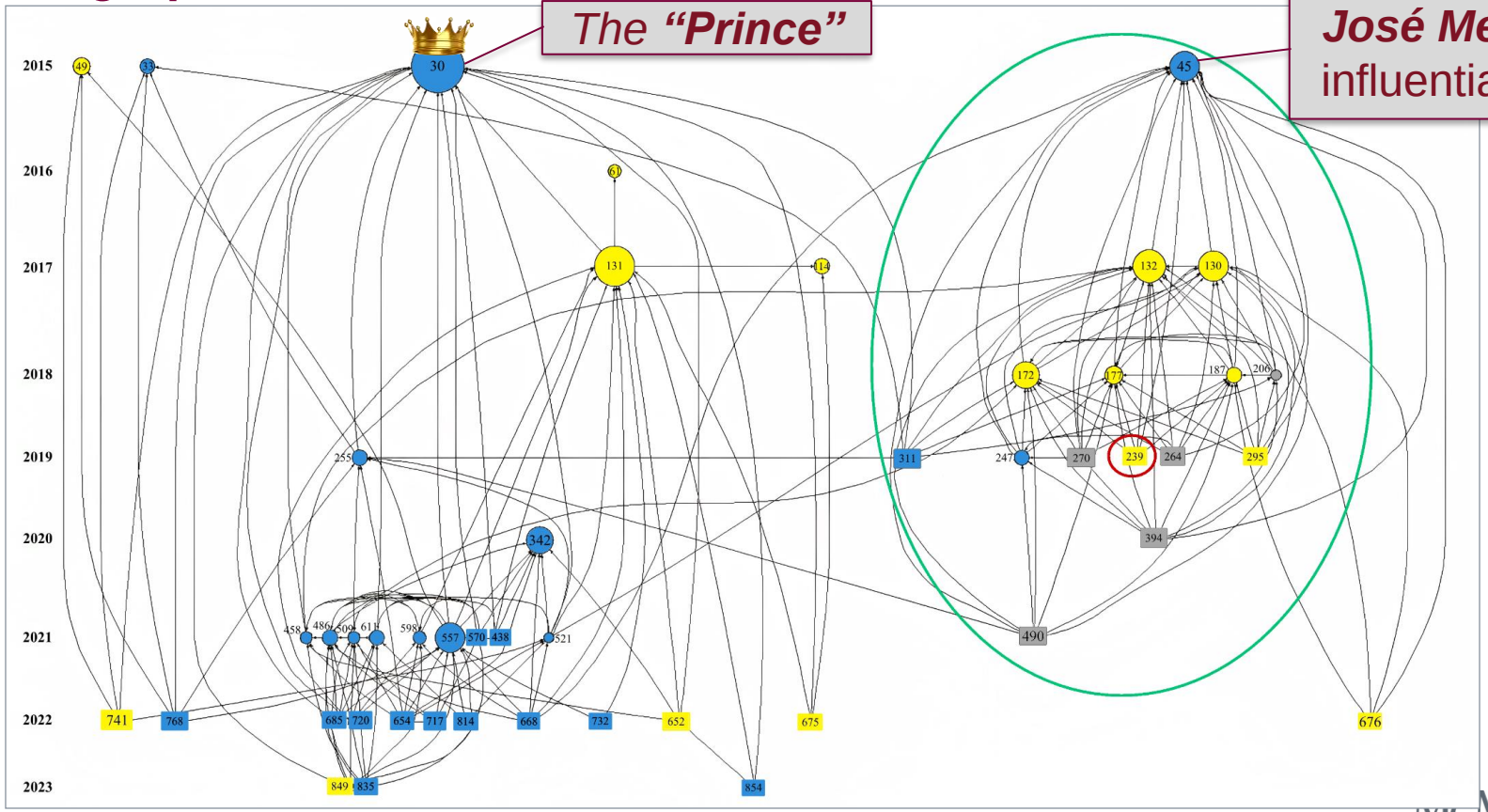
#	Date / Author / Journal	LCS	GCS	LCR	CR
	2015				
1	1 Huang MH, Chang CP **A comparative study on detecting research fronts in the organic light-emitting diode (OLED) field using bibliographic coupling and co-citation** SCIENTOMETRICS. 2015 MAR; 102 (3): 2041-2057	0	26	0	63
2	2 Zupic I, Cater T **Bibliometric Methods in Management and Organization** ORGANIZATIONAL RESEARCH METHODS. 2015 JUL; 18 (3): 429-472	17	1671	0	142
3	3 Yuan YL, Gretzel U, Tseng YH **Revealing the Nature of Contemporary Tourism Research: Extracting Common Subject Areas through Bibliographic Coupling** INTERNATIONAL JOURNAL OF TOURISM RESEARCH. 2015 SEP-OCT; 17 (5): 417-431	4	46	0	60
4	4 Merigo JM, Mas-Tur A, Roig-Tierno N, Ribeiro-Soriano D **A bibliometric overview of the Journal of Business Research between 1973 and 2014** JOURNAL OF BUSINESS RESEARCH. 2015 DEC; 68 (12): 2645-2653	15	260	0	29
5	5 Chang YW, Huang MH, Lin CW **Evolution of research subjects in library and information science based on keyword, bibliographical coupling, and co-citation analyses** SCIENTOMETRICS. 2015 DEC; 105 (3): 2071-2087	3	140	0	31
	2016				
6	6 Yang SL, Han RZ, Wolfram D, Zhao YH **Visualizing the intellectual structure of information science (2006-2015): Introducing author keyword coupling analysis** JOURNAL OF INFORMETRICS. 2016 FEB; 10 (1): 132-150	1	58	0	43
	2017				

Historiograph



Yellow = Information & Computing Science (the "Home Field" of BC)
Blue = Commerce, Marketing, Tourism & Services

Historiograph



Yellow = Information & Computing Science (the "Home Field" of BC)
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McMaster University

Prince article

Zupic, Ivan; **Cater**, Tomaz. (2015) "Bibliometric Methods in Management and Organization." *Organizational Research Methods*. **18**(3):429-472.

Times Cited (WoS) = 1,729

Ivan Zupic [*University of Ljubljana → Kingston University (Yorkshire)*]

- 6 other publications, 65 citations

Tomaz Cater [*University of Ljubljana*]

- 26 other publications, 484 citations

Also: **José Merigo** [*University of Chile & many more…*] ORCID = 0000-0002-4672-6961

- Highly Cited Researcher: 2015, 2016, 2020, 2022
- 186 publications, **6,151 citations**

Macro + micro patterns tell a story

- The ***Sleeping Beauty*** pattern acts as a **seismograph**
  - Indicates a ***paradigm shift*** has occurred
  - Easy to operationalize with WoS + Excel.
  - Scan thousands of records to listen for “seismic activity” in science.

- ***Historiograph*** technique acts as a **microscope**
  - Allows detailed analysis of citation patterns.
  - Easily visualized with **CitNetExplorer** [`www.citnetexplorer.nl`].

Happily Ever After…

Awakened in 2015 by ***Zupic & Cater***, interest in Bibliographic Coupling has jumped from its home field of Information Science and is now used in studies of Commerce & Marketing research.

Dataset available: www.doi.org/10.6084/m9.figshare.24073896

Article forthcoming in **Quantitative Science Studies**

Bibliography – *significant articles about Bibliographic Coupling*

- **Kessler, M.M.** (1963a) Bibliographic coupling between scientific papers. American Documentation, 24, 123–131.
- **Kessler, M.M**. (1963b) An experimental study of bibliographic coupling between technical papers. IEEE Transactions on Information Theory, 9, 49–51.
- **Sen, S.K.**, Gan, S.K. (1983) A mathematical extension of the idea of bibliographic coupling and its applications. *Annals of Library Science and Documentation*. **30**(2), 78-82.
- **Boyack, K.W.** and Klavans, R. (2010) Co-citation analysis, bibliographic coupling, and direct citation: which citation approach represents the research front most accurately? Journal of the American Society for Information Science and Technology, 61, 2389–2404.
- **Shen, S.**, Zhu, D., Rousseau, R., Su, X., & Wang, D. (2019). A refined method for computing bibliographic coupling strengths. *Journal of Informetrics*, *13*(2), 605–615. https://doi.org/10.1016/J.JOI.2019.01.012

Bibliography – *significant articles about Sleeping Beauties*

- **van Raan, A.F.J.** (2004) “Sleeping Beauties in science”, *Scientometrics*, **59**(3), pp. 467–472. Available at: https://doi.org/10.1023/B:SCIE.0000018543.82441.f1.
- **van Raan, A.F.J.** (2015) “Dormitory of Physical and Engineering Sciences: Sleeping Beauties May Be Sleeping Innovations.”, *PloS one*, **10**(10), p. e0139786. Available at: https://doi.org/10.1371/journal.pone.0139786.
- **Ke, Qing**; Ferrara, Emilio; Radicchi, Filippo; Flammini, Alessandro (2015) “Defining and identifying Sleeping Beauties in science”, **112**(24): 7426-7431. https://doi.org/10.1371/journal.pone.0139786
- **Demaine, J.** (2018) “Rediscovering Forgotten Research: Sleeping Beauties at the University of Waterloo”, *Journal of Information Science Theory and Practice*, **6**(3), pp. 37–44. Available at: https://doi.org/https://doi.org/10.1633/JISTaP.2018.6.3.4.

Canadian Bibliometrics Conference

- 2024 → **June 4th, 5th, 6th**
- Simon Fraser University
- Boutique event (~80 attendees)
- Vancouver, British Columbia

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