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What should a researcher first read? A Bi-relational citation networks model for strategical heuristic reading and scientific discovery

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The problem: Abundance, Relevance and Time

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Scientists look forward to discovering the emergent knowledge or Research Front

Documents cited more frequently
(Shibata et al., 2009; Upham & Small, 2010)

Scientists tend to mention the most recent documents to gather the more updated knowledge:
Immediacy factor (Price, 1965).

BACKWARDS

Relevance vs Time

Abundance

What to read?

How to order the Reading?

The number of scientific documents doubles every 1.8 years
(Kleinberg, 1999; Wang, Song, & Barabási, 2013)

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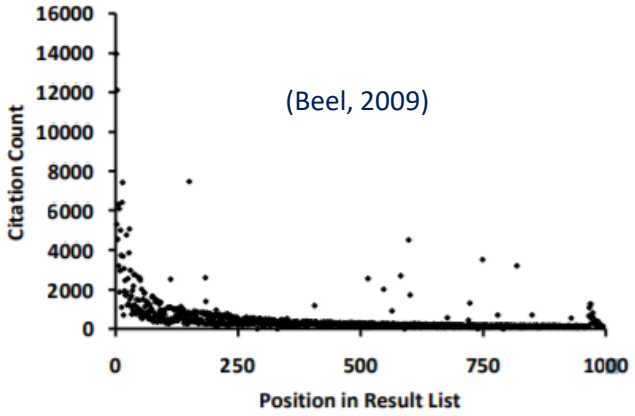
State of the art

1

Google Scholar

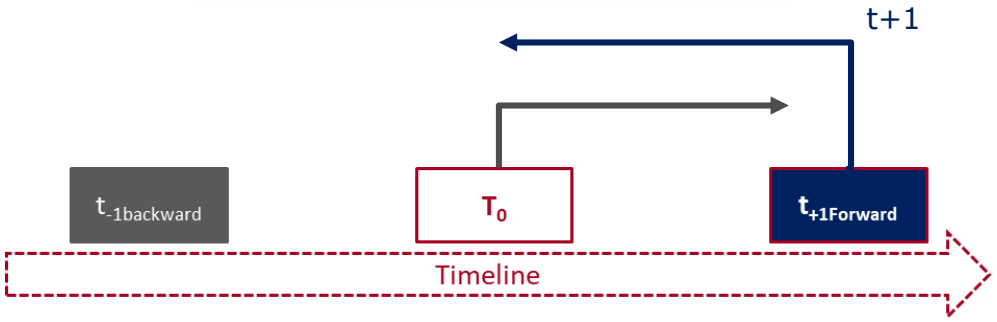
Citation based ranking

Delayed front



(Beel, 2009)

BACKWARDS



Global production networks, **knowledge diffusion**, and local capability formation
D Ernst, L Kim - Research policy, 2002 - Elsevier
This paper develops a conceptual framework that explores the linkage between the evolution of global production networks (GPN), the role of network flagships in transferring **knowledge**, and the formation of capabilities by local suppliers. GPN are a major innovation …
☆ Citado por 1291 Artículos relacionados Las 8 versiones

Collaborative networks as determinants of **knowledge diffusion** patterns
J Singh - Management science, 2005 - pubsonline.informs.org
This paper examines whether interpersonal networks help explain two widely documented patterns of **knowledge diffusion**:(1) geographic localization of **knowledge** flows, and (2) concentration of **knowledge** flows within firm boundaries. I measure **knowledge** flows using …
☆ Citado por 1049 Artículos relacionados Las 18 versiones

Difficulties in **diffusion** of tacit **knowledge** in organizations
T Haldin-Herrgard - Journal of Intellectual capital, 2000 - emeraldinsight.com
To manage intangible assets such as **knowledge** is perceived as an important capability for competition. One of the main matters for managing **knowledge** resources is **diffusion** of **knowledge** within organizations. **Knowledge** management needs different forms according …
☆ Citado por 678 Artículos relacionados Las 4 versiones

Knowledge diffusion through "strategic communities"
J Storck, PA Hill - **Knowledge** and communities, 2000 - Elsevier
Even though "strategic communities" are formed to meet short term operational needs, they provide long term value to their organizations through learning, innovation, and **knowledge** transfer. While similar to communities of practice, strategic communities differ in two …
☆ Citado por 483 Artículos relacionados Las 7 versiones

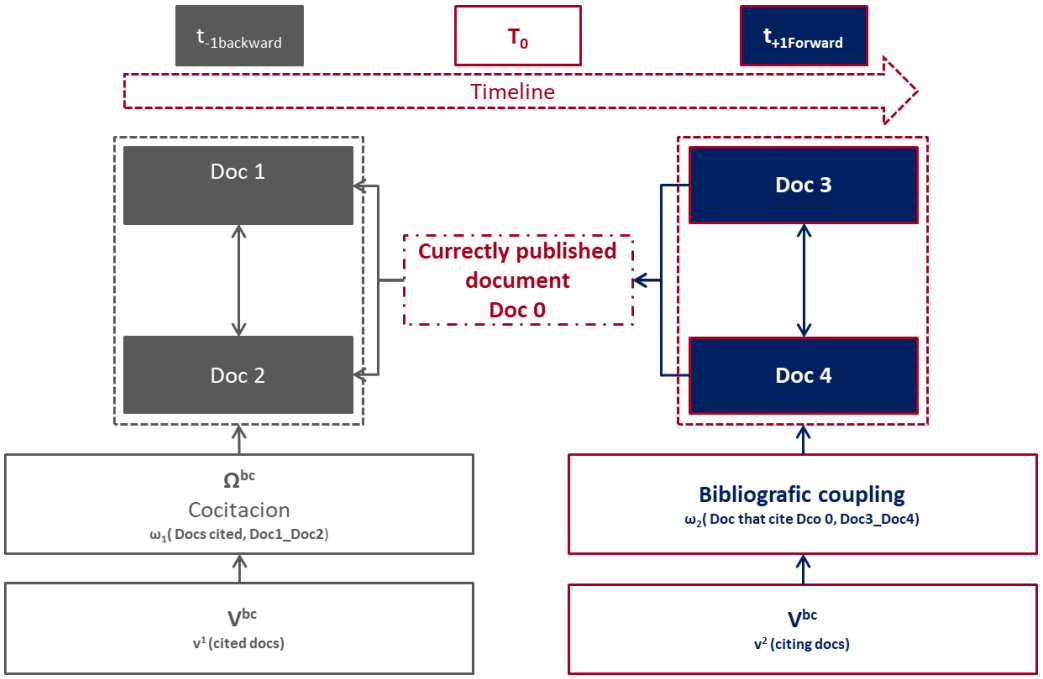
[HTML] The missing link: **knowledge diffusion** and entrepreneurship in endogenous growth
P Braunerhjelm, ZJ Acs, DB Audretsch… - Small Business …, 2010 - Springer
The intellectual breakthrough contributed by the new growth theory was the recognition that investments in **knowledge** and human capital endogenously generate economic growth

State of the art

2

- Cocitation networks (Henry Small, 1973)
- Bibliografic coupling (Kessler,1963)
- Both (Boyack & Klavans, 2014)

Time delay



BACKWARDS

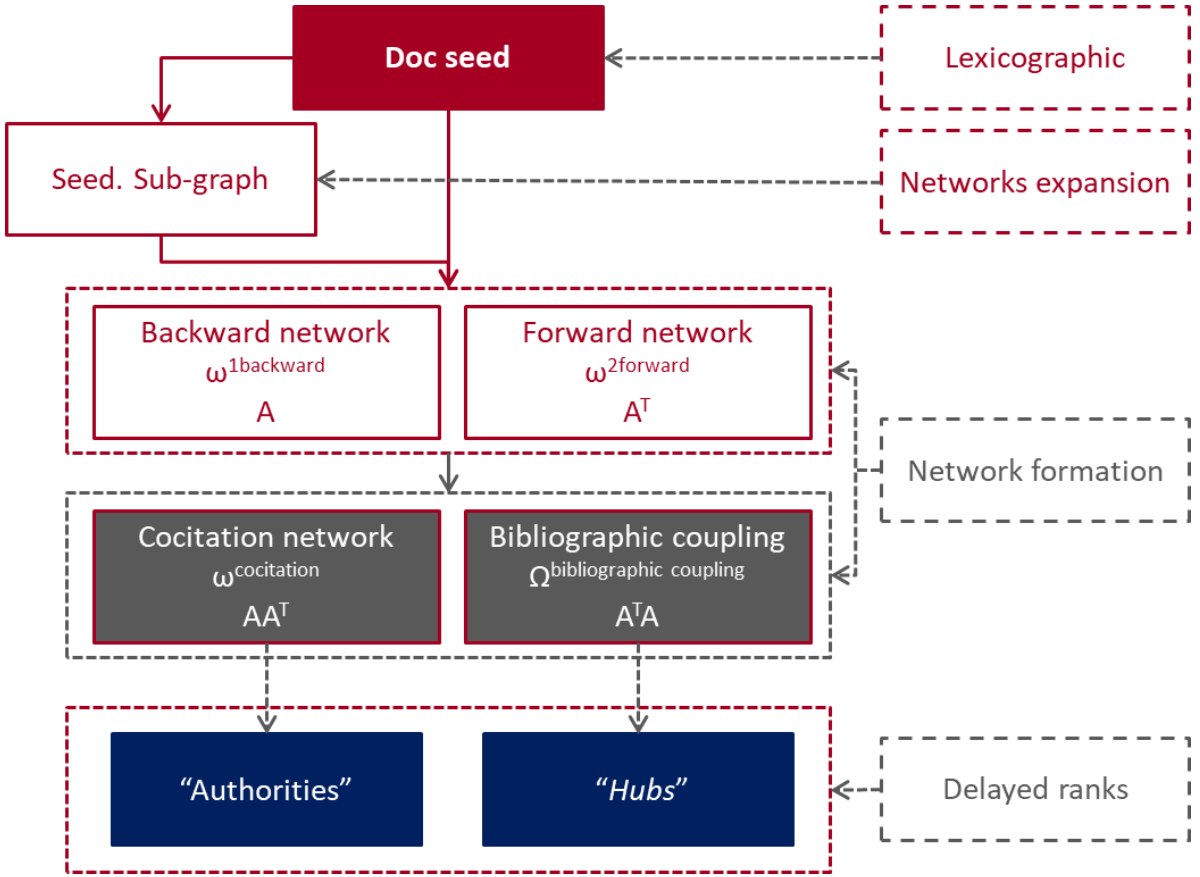
- Symmetrized networks
- Prestige based ranks
- Delayed Fronts

State of the art

3

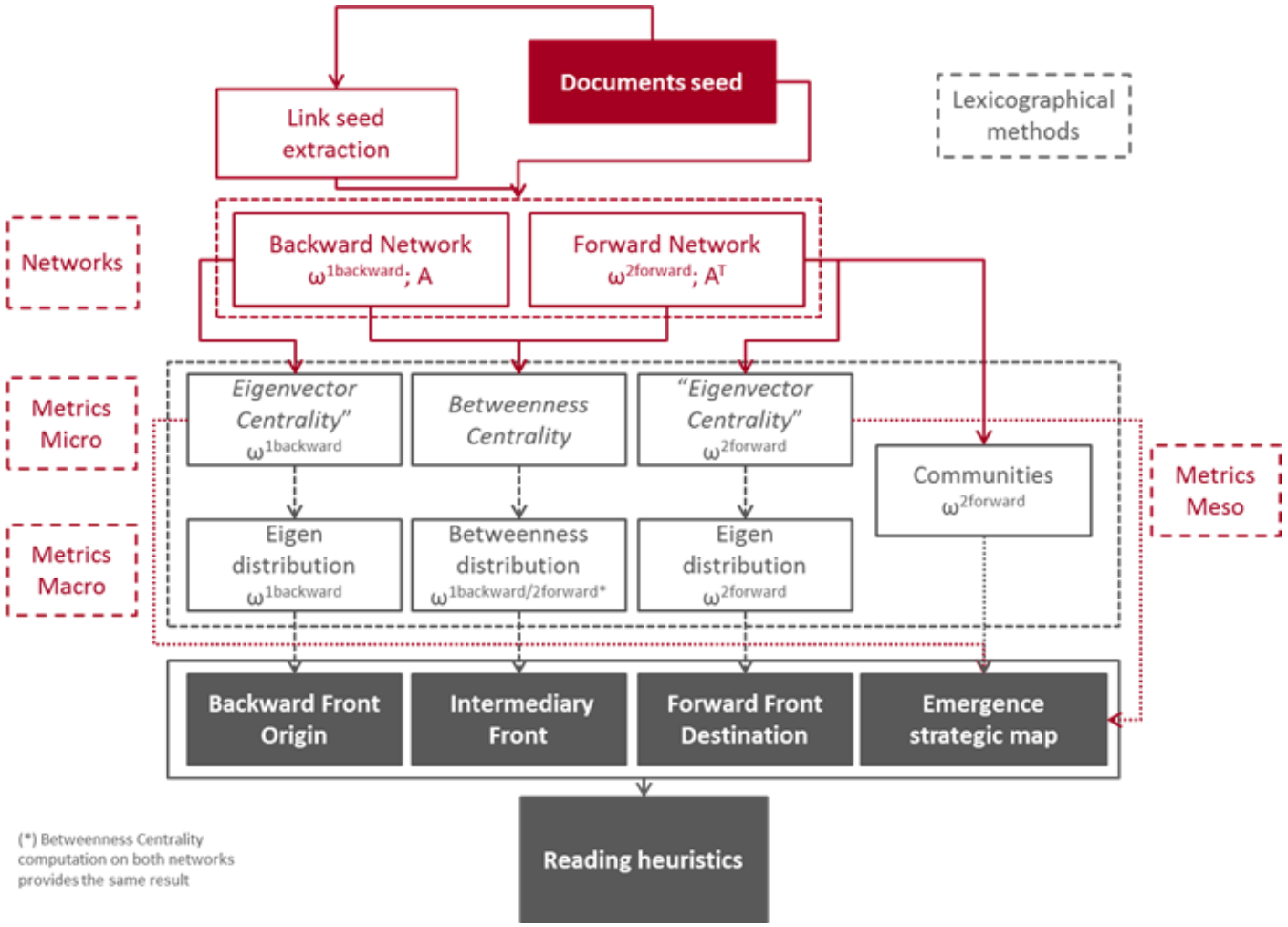
Modelo de Kleinberg (J. Kleinberg, 1999)

Two delayed fronts



- 2 symmetrized networks
- Two Prestige based ranks
- Two delayed Fronts

Our model: (2)Bi-relational networks, (3) levels, (3) Fronts

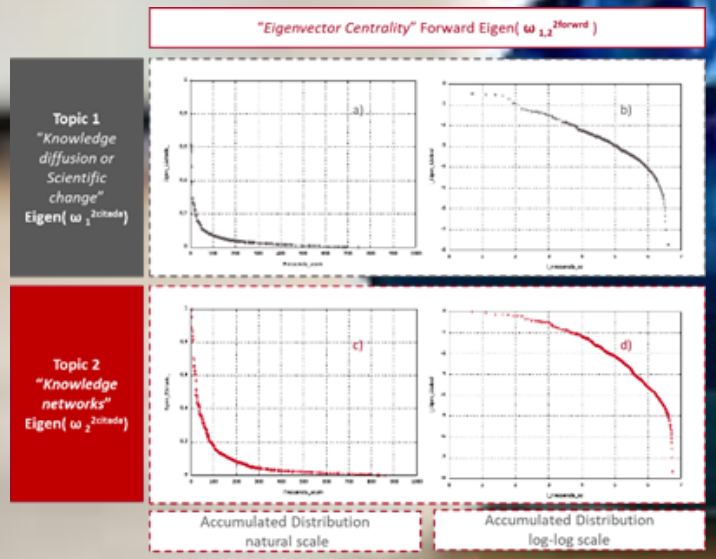


- 2 directed networks
- 3 Prestige based ranks
- 3 levels of analisys combined
- **Backward front: Origin**
  Intermediary front The broker
  Forward front : Destination

1est Innovation: Forward Front based on the whole structure

Eigenvector Centrality is an energy diffusion vector in a steady state of energy, representing a ranking of documents where the knowledge (the diffused element) of the network is deposited (Rodriguez & Shinavier, 2010)

- Take advantage of the acyclical feature
- Abundance reduction
- Prestige based using the whole structure of the forward network
- Forward current front



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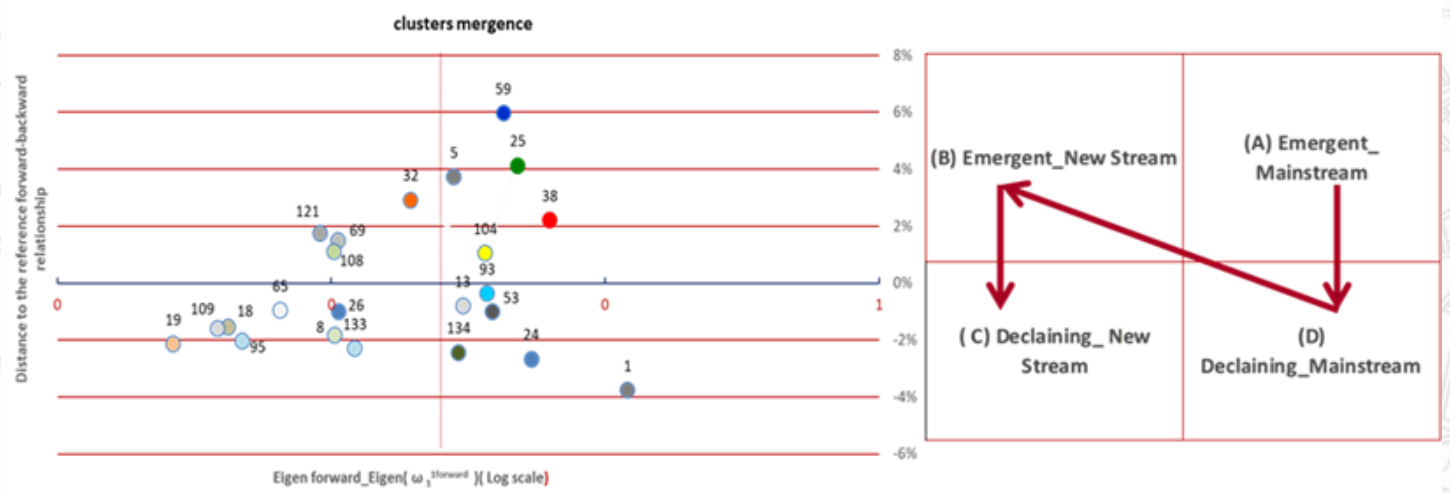
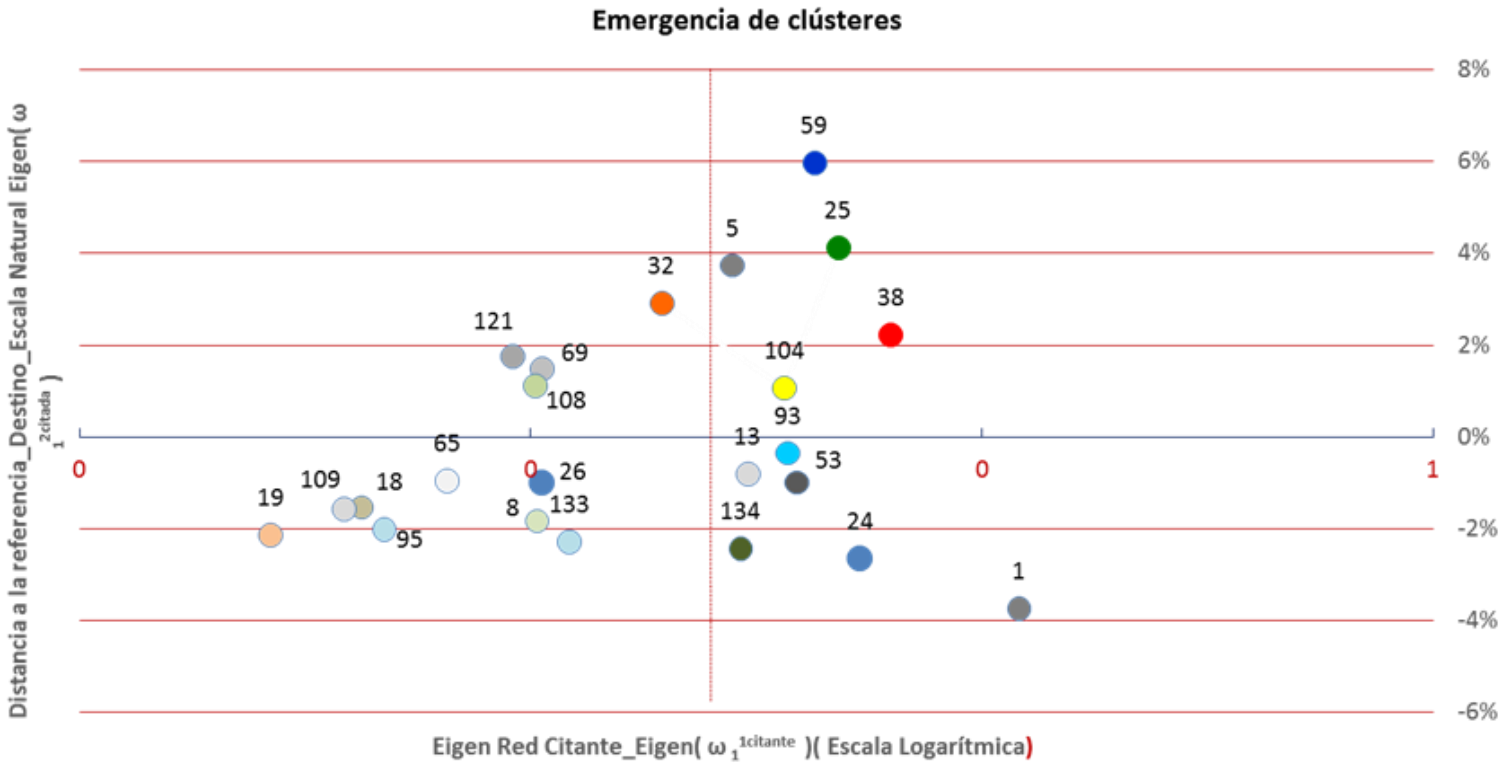
2nd Innovation Strategical Reading recommendation map



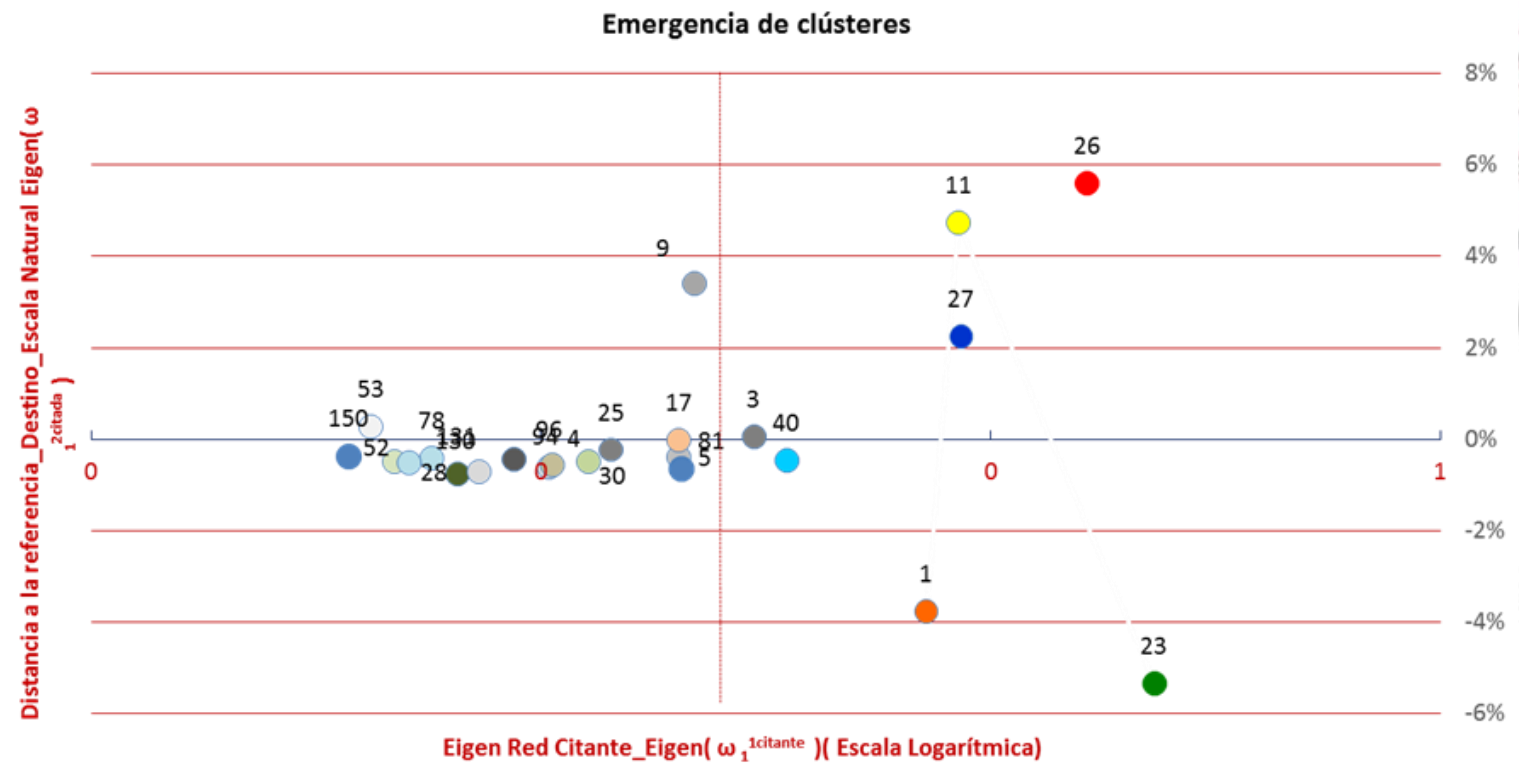
Topic	Seed	Expanded network	Reduction			
			Clustering	Eigen($\omega_{1,2}^{2forward}$)	Betw($\omega_{1,2}^{2forward}$) (*)	Suggested documents to read
Knowledge diffusion or scientific change	721	22986	11,778	87	20	**107**
Knowledge networks	884	31925	9,184	72	15	**87**

- Relates forward and backward undestanding current relevence
- Classifies Communities
- Provides 3 levels of reduction
- Gives a Reading recommended group and inside each 3 document level lists

Example: knowledge diffusion



Example: knowledge networks



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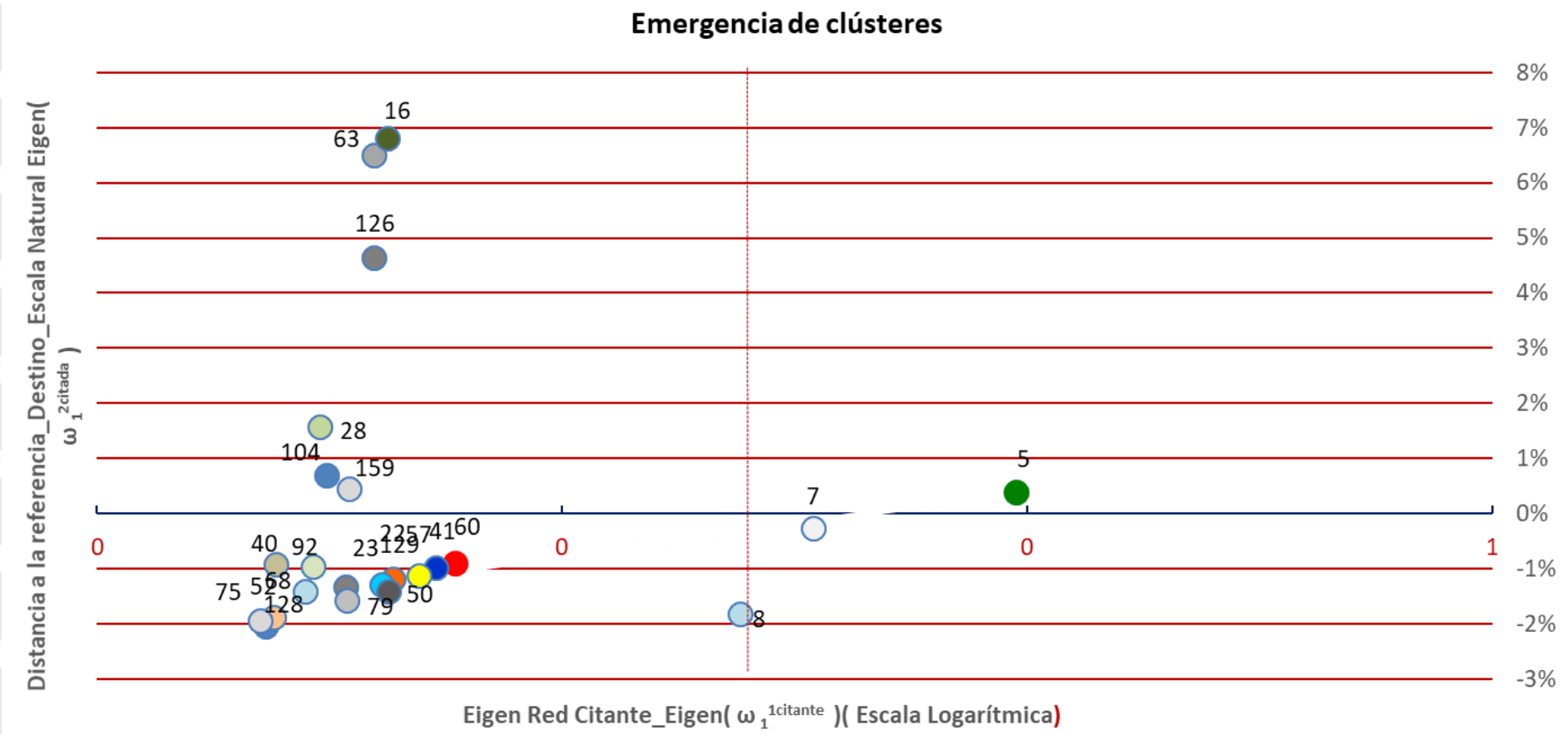
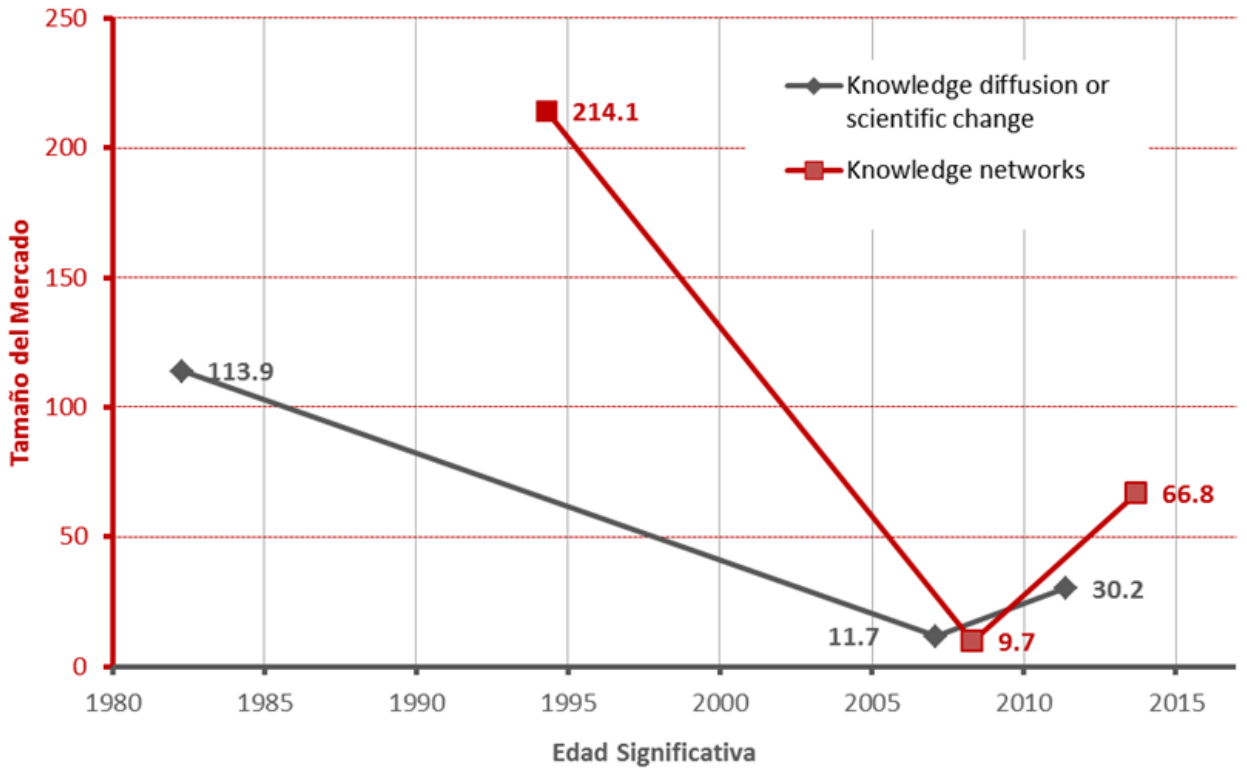
Example: OBD (On Board Diagnostics)



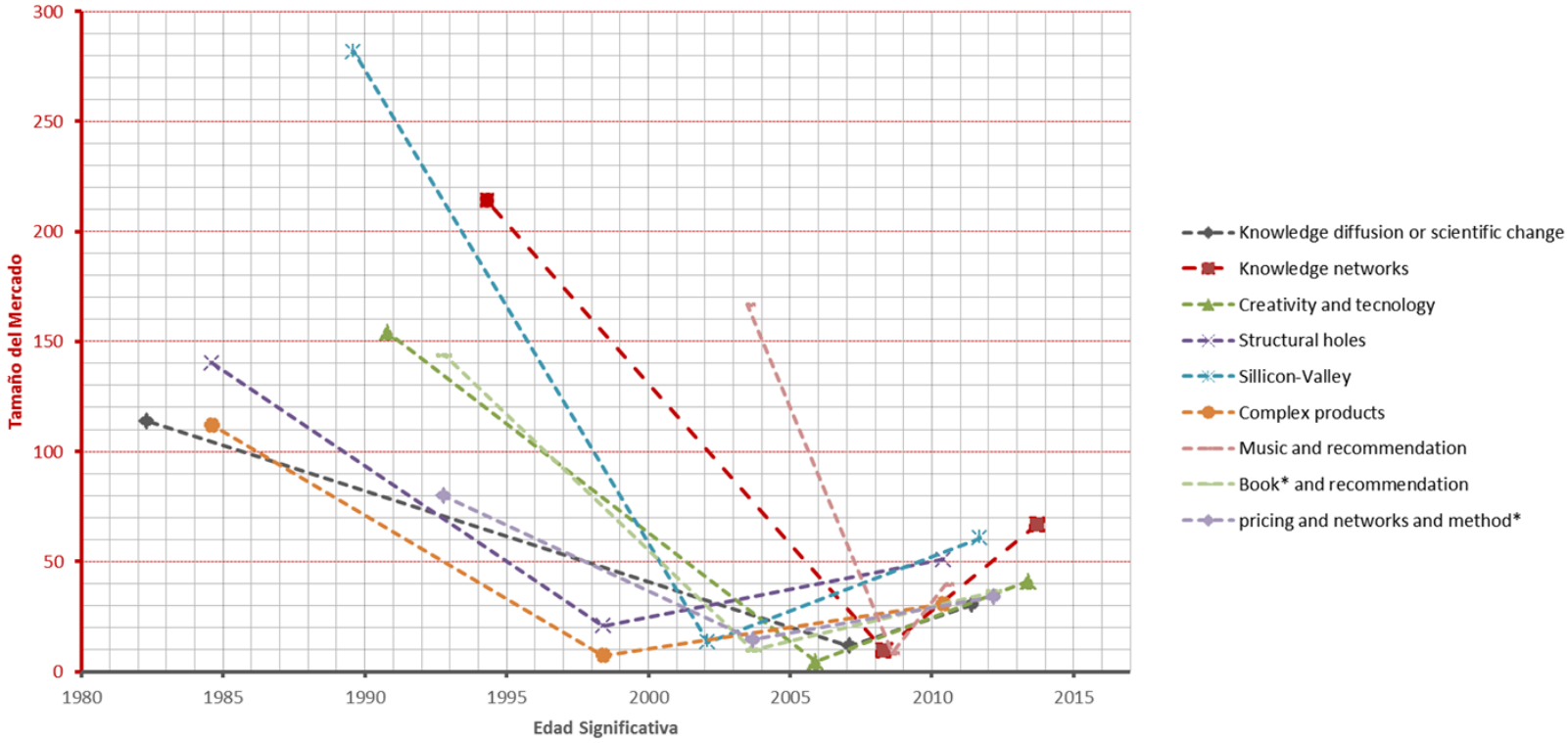
3nd Innovation: Asymmetric bow tie: 3 Fronts



- **Backward front: Origin**
  Intermediary front
  The broker
  Forward front : Destination
- **Size of the Forward Front shorter than the Backward Front**
- **The Intermediary Front is very small**

3nd Innovation: Asymmetric bow tie: 3 Fronts

	Tema de búsqueda	Frente Destino	Frente Intermediario	Frente Origen
1	Knowledge diffusion or scientific change	30.2	11.7	113.9
2	Knowledge networks	66.8	9.7	214.1
3	Creativity and tecnology	40.9	4.5	154.2
4	Structural holes	50.8	20.7	140.3
5	Silicon-Valley	60.7	13.3	281.7
6	Complex products	30.8	7.2	112.1
8	Music and recommendation	39.6	8.3	166.8
8	Book* and recommendation	36.4	9.7	143.8
9	Pricing and networks and method*	33.9	14.5	79.7
	Máximo	**66.8**	**20.7**	**281.7**
	Mínimo	**30.2**	**4.5**	**79.7**
	Media	**43.3**	**11.1**	**156.3**



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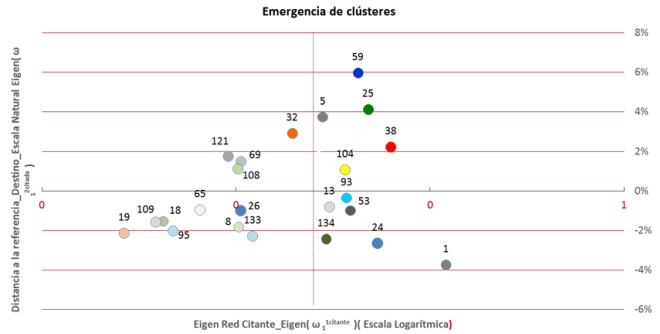
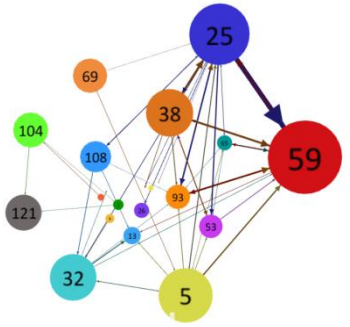
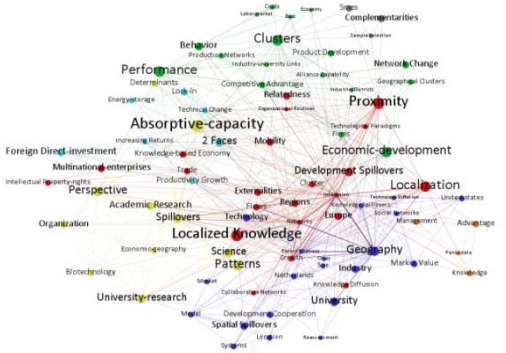
Reading dashboard

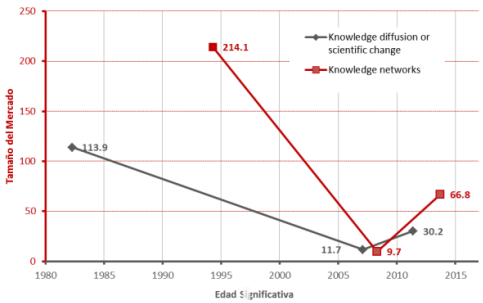
MESO LEVEL







MACRO LEVEL



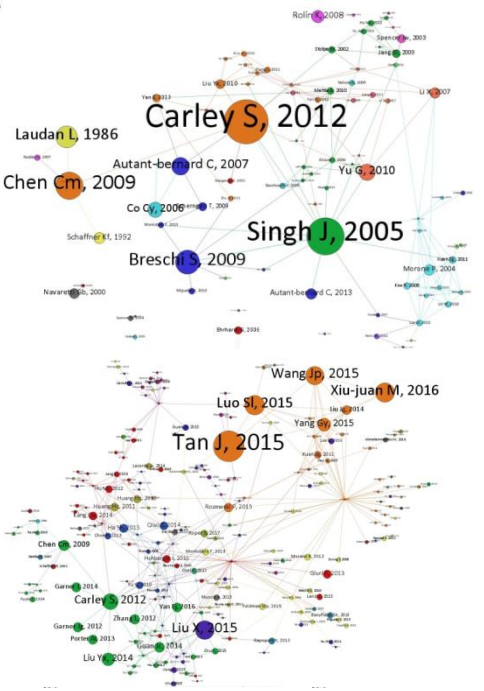
Tema de búsqueda	Semilla	Red Expandida	Reducción			Total documentos a leer
			Clusterización	Eigen($\omega_{1,2}^{2citada}$)	Betw($\omega_{1,2}^{2citada}$) (*)	
Knowledge diffusion or scientific change	721	22986	11.778	87	20	107

MICRO LEVEL
INTERMEDIARY

Id	Label	Betweenness Centrality	Comunidad
5,830	Carley S, 2012, Scientometrics, V90, P407, Doi 10.1007/s11192-011-0528-1	1	32
905	Singh J, 2005, Manage Sci, V51, P756, Doi 10.1287/mnsc.1040.0349	0.833761283	25
6,940	Aregbeshola Ar, 2014, S Afr J Econ Manag S, V17, P557	0.710551691	74
10,490	Chen Cm, 2009, J Informetr, V3, P191, Doi 10.1016/j.joi.2009.03.004	0.595545085	32
13	Breschi S, 2009, J Econ Geogr, V9, P439, Doi 10.1093/jeg/lbp008	0.519006211	59
571	Laudan L, 1986, Synthese, V69, P141, Doi 10.1007/bf00413981	0.457485543	104
918	Autant-bernard C, 2007, Pap Reg Sci, V86, P341, Doi 10.1111/j.1435-5957.2007.00134.x	0.368558578	59
9,217	Yu G, 2010, Scientometrics, V84, P81, Doi 10.1007/s11192-009-0090-2	0.331270079	108
15,968	Co Cy, 2006, Pap Reg Sci, V85, P47, Doi 10.1111/j.1435-5957.2006.00027.x	0.301734847	93
125	Rolin K, 2008, Cogn Syst Res, V9, P115, Doi 10.1016/j.cogsys.2007.07.007	0.244454915	1
13,520	Schaffner Kf, 1992, Theor Med, V13, P175, Doi 10.1007/bf02163627	0.210751767	134
488	Autant-bernard C, 2013, Res Policy, V42, P196, Doi 10.1016/j.respol.2012.07.009	0.201458862	59
2,682	Li X, 2007, J Nanopart Res, V9, P337, Doi 10.1007/s11051-006-9194-2	0.195159563	108
4,549	Morone P, 2004, J Evol Econ, V14, P327, Doi 10.1007/s00191-004-0211-2	0.191998917	5
11,484	Navaretti Gb, 2000, World Bank Econ Rev, V14, P1	0.18375241	53
291	Canello J, 2016, Res Policy, V45, P1953, Doi 10.1016/j.respol.2016.05.006	0.16633112	24
7,981	Zhang Q, 2013, Sci Rep-uk, V3, Doi 10.1038/srep01640	0.160376954	108
2,591	Liu Yx, 2010, J Am Soc Inf Sci Tec, V61, P340, Doi 10.1002/asi.21248	0.154465624	32
8,470	Perrin Ce, 1987, Hist Sci, V25, P395	0.14709788	104

FORWARD FRONT

Id	Label	Eigen($\omega_{3}^{2citada}$)	Comunidad
4,960	Tan J, 2015, Chem Engineer Trans, V46, P529, Doi 10.3303/cet1546089	1	5
4,014	Luo Sl, 2015, Expert Syst Appl, V42, P3619, Doi 10.1016/j.eswa.2014.12.038	0.618162813	5
1,417	Xiu-juan M, 2016, Acta Phys Sin-ch Ed, V65, Doi 10.7498/aps.65.088901	0.60682025	5
2,621	Liu X, 2015, Scientometrics, V105, P1953, Doi 10.1007/s11192-015-1761-9	0.58883174	13
1,379	Wang Jp, 2015, Physica A, V428, P250, Doi 10.1016/j.physa.2015.01.062	0.574809277	5
5,830	Carley S, 2012, Scientometrics, V90, P407, Doi 10.1007/s11192-011-0528-1	0.484688415	32
1,403	Yang Gy, 2015, Physica A, V419, P429, Doi 10.1016/j.physa.2014.10.012	0.392870212	5
6,626	Liu Yx, 2014, J Assoc Inf Sci Tech, V65, P281, Doi 10.1002/asi.22978	0.382000376	32
10,490	Chen Cm, 2009, J Informetr, V3, P191, Doi 10.1016/j.joi.2009.03.004	0.29867923	32
2,579	Guan Jc, 2014, Scientometrics, V98, P2129, Doi 10.1007/s11192-013-1134-1	0.291325493	32
9,220	Zhang L, 2012, Malays J Libr Inf Sc, V17, P67	0.274917221	32
9,753	Garner Jg, 2012, Res Evaluat, V21, P89, Doi 10.1093/reseval/rvs004	0.267639419	32
5,845	Garner J, 2014, Scientometrics, V100, P687, Doi 10.1007/s11192-014-1316-5	0.264984256	32
9,101	Porter Al, 2013, Pro Int Conf Sci Inf, P1188	0.262771621	32
945	Yan Ej, 2016, J Assoc Inf Sci Tech, V67, P1943, Doi 10.1002/asi.23516	0.256670021	32
1,410	Liu Jg, 2014, Plos One, V9, Doi 10.1371/journal.pone.0089746	0.255942998	5
5,092	Rozewski P, 2015, Math Probl Eng, Doi 10.1155/2015/529256	0.244767578	5
2,749	Ha Sh, 2015, Technol Forecast Soc, V100, P277, Doi 10.1016/j.techfore.2015.07.016	0.234120439	108



Future improvements and limitations

1. Iterative seed definition
2. Semantic link definition and weighting
3. Other relationship applications: merging and overlapping concepts
4. Database consolidation
5. Open use tool
6. Massive verification
7. Other acyclic networks scenarios application

GRACIAS!