SCIENTIFIC INDICATORS ON LITERATURE IN BIBLIOMETRY AND SCIENTOMETRY THROUGH SOCIAL NETWORKS

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ABSTRACT

This work explores Social Networks map generation in the area of the Metric Studies, Bibliometry and Scientometry. This kind of map show (i) index of co-authors by area ISI, (ii) comparative of the documentary typology of registries source by citation, (iii) which authors have made the biggest scientific contribution, (iv) authors which have the biggest citation, (v) the documents more mentioned and (vi) the more relevant magazines related to the information consumption. The evaluation had been modeled by centrality and frequency, inquired amongst 635 registers rescued on the thematic. The main registers source has been the packages of the *Institute for Scientific Information* (*Science Citation Index, Social Science Citation Index and Arts & Humanities*), and the studied period goes from 1975 to 2005. To realize the data treatment we used *CiteSpace* application, which has given the relation maps, a methodology of documentary control, developed by Efrain-García.

Keywords: Social Networks; Bibliometry and Scientometry; Information Consumers; Metrics Studies.
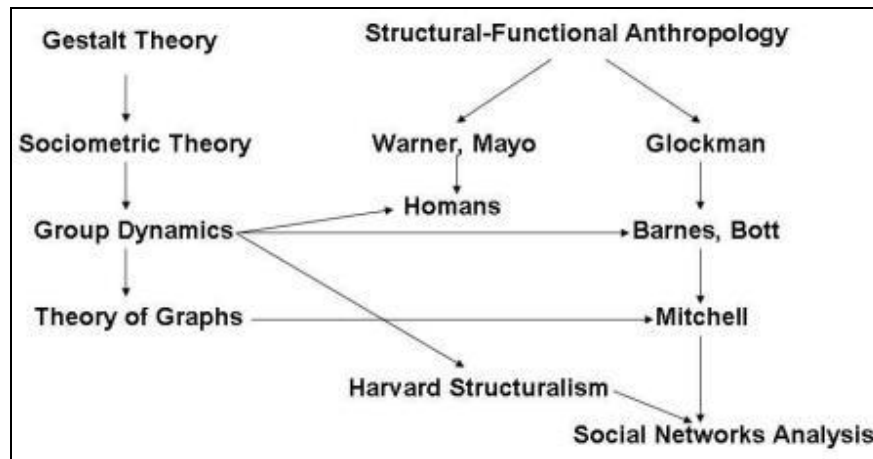
1 THE SOCIAL NETWORK AND ITS ASPECTS

A social network represents the interactions between participants who connect horizontally, directly or through those around them. The group resulting from this relationship is a fabric of multiple threads that may spread out indefinitely on all sides, without any one being considered principal or central, or representative of the rest. There is no "commander". What there is a collective will to carry out and achieve aims (WHITAKER, 1998).

For decades, the concept of the social network and the analyses of these relationships have been developing as one of the most promising routes for measuring the social structure of scientific cooperation. Its basis, however, was first used in the middle of the 1930s (MORENO, 1934) in the consolidation of Sociometry, by introducing the mathematical theory of graphs, with a complementary adaptation to the Theory of Structural Equilibrium (CARTWRIGHT; HARARY, 1956).

In parallel, a study of the analysis of equilibrium in relationships initiating in a cognitive experience, was carried out, determining two possible types of cooperation: sympathetic or positive, when the relationships are obvious within a scientific universe; and the relationship by disapproval or negativity, that in general is made up of causalities, indeed an aid that possesses no centrality (HEIDER, 1946).

From these initial frameworks, the origins of Social Networks Theory were designed (SCOTT, 1991), developed a priori by the University of Manchester in the 1950s (GLUCKMAN, 1954), where the major exponents of Social Networks Theory at that time were to be found (BARNES, 1954).

Figure 1: Theoretical Origins of the Social Network
Source: Scott - 1991 - p.7.

In terms of its anthropological bases, we can observe studies focusing on the clinical aspect of Medicine and its environment (network of patients and control guidelines), both with a focus on the standardization of treatment techniques in a group of people, and starting from cognitive presuppositions, focusing on the control of treatments in scales of networks of patients (LITWIN, 1997).

Another habitually applied aspect is the structuring and application of networks in business activity, primarily for the control of groups and their production, in procedures and business clusters (GRANNOVETTER, 1985).

These visions (anthropological) are derived from initial studies on invisible colleges and social capital which always operated through the prism of the relationship between individuals or institutions.

Faced with this assumption, it is essential to observe that social networks are not only evolutionary. We are dealing with a discipline that aggregates the principles of the invisible colleges and social capital, generating new knowledge with the aim of resolving oppositions (up to the time difficult to overcome), in the area of Social Sciences, by working with structured actions and micro and macro pairs, basically exploring the quantitative generation of data .

In Spain, the possibility of generating a social network for studies of a metric nature was described using the structuration of co-authorship to form the

relationships of scientific cooperation at the individual, group and network of authors levels (MOLINA; MUÑOZ; DOMENECH, 2002).

To strengthen this quantitative aspect of networks, it is essential to aggregate Metric Studies to be able to base other aspects within the relationships, such as graphs, densities, centralities, intermediations, proximities and vectors.

This reinforces the view that social networks are a foundation for Statistics, as they are a sum of cooperation between two or more points, or simply because they constitute a representation of scientific frequency designed in a map by similarity (of authors, topics or scientific institutions). For this reason, an exploration of the scientific publications in Bibliometry and Scientometry, from the point of view of co-authorship and co-citations, was carried out.

2 OBJECTIVES

Our study focused on objectivizing the analysis of the scientific production of the journal studied, through two aspects: (i) from the point of view of the social network and the relations of proximity of the embedded agents and (ii) by determining the frequencies of the points related in the analysis.

Within this view, we fixed our specific objectives, and:

1. We index co-authors by area ISI;
2. We made a comparative study of the documentary typology of registries source by citation;
3. We discovered the centralities and the frequencies in co-citations;
4. We analyzed the documents cited with the greatest relevance in accordance with the point of view of information consumption on the part of the authors who published in the journal studied;
5. We established the journals most cited by the authors;
6. We established the most productive authors in the journal.

3 METHODOLOGY

Faced with these associations we resolved to carry out a social network applicable to the maps of relationships environment, determining the scientific universe of the literature in Bibliometry and Scientometry, and collecting all the documents in existence during the period from 1975 to 2005. The products of the *Institute for Scientific Information "ISI"* (*Science Citation Index*, *Social Science Citation Index* and *Arts and Humanities*) were used.

As a result of this paper, we were able to retrieve a total of 635 published works in the ISI products, which are divided as follows: 454 articles; 44 review; 38 editorial material; 37 book review; 25 notes; 10 letter; 7 bibliography; 6 biographical item; 5 reprint; 3 item about and individual; 2 correction addition; 2 meeting abstract; and 2 correction.

The treatable part of the data was incorporated into a structural program of social networks analysis (*CiteSpace*) (CHEN, 2006), and for the non-associative part of the data a refinement was carried out so that it could be used in the practical complementation of the networks, through a methodology of documentary control, developed by Efrain-García operating systems.

Once we made the consultation to *WoS*, we downloaded the data in delimited format by tabulators or in bibliographical format we proceed to execute a program written in *Perl* language that takes charge introducing all the fields of the records unloaded to a base of information relational created in *MySQL*. These database has five tables witch stores data about the authors, ISI categories, cites and the last one, references isolated data about one register. All the registers are identified with a unique key to combine all the tables and to know at every moment which original register belongs to. We used another programs in *Perl* that allow assign a documental typology to the cites as identify witch are ISI magazines and which not. We elaborated another program *Perl* which allows calculate co-citing authors indexed by ISI areas.

4 RESULTS

The first analysis made was to identify the degree of co-authors for ISI of the studied thematic, where we inquire that the most of recouped documents are indexed in Social Sciences, followed by Clinical Medicine, Mathematical, Engineering, Computer science and Economy and Businesses, the remaining concentration areas had a more modest index.

Table 1: ISI Concentration Areas and its Frequency of Co-Authorship

Co-authorship by area	1969/ 1978	1979/ 1983	1984/ 1988	1989/ 1992	1994/ 1998	1999/ 2003	2004/ 2006	Total
Agricultural Sciences	0,00	0,00	0,00	0,00	0,00	3,00	0,00	**3,00**
Biology & Biochemistry	0,00	0,00	0,00	2,00	0,00	0,00	1,00	**3,00**
Chemistry	1,00	1,00	2,00	1,00	2,00	6,65	4,50	**18,15**
Clinical Medicine	1,00	0,00	0,00	4,00	10,30	13,74	5,72	**34,76**
Computer Science	0,00	0,00	0,00	5,00	0,00	10,20	6,00	**21,20**
Economics & Business	0,00	0,00	0,00	2,00	5,00	9,10	4,92	**21,02**
Engineering	0,00	0,00	0,00	7,00	4,50	5,00	7,40	**23,90**
Geosciences	0,00	0,00	0,00	0,00	2,00	0,00	0,00	**2,00**
Materials Science	0,00	0,00	0,00	0,00	0,00	0,00	2,00	**2,00**
Mathematics	0,00	0,00	0,00	1,00	4,00	6,00	19,00	**30,00**
Microbiology	0,00	0,00	0,00	2,00	0,00	0,00	0,00	**2,00**
Molecular Biology & Genetics	0,00	0,00	0,00	0,00	0,00	2,00	0,00	**2,00**
Multidisciplinary	0,00	1,00	0,00	2,00	3,00	4,00	2,50	**12,50**
Neuroscience & Behavior	0,00	0,00	0,00	0,00	0,00	2,00	3,40	**5,40**
Physics	0,00	0,00	1,00	1,50	0,00	2,00	3,00	**7,50**
Plant & Animal Science	0,00	0,00	0,00	2,80	4,00	0,00	0,00	**6,80**
Psychiatry/Psychology	0,00	1,00	0,00	9,00	2,80	15,00	3,50	**31,30**
Social Sciences, General	4,07	7,17	5,66	7,29	7,39	9,29	6,48	**47,35**
Space Science	0,00	0,00	0,00	0,00	0,00	0,00	2,00	**2,00**
Total	**6,07**	**10,17**	**8,66**	**46,59**	**44,99**	**87,98**	**71,42**	**275,88**

Source: ISI - 2006.

Ahead of this, we also carry through an analysis by thematic of indexation, and a great part where centred in the related studies of the Information Science

(Library Science, Social Computer Sciences, Administration, Communication, Social Sciences), mainly for this area to have one disciplines exclusive for the metric studies, the Bibliometry.

Table 2: Categories of Documents Indexed in ISI

ISI Categories	Frequency
Information Science & Library Science	374
Computer Science, Interdisciplinary Applications	197
Computer Science, Information Systems	123
Multidisciplinary Sciences	26
Computer Science, Cybernetics	24
Planning and Development	19
Management	19
Medicine, General & Internal	17
Business	13
Chemistry, Multidisciplinary	12
Social Work	9
Operations Research & Management Science	9
Public, Environmental & Occupational Health	9
Communication	9
Social Sciences, Interdisciplinary	7

Source: ISI - 2006.

The thematic with an index inferior to 6 documents are not represented because the big thematic areas are represented by the related ones to Information Science.

Concentration areas of cites and resource documents had a similar representation, mainly in Social Science in general, Economics & Business and Clinical Medicine. Is important to mention the certainty of Computer Science and Multidisciplinary, as we can see on the table 3.

Table 3: Representation by Areas of Cites and Source Documents

Areas	Cites	Areas	Source documents
Social Sciences, general	4107	Social Sciences, general	429
Economics & Business	571	Clinical Medicine	70
Clinical Medicine	560	Economics & Business	22
Multidisciplinary	552	Chemistry	16
Psychiatry/Psychology	220	Engineering	15
Computer Science	167	Computer Science	13
Engineering	158	Psychiatry/Psychology	12
Neuroscience & Behavior	139	Multidisciplinary	12
Chemistry	71	Mathematics	8

Physics	48	Physics	6
Biology & Biochemistry	47	Plant & Animal Science	6
Mathematics	37	Neuroscience & Behavior	3
Environment/Ecology	34	Biology & Biochemistry	2
Plant & Animal Science	27	Microbiology	1
Agricultural Sciences	18	Agricultural Sciences	1
Immunology	16	Molecular Biology & Genetics	1
Molecular Biology & Genetics	11	Materials Science	1
Space Science	5	Geosciences	1
Geosciences	4	Space Science	1
Pharmacology & Toxicology	3	-	-
Materials Science	2	-	-
Microbiology	1	-	-
Total	**6798**	**Total**	**620**

Source: ISI - 2006.

The next analysis is centred in the Social Network, where we will work with two patterns: the centrality of figures and the frequency of tables.

The first result it is about co-authorship or corresponsability of the authors which more scientific collaboration, where four relations are of representation in chain form (Kostoff / Shlesingr / Humenik; Christensen / Wormell / Ingwersen; Rafferty / Lewison / Traynor; Barker / Rosenberg / Holden), one about power (Thelwall with Vaughan, Wilkinson, Price, Harries and Tang), one about shared power between all the agents (Molina, Benavent, Melendez, Gomez and Zurian) and the rest of relations of co-authorship of pair.

In order to understand better the figures we recommend to consider the tonalities related to different temporal periods of 10 years: dark blue for the period between 1975 an 1984; soft blue for the period between 1985 and 1994; green for the period between 1995 and 2004; and yellow for the period between 2005 and 2006. The last one was represented by a short period in order to identify which citations are present.
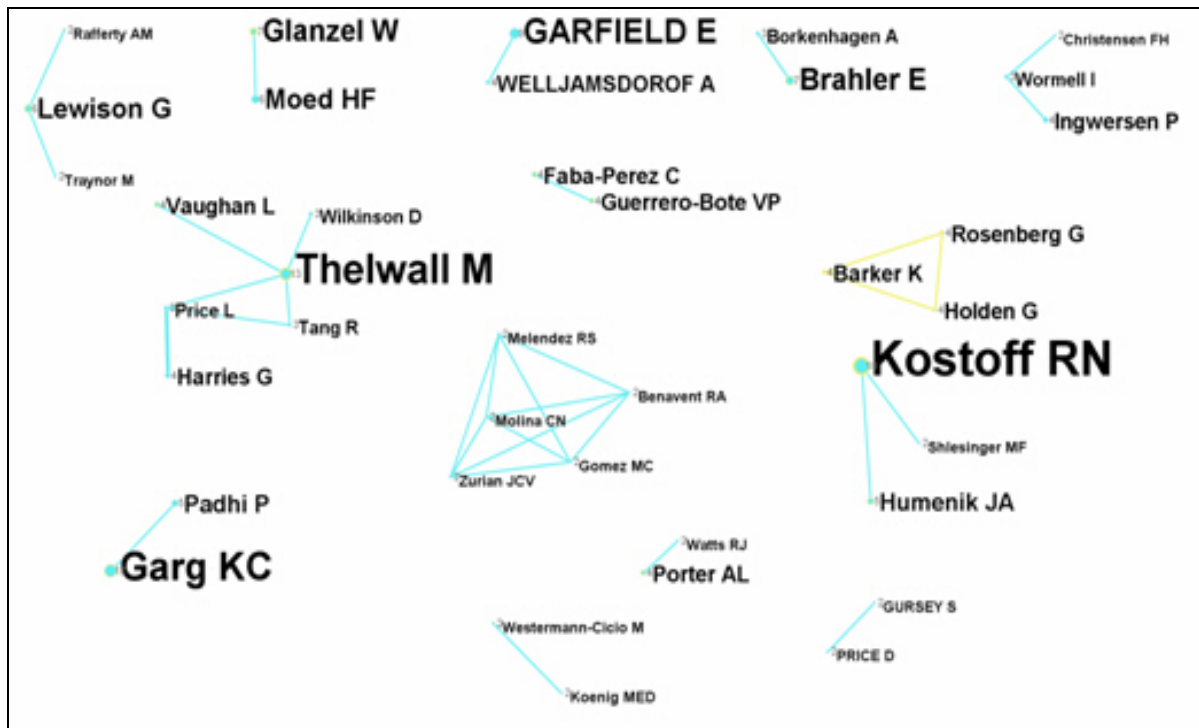
Figure 2: Co-Authorship of Authors with Scientific Relation
Source: ISI - 2006.

Inside the analysis of the first map, we can see three types of relationships: authors with a big representation in Bibliometry, Scientometry and of the two. For the relationships in Bibliometry, it is necessary to emphasize the principal node represented by Thelwall, by Kostoff, Molina (the Spanish group), Ingwersen, and Lewinson, the simplest relations are the ones of Borkenhagem with Brahler and the ones of the Spanish authors, Guerrero and Faba-Pérez.

In relation to the collaboration in Scientrometric, we emphasize the most simplest cooperations between Padhgi and Garg; of Wellamsdorof with Garfield; of Koenin with Westermann-Cicio and of Price with Gursey.

The mixed relations of Holden, Rosenberg and Barker; of Glänzel and Moed, produce in the two thematics with the same intensity.

Another made analysis was about the information consume by the authors which produce in the studied thematics, we discovered the more cited authors, the more used documents and the more consulted magazines when publishing the works about Bibliometry and Scientometry, as we can see in the next picture.
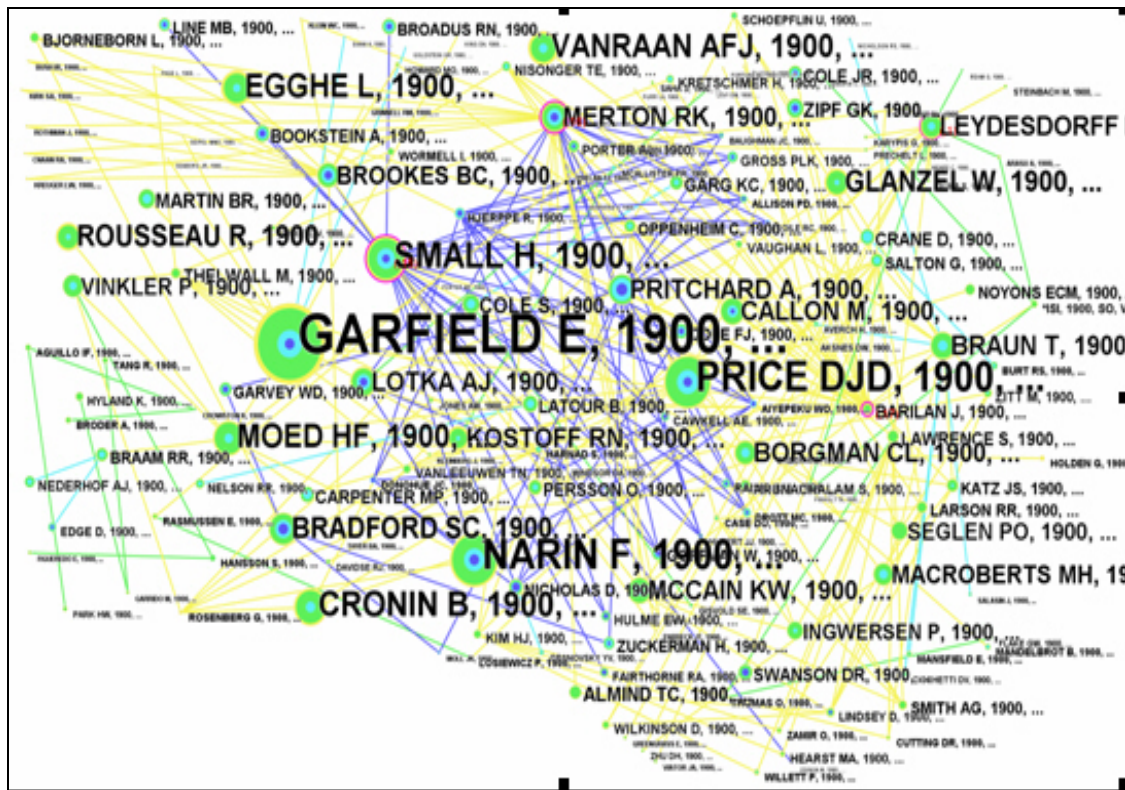
Figure 3: Centrality and Frequency of the More Cited Authors
Source: ISI - 2006.

In relation to the centrality relation, we emphasize Small, Merton, Brookes, Garfield, Price, Pritchard, Bradford, Narin, Callon, Nicholas, Zuckerman, Lotka and Bookstein, where them publications where cited throughout all the studied period. We can visualize by the tonalities, mainly because these documents are considered as the keys for Bibliometry and Scientometry.

Related to the frequency analysis we can confirm that, inside of the universe of the Bibliometry and Scientometry, some authors have more representation. We present a ranking with the 35 more cited authors and we make a comparison with the most productive authors of the 635 source documents.

Table 4: The More Cited Authors Representation and Source Authors with the Highest Frequency in Bibliometry and Scientometry

Ranking	Cited Authors	Frequency	Source Authors	Signed Documents
1	**GARFIELD E**	464	**KOSTOFF, RN**	22
2	PRICE DJD	295	**GARFIELD, E**	14
3	**KOSTOFF RN**	292	**GARG, KC**	14

4	NARIN F	204	**THELWALL, M**	13
5	Without authory	194	**SCHUBERT, A**	11
6	SMALL H	171	**GLANZEL, W**	9
7	**CRONIN B**	153	**VAN RAAN AFJ**	8
8	WHITE HD	138	BONITZ, M	7
9	**THELWALL M**	135	BRAHLER, E	7
10	**EGGHE L**	123	**LEYDESDORFF, L**	7
11	BROOKES BC	109	**MOED, HF**	7
12	**LEYDESDORFF L**	106	COURTIAL, JP	6
13	**SCHUBERT A**	105	**CRONIN, B**	6
14	**BRAUN T**	99	EOM, SB	6
15	**MOED HF**	97	HICKS, D	6
16	**VAN RAAN AFJ**	93	LEWISON, G	6
17	**ROUSSEAU R**	91	PERSSON, O	6
18	NALIMOV VV	85	WOUTERS, P	6
19	CALLON M	81	**BORGMAN, CL**	5
20	MCCAIN KW	80	**EGGHE, L**	5
21	MERTON RK	79	HUMENIK, JA	5
22	**GLANZEL W**	77	KRETSCHMER, H	5
23	**BORGMAN CL**	75	PADHI, P	5
24	PRITCHARD A	69	PERITZ, BC	5
25	**VINKLER P**	67	PORTER, AL	5
26	BRADFORD SC	64	**ROUSSEAU, R**	5
27	MACROBERTS MH	56	SCHOEPFLIN, U	5
28	**GARG KC**	51	**VINKLER, P**	5
29	SEGLEN PO	51	BARKER, K	4
30	LOTKA AJ	48	**BRAUN, T**	4
31	MORAVCSIK MJ	48	FABA-PEREZ, C	4
32	MARTIN BR	45	GUERRERO BOTE, VP	4
33	LAWANI SM	44	MOYA ANEGÓN, F	4
34	LINE MB	44	HARTER, SP	4
35	LINDSEY D	43	HOLDEN, G	4

Source: ISI - 2006.

The comparative study about authors source with the mentioned authors gave like result that 15 of the authorities are between the 35 in both representations

The most cited authors, without doubts, are the ones who made the metrics studies a constant in the universe of the analysis of the scientific production, with them theories (Lotka, Bradford, Price and Narin) and them applications (Garfield, White, Cronin, Van Raan, Braun, Moed, Schubert and Glänzel). That's why inside our analysis, it is fundamental to emphasize another authors with a more modest production and with a big relevance in our research. Those are Faba-Pérez, Guerrero Bote, Courtial and Moya Anegón, they are a Spanish group with an impressive international visibility.

For the next analysis we stand out a strong centrality for documents of: Glue 1917, Bradford 1934, Price 1963, Bookstein 1976, Narin 1976, Price 1976, Lindsey 1980, Macroberts 1989, Narin 1994, Garfield 1996, Almind 1997, Cronin 1998, Kostoff 1998, Borgman 2002, Helden 2005 and Rosenberg 2005. These authors had kept a constancy represented by a pink circle, determinative for the studied periods. However is interesting to mention some documents that had also been with centrality visualization as: Lotka 1926, Garfield 1955, Pritchard 1969, Price 1970, Garfield 1972 and Small 1973.
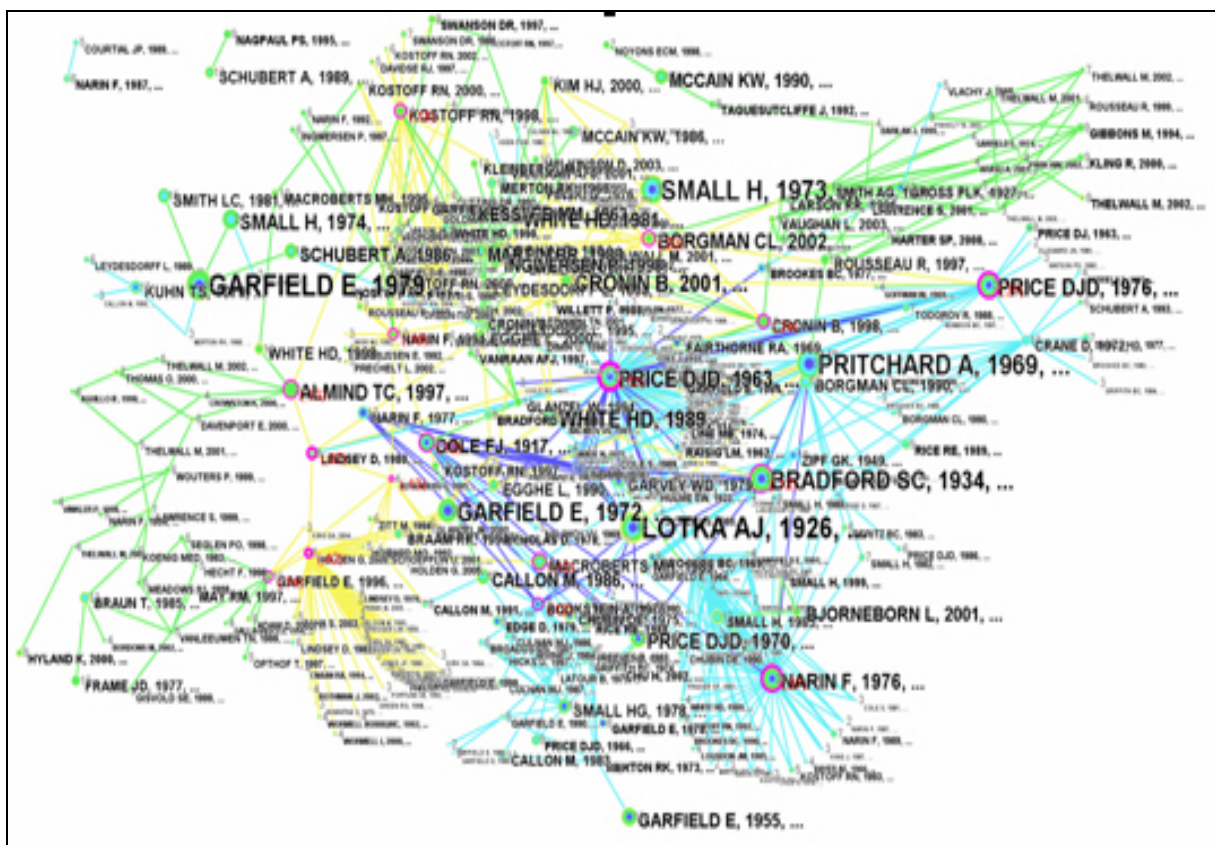
Figure 4: The Most Consumed Documents by the Authors in Bibliometry and Scientometry
Source: ISI - 2006.

Related to the centrality it is important to mention the role carried out by Narin, Price, Crane and Small for the period between 1975 and 1984: it is important to mention too the centrality of Cole, Garvey and Bookstein for the decade of 1985 to 1994; for the period between 1995 and 2004, we emphasize as central nodes

Kostoff, Borgman, Braun, Gardfield, Small and McCain, and finally, related to the last period (2005) we mention Small, Holden and Almind.

It is fundamental to emphasize the importance of Price, Narin, Cronin, Macrobets, Lindsey and Borgman in all the studied period, having a centrality by intermediation and by proximity to other authors with lesser representation of centrality.

Unlike the centrality analysis, whose preoccupation was not to find out the most cited documents, the consideration made for the frequency has this scientific importance, where we mention the most used 35 documents about metrics studies.

Table 5: The Most Consumed Documents in Metric Studies

Ranking	Cited documents	Quantity
1	PRICE DJD, 1963, LITTLE SCI BIG SCI	49
2	LOTKA AJ, 1926, J WASHINGTON ACADEMY, V16, P317	48
3	GARFIELD E, 1979, CITATION INDEXING	46
4	PRITCHARD A, 1969, J DOC, V25, P358	39
5	SMALL H, 1973, J AM SOC INFORM SCI, V24, P265	39
6	BRADFORD SC, 1934, ENGINEERING-LONDON, V137, P85	36
7	PRICE DJD, 1965, SCIENCE, V149, P510	31
8	WHITE HD, 1989, ANNU REV INFORM SCI, V24, P119	31
9	GARFIELD E, 1972, SCIENCE, V178, P471	30
10	WHITE HD, 1981, J AM SOC INFORM SCI, V32, P163	30
11	PRICE DJD, 1976, J AM SOC INFORM SCI, V27, P292	27
12	CRONIN B, 1984, CITATION PROCESS ROL	26
13	CRONIN B, 2001, J INFORM SCI, V27, P1	25
14	EGGHE L, 1990, INTRO INFORMETRICS Q	25
15	NARIN F, 1976, EVALUATIVE BIBLIOMET	25
16	ALMIND TC, 1997, J DOC, V53, P404	24
17	PRICE DJD, 1970, COMMUNICATION SCI EN, P1	24
18	ROUSSEAU R, 1997, CYBERMETRICS, V1, P1	24
19	SMALL H, 1974, SCI STUD, V4, P17	24
20	BORGMAN CL, 1990, SCHOLARLY COMMUNICAT, P10	23
21	BORGMAN CL, 2002, ANNU REV INFORM SCI, V36, P3	22
22	CALLON M, 1986, MAPPING DYNAMICS SCI	22
23	MCCAIN KW, 1990, J AM SOC INFORM SCI, V41, P433	21
24	SCHUBERT A, 1990, SCIENTOMETRICS, V19, P3	21
25	COLE FJ, 1971, SCI PROGR, V11, P578	20
26	KING J, 1987, J INFORM SCI, V13, P261	20
27	SCHUBERT A, 1986, SCIENTOMETRICS, V9, P281	20
28	GARFIELD E, 1955, SCIENCE, V122, P108	19
29	INGWERSEN P, 1998, J DOC, V54, P236	19
30	ZIPF GK, 1949, HUMAN BEHAVIOUR PRIN	19
31	BRAAM RR, 1991, J AM SOC INFORM SCI, V42, P252	18
32	KESSLER MM, 1963, AM DOC, V14, P10	18
33	MARTIN BR, 1983, RES POLICY, V12, P61	18

34	MERTON RK, 1973, SOCIOLOGY SCI THEORE, P286	18
35	BJORNEBORN L, 2001, SCIENTOMETRICS, V50, P65	17

Source: ISI - 2006.

Respect to the amount, the table 5 is justified by itself, being distinguished the document of Price (1963), followed for the one of Lotka, Garfield, Pritchard, Small, Bradford, Price, White, Cronin, Egge among others; however, it is basic to mention the constant production for the thematic of Price (that it appears with 4 of the most cited documents); of Garfield (with 3 documents); and of White, Schubert, Small, Borgman and Cronin (each one with 2 cited document).

The present analysis was focused to study the period from 1975 to 2006, however the most used documents date from 1926 (Lotka), 1934 (Bradford), 1949 (Zipf), 1955 (Garfield), 1963 (Price and Kessler), 1969 (Pritchard), 1971 (It Glue), 1973 (Small and Merton), 1976 (Narin) and 1978 (Nicholas). It is very important to mention that these documents are foundations of the Bibliometry and Scientometry Studies and, for this reason, can be affirmed that the existing theories are the fruits of a work bases in these authors and documents identified here.

About the frequency, we distinguish some contemporary documents (White 1989; McCain 1990; Cronin 2001; Borgman 2002) that surely they will have, with passing of the time, a bigger citation index by the scientific community.

Figure 5: Magazines Used by the Authors in the Information Consume
Source: ISI - 2006.

In this confusion of relations, it can be detached the most cited magazines (represented in the biggest graph), having a great prominence the following headings: *Scientometrics Journal, Journal of American Society, Journal of Documentation, Science, Journal of Information Science, Nature, Arist, Resource Policy, Information Process Management, Social Studies Science, Current Contents, Library Quarterly, British Medical Journal, Washington Academy,* and *Citation Index,* all of them with more than 50 citations each one.

The magazines with the most frequency also exert a union roll (on citation) with other magazines with lesser representativeness for de metrics studies.

The union periods between the most cited magazines and those ones with less visibility are represented by *Cybermetrics, Evaluation Review, Essays Information Science, American Documentation, H&D Quantitative Studies* and *Web Knowledge Study Science.*

Another important information to consider are de magazines with a big visibility for the area Information Science, and consequently the metric studies

universe are not in constant citation, as we can see in the fifth figure. These are: *Interciencia, Library Research, Libri, Management Science, Scientist, R&D Management, Online Information* and *Information Systems*.

Related to the centrality, we can affirm that the main magazine for the metric studies is *Scientometrics Journal*, entailed merit to the fact of being practically the only magazine who publishes articles about Bibliometry, Scientometry, Infometry, Webmetry, Cibermetry, Information Consumption and mathematical analysis focused to evaluate Science in general.

Other magazines detached in the centrality are not focused in this thematic as specific one, always contemplating the multidisciplinary of Sciences. These are: *Journal of Documentation, Journal of American Society, Nature, Science, Journal of Information Science, Social Studies Science* and *Resource Policy*.

5 FINAL CONSIDERATIONS

We concluded that to be able to make an investigation with ISI information, a normalization must be made of all the data to find out the duplications and the entrances of the authors, for example:

(1) PRICE DJD, 1963, *LITTLE SCI BIG SCI*, P62 or DESOLA, JD 1963, *LITTLE SCI BIG SCI*.

(2) GARFIELD E, 1972, *SCIENCE*, V178, P471 or GARFIELD E, 1972, *SCIENCE*, V178, P510.

A challenge that would fit in the present analysis would be to evaluate the most used terms used by the authors, as a way to verify if the works were centred specifically on Metric Studies or if existed different thematic. However inside of the established objectives it can be concluded that all the points had been verified and it was found a good symmetry between the centrality and frequencies of co-citations, inquiring themselves cooperation between personage-key for the Bibliometry and the Scientometry.

These personages are represented in three categories:

(1) In Bibliometry, it can be detached the node commanded for Thelwall, Kostoff and the simplest relation t of Borkenhagem with Brahler, and for Guerrero with Faba-Perez;

(2) In Scienciometry, the cooperations between Padhgi with Garg, and Welljamsdorof with Garfield are distinguished;

(3) In the mixed relation, we distinguished the representation of Holden, Rosenberg and Barker.

On information consumption, it can be affirmed that the analysis of cited documents corresponds to the theoretical and practical formation of the Metric Studies, with documents since 1926 (Lotka) until the more contemporaries as Cronin (2001) and Borgman (2002).

For the analysis of the most representative authors in Metric Studies, we concluded that the centrality that Narin, Cronin, McCain, Bordons and Seglen had is the most significant; and the frequency counted on Lotka, Bradford, Price, Narin, Garfield, White, Cronin, Van Raan and Glänzel, are the most cited.

Related to the most important magazines in Bibliometry and Scientometry, we distinguish *Scientometrics Journal, Journal of American Society, Journal of Documentation, Science, Journal of Information Science, Nature, Arist, Resource Policy, Information Process Management, Social Studies Science, Current Contents, Library Quarterly, British Medical Journal, Washington Academy* and *Citation Index*.

About centrality, the *Scientometrics* magazine had great prominence, mainly because is the most complete in articles for Metric Studies. The rest of the cited magazines, in general, contain approaches to multidisciplinary thematic (*Journal of Documentation, Journal of American Society, Nature, Science, Journal of Information Science, Social Studies Science* and *Resource Policy*).

REFERENCES

BARNES, John A. Class and Committee in a Norwegian Island Parish. **Human Relations**, London, n.7, p.39-58, 1954.

CARTWRIGHT, Dorwin; HARARY, Frank. Structural balance: a generalization of Heider´s Theory. **Psychological Review**, Washington, v.63, n.5, p.277-293, 1956.

CHEN, Chaomei. CiteSpace II: detecting and visualizing emerging trends and transient patterns in scientific literature. **Journal of the American Society for Information Science and Technology**, Maryland, v.57, n.3, p.359-377, 2006.

GLUCKMAN, Max H. **Rituals of rebellion in South-East Africa**. Manchester: Manchester University, 1954.

GRANNOVETTER, Mark S. Economic action and social structure: the problem of embeddedness. **American Journal of Sociology**, Chicago, v.91, n.3, p.481-510, 1985.

HEIDER, Fritz. Attitudes and cognitive organization. **Journal of Psychology**, Washington, v.21, n.2, p.107-112, 1946.

LITWIN, Howard. Support network type and health service utilization. **Research On Aging**, London, v.19, n.3, p.274-299, 1997.

MOLINA, José Luís; MUÑOZ, Juan Manuel; DOMENECH, Miquel. Redes de publicaciones científicas: un análisis de la estructura de coautorías. **Redes - Revista Hispánica para el Análisis de Redes Sociales**, Barcelona, v.1, 2002. Available in: <http://revista-redes.rediris.es/pdf-vol1/vol1_3.pdf>. Access in: Nov., 10, 2006.

MORENO, Jacob Levy. **Who shall survive?** New York: Beacon, 1934.

SCOTT, John. **Social Network Analysis**. London: Sage, 1991.

WHITAKER, Francisco. **Redes**: uma estrutura alternativa de organização. 1998. Available in: <http://www.rits.org.br/redes_teste/rd_estrutalternativa.cfm>. Access in: Nov., 10, 2006.

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