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Proceedings literature as additional data source for bibliometric analysis

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Scientific meetings have become increasingly important channels for scholarly communication. In several fields of applied and engineering sciences they are – according to the statements of scientists active in those fields – even more important than publishing in periodicals. One objective of this study is to analyse the weight of proceedings literature in all fields of the sciences, social sciences and humanities as well as the use of the ISI Proceedings database as additional data source for bibliometric studies. The second objective is exploring the use of a further important feature of this database, namely, of information about conference location for the analysis of bibliometrically relevant aspects of information flow such as the relative attractivity, the extent of mobility and unidirectional or mutual affinity of countries.

Introduction

Scientific meetings are important channels for communicating research results. Proceedings literature may thus usefully supplement journal literature as a measurable object of documented scholarly communication in basic and applied sciences. The two forms of literature are not quite independent of each other: Journal papers are often based on and preceded by presentations given at scientific conferences and, on the other

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hand, journal editors tend more and more to publish selected papers from international or national conferences in dedicated issues of their journals. DROTT (1995) has studied the role of proceedings literature in scientific communication on the example of the field Information Science where he found that proceedings literature is rated much lower than would be expected from studies of other literature (e.g., MARTENS & SARETZKI, 1993). Above all, scientists in applied and engineering sciences complain that their field is not covered by journal literature in an adequate manner, and that (non-periodical) proceedings literature is of immense importance in scholarly communication of their fields. According to GOODRUM et al. (2001) proceedings papers become more and more substitutes for journals articles in computer science. There is also indication that the acceptance of a paper by an international conference in social sciences is frequently much harder than publishing it in a journal (ULUSOY, 1995). In the North American academic reward system, specifically promotion and tenure, publication in peer-reviewed journals has always been stressed, yet in some fields, as the data here show, publication in conference proceedings is as or even more important. Also these findings have implications for how review committees assess work in different disciplinary cultures.

Unlike in the case of 'regular' journal literature, special issues dedicated to conferences as well as non-serial proceedings literature allow the analysis of a kind of mobility of scientists shedding light on many aspects of the relationship among countries, organisations and individual researchers. Data on organisation of and attendance at conferences, therefore, reveal interesting details on the open or closed nature of scientific communities as well as on the infrastructural, intra-scientific and commercial background of organising scientific meetings and also the attraction of attendees from other countries. SCHUBERT et al. (1983) have laid the groundwork for cross-national analyses of mutual relationship patterns in attendance of international scientific meetings. SODERQVIST & SILVERSTEIN (1994a, 1994b) and later also GODIN (1998) have studied international flows of knowledge based on scientific meeting data in different science areas. In the present study, the authors try to extend those results to all fields of the sciences, social sciences and humanities by introducing new indicators designed to measure relative attractivity, extent of mobility and mutual affinity of countries.

Data sources and data processing

The analysis is based on the ISI Proceedings database by the Institute for Scientific Information (Thomson – ISI, Philadelphia, PA, USA). Data were extracted from the 1994–2002 volumes of the ISI Proceedings database of Thomson-ISI. Both the Science & Technology (STP) and the Social Sciences & Humanities (SSHP) editions have been

used. In the first part of the study, aiming at the analysis of subject coverage and national publication profiles, only documents of the type articles, letters, notes, proceedings and reviews have been selected. Subject classification of publications was based on the field assignment of journals, serials and books (in which the publications in question appeared) according to the twelve major fields of science and three fields of social sciences and humanities developed in Leuven and Budapest (see, for instance, GLÄNZEL & SCHUBERT, 2003).

In the second part, where the international flows of knowledge are analysed, other document types such as meeting abstracts are also taken into consideration. This part is based on the 2002 volumes of the ISI Proceedings.

The documents were assigned to countries according to the address in the by-line of the paper. Unlike in the period 1991–1993 where at most one correspondence address has been recorded in the database (cf., GODIN, 1998), address recording practice follows that applied to the Web of Science (WoS) from 1994 on. The share of papers without address is of the same low order as that in the WoS. Teleconferences and internet conferences have not been assigned to any particular location. They are still a marginal phenomenon in 2002 and their share in the Proceedings Index is therefore negligible.

Internationally co-authored papers indexed in the 2002 volume have been assigned to each country involved (source country). Duplicate country addresses have been removed. In addition, all papers have been assigned to the country in which the conference was held (location country).

Proceedings literature as additional data source for bibliometric studies

National and disciplinary coverage

The first part of the study is devoted to the question whether in which fields (and for which countries) proceedings literature plays an important part. In verbal terms the question arises of how far proceedings databases might be useful as additional input for bibliometric studies. The proceedings database has been split up, namely, the part that is not already covered by the WoS was separated. The comparative analysis of subject coverage and national representation was based on two components, the WoS and non-serial proceedings literature and documents not indexed in the WoS. Analysis is only based on the WoS (including overlap with ISI Proceedings) and that part of the Proceedings database which is not already covered by the WoS.

Table 1 presents the subject profile of the two editions of the ISI Proceedings database as compared with that of the WoS database in the period 1994–2002.

Table 1. Subject profile of the Web of Science (W) and the ISI Proceedings (P) in the period 1994–2002
(key to the subject codes can be found in the Appendix)

	1994		1995		1996		1997		1998		1999		2000		2001		2002	
Field	W	P	W	P	W	P	W	P	W	P	W	P	W	P	W	P	W	P
AGRI	5.1%	10.8%	5.1%	13.3%	5.0%	11.0%	5.3%	9.4%	5.5%	11.2%	5.3%	12.0%	5.4%	12.0%	5.5%	8.3%	5.8%	8.4%
BIOL	8.3%	6.3%	8.5%	6.6%	8.6%	6.1%	9.1%	5.0%	9.1%	5.8%	9.1%	3.8%	9.0%	5.6%	9.1%	3.2%	9.2%	3.8%
BIOS	9.2%	5.2%	9.6%	5.9%	9.4%	3.8%	10.1%	2.5%	10.4%	2.6%	10.3%	2.6%	10.1%	4.2%	10.2%	2.3%	9.7%	2.4%
BIOM	6.9%	6.4%	6.4%	6.2%	6.7%	5.2%	6.6%	4.0%	7.0%	6.3%	6.8%	7.0%	6.9%	3.7%	6.7%	4.7%	6.7%	4.9%
CLI1	12.2%	5.6%	11.8%	5.9%	11.7%	4.2%	11.7%	3.7%	12.2%	4.3%	12.4%	3.8%	12.2%	2.7%	12.1%	2.3%	11.9%	3.0%
CLI2	14.9%	7.1%	15.1%	9.5%	15.2%	7.5%	16.0%	9.2%	16.4%	8.3%	16.5%	7.7%	16.5%	6.9%	16.7%	4.6%	16.4%	5.5%
NEUR	4.7%	4.3%	5.1%	2.6%	5.2%	2.4%	5.4%	1.9%	5.3%	2.1%	5.3%	2.6%	5.3%	1.9%	5.2%	1.9%	5.2%	1.9%
CHEM	15.6%	15.5%	16.3%	17.7%	16.7%	14.6%	16.5%	15.9%	17.3%	17.5%	17.4%	18.5%	17.0%	16.8%	17.8%	15.4%	17.8%	11.9%
PHYS	13.0%	24.8%	13.1%	22.9%	13.0%	23.5%	13.0%	22.9%	12.9%	23.1%	13.1%	27.5%	12.8%	26.6%	13.2%	26.6%	13.4%	31.8%
GEOS	4.8%	10.9%	4.9%	14.6%	4.8%	15.2%	4.8%	10.9%	4.8%	15.6%	5.1%	14.6%	5.2%	13.9%	5.2%	11.6%	5.1%	12.3%
ENGN	9.4%	42.2%	9.3%	43.5%	9.2%	44.3%	9.0%	51.2%	9.5%	49.8%	9.4%	52.0%	9.3%	46.8%	9.8%	61.2%	9.5%	61.4%
MATH	3.1%	3.4%	3.1%	4.4%	3.2%	3.7%	3.3%	4.1%	3.5%	3.8%	3.5%	4.6%	3.6%	3.8%	3.6%	5.0%	3.7%	5.7%
SOC1	3.3%	4.9%	3.3%	4.4%	3.1%	4.6%	3.2%	4.4%	3.4%	4.8%	3.4%	4.2%	3.3%	4.1%	3.3%	3.1%	3.3%	2.5%
SOC2	3.5%	3.9%	3.4%	4.1%	3.6%	3.3%	3.7%	3.6%	3.6%	3.3%	3.5%	4.8%	3.7%	3.4%	3.5%	2.0%	3.3%	2.6%
AHUM	3.6%	3.3%	3.4%	2.5%	3.3%	2.7%	3.3%	2.3%	3.0%	2.0%	3.0%	2.1%	3.2%	2.8%	3.0%	2.4%	2.9%	1.9%

Table 2. Share of proceedings literature in the total publication outputs indexed by the ISI Proceedings and the Web of Science databases between 1994 and 2002 (key to the subject codes can be found in the Appendix)

Field	1994	1995	1996	1997	1998	1999	2000	2001	2002
AGRI	27.0%	34.4%	28.7%	23.0%	25.7%	24.7%	22.8%	17.7%	21.3%
BIOL	11.5%	13.5%	11.5%	8.4%	9.8%	5.6%	7.7%	4.8%	7.1%
BIOS	8.9%	11.0%	6.9%	4.0%	4.1%	3.5%	5.2%	3.1%	4.4%
BIOM	13.9%	16.3%	12.4%	9.1%	13.3%	13.0%	6.7%	9.2%	12.1%
CLI1	7.4%	9.1%	6.2%	5.0%	5.6%	4.2%	2.9%	2.6%	4.5%
CLI2	7.6%	11.1%	8.3%	8.8%	7.8%	6.3%	5.3%	3.8%	5.9%
NEUR	13.6%	9.1%	7.7%	5.5%	6.3%	6.8%	4.5%	4.9%	6.3%
CHEM	14.8%	17.9%	13.8%	13.9%	14.6%	13.4%	11.6%	11.0%	11.1%
PHYS	24.8%	26.0%	24.8%	22.8%	23.2%	23.3%	21.6%	22.4%	30.8%
GEOS	28.4%	37.6%	36.7%	27.7%	35.6%	29.3%	26.4%	24.3%	31.1%
ENGN	43.8%	48.3%	46.7%	48.7%	46.9%	44.4%	40.1%	47.3%	54.7%
MATH	15.8%	22.4%	17.1%	17.3%	15.4%	16.3%	12.5%	16.8%	22.5%
SOC1	20.4%	21.2%	21.1%	18.6%	19.3%	15.2%	14.1%	11.9%	12.4%
SOC2	16.4%	19.2%	14.2%	14.0%	13.3%	16.5%	11.0%	7.6%	12.8%
AHUM	13.6%	12.9%	12.8%	10.6%	10.0%	9.0%	10.3%	10.4%	10.9%

Table 3. National representation in the STP Edition and the SCIE (1994–2002)

Country	SCIE+STP		SCIE			STP		
	1994–2002		1994–1996	1997–1999	2000–2002	1994–1996	1997–1999	2000–2002
	Share	Rank	Share	Share	Share	Share	Share	Share
USA	31.8%	1	33.1%	31.6%	30.8%	35.7%	32.2%	27.6%
Japan	9.0%	2	8.7%	9.3%	9.5%	7.6%	8.3%	8.8%
UK	8.5%	3	9.0%	9.0%	8.9%	6.8%	5.6%	5.7%
Germany	8.1%	4	7.7%	8.6%	8.6%	6.8%	6.8%	6.6%
France	6.0%	5	6.1%	6.4%	6.2%	4.9%	4.5%	4.2%
Canada	4.1%	6	4.5%	4.2%	4.1%	3.7%	3.1%	3.1%
Italy	4.0%	7	3.8%	4.1%	4.3%	3.9%	3.6%	3.7%
Russia	3.4%	8	3.8%	3.6%	3.4%	2.2%	2.5%	2.6%
PR China	3.1%	9	1.7%	2.6%	4.4%	2.6%	3.4%	6.0%
Spain	2.6%	10	2.3%	2.8%	3.1%	1.2%	1.5%	1.7%
Australia	2.5%	11	2.4%	2.6%	2.7%	2.0%	2.1%	2.0%
Netherlands	2.3%	12	2.4%	2.4%	2.4%	2.0%	1.8%	1.7%
India	2.1%	13	2.2%	2.2%	2.4%	1.0%	1.1%	1.1%
Sweden	1.8%	14	1.8%	1.9%	1.9%	1.1%	1.1%	1.1%
Switzerland	1.7%	15	1.6%	1.8%	1.8%	1.2%	1.2%	1.1%
South Korea	1.4%	16	0.8%	1.4%	2.0%	0.9%	1.6%	2.0%
Belgium	1.2%	17	1.2%	1.3%	1.3%	0.9%	0.9%	1.0%
Poland	1.2%	18	1.0%	1.2%	1.4%	0.9%	1.1%	1.3%
Taiwan	1.2%	19	1.0%	1.2%	1.4%	0.8%	1.1%	1.3%

Table 3. (continued)

Country	SCIE+STP		SCIE			STP		
	1994–2002		1994–1996	1997–1999	2000–2002	1994–1996	1997–1999	2000–2002
	Share	Rank	Share	Share	Share	Share	Share	Share
Brazil	1.1%	20	0.8%	1.2%	1.5%	0.6%	1.1%	1.1%
Israel	1.1%	21	1.1%	1.2%	1.2%	0.6%	0.7%	0.6%
Denmark	0.9%	22	0.9%	1.0%	1.0%	0.6%	0.5%	0.5%
Finland	0.9%	23	0.8%	0.9%	1.0%	0.6%	0.7%	0.8%
Austria	0.8%	24	0.8%	0.9%	1.0%	0.7%	0.7%	0.7%
Turkey	0.6%	25	0.4%	0.6%	0.9%	0.4%	0.4%	0.4%
Greece	0.6%	26	0.5%	0.6%	0.7%	0.5%	0.6%	0.7%
Norway	0.6%	27	0.6%	0.6%	0.6%	0.5%	0.5%	0.4%
Ukraine	0.6%	28	0.6%	0.6%	0.5%	0.4%	0.6%	0.6%
Mexico	0.5%	29	0.4%	0.5%	0.6%	0.4%	0.5%	0.6%
Czech Republic	0.5%	30	0.5%	0.5%	0.6%	0.3%	0.4%	0.6%
New Zealand	0.5%	31	0.5%	0.5%	0.5%	0.4%	0.3%	0.4%
Hungary	0.5%	32	0.5%	0.5%	0.5%	0.4%	0.4%	0.4%
South Africa	0.5%	33	0.5%	0.5%	0.5%	0.3%	0.4%	0.3%
Argentina	0.5%	34	0.4%	0.5%	0.6%	0.1%	0.2%	0.2%
Singapore	0.4%	35	0.3%	0.4%	0.5%	0.3%	0.5%	0.8%

The results completely meet all expectations: Roughly half the papers indexed in the Science & Technology edition were assigned to the field of engineering. The share of this field is thus almost five times as high as the corresponding share in the WoS, and this share continuously increases (from 43% in 1994/1995 to 61% in 2001/2002). Physics comes to one quarter of the database, followed by chemistry, geosciences and agriculture & ecology. Life-sciences play a secondary part in this database.

Table 2 presents the share of proceedings literature in the total publication outputs indexed by both the ISI Proceedings and the Web of Science databases in the period 1994–2002. About one half of engineering literature, about one third of geosciences and more than 20% of physics, agriculture and mathematics is covered by the ISI Proceedings. The ISI Proceedings database thus proved to have a complementary coverage to the WoS, and thus to form a valuable additional data source above all for bibliometrics in the applied and technical sciences.

Table 3 presents the national representation of the ISI Proceedings. Here coverage is restricted to the STP Edition. For comparison, the national representation of the Science Citation Index Expanded (SCIE) is added. Countries are ranked on basis of their total publication output in the two databases in the period 1994–2002. The 35 most active countries in the nine-year period have been selected. In order to visualise trends, the period has been split up into three sub-periods of three years each.

Although the national shares in the world total is similar to what was expected on basis of the SCIE, the large share of Chinese proceedings papers is worth mentioning. The evolution of China's share in the STP is spectacular: Its share has more than doubled during the period of nine years and China holds already rank four behind USA, Japan and Germany in 2000–2002. Although the USA still plays the central part in both the SCIE and STP database, their share decreases and this trend is quite dramatic in the proceedings literature. Canada follows this trend. The stable share of France and UK in the SCIE database is contrasted by their shrinking share in the STP. The only European countries with pronounced growth patterns are Spain and Poland; this evolution applies to both the SCIE and STP (cf. Table 3).

Transactional matrix analysis of national attendance on international scientific meetings

The second part is concerned with international information flows as reflected by scientific meetings. This part is based on all documents indexed in the ISI Proceedings database even if those are already indexed in the WoS.

Conferences have been assigned to the country where the conference took place (location country). Data based on source and location countries have been organised in a cross-national transaction matrix, the main diagonal of which contains contributions from the location country itself. The off-diagonal elements thus represent the pure

transactions among different countries. Three bibliometric measures recently introduced by GLÄNZEL et al. (2005b) have been applied: 1. the "import/export" relation measuring the Relative Attractivity (RA) of a country, 2. the Extent of Self-Transactions (EST) reflecting the preference of "staying at home" and 3. a measure designed to express unidirectional and mutual affinity of national scientific communities. Here we briefly summarise the definition of these indicators. In order to be able to define these variables in an accurate manner, we have first to introduce some mathematical rudiments concerning the transaction matrix.

The elements p_{ij} of transaction matrix $\mathbf{T} = \{p_{ij}\}$ denote the number of proceedings papers from country *i* in the proceedings of a conference held in country *j*. The total of out-transactions of country *i* can then be expressed as $\tau_{i*} = \sum_j p_{ij}$, that of in-transactions of country *j* correspondingly as $\tau_{*j} = \sum_i p_{ij}$. Self-transactions p_{ii} of country *i* will be denoted by σ_i.

The Relative Attractivity (RA) of a country is based on the off-diagonal elements of the transaction matrix. All self-transactions are thus eliminated. This indicator is defined in the following way.

$$RA_i = \frac{\tau_{*i} - \sigma_i}{\tau_{i*} - \sigma_i},$$

where *i* is a given country. The neutral value is 1.0. $RA_i > 1$ ($RA_i < 1$) means that relatively more (less) papers are attracted than the county contributes abroad. RA_i is infinity if the country does not contribute abroad. Furthermore, RA_i is not defined is a country has only self-transactions; however, we can hardly speak about international meetings if a country organises only conferences which are not attended by foreign scientists. Consequently, we can exclude this case.

The Extent of Self-Transactions (EST) is expressed through the relation of self-transactions with all in/out-transactions on basis of Salton's measure, namely,

$$EST_i = \frac{\sigma_i}{\sqrt{\tau_{i*} \cdot \tau_{*i}}}.$$

EST_i takes values in the interval [0, 1]; $EST_i = 1$ means that a country only contributes to its own conferences, and is also the only contributor to its own conferences, $EST_i = 0$ means that the country only contributes abroad. These two extreme values will in practice hardly be observed.

The total of national transactions, particularly the number of papers a country contributes at all conferences and the number of all papers at conferences organised by the country, is supplemented by the number of self-transactions and the values of the first two variables in Table 4.

Table 4. Indicator values characterising national transactions at international scientific meetings

Country	Transactions		σ	Relative Attractivity		Extent of ST	
	Out (τ_{i*})	In (τ_{*i})		Rank	Value	Rank	Value
Argentina	925	396	119	38	0.34	25	19.7%
Australia	5450	6887	1704	14	1.38	15	27.8%
Austria	2228	3284	279	8	1.54	39	10.3%
Belgium	3057	1812	269	30	0.55	36	11.4%
Brazil	3535	2223	957	32	0.49	10	34.1%
Canada	8734	12125	2211	10	1.52	23	21.5%
Czech Republic	1817	2375	384	13	1.39	27	18.5%
Denmark	1737	1446	120	25	0.82	42	7.6%
Egypt	565	283	129	37	0.35	11	32.3%
Finland	2154	1660	199	26	0.75	38	10.5%
France	13869	15641	3532	18	1.17	18	24.0%
Germany	20516	14420	4801	29	0.61	14	27.9%
Greece	1931	4590	675	1	3.12	20	22.7%
Hungary	1309	3171	268	2	2.79	32	13.2%
India	2665	1898	972	31	0.55	4	43.2%
Ireland	805	1133	110	11	1.47	35	11.5%
Israel	2027	874	202	36	0.37	31	15.2%
Italy	11331	12284	3099	19	1.12	17	26.3%
Japan	25301	14423	7606	33	0.39	7	39.8%
Korea	5852	2369	812	41	0.31	22	21.8%
Malaysia	543	651	282	12	1.41	3	47.4%
Mexico	1584	2192	424	9	1.52	19	22.8%

Table 4. (continued)

Country	Transactions		σ	Relative Attractivity		Extent of ST	
	Out (τ_{i*})	In (τ_{*i})		Rank	Value	Rank	Value
Netherlands	5248	4620	576	24	0.87	34	11.7%
New Zealand	1068	1132	393	20	1.09	8	35.7%
Norway	1067	398	77	40	0.32	33	11.8%
PR China	14035	13445	8387	23	0.90	1	61.1%
Poland	4387	5042	1610	16	1.24	9	34.2%
Portugal	1497	2307	178	7	1.61	41	9.6%
Romania	865	387	152	39	0.33	16	26.3%
Russia	7579	3623	2254	42	0.26	5	43.0%
Singapore	1893	1756	345	22	0.91	26	18.9%
Slovakia	573	839	223	6	1.76	12	32.2%
Slovenia	676	794	120	17	1.21	30	16.4%
South Africa	937	1459	264	5	1.78	21	22.6%
Spain	5781	7461	1381	15	1.38	24	21.0%
Sweden	3517	2555	291	28	0.70	40	9.7%
Switzerland	3793	3951	440	21	1.05	37	11.4%
Taiwan	3275	1502	395	34	0.38	28	17.8%
Turkey	1241	2616	303	3	2.47	29	16.8%
UK	16765	13060	4296	27	0.70	13	29.0%
Ukraine	1620	926	511	35	0.37	6	41.7%
USA	76557	98110	51594	4	1.86	2	59.5%

The central role of the USA in organising conferences and in contributing to scientific meetings has already been reported by GODIN (1998) for the period 1991–1993. One decade later the USA plays still the most important part in the world; 27.5% of all proceedings papers have an American author in 2002 and 35.3% of all papers indexed in the proceedings database were presented at conferences held in the USA. The share of US-authored papers is thus somewhat lower than in the WoS. Also the relatively low share of British papers is striking. On the other hand, the high activity in China was somewhat unexpected. The two variables, Relative Attractivity and Extent of Self-Transactions provide insight on two important aspects of bibliometric transactions.

The first important observation concerning these two variables is utmost striking: In/out-transactions and the preference of staying at home are almost uncorrelated variables; the correlation coefficient on basis of the 42 selected countries amounts to $r = 0.097$. Since the random variable

$$t = \sqrt{n-2}\,\frac{r}{\sqrt{1-r^2}}$$

has a *Student distribution* with parameter n–2, where n is the sample size, i.e., the number of countries and r is the correlation coefficient and the actual value $t = 0.617$ does not exceed the corresponding critical values $t_{40,*} = [1.303, 2.201]$ at any reasonable confidence level ($c_p = [0.900, 0.975]$) we can conclude that the two variables Relative Attractivity and Extent of Self-Transactions can be considered independent, indeed (cf. Figure 1). The two variables can thus be used to completely describe national transaction patterns in the context of proceedings literature.

The analysis of the relative attractivity measure RA clearly shows that several factors are simultaneously influencing attractivity thus creating a complex situation. Economic, intra-scientific, geopolitical and touristic-commercial factors are obviously among those aspects playing an important part in organising conferences and attracting contributions from abroad. Greece, Hungary and Turkey have the highest relative attractivity (RA > 2). Each paper these countries contribute abroad attracts on an average 2–3 papers from other countries at their conferences. Since the data are based on all fields combined, this effect can hardly be explained with intra-scientific and geopolitical reasons alone. The high RA value of the USA ranking fourth is quite plausible; America is a scientific super-power, and forms the centre of gravity in practically all science fields. On the other hand, countries like Argentina, Romania, Norway, Korea and Russia contribute about 3 papers abroad to attract one foreign at their conferences. Again, there is no recognisable intra-scientific and geopolitical reason in the background of this pattern.

Also the second indicator reflects strong national characteristics but this time with interesting geopolitical similarities. Also there seems to be a certain size-dependence since the big countries tend to appear rather on top (USA, China, Russia, UK,

Germany), but geographical similarities are conspicuous as, for instance, the very low share of self-transactions in the Nordic countries, low shares also in Austria and Switzerland, or – by contrast – the high shares of self-transactions in Russia and Ukraine. The range of the extent of self-transactions is huge; about 60% according to Salton's measure in China and the USA but only 10% or even less in Portugal and Scandinavia.

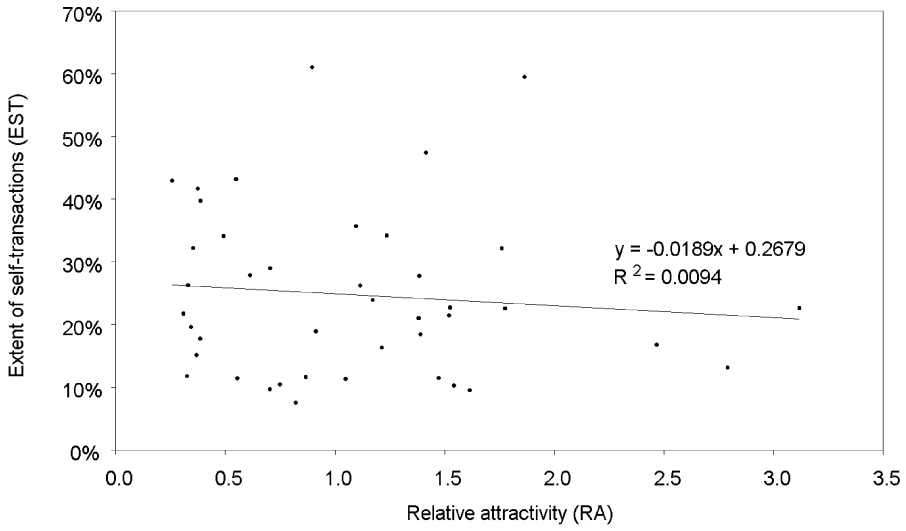


Figure 1 Plot of Extent of Self-Transactions (EST) vs. Relative Attractivity (RA) in 2002

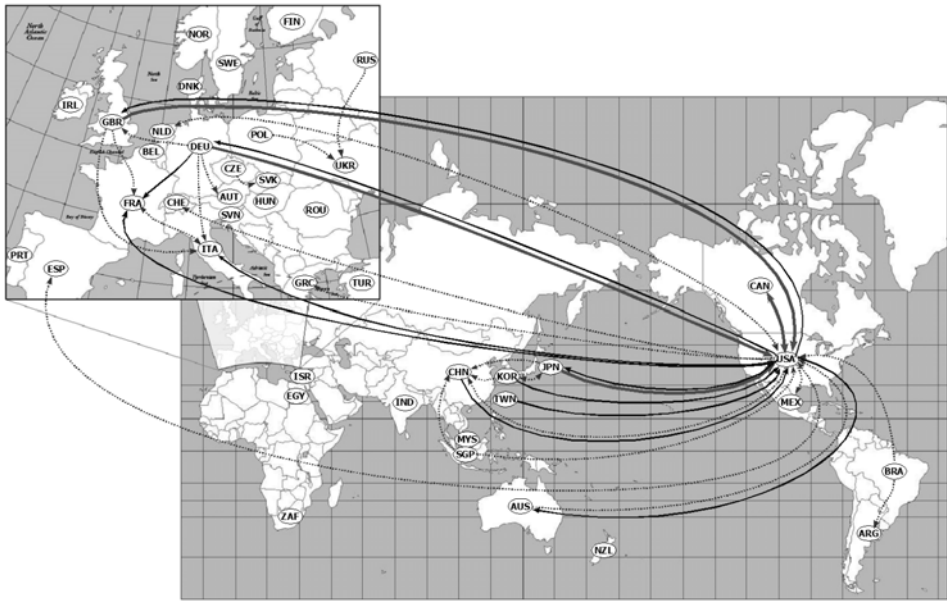
The analysis of the transaction matrix of the most active 42 countries is based on Salton's measure using the following formula:

$$r_{ij} = \frac{p_{ij}}{\sqrt{(\tau_{i*} - \sigma_i) \cdot (\tau_{*j} - \sigma_j)}} .$$

As expected from related studies (e.g., SCHUBERT et al., 1983; GLÄNZEL, 2001), national affinity shows non-symmetric patterns. Links are, of course, much stronger than in the case of co-authorship patterns. The results can be visualised in so-called 'scientopographical' maps introduced by SCHUBERT & BRAUN in 1996 (see Figure 2). We have used three zones of strengths: $0.075 \le r_{ij} < 0.100$ (medium), $0.100 \le r_{ij} < 0.150$ (strong) and $0.150 \le r_{ij}$ (very strong). If we compare these thresholds with those used in bibliometric studies of the network of internationally co-authored publications, links in the network of contributions to conferences are distinctly stronger.

However, this effect lies in the nature of (international) scientific meetings; their objective is to promote the exchange of scientific information through the attendance and presentation at conferences and finally through contributing to the proceedings.

The central role of the USA is obvious (cf. Figure 2). Extremely strong links are established with Canada (mutual relationship) and with three other scientific Great Powers, UK, Germany and Japan as attractors. However, the USA plays this part globally; many medium-strong links connect America with countries in Europe, Asia and Latin-America. Both important local and global centres in Europe are UK, France, Germany and Italy. Austria seems to be attractive not only to its northern neighbour Germany but also to the USA, although the strength of this link is somewhat below the given thresholds. In Asia a new Great Power is arising: China seems to evolve to a new centre attracting contributions above all from the southern and western neighbourhood, but China is also strongly contributing to US conferences. China has established somewhat weaker links ($0.05 \leq r_{ij} < 0.075$) also with Australia and Canada.



:: map source: Cartographic Research Lab, University of Alabama ::

Figure 2. 'Scientopographical' map representing unidirectional and mutual affinity of national scientific communities based on proceedings data in 2002 (dotted line ≥ 7.5%, solid line ≥ 10%, thick line ≥ 15%)

Beyond mutual relationships, strong asymmetries in bilateral links can also be found. The unidirectional links of Taiwan and South Korea with USA might serve just as examples.

The comparison of the above results with those of GLÄNZEL (2001) and GLÄNZEL & SCHUBERT (2004) clearly show that despite certain similarities between scientific co-publication patterns and 'conference transactions', national affinities are more pronounced in the latter ones and other factors are in part influencing transactions here.

Conclusions

The results of the first part of the paper of the study characterise the ISI Proceedings – especially in the applied and technical sciences, but also in the social sciences and humanities – as valuable supplement to the Web of Science database. The analysis conducted in the second part yields results that are, in part, somewhat unexpected. Above all, several medium-sized countries show interesting attractivity patterns. As mentioned above, certain similarity with collaboration patterns could be found. Nevertheless, contributions at international conferences are non-symmetric by nature and unidirectional affinities and strength of relationships are, of course, much more pronounced in the case of international meetings.

Tasks of future research will include the comparison of the present findings with those observed in co-publication studies, the analysis of the extent of international collaboration in proceedings and the role of the organising countries in collaboration as well as the comparison of national conference, research and publication profiles.

Although citations to proceedings papers published in non-serials are not yet available, to extend the citation analysis for journal papers indexed in the Web of Science on basis on the cited references included in ISI Proceedings databases might be another promising task of future research. Above all, engineering sciences, computer sciences and social sciences might benefit from such extension since this could essentially increase the validity of citation analysis in these fields.

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References

DROTT, M. C. (1995), Re-examining the role of conference papers in scholarly communication, *JASIS,* 46 (4) : 299–305.

GLÄNZEL, W. (2001), National characteristics in international scientific co-authorship, *Scientometrics*, 51 (1) : 69–115.

GLÄNZEL, W., SCHUBERT, A. (2003), A new classification scheme of science fields and subfields designed for scientometric evaluation purposes, *Scientometrics*, 56 (3) : 357–367.

GLÄNZEL, W., SCHUBERT, A. (2004), Analyzing scientific networks through co-authorship, In: H. F. M. MOED, W. GLÄNZEL, U. SCHMOCH (Eds), *Handbook of Quantitative science and Technology Research. The Use of Publication and Patent Statistics in Studies on S&T Systems*. Kluwer Academic Publishers, Dordrecht, The Netherlands, pp. 257–276.

GLÄNZEL, W., SCHLEMMER, B., SCHUBERT, A., THIJS, B. (2005a), Proceedings literature as additional data source for bibliometric analysis. In: P. INGWERSEN, B. LARSEN, *Proceedings of ISSI 2005 – the 10th International Conference of the International Society for Scientometrics and Informetrics*, Stockholm, Sweden, July 24-28, 2005, Karolinska University Press, pp. 159–167.

GLÄNZEL, W., SCHLEMMER, B., SCHUBERT, A. (2005b), A transactional matrix analysis of national attendance on international scientific meetings, In: L. VAUGHAN (Ed.), *Data, Information, and Knowledge in a Networked World*. Proceedings of the 2005 Annual Conference of the Canadian Association for Information Science (CAIS), held in London, Ontario (Canada) on June 2-4, 2005. http://www.cais-acsi.ca/proceedings/2005/glanzel_1_2005.pdf.

GODIN, B. (1998), Measuring knowledge flows between countries: The use of scientific meeting data, *Scientometrics,* 42 (3) : 313–323.

GOODRUM, A. A., MCCAIN, K. W., LAWRENCE, S., GILES, C. L. (2001), Scholarly publishing in the Internet age: a citation analysis of computer science literature. *Information Processing & Management*, 37 (5) : 661–675.

MARTENS, B., SARETZKI, T. (1993), Conferences and courses on biotechnology – describing scientific communication by exploratory methods, *Scientometrics*, 27 (3) : 237–260.

SCHUBERT, A., BRAUN, T. (1996), Scientopography – World maps and charts based on scientometric indicators. A bird's eye view on the metropolis and beyond. In: R. WAAST (Ed.), *20th Century Sciences: Beyond the Metropolis. Vol. 6. Sciences in the South: Current Issues*, ORSTOM, Paris, pp. 65–72.

SCHUBERT, A., ZSINDELY, S., BRAUN, T. (1983), Scientometric analysis of attendance at international scientific meetings, *Scientometrics*, 5 (3) : 177–187.

SODERQVIST, T., SILVERSTEIN, A. M. (1994a), Studying leadership and subdisciplinary structure of scientific disciplines – cluster-analysis of participation in scientific meetings, *Scientometrics*, 30 (1) : 243–258.

SODERQVIST, T., SILVERSTEIN, A. M. (1994b), Participation in scientific meetings – a new prosopographical approach to the disciplinary history of science – the case of immunology, 1951-72, *Social Studies of Science*, 24 (3) : 513–548.

ULUSOY, Ö. (1995), In search of a fair rating system for publications. *Journal of Information Science*, 21 (6) : 490–491.

Appendix
Key to field abbreviations and subject codes

Abbreviation	Code	Subject field
AGRI	A	Agriculture & Environment
BIOL	Z	Biology (Organismic & Supraorganismic Level)
BIOS	B	Biosciences (General, Cellular & Subcellular Biology; Genetics)
BIOM	R	Biomedical Research
CLI1	I	Clinical and Experimental Medicine I (General & Internal Medicine)
CLI2	M	Clinical and Experimental Medicine Ii (Non-Internal Medicine Specialties)
NEUR	N	Neuroscience & Behaviour
CHEM	C	Chemistry
PHYS	P	Physics
GEOS	G	Geosciences & Space Sciences
ENGN	E	Engineering
MATH	H	Mathematics
SOC1	S	Social Sciences I (General, Regional & Community Issues)
SOC2	O	Social Sciences II (Economical & Political Issues)
AHUM	U	Arts & Humanities