Behind citing-side normalization of citation impact: the determinants of the journal impact factor across fields

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Macro-level analysis of academic web performance: A country multidimensional ranking

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Introduction

The publication of the Shanghai Jiatong University's Academic Ranking of World Universities (ARWU) in 2003 had a strong impact in the higher education sector worldwide. Apart of considerations about individual universities ranks, most of the debate took part at national level, generating not only academic but political discussions in countries like France, Malaysia, Germany, Russia and others.
Other world rankings are today available but as they focusing in the so-called "World class" universities (about 500 universities) the country level analysis based on their data are still very descriptive. The Ranking Web is an exception as it intends to cover all the Higher Education Institutions (HEIs) with independent web presence, currently almost 18,000 HEIs.
The objective of this paper is to analyze the results from the Ranking Web at macro-level (country/regions) using both ranks and webometric indicators, but also other non-internet based variables (population, GDP).

Method

The Ranking Web of Universities (www.webometrics.info) is published two times (January and July) per year since 2003. Using commercial search engines (Google; Yahoo, Bing & Exalead) and a web based academic citation database (Google Scholar) several indicators of activity (web presence) and impact (link visibility) are extracted for building a composite indicator that allow to rank universities main webdomains.
The last edition was derived from data collected in January 2010 for about 18800 different webdomains. After selecting the best ranked domain in universities with duplicate domains, the final number of universities analyzed was 17,716.
For each HEIs the global, regional and national rank were obtained from the composite index WR (number of web pages -20%-; number of documents -15%-; number of papers -15%-; number of external inlinks -50%-), inspired by the Web Impact Factor and its ratio 1:1 between activity and impact.
A Country Scoreboard was build combining with equal weighting web and non web indicators for the Top 500 universities of the Ranking Web and their countries: The data were normalized with z-scores as follows: System: Number of universities of each country in the Top 500 divided by the mean position of those institutions. Access: A quintiles based score system divided by the population size. Flagship: A normalized score for the leading university rank of each country. Economic: Same score as the Access' one but divided by the GDP (PPP) per capita of the country.

Results

Table 1 shows a digital divide between North American and European universities at least for the top ranked HEIs, with Asian/Pacific far from these two regions, even considering they represent the 25% of the world top 8000 HEIs.

Table 1. Distribution of Top Universities by Region

Region	Top 100	Top 200	Top 500	Top 1000	Top 8000	TOTAL
North America	76	114	200	370	2577	3508
Europe	17	60	223	408	2424	4976
Asia	3	15	45	134	2009	4695
Oceania	2	6	14	35	80	135
Latin America	2	4	14	44	744	3498
Arab World	0	1	3	4	115	555
Africa	0	0	1	5	51	349

Figure 1 shows the relationship between the scoreboard values and the GDP per capita and population (square root) of each country. The correlations are low and not significant.
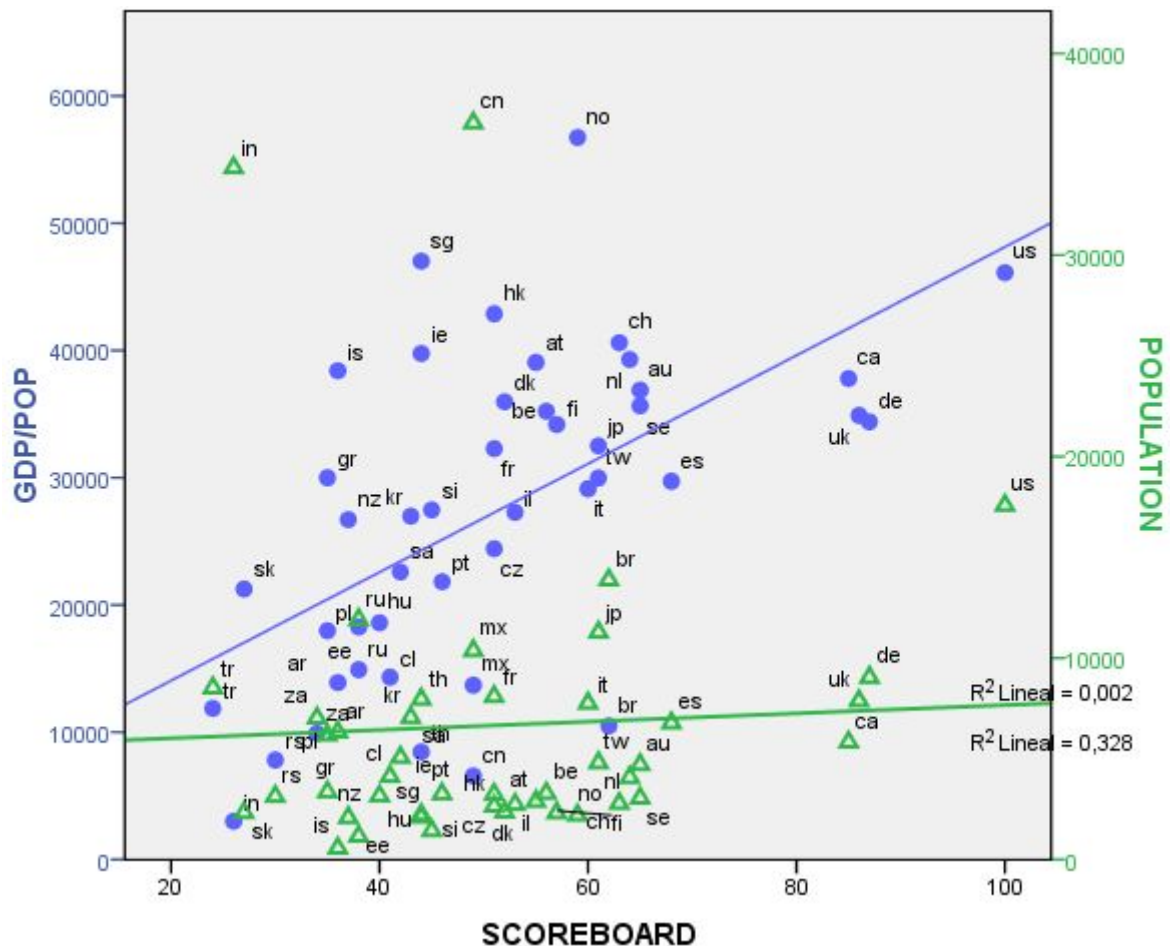
Figure 1. Country Scoreboard from Top500 universities in the Ranking Web

Explanations for this behaviour requires a better understanding of each university system, but also considering the representativeness of "world class" or research-oriented HEIs and the different attitude to web publication in the academia.

The Ranking Web is a good tool to explore in detail the situation of the universities of emerging and developing countries as it provides information beyond 500th rank (Table 1). For that group of countries, further analysis involving a larger number of universities could show that correlation between GDP and Scoreboard increases significantly.

This is a plea to use full list of research or academic institutions when global macro-analysis are intended.

Productivity differences across fields – a macro analysis
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Introduction

The purpose of this study is to gain knowledge about differences between disciplines with regard to average scholarly publishing productivity among faculty staff. The study is based on the total scholarly publication output of almost 12,000 researchers at the main Norwegian universities during four years.

Several previous studies have analyzed productivity at individual levels. It has been shown that the number of publications per person depends on various factors such as age, gender, academic position and rank, availability of research funds, teaching loads, equipment, research assistants, workload policies, department culture and working conditions, size of department and organizational context (Dundar & Lewis, 1998; Kyvik, 1993; Ramesh & Singh, 1998). In this study, we focus on differences in average productivity between major areas of research at a macro level. The academic position of the researchers is taken into account because it has been shown to be an important variable associated with productivity differences (Kyvik, 1993).

Data and methods

All institutions in the Higher Education Sector in Norway share a bibliographic database as part of a common documentation system. The database has a complete coverage of the scientific and scholarly publication output of the institutions. As the basis for this study, we selected publication data from the four major Norwegian universities (in Oslo, Bergen, Trondheim, and Tromsø) for the four year period 2005–2008.

In order to provide information on individual characteristics of the persons (institutional affiliations, position), the bibliographic database was coupled at the level of individuals to another database, the *Norwegian Research Personnel Register*. The latter database has biographical information for all researchers in the Higher Education Sector and Institute Sector in Norway.

The publications of the staff at individual departments were assigned to five broad fields: Humanities, Social Sciences, Natural Sciences, Medicine, and Engineering.

Three publication indicators were calculated:

- Average number of publications (whole counts) per person
- Average number of fractionalised publications per person (each publication is divided by its number of authors)
- Average number of article equivalents per person (fractionalised publication counts combined with a weighting of monographs as equal to 5 articles (in journals or books)

Results

Preliminary results of our study are shown in Table 1.

Table 1. Average number of publications per person 2005-2008, by field and academic position

Field	Position*	Number of persons	Whole counts	Fractionalised counts	Fractionalised article equivalents
Humanities	Professors	402	5.6	4.9	6.1
Social sciences		530	7.6	4.4	5.3
Natural sciences		591	13.8	3.6	3.7
Engineering		284	12.6	4.3	4.5
Medicine		530	13.5	2.9	2.9
Humanities	Associate professors	337	3.9	3.4	4.4
Social sciences		497	4.9	3.0	3.5
Natural sciences		366	6.9	2.2	2.2
Engineering		150	7.6	2.6	2.7
Medicine		302	6.5	1.7	1.7
Humanities	Post docs	138	3.6	3.0	3.7
Social sciences		182	4.8	3.0	3.7
Natural sciences		525	5.9	1.6	1.6
Engineering		218	6.2	2.0	2.1
Medicine		494	5.1	1.0	1.0
Humanities	PhD-students	239	1.9	1.6	1.8
Social sciences		496	2.8	1.6	1.8
Natural sciences		893	3.6	0.9	0.9
Engineering		660	3.3	1.1	1.1
Medicine		1127	3.0	0.5	0.5
Humanities	Others**	395	2.9	2.4	2.9
Social sciences		677	3.8	2.2	2.6
Natural sciences		918	5.0	1.2	1.3
Engineering		502	4.5	1.4	1.4
Medicine		2147	5.0	0.9	0.9
Humanities	Total	1233	3.7	3.2	4.0
Social sciences		1865	4.6	2.7	3.2
Natural sciences		2685	6.5	1.7	1.7
Engineering		1501	5.6	1.9	1.9
Medicine		3746	5.5	1.1	1.1

*) Persons who have changed academic position during the time period are classified and included in more than one category.
**) Includes a variety of other positions: adjunct professors and other scientific positions (e.g. researchers), medical doctors, administrative and technical personnel, as well as retired persons.

The scientific publishing productivity shows large variation between fields and academic positions. As expected, the number of publications per researcher is much higher in the natural sciences, engineering and medicine than in the humanities and the social sciences when using whole count measures. However, due to the higher number of authors per publication in the first fields, the productivity drops significantly when using fractionalized measures. In fact, the fractionalized productivity measures are substantially higher in the humanities and the social sciences than in the other fields. Possible explanations and methodological implications will be discussed in our full paper.
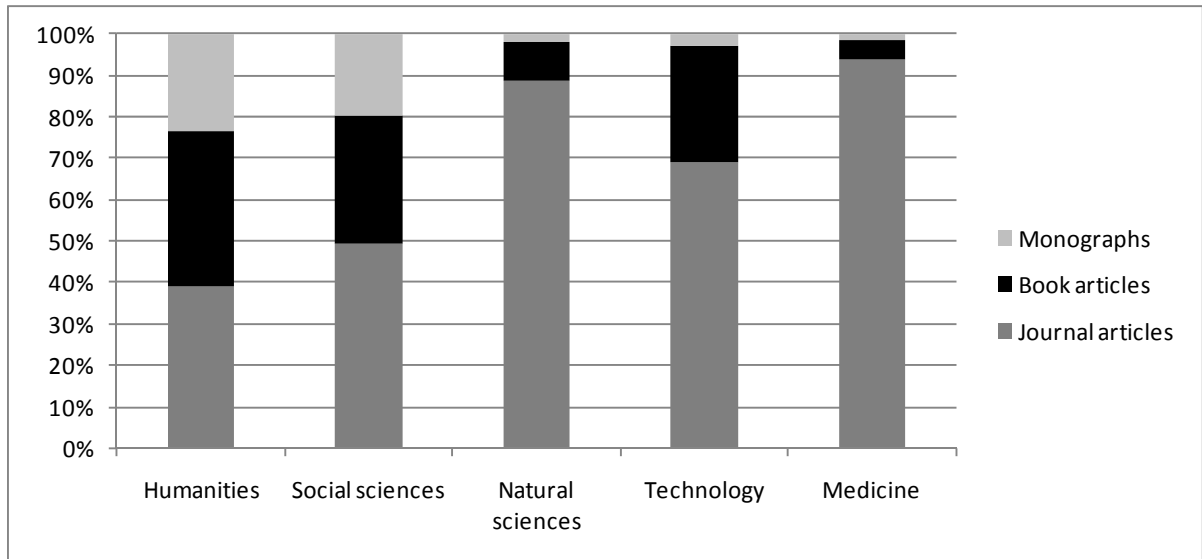
Figure 1. Publication types in five major areas, proportion of article equivalents (N=59,861)

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The Skewness of Science in 219 Sub-Fields and a Number of Aggregates

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Abstract

It is generally believed that citation distributions in the periodical literature are highly skewed. Moreover, it is often thought that they can be represented by power laws. However, after many years since the classical papers by Price (1965) and Seglen's (1992), there is little systematic evidence about whether this is the case in practice. This paper studies massive evidence at different aggregation levels for a large sample acquired from Thomson Scientific consisting of 3.6 million scientific articles published in 1998-2002 with a five-year citation window.

In the first place, two issues are studied for 219 scientific sub-fields identified with Web of Science categories. Firstly, using the Characteristic Scores and Scales technique pioneered by Schubert *et al.* (1987), it is found that the mean citation rate is about 19 percentage points to the right of the median, and articles with a remarkable or outstanding number of citations represent about 10% of the total. Secondly, the existence of a power law representing the upper tail of citation distributions cannot be rejected in 180 sub-fields whose articles represent 77.4% of the total. Contrary to the evidence in other contexts, the value of the scale parameter is greater than three in 159 cases. Power laws are typically small (representing on average 6% of the total sub-field size) but capture a considerable proportion (about 31%) of the total citations received.

In the second place, similar results are now being investigated for two aggregation schemes inspired in Glänzel and Schubert (2003) and Tijssen and van Leeuwen (2003). The 219 sub-fields are aggregated into 67 disciplines and 15 broad fields in the first case, and into 38 disciplines and 22 broad fields in the second case. Special attention will be paid to the maintenance or dissolution of power laws at the upper level when they already exist at the lower level, as well as to the generation of power laws at the upper level when they did not exist in all sub-fields at the lower level.

A time and field dependent h-type index for individual scientific performance measuring

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Introduction

The last few years, the focus of public research funding is directed increasingly towards individual programs of excellence. Research excellence is a complex and multicharacteristic concept which cannot be evaluated along a single dimensional line (Tijssen 2002, 2003). Apart from factors such as the managerial capacities of the researcher, societal value of the proposal and intrinsic project risk, the publication/citation profile of a researcher remains one of the major issues in assessing research potential. Bibliometric indicators at individual level are therefore increasingly requested for both the purpose of project allocation decisions and research assessment exercises.

The legitimacy of bibliometric indicators at individual level is strongly debated. Using an indicator obeying minimal ex ante requirements is as such fundamental. Rons and Amez (2009) describe a set of premises by which a workable excellence measure ideally ought to be inspired. Apart from being a balanced reflector of a researcher's capacities, the most important criteria for indicators to be used for allocation decisions are the acknowledgement of the nature of scientific communication and the independency of carrier length in the sense of not showing bias towards and favouring the achievements that were established in the far past. Excellence programs generally seek for researchers finding themselves at expansive stages of their careers.

Few indicators were developed with the specific aim of being applied at individual level of evaluation. The so called crown indicator (Van Raan 2006), the normalised mean citation rate (Glänzel et al. 2009), was intended as a measure rather to be implemented at more aggregated levels and can only be justified at micro level conditional on minimal publication volume and a sufficiently and conscientiously identified publication set. The h-index (Hirsch 2005), on the contrary, was designed with the intention to be used for individual assessment. A scientist has an index value of h if h of his or her published papers have at least h citations each. Catching both the publication and the citation volume into a single number, and being straightforward to calculate, the h-index became one of the most popular individual assessment measures. Its strengths and weaknesses have been largely commented in scientific literature (Glanzel 2006, Costas and Bordons 2007, Van Raan 2006) and some alternatives such as the g-index (Egghe 2006) and Jin's R- and RA-index (Jin 2007) were presented to deal with some of its shortcomings.

Method

The presented poster bears on some criteria, considered as important qualities for an individual excellence measure to possess, but not present in the traditional h-index, such as the independence of career length and the acknowledgement of the inter-field differences in publication and citation practices. Starting from elements of criticisms on the original h-index a modified measure is suggested which is 1. scaled for the field of the publication 2. considered over a limited time span 3. normalised at the level of publication before calculation. The indicator is tested on a dataset of German price winning scientists, considered as excellent in their field, and over a fixed publication and citation period just before the price was awarded. The publication set of each scientist was composed joining Thomson-Reuters Web of Science and CV information. Results are compared with traditional h-index outcomes and NMCR scores by calculating and visualising the interrelationship between the different measures.

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Dynamic research profile visualisation using cluster transition

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Introduction

Aalborg Hospital annually assesses research and innovation using a model of five composite indicators of funding, scholarly publishing, mediation, other scientific communication and innovation & technology transfer. Previous research (Andersen, 2009) has shown that clustering methods can group hospital departments into profiles, visualising distributions of indicators. The purpose of these profiles is to provide research managers with a tool for providing latent information about the research and innovation output of individual departments. Coccia (2008) conducted related research on the national level (for Italy), also showing the usefulness of profiling for research management.

This study builds on previous research (Andersen, 2009), but uses data from several years. The purpose of this is to describe the progress of research departments over time, as the transition of a department from one profile to another, and thus explore if this approach gives research managers additional information.

Materials & Methods

Data were collected for a three-year period (2007-2009), covering five indicators. 34 different hospital departments were included in the assessment. Annual profiles were formed as vectors for each department and an agglomerative clustering method was applied to measure the similarity of departments. Similarity was measured with cosine. The vector values were calculated as means of the current and previous year to minimise noise (except for 2007 which used raw scores).

Based on similarities of the initial data (2007) a threshold for forming clusters was decided upon (similarity = 0.8), and the clusters were created according to this threshold. Each cluster was labelled in accordance with the profile (distribution of indicators) of the included departments. For the purpose of visualisation, clusters were displayed in columns, where each cluster is placed with its nearest neighbours. As annual clusters were created independently of previous formations it is expected that some departments will move between clusters or split or merge clusters. These cluster transitions are visualised by lines between the annual columns, thereby providing information about which departments shift focus, e.g. by improving publishing activities.

Results

The data shows no merges or splits in clusters, although both cases are close, nearing the 0.8 threshold in 2009. Also, the profiles represented in the clusters remain (see Figure 1.). Several departments change their profile over time, and it is possible to see some very substantial changes as well (e.g., DEP 33 moves from the highest publishing group to the low-output group).
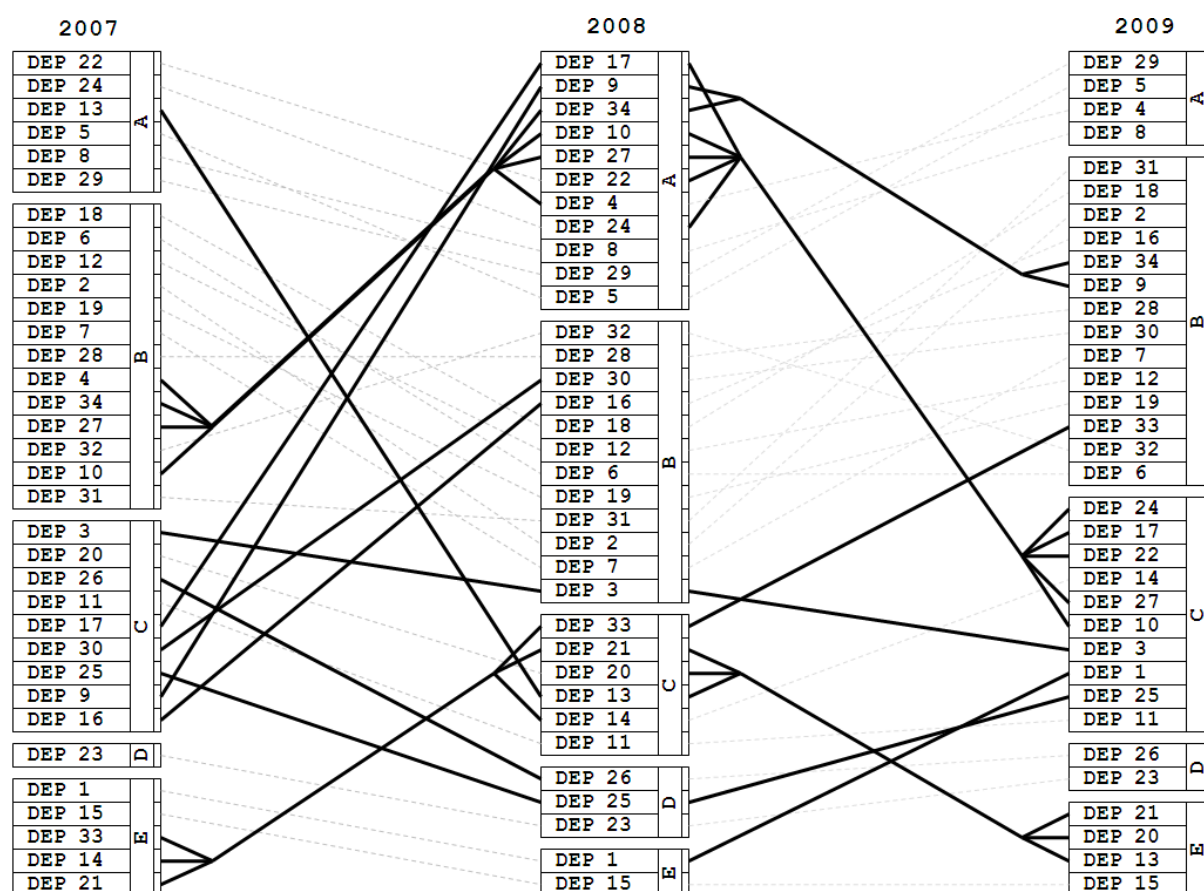
Figure 1. Transitions between clusters are shown by solid lines between same departments. Dotted lines indicate departments remaining in the same cluster. Cluster labels: A High-networking & other research activities, medium publishing; B – low-output; C – All-round high, low mediation; D – Highly innovative; E – Top publishing

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Individual Researchers' Research Productivity: A Comparative Analysis of Counting Methods

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Introduction

Productivity can be studied at different scales (e.g., country, organisation, author). The present work examines productivity at the researcher level, with the financial support received by researchers representing input and researchers' papers representing output. Regardless of the scale at which productivity is examined, science must be considered a collective endeavour, particularly since there is a growing trend towards more collaboration in nearly every field. Importantly though, very distinct collaboration practices exist across fields of research. For instance, over 90% of the papers in the natural sciences and engineering (NSE) are written in collaboration (more than one author), whereas this proportion is 60% in the social sciences and 10% in the humanities (Larivière, Gingras and Archambault, 2006). Whether one uses fractional or whole counts can be expected to yield hugely different productivity measures (Lindsey, 1980; Egghe, Rousseau, and Van Hooydonk, 2000; Gauffriau, M. et al., 2008). This paper examines how fractional versus whole-paper counting affects the measurement of researchers' performance in the social sciences and the humanities (SSH) versus in the NSE.

Method

This paper uses a very large dataset comprising funding, publication and citation data of all professors and university-based researchers (hereafter "researchers") in the Canadian province of Quebec over the 2000–2007 period (1999–2006 for funding). To compile this dataset, lists of researchers (n=13,479) were obtained from Quebec's Ministère du développement économique, de l'innovation et de l'exportation, and its three research councils. Bibliometric indicators in this paper were calculated using Thomson Reuters' Web of Science database for the 2000–2007 period (n=62,026 papers). Research funding comes from the SIRU database. Statistics on output per researcher were computed for researchers with at least one paper, while those on output per research dollar were computed for researchers with at least one paper and one dollar of financial support. This was deemed necessary so that the fact that researchers in the SSH often prefer books to peer-reviewed journals could be taken into account (Larivière et al., 2006).

Results

Table 1 shows that when full-paper counting is used, researchers in the basic medical sciences are the most productive, followed closely by natural scientists. Health sciences and engineering researchers follow at a certain distance, while those in the humanities and various social sciences trail noticeably. However, fractional counting evens things out in a drastic manner: productivity falls to one paper every other year,

on average, in the natural sciences (i.e., 4.1 papers over the eight-year period). Researchers in the SSH were half as productive, i.e., one full-paper equivalent every four years. Education researchers did not produce the equivalent of a full paper during the eight year period.

Table 1. Difference in measured productivity, full and fractional counting, 2000–2007

Field	Full counting	Fractional counting	Ratio (Full/Fractional)
Natural Sciences	17,4	4,1	4,2
Engineering	13,2	3,7	3,6
Basic Medical Sciences	20,3	3,3	6,3
Health Sciences	14,6	2,3	6,5
Humanities	2,5	2,1	1,2
Social Sciences	6,9	2,1	3,4
Business & Management	4,5	1,4	3,1
Non-Health Professional	4,4	1,4	3,1
Education	2,3	0,6	3,6

If one looks at productivity per research dollar, the results are even more striking: whereas papers in the basic medical sciences cost in excess of \$475,000 on average, researchers in the humanities produced papers for less than \$75,000 each. As previously noted, SSH researchers usually prefer to publish books instead of papers. Moreover, Thomson Reuters seriously underestimates the production of works in languages other than English, which are common in the SSH (Archambault et al., 2006). This means that productivity in the SSH is underestimated and the cost per publication in the SSH is likely substantially lower in reality.
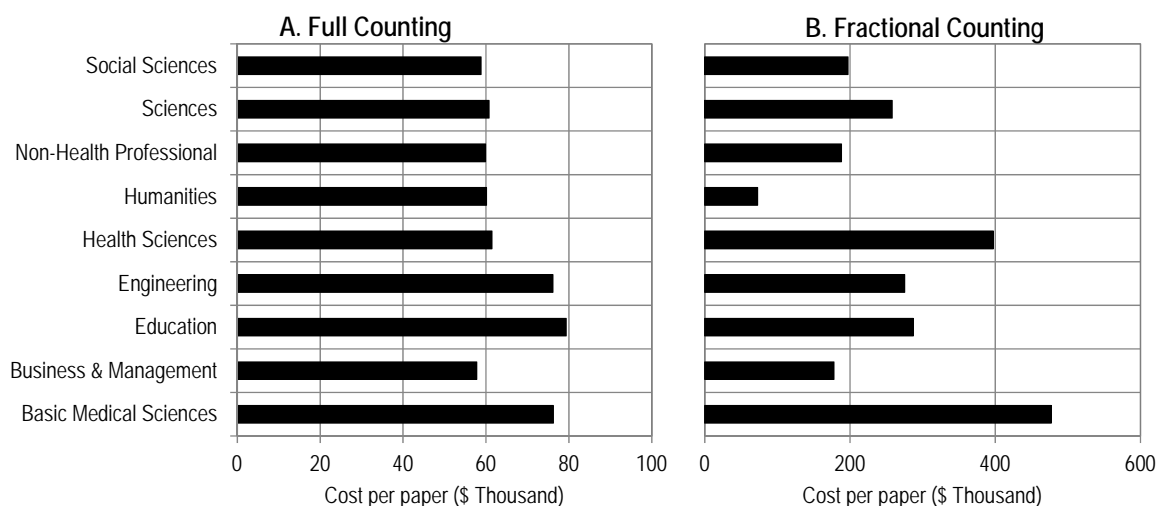
Figure 1. Cost per paper, fractional and full counting, by discipline, 2000–2007

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Exploring indicators of Open Innovation: The role of co-patents

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Introduction

This paper investigates the relevance of co-patents – i.e. patents applied for by different assignees – as an indicator of Open Innovation. Recently the importance of collaborative innovation and networking has been widely acknowledged: many authors have underlined that firms should not rely only on their own internal innovations but can benefit by engaging in transactions and collaborative efforts with external parties (e.g., Chesbrough, 2003). In this regard many authors (e.g., Etzkowitz and Leydesdorff, 1998) previously highlighted a complex and dynamic process of interactions between University, Industry and Governments instrumental for transferring and creating knowledge among the organizations involved. These processes can influence innovation performance (e.g., Cohen and Levinthal, 1990, Shan et al., 1994) and act as sources of competitive advantage for private firms (e.g., Spencer, 2001).

Given the importance of these collaborative innovation activities, several studies have focused on interactions among organizations, especially trying to understand their effects on firm's innovative performance (e.g. Hagedoorn & Schakenraad, 1994; Powel et al. 1996; Rothaermel & Deeds, 2004). Recently, co-patents are being introduced, within innovation and technology studies (e.g., Lee et al., 2008; Lecocq & Van Looy, 2009; Belderbos et al., 2010). At the same time, a systematic assessment of the occurrence and nature of co-patents is lacking. Within this contribution we analyze whether co-patenting can be considered as a proper indicator of inter-organizational knowledge flows, evaluating its impact from the viewpoint of countries, technological fields and quality of underlying inventions.

Data and Methods

Building on PATSTAT database and citations data contained in OECD citations database (Webb et al., 2005), we obtained information on patents and co-patents in terms of applicant country, priority/application year and amount of citations from subsequent publications. Self-citations have been detected by relying on the name harmonizing algorithms developed by Magerman et al. (2009). These efforts resulted in a dataset containing relevant information on about 640,000 EPO patents with at least one applicant from EU-15.

Within a first step we explore and analyze the occurrence of co-patents over time as well as by applicant country and field (applicants). Then, we engage in a comparison of co-applicants' names with the organizations involved in technology/R&D alliances, contained in the CATI database, frequently used to asses the occurrence of this kind of agreements at institutional level (Hagedoorn and van Ekert, 2002; Shilling, 2009). The aim is to understand the relationships between the two databases and in particular

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if and to what extent technology agreements flow into co-patented inventions. In a final step we analyze the citations patterns of co-patents, which can be considered as signalling the impact or quality of underlying inventions (Harhoff et al., 1999, Hall et al., 2005).

Results

Descriptive statistics indicate that the inclination/propensity to co-patent varies significantly as a function of applicant country and technology field. At the same time, our findings reveal that co-patent data signal much more alliances – on average 10 times more – than included in the CATI database. About patent quality, we apply Negative Binomial Regression of the amount of citations on the dummy *Copat* (1 if co-patent, 0 otherwise), entering country, field and time as control variables (also considering their interaction effect), building 5 different models (as Table 1 clarifies). It becomes apparent that co-patents receive on average more citations (even after removing 'self citations') than single owned patents; at the same time the presence of this positive relationship is country and field specific. Overall, our findings clearly suggest that co-patents can act as valuable and relevant indicator of collaboration, at least for technological fields characterized by a high propensity to patent. Implications and limitations will be discussed.

Table 1. Citations patterns

	Model 1	Model 2	Model 3	Model 4	Model 5
[Copat=1,00]	Positive P value < 0,001	Positive P value < 0,001	Positive P value < 0,001	Positive P value < 0,001	Positive – Field/country dependent
Applt_ctry		Significant P value < 0,001		Significant P value < 0,001	Significant P value < 0,001
FhG_class			Significant P value < 0,001	Significant P value < 0,001	Significant P value < 0,001
*Copat * FhG_class*					Significant P value < 0,001
*Copat * Applt_ctry*					Significant P value < 0,001
*FhG_class * Applt_ctry*					Significant P value < 0,001
Time	Positive P value < 0,001	Positive P value < 0,001	Positive P value < 0,001	Positive P value < 0,001	Positive P value < 0,001
Time^2	Negative P value < 0,001	Negative P value < 0,001	Negative P value < 0,001	Negative P value < 0,001	Negative P value < 0,001

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Google Scholar Citations to Information and Library Science Journals

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Introduction

JCR journal categories are often criticized. The "Information and Library Science" category is no exception. The list for 2008 is comprised of 61 journals including a large number of information systems journals. The Scopus category "Library and Information Science" as of April 2010 (http://info.scopus.com/documents/files/scopus-training/resourcelibrary/xls/titlelist.xls) contains 175 journals. The two major field specific bibliographical databases, LISA and LLit, index currently 414 and 155 journals respectively. Do WOS and Scopus index the "best" journals in the field? This is a difficult question. In the past attempts were made to create ranked lists of journals in the field by surveying prominent researchers and librarians (e.g., Nisonger, 1999; Nisonger & Davis, 2005). In this paper we propose a different approach. We will use Google Scholar as an independent citation database to count the number of citations received until the end of June 2010 to articles published between 2000 and 2004 in the journals listed in the four above-mentioned sources. More precisely, instead of the citation counts we will use the h and g-indexes (Hirsch, 2005; Egghe; 2006; Braun, Glänzel & Schubert, 2006) of the journals as a measure supporting their prominence.

Method

The h and g-indexes for the union list of 505 journals obtained from the four bibliographical databases were recorded using Harzing's "Publish or Perish" software (http://www.harzing.com/pop.htm). "Publish or Perish" computes a large number of measures for the items retrieved from Google Scholar. One has to take into account that Google Scholar data is far from perfect (e.g. Jacsó, 2008; Bar-Ilan, 2009). Some of the journals have highly ambiguous names, attempts were made to clean the data, but for 28 journals it was impossible to obtain reasonable citation counts, thus they were excluded. There is also a limitation on the length of the journal title and sometimes Google Scholar only records a partial title. Various ad-hoc methods were employed in an attempt to overcome at least some of the problems.

Results

Table 1 displays the list of 51 journals with h-index 30 or above, for articles published in 2000-2004 and cited by the end of June 2010. For Scopus and WOS, for those journals that are not listed in the considered category, we checked whether the journal is indexed in another category. For such journals a + sign is placed in the appropriate cell. Fourteen journals in the WOS LIS category have h-index 15 or less. It is not clear whether all the journals in the list can be considered LIS journals, but the list was created based on the information from the bibliographical databases.

Conclusion

The method proposed here can be utilized to assess the visibility of non-source journals in WOS or Scopus, while taking into account the limitations of working with Google Scholar.

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Table 1. LIS journals

Serial title	LISA	Scopus	WOS	Llit	h	g
IEEE Transactions on Information Theory		y	+		120	258
Computer Networks	y	+	+		84	165
Artificial Intelligence	y	+	+		80	140
Journal of the American Society for Information Science and Technology	y	+	y	y	74	104
Journal of the American Medical Informatics Association		+	y		69	107
Journal of Management Information Systems		+	y		68	126
IEEE Intelligent Systems	y	+	+		67	128
Information Systems Research		y	y		66	133
International Journal of Human-Computer Studies	y	+	+		66	106
Journal of Knowledge Management	y	+	+		54	91
Information Processing & Management	y	y	y	y	54	91
Computer Communications	y	+	+		52	90
MIS Quarterly		+	y		50	107
ACM Transactions on Information Systems	y	+	+		49	102
Journal of Intellectual Capital	y	+			49	80
ACM Transactions on Computer-Human Interaction	y	+	+		48	94
Scientometrics	y	y	y		46	65
Human-Computer Interaction	y	+	+		44	97
Journal of Communication	y	+	+		44	70
Internet Research: Electronic Networking Applications and Policy	y	+	+	y	44	66
Artificial Intelligence in Medicine	y	+	+		44	62
AI Magazine	y	+	+		44	83
European Journal of Information Systems	y	y	+		44	71
Information Society	y	+	y		43	76
Information and Software Technology	y	+	+		42	62
Information Systems Journal		+	y		41	65
International Journal of Information	y	y	y		40	64

Management						
Telecommunications Policy	y	+	y		40	60
D-Lib Magazine	y	y			39	62
First Monday	y	+		y	39	78
Interacting with Computers	y	+	+		39	67
Journal of Medical Internet Research	y	+	+		39	61
Journal of Computer-Mediated Communication		+	y		38	67
Knowledge-Based Systems	y	+	+		38	55
Behaviour and Information Technology	y	+	+		36	56
Journal of Strategic Information Systems	y	+	+		36	73
Internet and Higher Education		+	+	y	36	61
Journal of Health Communication		y	y		36	52
Journal of Information Technology	y	y	y		35	62
Journalism and Mass Communication Quarterly	y	+	+		35	58
Journal of Documentation	y	y	y	y	35	70
Information Retrieval		y	+		34	66
Information Technology & People	y	y			34	55
Journal of Academic Librarianship	y	y	y	y	34	47
Social Science Computer Review	y	y	y		34	56
Applied Intelligence	y	+	+		33	48
Information Research	y	y	y		33	56
Media, Culture & Society	y	+	+		33	45
Information Communication and Society		y			32	54
Information Systems Management		y	+		31	46
College & Research Libraries	y	y	y	y	30	46
Total indexed	**39**	**51 (18 in LibInf category)**	**46 (19 in InfLib category)**	**8**		

Scholarly communication in business administration and management science: German-language vs. international journals

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Introduction

German-language business administration and management science had a relatively strong central European orientation in the past. This is also reflected by several high-quality German-language journals from which only one periodical ("Betriebswirtschaftliche Forschung und Praxis") is included in the JCR. This lead to an ongoing discussion among researchers in the field whether an article in a German-language journal has the same "value" as in an international journal.

Method

It is the goal of this contribution to compare German-language business administration journals with their equivalents included in JCR subject categories "business", "management" and "business, finance" with regard to most common indicators of science communication (impact factor, citations per article, references per article, immediacy index, cited half-life, citing half-life, self-reference rate). Furthermore, it will be investigated to which extent German-language authors pick up research results from the international journals and to which extent there is an information transfer in the other direction. This should clarify if there still is a strong "German tradition" in business administration and management science. In order to analyse this issue we computed the degree centrality and degree prestige and plotted the citation graph. Finally, we tried to identify the subfields of the 168 journals on the basis of their mutual citations.

The following German-language journals were analysed: „Betriebswirtschaftliche Forschung und Praxis" (BFuP), „Die Betriebswirtschaft" (DBW), „Die Unternehmung" (DU), „Journal für Betriebswirtschaft" (JfB), „Zeitschrift für Betriebswirtschaft" (ZfB), „Zeitschrift für betriebswirtschaftliche Forschung" (ZfbF) and „Schmalenbach Business Review" (SBR) (actually this journal is part of ZfbF and publishes English-language articles). For the calculation of the impact factor of the German-language journals we used the formula by Sen, Karanjai and Munshi (1989). Accordingly, for each German-language journal we counted the number of citations each journal received from the other six German periodicals and added the WoS citations which each German journal received from a JCR journal. In total the seven German-language journals included 208 articles and 11181 references in 2006. Data for the international journals were collected from JCR.

Results

As can be seen in Table 1, the German-language journals can only be found at the bottom of the impact factor and citation per article rankings. The only two journals

which are located closer to centre span in the impact factor ranking are DBW and SBR. However, not such a clear distinction between German-language and JCR journals can be made with regard to number of references per article, immediacy index, citing half-life and cited half-life. There is only one further interesting phenomenon: German-language journals have a lower self-citation rate indicating that a language focus other than English does not necessarily mean a smaller openness. This is also confirmed by the degree centrality according to which all German-language journals are placed in the upper half of the corresponding ranking. Accordingly, there is a high information flow from JCR journals to German-language periodicals. However, there is hardly any information transfer to the international journals which might be due to the language barrier (see Figure 1). The results of the network analysis show that existing JCR subject categories are not ideal (for instance, there is a high overlap between "business" and "management") and that a division into functional business administration categories could be a better alternative.

Table 1. Journal indicators of German-language business administration and management journals in relation to JCR periodicals included in subject categories "business", "management" and "business, finance" (altogether 168 periodicals)

Journal	IF	Rank	Cit/art	Rank	Ref/art	Rank	II	Rank	CHL	Rank	SR(%)	Rank
BFuP	0.235	155	3.1	151	42.7	87	0.17	69	6.4	120	1.6	141
DBW	0.645	105	5.9	137	69.1	30	0.06	115	6.5	119	1.8	136
DU	0.250	152	1.3	158	48.3	74	0.04	131	4.0	153	0.8	155
JfB	0.080	166	0.4	161	78.5	15	0.00	143	2.8	157	0.0	160
SBR	0.543	115	3.4	149	44.0	82	0.28	42	3.9	155	0.6	157
ZfB	0.414	140	7.4	127	56.3	58	0.04	129	8.5	65	2.2	129
ZfbF	0.348	143	5.7	139	50.4	67	0.49	14	8.6	61	3.6	105

BFuP="Betriebswirtschaftliche Forschung und Praxis", DBW="Die Betriebswirtschaft", DU="Die Unternehmung", JfB="Journal für Betriebswirtschaft", SBR="Schmalenbach Business Review", ZfB="Zeitschrift für Betriebswirtschaft", ZfbF="Zeitschrift für betriebswirtschaftliche Forschung"
IF=impact factor, Cit/art=citations per article, Ref/art=references per article, II=Immediacy Index, CHL=Cited Half-Life, SR(%)=Self reference rate

Figure 1. Citations between German-language (in light blue and encircled) and JCR journals (threshold: only relations with more than 10 citations are displayed)

Fuel cells and battery technology in the age of electric vehicles: Have Europe and North America bet on the wrong horse?

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Introduction

As a major transition to electric vehicles (EVs) appears to be gaining momentum, governments are increasingly recognising battery technology as a field of strategic importance. Particularly in the US, there is growing concern that Asian strengths in battery technology could give Japanese, Korean and Chinese industry an important competitive advantage in hybrid, plug-in hybrid and pure electric vehicles (Brodd, 2005; Grove and Burgelman, 2008; Murphy, 2008). This may have prompted the Obama administration to offer US$1.5 billion in grants to US manufacturers of advanced batteries. At the same time, automotive industry and government interest in hydrogen and fuel cell vehicles appears to be waning. While demonstration activity continues, many now believe EVs have much stronger chances of achieving commercial success (King, 2007; Romm, 2006).

Methods

What do these trends imply for the firms, industries and countries that have invested heavily in fuel cells while neglecting battery technology? In the present study, we use patent statistics, based on a dataset comprising over 30,000 power source related US patents and complemented by qualitative industry data, to show that the automotive industry, and European industry in general, may have over-invested in fuel cell technology relative to battery technology. In fact, Japan and Korea have increasingly specialised in batteries (Table 1).

In addition, industry specialisation index scores and other data reveal that, compared to other sectors, the automotive industry (including Japanese manufacturers) has tended to invest more on fuel cell technology than batteries. Only the academic sector places more emphasis on fuel cells than the auto industry. Partly as a result of this imbalance in IP, vehicle manufacturers developing hybrids and EVs are forced to work with established consumer electronics manufacturers such as Panasonic and Sanyo, who are the driving forces of innovation in battery technology since the 1980s.

Two major implications may be drawn. On the one hand, strong technological and organisational linkages between the automotive and consumer electronics industries, which share a similar requirement for high energy density electricity storage, could accelerate the development and commercialisation of EVs. These linkages allow vehicle developers to draw on a steady flow of spillovers from the consumer

electronics industry, including technological innovations, skilled workers and engineers, cheap materials, high-volume manufacturing capacity and related know-how (Beaudet, 2010).

On the other hand, the wider trend is clear: if the world transitions to electric vehicles, Asian countries led by Japan stand to benefit the most (Figure 1). Indeed, not only does Japan dominate in terms of patents and specialisation, but its patents are also more cited, on average, than those of most other countries (with the exception of the US, which benefits from the home country bias effect). In Japan, spillovers from local consumer electronics industries are complemented with in-house knowledge of batteries gained through R&D as well hybrid vehicle development and manufacturing. Indeed, while all vehicle manufacturers are dependent on the (Asian) consumer electronics industry for battery technology, Japanese car manufacturers have tended to invest more in battery technology R&D than their European and American peers (supporting data to be included in final paper). Only time will tell if recent efforts to redress the situation in the US and Europe can rebalance the terms of trade in battery technology.

Table 1. Fuel cell & battery patents

	Number of patents				Specialisation index (SI)			
Years:	80-86	87-93	94-00	01-07	80-86	87-93	94-00	01-07
World – Fuel Cells	441	659	1094	3805	1	1	1	1
North America – FC	300	380	624	2217	1.10	1.01	0.97	1.06
Europe – FC	70	75	195	448	0.74	0.60	1.17	0.78
Japan/Korea - FC	66	196	278	1096	0.97	1.36	1.11	1.17
World – Batteries	1966	1938	3699	4372	1	1	1	1
North America –B	1323	1194	2020	1770	1.09	1.08	0.93	0.74
Europe – B	363	301	342	349	0.86	0.82	0.61	0.53
Japan/Korea – B	229	412	1221	2139	0.76	0.97	1.44	1.99
World – All	457148	644627	894295	1162035	-	-	-	-
North America - All	282210	369374	526740	639790	-	-	-	-
Europe - All	97658	121967	136018	176264	-	-	-	-
Japan/Korea - All	70226	141080	205010	285673	-	-	-	-

Figure 1. Positioning of leading countries in battery technology (as of end of 2007)
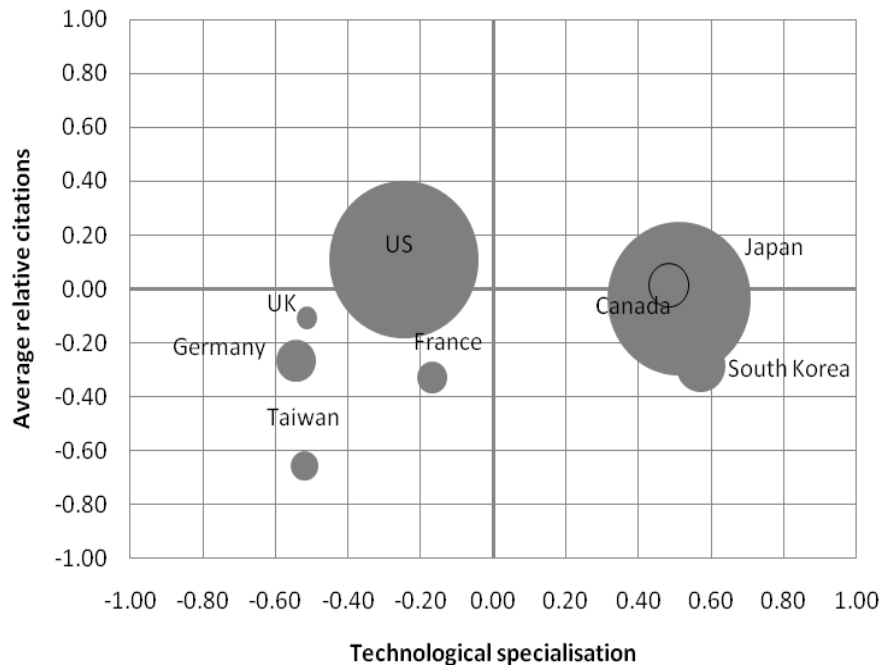
Source: Computed by Alexandre Beaudet and Science-Metrix using UPSTO data

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Exploring the bibliometric and semantic nature of negative results

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Keywords: bibliometrics, scientometrics, negative results, negative result publication, S&T information

Background

Scientific progress in some disciplines is hampered by researchers' tendencies to bin negative results. However, their publication is beneficial in order to prevent duplication of effort, save public money and to facilitate and promote scientific communication and progress.

A bibliometric analysis of negative results literature was performed in order to identify their most important attributes, to study their outcome and to explore their hidden relationships, focussing on the distribution of publications openly declared as containing negative results and published in journals completely devoted to this kind of publications.
The Journal of Negative Results in BioMedicine (JNRBM) was used as a role model, since all the other relevant journals are not indexed in the largest citation databases. In order to evaluate the prestige of this journal, the impact factor as well as the new alternative indicators SJR and SNIP were looked up for all assigned categories.
The complete article records of JNRBM, the number of citations and the citation percentiles & averages were retrieved from Scopus and Web of Knowledge to generate an impact profile.

Data analysis and visualization of relationships were performed using the software tool BibTechMon. A co-author and a co-affiliation map were produced in order to examine the plurality of communities based on the existing relationships between the authors publishing in JNRBM.

Furthermore two samples of "positive results" based on related articles containing the same number of items, either sharing the same descriptors or the same references (bibliographical coupling) were compiled in Scopus.
The first sample, obtained from Scopus by retrieving articles sharing the maximal number of references, was used to test if bibliographic coupling revealed other publications of negative results.
The second sample of "positive results", sharing the maximal number of descriptors, was used to enable a comparison with the sample of "negative results". Thereafter,

their abstracts were subjected to assisted data extraction, in order to identify vocabulary characterising negative results publications.

Results

The unofficial impact factor of JNRBM is 1.64 based on the information gained from the official journal website. The median impact factor (IF) in the corresponding WoS category "Medicine, research & experimental" (to which biomedical science journals are assigned) is 2.023, and the aggregate IF is 3.474. Thus the IF of JNRBM is below these values and corresponds to quartile 3 (Q3). According to Scopus data, in SCImago Journal Rank JNRBM has a SJR of 0.124 and is assigned to the categories "Medicine" (Q1) and "Pharmacology, Toxicology and Pharmaceutics" (Q2), whereas in CWTS Journal Indicators a SNIP of 0.43 is reached in the category "Biochemistry, Genetics and Molecular Biology (all)" (Q2).

JNRBM publications (93% of them articles) are cited by a broad spectrum of journals rather than by specific titles. Journals exclusively devoted to their official publication like JNRBM have a rather low impact. Only 11% of their items are above citation average. However, only one third of the publications remain uncited.
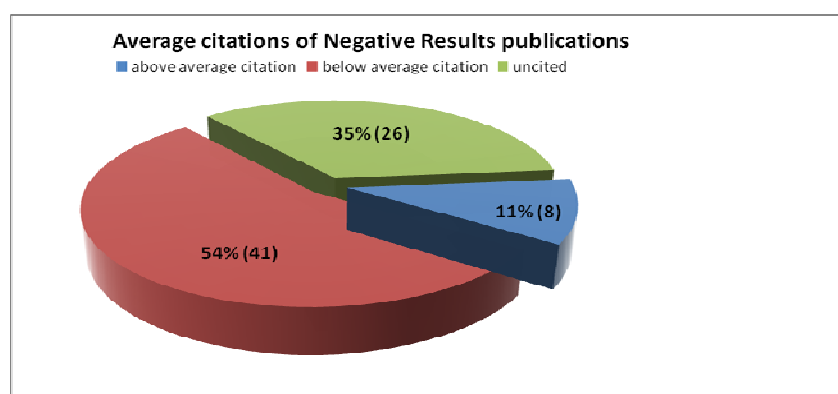
Figure 1. Average citations of publications in JNRBM (2002-2009)

Apart from single publications there is no specific community for the publication of negative results in devoted literature like JNRBM. Authorship is widely spread, with 95% of the authors contributing with a unique paper and the most active author publishing 6 papers.
Neither the co-author nor the co-affiliation analyses indicate a strong interconnectivity of authors or affiliations. There are only few clusters, whereas the majority of the publications have affiliations originating from a single country.
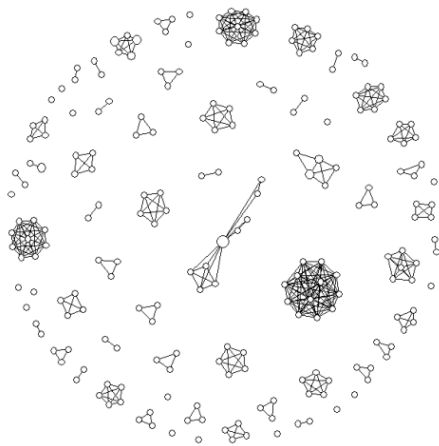
Fig.2a: Co-authors map, Articles: 75, authors: 377, edges: 1218; network density: 0.01718; source: Scopus, 2009, 11., *Journal of Negative Results in BioMedicine*
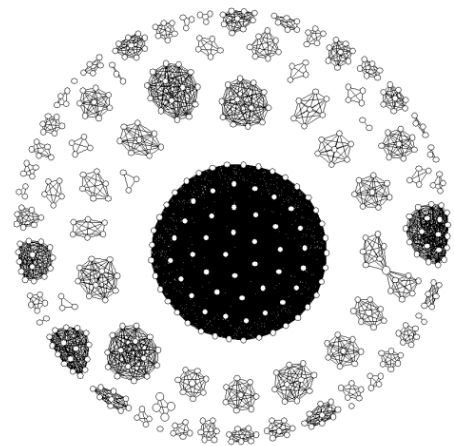
Fig.2b: Co-authors map, Articles: 75, authors: 528, edges: 4352, network density: 0.03128 source: Scopus, 2010, 2., *same descriptors as JNRBM.*
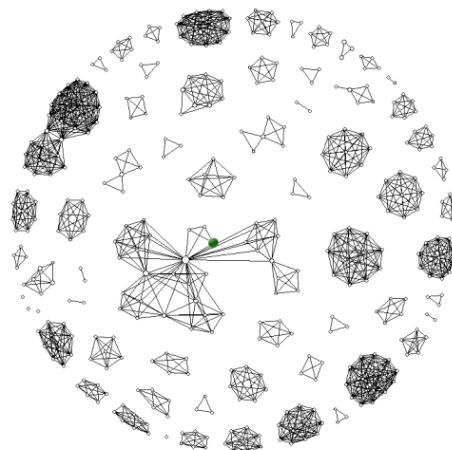
Fig.2c: Co-Affiliations map, Articles: 75, affiliations: 213, edges: 371; network density: 0,01643; source: Scopus, 2009, 11., *Journal of Negative Results in BioMedicine*
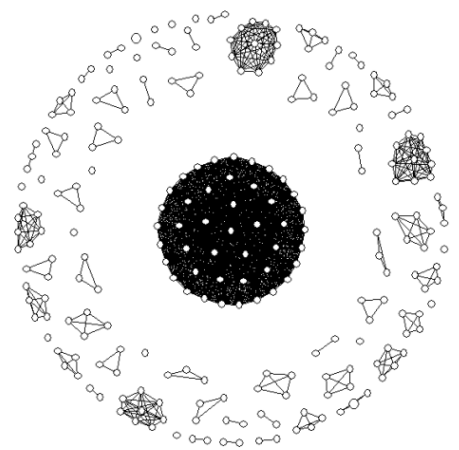
Fig.2d: Co-Affiliations map, Articles: 75, affiliations: 237, edges: 1253; network density: 0,0448; source: Scopus, 2010, 2., *same descriptors as JNRBM.*

Figure 2. Co-authorships and co affiliations of publications in JNRBM (2002-2009) and similar publications (high concordance in descriptors) in Scopus

Our first analysis shows that bibliographic coupling can be useful for the identification of other negative results, however, can only be regarded as a supplementary method.

A text mining approach was applied to the JNRBM publications and resulted in a list of around 50 terms expressing negative assertions. These were employed to query the database PASCAL. An indicator measuring the degree of negativeness of a

publication is defined. This indicator can be then applied to both the PASCAL corpus and the JNRBM publications and the obtained results compared.

At this stage it is impossible to distinguish between the various possible negation meanings. This exploratory work opened a challenge in the refinement of mining techniques - not only to detect negative assertions, but especially to allow categorization by their real semantic meaning.

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Knowledge Creation Process in an Emerging Economy in a Frontier Technology: A case study of Nanotechnology research in India

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Introduction

Nanotechnology is promising to be the 'transformative' technology of the 21st century with applications already being created across different industries. However, there are immense challenges for innovation as the technology is still at the concept level, highly uncertain, interdisciplinary and intensively science based. OECD economies have been trying to address this by creating an innovation ecosystem driven by massive public funding. Emerging economies are trying to 'catch up' by adopting strategies of OECD economies and are increasingly playing an important role in global R&D (Hasan, 2005, Liu, et al.). Knowledge creation in 'Systems of Innovation' framework (Edquist, 2004) provides rich understanding of the innovation process. This perspective underscores knowledge flows in the system and how different actors are involved in this process. Present paper applies this framework to examine knowledge creation process in India; an emerging economy devoting high priority to this area.

Method

Study examines research publication and patent data 2000-09. Patenting activity is observed in the US and domestic patent office (IPO). Broadly examine knowledge creation process in other countries, especially China to have understanding of the characteristic of knowledge production. Using this we draw conclusions from findings.

Findings

India published 13366 papers (2000-09) with 2009 alone accounting for 24% of publications. Upward trends are on account of increasing activity of institutions, increase in number of institutions, publication across wider set of journals and increasing collaborations and increasing interdisciplinarity. Predominant activity is in nanomaterials/nanostructured materials, photoluminescence, and chemical synthesis. X-ray diffraction emerges as the key analytical technique. Institutional linkages are developing from sparse network (2001) towards a more connected network (2009). Three central poles are visible in 2009--- university (IISc), research entity (CSIR) and an engineering school (IIT). A few foreign universities are connecting to this network. Patenting is an insignificant activity in comparison to publication; 35 patents in USPTO and 50 domestic patents. CSIR is a key player. Academia is dominating this activity; however, in the IPO Indian firms are also visible. Linkages are almost non-existent. Key areas addressed by Indian patents: Medical preparation, catalyst/colloidal and Non-metallic compounds.

Discussion and Conclusions

Science intensity calls for strong linkage with producers of knowledge and product development, diverse locus of knowledge production and strong University Industry

linkage. Unlike US patenting in China is dominated by academia. But changing trend is observed from patent application. Universities are developing linkages with industry. India is producing research papers and has started patenting in this area. However, the knowledge creation behaviour is not exhibiting characteristics of other prominent countries. Linkages that SI perspective articulates are weak and require to be strengthened for translation of knowledge into commercial applications.
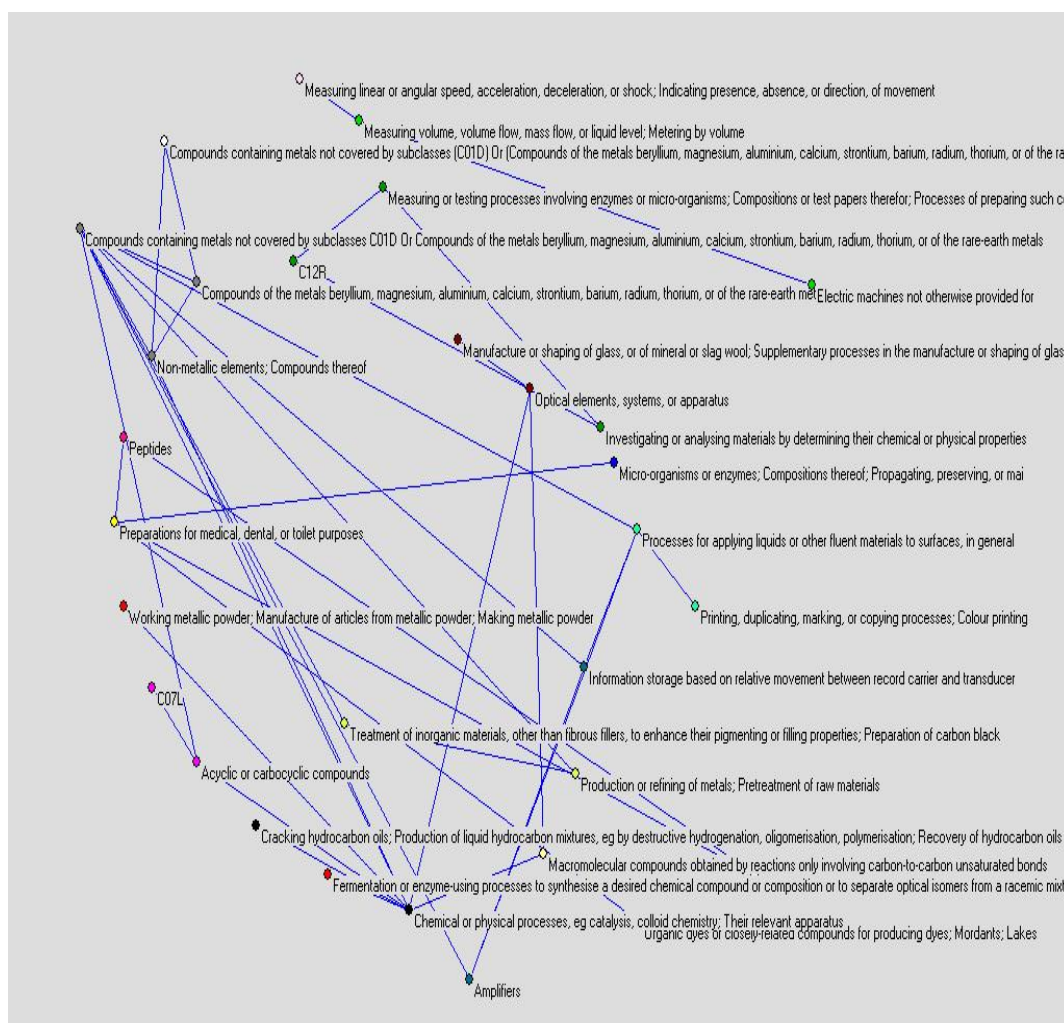
Figure 1. Patent Co-Classification Matrix

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Does scientific advancement lean on the shoulders of mediocre research?
An investigation of the Ortega hypothesis

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Introduction

The well-known Ortega hypothesis can be formulated as: top-level research would not be able to succeed without mediocre research; a pyramid of small discoveries is a necessary condition for scientific breakthroughs (Ortega y Gasset 1932). This view of science is controversial and two opposing hypotheses have been proposed: the Newton hypothesis (Oromaner 1985) claims that scientific advancement (top-level research) rests on the shoulders of past top-level research. The Ecclesiastes hypothesis regards scientific advancements as a result of chance or fortune (Turner and Chubin 1976).

The question is urgent because of an increasing tendency in research funding today to replace the allocation of resources on the basis of block grants to institutions—this kind of allocation follows a principle of equality that can perhaps be legitimated in terms of the Ortega hypothesis—by a system in which resource allocation is linked to a system of output control, and with a strong focus on "scientific excellence" (assuming an inequality principle as proposed by the Newton hypothesis) (Engwall and Nybom 2007). The objective of this model is a concentration of funding on the best scientists in order to create a critical mass of elite scientists (Whitley 2007).

At present, it is unclear which of the three competing hypotheses is valid. Is current top-level research systematically connected to past top-level research or does top-level research need research on the mediocre level? As the example of the *h* index in information science shows (Bornmann and Daniel 2009), scientific breakthroughs can be expected to emerge unpredictably or as a twist of fate for a discipline. The few studies that examined these hypotheses (see an overview in Kretschmer and Müller 1990) were mostly published several years ago and based on small samples within a single discipline. As the validity of the three hypotheses could have direct implications for the system of resource allocation, a comprehensive study including a wide range of disciplines seems to be necessary.

Methodology

Our analysis is based on (*i*) all articles and proceedings papers in the Scopus database which were published in 2003 in the life sciences (n=248,812), health sciences (n=210,758), physical sciences (n=366,974), and social sciences (n=41,095), and (*ii*) all articles and proceeding papers which were cited within these publications. These

cited references amount to: life sciences (n=3,809,845), health sciences (n= 2,373,799), physical sciences (n=3,317,683), and social sciences (n=278,146). Since researchers grouped in the social sciences category frequently publish in books and non-English journals, the numbers in this area are smaller than in the life sciences, health sciences, and physical sciences (Klavans and Boyack 2010; Lancho-Barrantes, Guerrero-Bote, and Moya-Anegon 2010). As Scopus provides reliable citation coverage only from 1996 onwards (Bar-Ilan 2008), we included only cited references published since that date.

We studied the citation impact of the papers which are cited in all the papers with publication year 2003. As normalizations, first, the citation windows are set to five years after the year of publication. Secondly, all articles and proceedings papers— both the cited and the citing—were categorized in six percentile rank classes (99th, 95th, 90th, 75th, 50th, and <50th). This normalization accords with that of the National Science Board of the U.S. National Science Foundation (National Science Board 2010): these percentile rank classes are suited for identifying lowly-, medium- and highly-cited papers in a field. Both the National Science Board and the Essential Science Indicators of Thomson Reuters classify papers as highly-cited if they belong to the top 1% of papers worldwide (that is, papers in or larger than the 99th percentile). The Ortega hypothesis predicts that highly-cited papers and medium-cited (or lowly-cited) papers would *equally* make references to papers with a medium impact (papers in the 50th or 75th percentile). The Newton hypothesis would be supported if the top-level research is more frequently based on previously highly-cited work (papers in the 99th percentile) than medium-level research. If scientific advancement is a result of chance processes (the Ecclesiastes hypothesis), no systematic association between the impact of cited and citing papers is expected.

Results

Our results show that highly-cited work in all scientific fields is more strongly based on previously highly-cited papers than on medium-cited work. In other words, the higher a paper's citation impact the stronger it is connected to preceding high-impact research (i.e., to research belonging to the 99th percentile rank class). These findings support the Newton hypothesis and call into question the Ortega and Ecclesiastes hypotheses (given our usage of citation counts as a proxy for impact). Our results also suggest that medium-impact research plays a different role in the four fields: whereas in the social sciences and physical sciences scholars cite this underlying research, in the life sciences and health sciences the subtop is less important.

Discussion

Our findings raise the issue of whether limited resources might best be concentrated in support of those scholars (research groups or institutions) who have already published high-impact papers (belonging to the 99th percentile rank class). A concentration of resources seems to be practical especially in the life sciences and health sciences. Indeed, one can witness currently trends in research funding which follow the concentration of scarce resources on outstanding researchers. The Wellcome Trust, for example, will allocate 20% of its total budget to an Investigator Awards program (Kaiser 2009). This program will fund only the very best scientists to investigate challenging and long-term research questions. The U.S. National Institutes of Health supports researchers with similar programs. Against the backdrop of our findings, these trends seem to be sensible especially in the life sciences and health sciences. In these fields, one can probably follow the argument of Cole and Cole (1972) that the

progress of science would be little impeded if only scientific excellence were supported.

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Investing in future academics: results of a doctoral fellowship programme at Catalan universities

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Introduction

Doctoral fellowship programmes are the basis for the training of future scientists. Although these programmes have an important educational aim and involve a huge economic investment, there is little data available about their results.

This poster presents the preliminary results of a project that aims to analyse the results of a PhD fellowship programme at Catalan universities: (a) success rate in PhD completion; (b) time invested in PhD completion; (c) rate of doctoral fellows who are presently employed by the same university where they were awarded their doctoral grant; and (d) scientific output of the doctoral fellows.

Method

A total of 489 students were identified as having been awarded with a doctoral fellowship between 1995 and 1999 in one of the eight public Catalan universities. In order to verify whether each of these students had finished his/her PhD three different databases were checked. In all cases, dissertation details — title, date of defence, university and department, gender of supervisor and field of knowledge — were recorded. All doctoral fellows were searched in the employee directory of the university where they had been awarded the grant in order to know whether they are presently employed by the same university. Finally, their scientific output — in terms of articles available through the Thomson Reuters ISI Web of Science — was analysed.

Initial results

Data showed that 66.7% (326) of the students awarded with a doctoral fellowship at Catalan universities between 1995 and 1999 had completed their PhD by 2009. This is a much higher figure than that reported for the whole population of Spanish doctoral students, since just 10% of the students enrolled in PhD programmes in Spain between 1997 and 2008 finished their degree.

Males and females showed a similar degree of success in completing their PhDs. However, data showed significant differences in PhD completion by field of knowledge. Students who carried out their dissertation in the Sciences showed a higher percentage of success than those in the Arts & Humanities or in the Social & Legal Sciences. Additionally, subjects in the Arts & Humanities invested significantly more time in order to obtain their PhD than those in other fields of knowledge (Table 1).

Table 1. PhD completion and time invested by field of knowledge

	% of PhDs completed	Years invested in PhD completion (SD)
Arts & Humanities	50.0	6.62 (2.22)
Sciences	88.6	4.59 (1.54)
Health Sciences	78.6	4.68 (1.94)
Social & Legal Sciences	50.8	5.41 (1.85)
Engineering & Architecture	60.0	4.69 (1.96)

Different patterns of supervision were also observed in different fields of knowledge. Students in the Arts & Humanities and those in the Social & Legal Science had a higher probability to be supervised by one single supervisor while students in the Sciences had a higher probability to be co-supervised.

According to the data in universities directories, 29.1% (140) of the fellowship recipients are presently employed by the same university where they were awarded their fellowship.

Data showed that 68.7% (224) of the grant recipients who had finished their PhD had published at least one article in a journal indexed by the WoS.

Further research

In the next stage of the project a survey will be sent to all the students in the sample in order to determine individual —gender and other sociodemographic characteristics— and institutional factors —characteristics of the research team, quality of the supervision process, etc.— which may have an effect on PhD completion success rate.

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Consistent bibliometric rankings of authors and of journals

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Rankings of journals and rankings of scientists are usually discussed separately. We argue that a consistent approach to both rankings is desirable because both the quality of a journal and the quality of a scientist depend on the papers it/he publishes. We present a pair of consistent rankings (impact factor for the journals and total number of citations for the authors) and we provide an axiomatic characterization thereof.

A Comparison of the Accuracy of Models for Mapping the Medical Sciences

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Introduction

Science mapping has a multi-decade history, and has employed a variety of units, approaches, and scales. However, to date there has been relatively little work done to compare the accuracies of the maps generated using the different approaches (cf. Ahlgren & Jarneving, 2008; Janssens, Zhang, De Moor, & Glänzel, 2009). In this work, which was performed for the U.S. National Institutes of Health (NIH), we create maps of over two million documents from MEDLINE using 13 different similarity methods, three of which are citation-based, and nine of which are text-based, and compare their relative accuracies.

Method

In order to properly compare text-based and citation-based approaches, a large corpus for which both text and citations are available is required. Given this project was performed for NIH, our corpus was based on MEDLINE. Scopus records were matched to MEDLINE records to generate a corpus with both textual and citation information. We further limited the set to 2,153,769 unique articles published from 2004-2008 that contained abstracts, at least 5 MeSH terms, and at least 5 references.

The three citation-based approaches used were co-citation, bibliographic coupling, and direct citation (Boyack & Klavans, 2010). The nine text-based approaches used were TFIDF (Salton, 1989) – MeSH terms, TFIDF – title/abstracts, LSA (Landauer & Dumais, 1997) – MeSH terms, LSA – titles/abstracts, bm25 (Sparck Jones, Walker, & Robertson, 2000a, 2000b) – MeSH terms, bm25 – titles/abstracts, SOM (Skupin, 2004) – MeSH terms, topic modelling (Griffiths & Steyvers, 2004) – titles/abstract, and the pmra (PubMed related articles) approach (Lin & Wilbur, 2007) used on MEDLINE to rank and display related articles. The final approach tested was a simple, naïve text/citation hybrid based on bibliographic coupling.

Similarity files from each method were run through a standardized and very robust clustering process to generate a set of document clusters. Most of the approaches generated solutions with around 30,000 clusters.

Two separate methods were used to infer the relative accuracies of each of the cluster solutions. First, coherence was calculated using the Jensen-Shannon divergence (Lin, 1991). Coherence measures how closely the documents in a cluster share the same elements. Three coherence values were calculated for each solution using textual elements, reference elements, and a combination of text and references as the three bases. The best text-based measure (pmra) slightly outperformed the best citation-

based measure (bibliographic coupling) in combined coherence (see Table 1), while the MeSH-based measures were among the worst overall.

We developed a second measure with which to compare the different cluster solutions. Given that grant-based portfolio analysis was the targeted application for this NIH study (thus requiring a map with the highest possible accuracy), we based this new measure on the grant-to-article linkages indexed in MEDLINE (Boyack, 2009). The assumption here is that papers acknowledging a single grant will be highly related, and should thus be concentrated in a cluster solution. Since grants are not inherently tied to the clustering of scientific articles either by text or by citations, a grant-based metric is unbiased. Our concentration measure is a variation on precision-recall. Clusters "recalled" for a particular set of grants should have a high concentration ("precision") of articles referencing that grant. High precision at a particular value of recall (80% recall is used in Table 1) indicates a more accurate cluster solution. Citation-based measures outperformed text-based measures in precision of grant-to-article linkages (see Table 1).

Table 1. Summary of key metrics for the different models.

	Compute	Coverage	Coherence	Pr80
TFIDF MeSH	Medium	95.77%	0.0758	0.2216
LSA MeSH	Very high	98.22%	0.0479	0.2127
SOM MeSH	Very high	99.97%	0.0409	0.2203
bm25 MeSH	Medium	93.39%	0.0759	0.2167
TFIDF TA	High	83.41%	0.0685	0.1571
LSA TA	Very high	90.92%	0.0715	0.2003
Topics TA	High	94.40%	0.0875	0.2379
bm25 TA	High	93.91%	0.0979	0.2578
pmra	Low	94.23%	0.1055	0.2637
Bibliographic coupling	Low	96.62%	0.1001	0.2706
Co-citation	Low	98.37%	0.0947	0.2621
Direct citation	Low	92.68%	0.0702	0.2480
Hybrid	Medium	96.83%	0.1014	0.2752

The simple, naïve hybrid measure improved upon the bibliographic coupling results in all respects. This suggests that a fine tuned hybrid approach has the potential to outperform text-based or citation-based methods. This is an area for future research.

Detailed results of all approaches and measures will be presented in the full presentation. Contributions from this study include a detailed comparison of text-based and citation-based similarity measures for a very large document corpus, and the introduction of a new method for comparing the accuracy of cluster solutions. Additional lessons learned will also be discussed.

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Spotlighting SciVal Spotlight: A Debate on Light and Shadow

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Introduction

This presentation is a dialectical discussion about the validity of a new methodology for identifying the scientific strengths of a university. The new methodology, embodied in Elsevier's SciVal Spotlight® tool, is based on a detailed co-citation model (2.1 million references, 5.6 million citing articles, 84,000 article clusters) of the scientific literature. Spotlight makes available web-based 'maps' of the scientific strengths of a university.

Method

The thesis of this presentation is based on an evaluation by the Bibliometrics Department of the University of Vienna (UV) of the Spotlight map of UV. They identified two perceived drawbacks in the new methodology: coverage and precision. The Spotlight map covered only 1/3 of publications in renowned journals (coverage in WoS) of the examined Faculty of Chemistry. In addition, 29% of highly cited publications (top 20% according to "Essential Science Indicators" percentiles) were missing. A considerable number of publications from authors with high h-indexes were not covered. With decreasing h-index the number of covered publications per author also seems to decrease but there are some exceptions (see Figure 1).
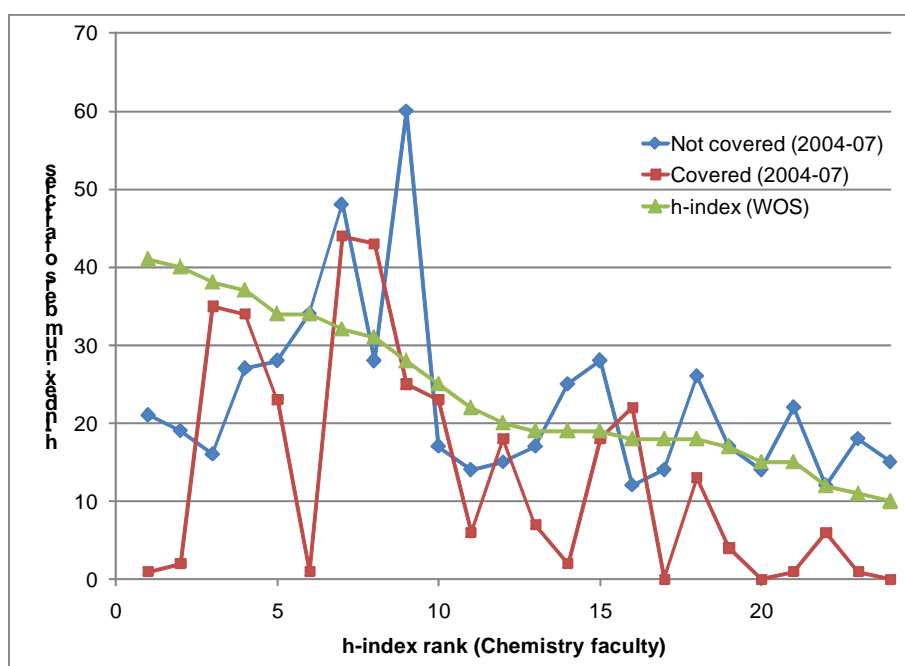
Figure 1. H-index and Spotlight coverage

Particularly, the publication output of one faculty member (Kenndler) with an h-index of 34 was studied in detail. Table 1 shows this author's number of publications covered / not covered in Spotlight and the respective number of citations per publication (cpp) during the analyzed time window (2004-2007). The impact of the articles covered / not covered is quite similar for this author, leading to the assumption that citing strategies could be a crucial factor for authors to be covered in Spotlight or not.

Table 1. Publications of Kenndler (h-index = 34)

Year	Covered in Spotlight		Not covered in Spotlight	
	number	cpp	number	cpp
2004	7	22,58	7	24,42
2005	6	13,00	7	12,00
2006	4	13,00	4	10,50
2007	6	4,83	8	4,75

Furthermore, in Spotlight's "Wheel of Science", publications of the Chemistry Faculty directly related to Chemistry were assigned to competencies not belonging to the field, even if their sources were strongly relying on Biochemistry, Physical Chemistry or Analytical Chemistry topics.

The antithesis of this presentation is based on the response of the developers of this new methodology. They point out that the methodology was not intended to cover all of the literature, nor was it intended to rank individuals. It was only intended to spotlight those areas of research ("competencies") where a team at the university has publication leadership. Thus, not all publications by high h-index researchers are covered; many of their articles are in areas where the university is not a leader. Competencies are based on publication patterns among teams rather than individuals; thus articles can appear in competencies that would not be obvious from a disciplinary perspective. They readily accept the idea of evaluating the methodology by focusing on research leadership, but point out that one should test the strengths and weaknesses of alternative methodologies for identifying the scientific strengths of a university.

The most important part of this presentation, however, is the synthesis that is emerging from the dialogue between these two parties. Specifically, we both agree that a comparison of alternative methods (h-index vs. Spotlight) can help to highlight the strengths, weaknesses and complementarities in both approaches. Methodologies and results from the two approaches will be presented and compared.

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Long term development of research groups/institutes

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Introduction:

Research groups and institutes are local units in the science system that produce novel results and disseminate knowledge. Understanding their long-term development is important to underpin evidence based research management and evaluation policy.

Research questions:

How do research groups/institutes develop over longer time periods? What patterns can be discerned in this? And, what processes/events/conditions do influence this?

Theory and Methods:

From science studies (Price, 1963) we take the notion that science grows according to an S-curve, defined by a ceiling of resources. We hypothesize a similar pattern at the group level. From organisational ecology a life cycle model - driven by an internal enfolding mechanism - is predicted in stable conditions (Poole et al., 2000). Actual patterns of development can be described by analysing the output of groups over their lifetime, and compared with a life cycle path (Braam and Van den Besselaar, 2010).

We developed three output indicators to describe the life history of research groups:
1) Growth of activities. This indicator is calculated by the sum of output items in different categories, and presented as a stapled graph, to follow developments.
2) Similarity of the activity profile[*]. This indicator measures the stability of the group activity profile (items in output categories), the value range is: 0.0 - 1.0.
3) Focus of activities: this indicator measures the percentage of output items in domains to new audiences, i.e. not attended earlier (e.g. new journals).

[*]Similarity formula:

$$\text{Sim}(APyr_t, APyr_{t-1}) = \frac{\sum_{i=1}^{n} (Ai_{yrt}) * (Ai_{yrt-1})}{\sqrt{\sum_{i=1}^{n} (Ai_{yrt})^2} * \sqrt{\sum_{i=1}^{n} (Ai_{yrt-1})^2}} = (0, 1)$$

$APyr_t$ = Activity Profile: items on activities of category i to n, in year t;
Ai_{yrt} = Output items in Activity category i (e.g. journal publication) in Year t.
The approach is borrowed from comparison of term profiles of document clusters (Braam, 1991).

The life cycle model, in stable conditions, would give the following pattern of indicator values over time as given below (Braam and van den Besselaar, 2010):
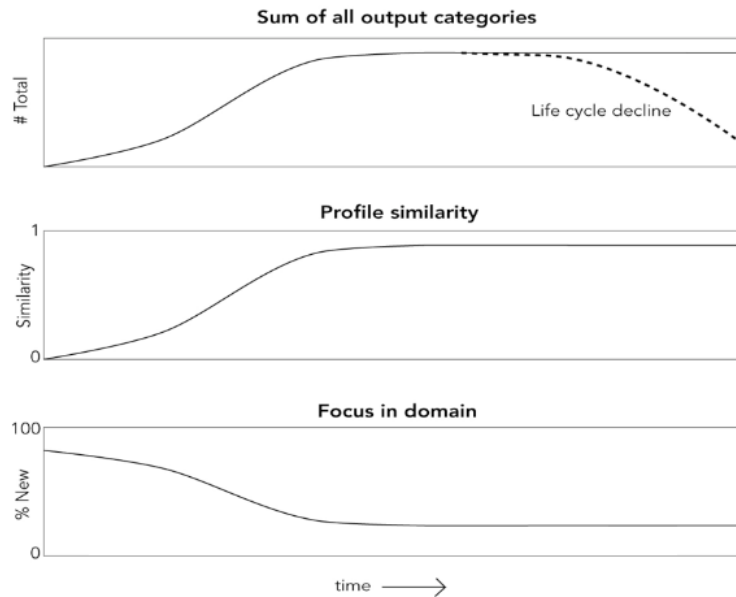
Figure 1 Development of indicator values in life cycle model

Deviations from these patterns point to changes in internal and or external conditions that influenced the development of the group or institute. Inspecting of documents on the history of a group, may be helpful to find further evidence explaining the changes.

Results (based on analysis of the first two indicator types):

The results of three case institutes reveal life cycle development patterns: a single life cycle in one case, while the other two cases show repeated life cycle start-ups and growth phases towards changed ceiling levels (escalation). Activity profiles of the institutes become increasingly stable over time, as expected. The phases of the life cycle, start-up and stable phase, appear to take one to several decades each (fig 1).

Conclusions (based on first two indicators):

The *life cycle model* fits the actual patterns of the three institutes, but cycles may repeat, with output growth to a new stable level (changed ceiling). Increasing similarity points to stability of the niche (activity profile). Initial growth to ceiling may take long time, and after long stability, novel growth may still come. This is important to take into account in research management and evaluation.

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Long-term research group dynamics reflected in science indicators.

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Introduction and methodology

As research groups and institutes are not static entities, development phases are important to take into account in designing indicators for research group management and evaluation. By studying the history of groups and institutes we learn more about their development patterns.

The history of research group output can be conceived as a patterned development resulting from internal driving forces, and strategic orientation and adaptation to external conditions. The concept of a life cycle points to a pattern of group development in stable conditions. If internal and/or external conditions change, the development path will deviate from the life cycle pattern. The actual pattern - life cycle and deviations - can be detected with hindsight by analysing time series of dynamics indicators of a research output of a group or institute. We earlier presented three types of output indicators and their application to selected pilot cases.

Selected case and data

In this paper we present results on the development of the Hubrecht Institute, Utrecht. Earlier five phases were identified in the output history of this institute in the period 1916–2008 as given in Table 1 (Braam et al., 2010). We inspect additional sources of information to learn more about the found stepwise pattern of output growth of the Institute. For this, we focus on the periods when output started to grow to a higher stable level (change points), and ask what processes and events caused these changes, looking at three additional sources of information:
1) Comparison of output results with citation results, gathered and analysed by CWTS (fig 1.)
2) Inspection of historic documentation on the Hubrecht Institute, available from its archive;
3) Additional analysis around change points of content data (titles of Hubrecht publications).

Analysis results

Citation data, available for the period since 1980, corroborate the pattern found in output data, as the citation scores run parallel to publication increase. Also, the earlier found increase of focus on international journal articles is reflected in a shift to higher impact journals in the field and in a decrease of self-citations and non-cited items. From documents on the history of the institute, available in its archive, we found evidence of the effect of leadership changes in combination with organisational policy and worldwide dynamics in the field. For example, we found a 'delayed' adaptation to

upcoming experimental, and later to molecular biology in the field of developmental biology, by a conservative effect of long enduring leadership. More results of citation data, qualitative findings based on inspection of archived history documents and of analysis of content data will be presented at the conference.

Implications

We discuss possible implications of findings for design and usage of publication and citation indicators in research evaluation, and for effective research management. In the presented case, systematic changes in output and impact citation levels reflect a life cycle development pattern (growth, stabilisation and ageing) and (delayed) adaptation to developments in the field coinciding with changes of leadership. Dynamics indicators might be used to predict and identify such development phases and to recognise stagnation at an early stage.

Table 1. Development phases of Hubrecht Inststitute 1916-2008

Phase	Time period	Characteristic
I	1916-1943	period primarily around embryo collection and service function
II	1943-1969	period of low output, in varied categories, of about 4 items per year;
III	1969-1983	period of increased output, at a stable level around 17 items per year.
IV	1983-2003	period of increasing output, towards a level of about 51 per year.
V	2003-2008	period of renewed growth towards a level above 100 items per year.
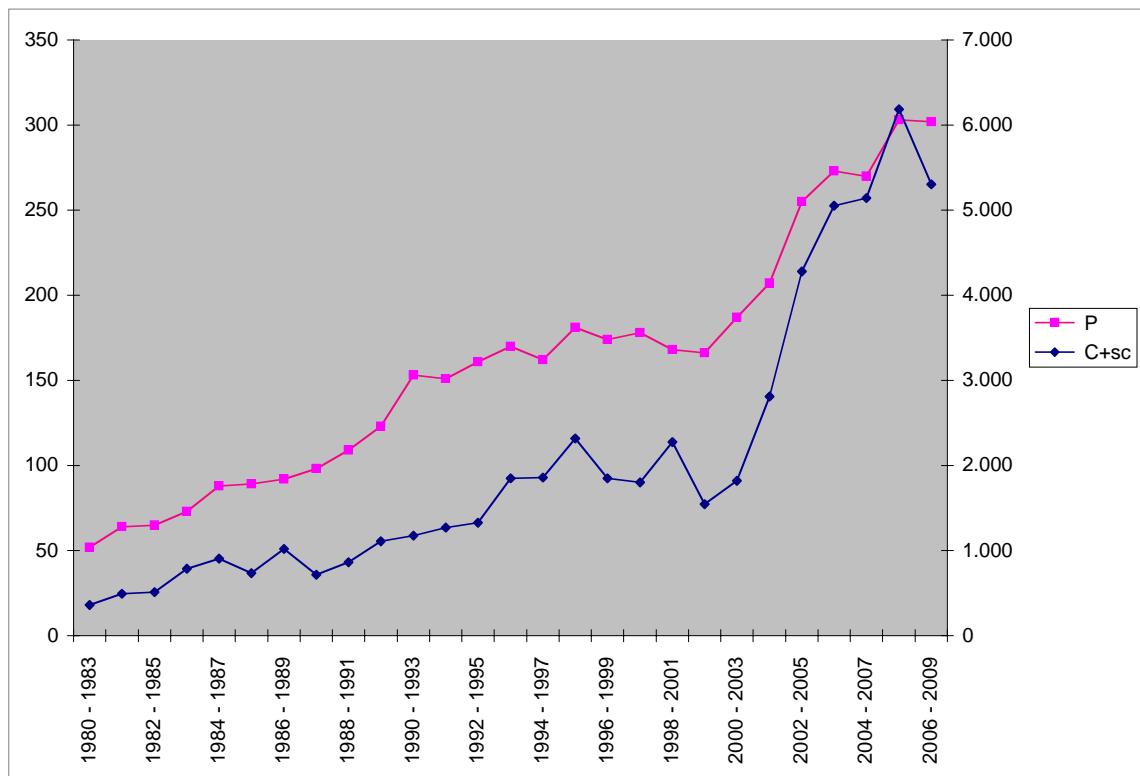
Figure 1. Publication and citation results for the Hubrecht Institute, 1980-2009

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The scientific basis of the IPCC Fourth Assessment Report: exploring a pinnacle of climate change research from the perspective of its knowledge base

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Introduction

On its website, the Intergovernmental Panel on Climate Change (IPCC) claims to be the leading body for the assessment of climate change. Moreover, the panel aims to provide a scientific view on climate change, its impacts, and consequences (IPCC, 2010), although the validity of this claim has recently been the subject of some public debate. One of the panel's core activities is the preparation of Assessment Reports (ARs). Presently, the panel has published four reports, and is currently preparing a fifth. In this paper we investigate the scientific knowledge base of the fourth AR report (AR4) from the perspective of scientific publications. The result of this investigation will be an overview of journals, topics, and affiliations in these publications, their relations, and how the publications connect (through the citing and cited relations) to the larger, scientific environment presented in the Web of Science database.

Method and data

The last report published by the IPCC (AR4) has three parts. Each part is under the responsibility of a specific working group (WG), and has a specific focus. The kind of focus can be judged from the titles of the parts:

  I. The Physical Science Basis
 II. Impacts, Adaptation and Vulnerability
III. Mitigation of Climate Change

We downloaded the PDF versions of the chapters of the three parts of the AR4 (IPCC, 2007a; 2007b; 2007c), and extracted the reference lists given at the end of the chapters. After converting to text, cleaning, and minor formatting, the bibliometrically relevant parts of the references (such as title, year, and volume) were automatically identified and used to search for publications in the WoS. The extraction of those relevant parts is not always perfect, and also, the references as given by the authors may contain errors. As a result, the search in the WoS using all available information may not always succeed. To account for such discrepancies between the given information and the information recorded in the WoS, we also search for publications by leaving out certain parts. The resulting alternatives were scored and the highest scoring one was used, provided its score was higher than some minimum. The result is a set of publications which can be considered a significant part of the *knowledge base* of the AR4, as present in the WoS. This set is the basis for our investigations.

Results

Matching

Extracting the reference lists from the chapters results in 18,328 citations to all kinds of publications, not all of them scientific. Matching the references, we find 7,962 distinct publications in the WoS database. In Table 1 we show an overview of the number of references per WG for which publications were found or not, and to how many distinct publications (P) these refer to.

WG	Found	Not found	P
I	4805	1369	3933
II	4516	3694	3469
III	1231	2713	1121

Table 1: The result of matching references to distinct WoS publications (P), per working group.

The table shows that most references are given by WG II (8,210), followed by group I (6,174), and II (3,944). However, group I has about ten percent more matches in the WoS.

Publications
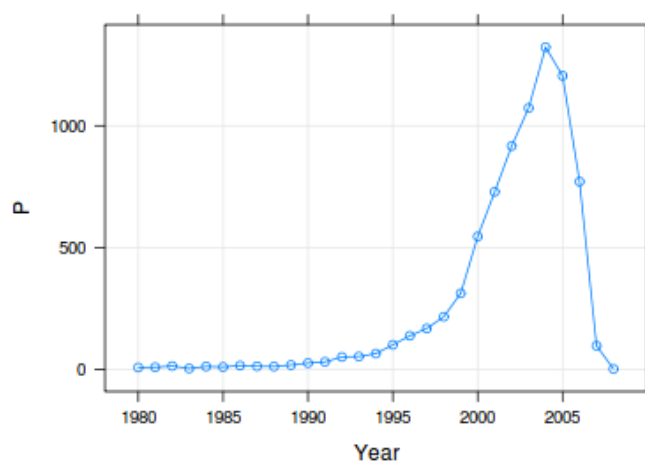
Figure 1:
The distribution of years in the knowledge base of the AR4 (as found in the WoS database).

Figure 1 shows the distribution of publications and references over the years. From it, we can deduce that the focus is on the year 2004. Surprisingly, even a few 2008 publications are referenced, even though the AR4 is from 2007.

Number of references and citations

There are several publications referenced more than once, but we find that this is not an indicator for the number of citations in the WoS. For example (Nicholls, 2004) is referenced 11 times in the report for WG II, and cited 49 times in the WoS. On the other hand, (Scharr, et al., 2004) is referenced 5 times in the report of WG I, while it is cited 478 times in the WoS.

Journal titles

For WG I we find that the most referenced journals are specialty journals, such as the *Geophysical Research Letters*. For WG II and III however, multidisciplinary journals are ranked high, perhaps highlighting the multidisciplinary character of the research described in these parts.

Organisations

Most of the references are to publications from organisations in the USA. However, in WGs II and II, we see British and Austrian organisation rise to prominence as well.

Conclusions

We searched for WoS publications cited by the IPCC Fourth Assessment Report (AR4). More than half of the citations could be found in the WoS. Most of these citations are from chapters written by WGs I and II. Our extended abstract highlighted a number of results. First we found that the focus is on 2004 publications. To update the knowledge on climate change research available to the general public (to include more recent research), an AR5 is thus necessary. We also found that the number of times a publication is cited by the AR4 is not correlated to the number of citations in the WoS. Next, we indicated that the focus of the WGs is visible in the kind of journal cited most. Finally, we noted that USA organisations dominate the research in absolute numbers, but that the influence of other, mostly European, organisations is visible as well.

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An alternative to WoS subject categories: redefining journal sets for closer alignment to a national classification scheme

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Introduction

A fundamental issue faced in bibliometric assessments of research performance is the need to delineate disciplines. National assessment exercises, given the huge size of the task and the diversity of fields to be assessed, rely on journal sets for this task, and the most commonly used journal classification scheme is that developed for Thomson Reuter's Web of Science (WoS). While it is not always an appropriate typology for every assessment exercise, to create an alternative scheme is a daunting task. Australia has its own well-established research classification scheme, developed by the Australian Bureau of Statistics (ABS, SNZ 2008). It is hierarchical, with 2-digit Division codes (e.g. Chemical Sciences), 4-digit Group codes (e.g. Inorganic Chemistry), and 6-digit Field codes (e.g. Non-metal Chemistry). Many WoS categories map closely to the ABS codes, most commonly at the 4-digit level, but there are a significant number that do not translate well to the ABS schema.

Policy context

For Australia, there was a strong policy imperative to undertake the massive task of developing its own purpose-built journal sets. The overriding driver was the introduction of a new Government initiative, Excellence in Research for Australia (ERA), which will assess the strengths and weaknesses of higher education research. Central to ERA is the use of a range of bibliometric measures for relevant disciplines, and its focus is at the Group, or 4-digit code level. All stakeholders in the sector agreed an alternative to the WoS scheme was required. The focus of this paper is restricted to analysing the newly constructed journal sets to determine their implications for citation analysis.

Method

An Australian-specific set of journals has taken three years to develop. The process was overseen in that period by the two Government agencies, and the task consisted of four distinct phases:

1. Initial construction of draft journal sets. This was 'started from scratch', using an analysis of data from 21 universities which tagged journal output to departments. Journals in which those universities did not publish were added, using Ulrich's database as the primary source. Both Scopus and WoS journal lists were also utlilised.
2. The four Learned Academies undertook the first scrutiny of the journal sets, using their own internal panels of experts.
3. Preliminary journal sets were published on the Australian Research Council's website and an extensive sector-wide consultation process was conducted.
4. There was a final expert adjudication involving 700 reviewers, a process overseen by the ARC to resolve conflicts in journal placement and rankings (an additional task undertaken in tandem with the journal classification project).

Results

Just over 20,700 journals were reassigned into Australian-specific journal sets. A detailed analysis was conducted of the 1,452 journals used in a trial conducted for ERA in 2009, covering all disciplines in physics, chemistry and earth sciences. Figure 1 demonstrates the difficulty of translating WoS categories directly to the Australian schema. The WoS Inorganic and Nuclear and Medicinal Chemistry sets are only a partial match for their Australian counterpart, and there is no direct translation for the Applied, Crystallography and Polymer WoS sets. Nor are there any WoS equivalents for the Australian fields of Macromolecular and Materials, and Theoretical and Computational.
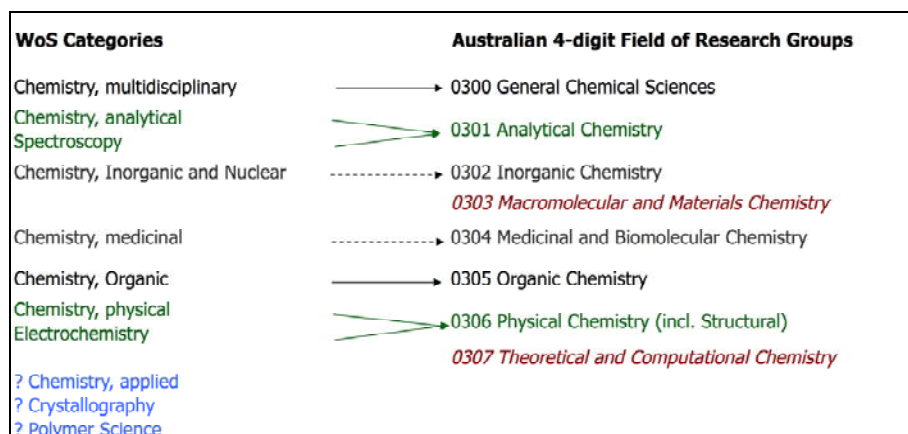
Figure 1. Example of convergence of WoS categories with 4-digit sets in Chemical Sciences

After all the work, did the Australian sets lead to different outcomes for institutions? The answer to that is complex. Even where journal lists appear quite different, the results can be very similar, because Australians were publishing primarily in the overlap between the two lists. But in some instances the two lists could lead to quite different rankings, as the results for Geology show in Table 1.

Table 1. Comparison of outcomes for Geology using alternative journal sets

	WoS set			Australian set		
	CPP*	RCI*	Rank	CPP*	RCI*	Rank
Institution A	9.38	2.19	1	8.05	2.13	1
Institution B	5.97	1.39	6	7.45	1.97	2
Institution C	7.03	1.64	3	7.43	1.97	3
Institution D	7.18	1.68	2	6.40	1.69	4
Institution E	6.46	1.51	5	5.72	1.51	5
Institution F	3.99	0.93	8	5.67	1.50	6
Institution G	6.91	1.62	4	5.40	1.43	7
Institution H	3.35	0.78	9	4.69	1.20	8
Institution I	4.86	1.13	7	4.14	1.09	9
World benchmark	4.28			3.78		

* CPP = Citations per Publication; RCI = Relative Citation Impact

Discussion

The exercise has produced distinctly Australian series of journal sets, which are much more closely aligned to the country's standard research classification scheme. In the three fields looked at in detail, citation benchmarks can vary by up to one-third and institutional performance can be significantly affected by choice of journal set. Yet

the process has succeeded in another of its primary goals – the sector has more confidence in the sets created, and their application in bibliometric analyses.

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Seed journal citation network maps: a method based on network theory

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Objective

We present a method for analyzing the citation environment of a journal. This approach considers at the same time the citing and cited dimension of a given journal and uses an algorithm developed in complex network theory to detect the prominent journals.

Methodology

Seed Journal Citation Network

The focus is on a specific journal, which is considered as the seed journal. For the seed journal we have a matrix that contains this journal, the journals receiving and giving citations to the seed journal and the citation connections between these other journals.. This is what we called the Seed Journal Citation Network.

Journal Relationship Measure

There are limitations of using only absolute numbers of citations in the citation links between journals. In particular, they do not reflect the fact that each number on a cell of the seed journal citation matrix depends on the total number of citations given and received on the Web of Science by the two journals linked. Thus, we developed an index to measure the journal relationships that controls this bias. Let C_{BA} be the total number of citations given by journal B to Journal A. Let *TcitingB* be the total number of citations given by Journal B (in the Web of Science) in 2006 and let be *TcitedA* the total number of citations received by Journal A between 1997-2006. The L index is

$$L_{BA} = \frac{C_{BA}}{\sqrt{TcitingB * TcitedA}},$$

The L index take values in the interval [0,1].

Hubs and Auhtorities

Next we extract the most prominent journals from the Seed Journal Citation Network using network analysis. We use a methodology first developed in complex network theory to separate web pages into authorities and hubs (Kleinberg, 1999). An authoritative journal, in our case, is one that many other journals cite to. But, this idea can be reinforced by observing that citations from all journals aren't equally valuable – some journals are better hubs for a given journal. Hubs and authorities stand in a mutually reinforcing relationship: a important authority is a journal that is cited by many important hubs, and an important hub is a journal citing to many important authorities. From our perspective the classification in hubs and authorities is a very useful tool to understand the role played by a journal in the citation environment of a seed journal. A journal can be both an important hub and authority at the same time: having a lot of influence (authority) but also being influenced by the bests (hub).

Batagelj adapted for the software Pajek1 the Kleinberg's hubs/authorities algorithm (Batagelj & Mrvar, 2006).

Results

As an example we have chosen as seed journal Scientometrics. The program used for visualizing the network is NetDraw (Borgatti, 2002).The network shows three types of nodes with different shapes. The squares (blue) are the journals considered the top important authorities, the circles (yellow) are the top important hubs and the triangles (red) represent the journals that are both top important hubs and authorities. The lines (directed edges) show the citation relation between the journals. The direction of the arrow indicates whether a journal is cited by or is citing to. The thickness of the connecting line reflects the strength of the L index among a pair of journals. The position in the map of the journals is based in a spring-embedded algorithm included in the software NetDraw. The journals that are linked or that have links in common are closer in the map. The journals appear on the map because they have been cited by Scientometrics but in the map we are considering the strongest citation links (based on the L Index) between the most important hubs and authorities journals.
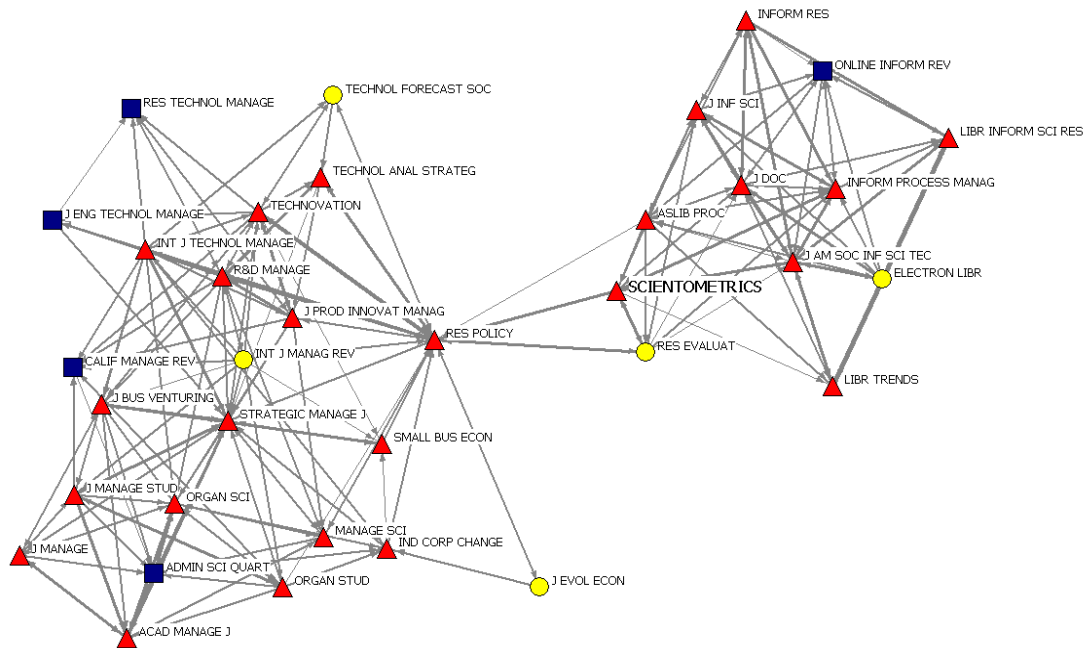
FIG. 1. Mapping of the citation environment of Scientometrics (2006) (L index>0.0163)

Conclusions

The method introduced here allows establishing the important journals in the citation environment of a given journal, the degree of importance they acquire and what position they occupy in the network.

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The Impacts of Academic Patenting on Paper Publication: A Quantity-Quality Examination

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This paper examines the relationship between academic patenting and academic publication. Previous studies provided little investigation of how the quality and quantity of academic patent inventors may further influence their quantity and quality of paper publication. This paper explores four hypotheses to examine the impacts of patenting on publication. This paper collects the patenting and publishing data of 395 academic patent inventors from 5 major universities in Taiwan from 2002 to 2006. Our analysis indicates that better patents will breed more and better papers. More patents generate better but not more papers. The paper concludes that generating better patents can mutually reinforce the further publication.

Identifying Core Patents by Citations, Bibliographic Coupling and Co-citation

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Introduction

Core patents are patents which can generate the most impact, and thus the most important, in a certain technological field. Identifying core patents is crucial to grasp and trace the technology development trend. The objective of this research therefore focuses on developing new methodologies in order to evaluate the importance of a patent and thus identify core patents. There are various approaches used to evaluate patent importance, in which this research chose patent citation network (PCN) analysis because a patent's citations can be considered endorsement to its importance, which, usually, is approximated by the number of times a patent is cited (Albert et al., 1991; Narin, 1994; Harhoff et al., 1999; Trajtenberg et al., 1997; Wartburg et al., 2005; Atallah and Rodriguez, 2006). Trajtenberg et al. (1997) measured the importance of a patent by counting both its number of direct citations and their respective number of direct citations with a discounted factor. Atallah and Rodriguez (2006) summed up all its direct and indirect citations with a weight mechanism to estimate the importance of a patent, assuming higher-ordered indirect citations contribute less to the importance of a patent. However, the discounted factor and the weight mechanism both had some fallacies. Additionally, not all direct citations are relevant to a patent (Akers, 2000; Wartburg et al., 2005), thereby causing incorrect evaluation of its importance. To estimate patent importance more accurately, a direct citation's relevance should be verified before being taken into consideration. On the other hand, bibliographic coupling (BC) and co-citation (CC) are commonly used to identify relevant documents via direct citations as BC strength and CC strength represent the extent of the correlation between documents (Kessler, 1963; Small, 1973).

Methodology

In this study, therefore, a PCN is first filtered where a direct citation linking two patents is excluded as lack of relevance if the two patents do not meet a BC threshold or a CC threshold. The BC and CC thresholds are determined respectively as the mean BC strength of BC pairs without direct citation and the mean CC strength of CC pairs without direct citation. An extracted patent citation network (EPCN) is thereby established by the foregoing filtering. Additionally, a link is supplemented between two patents without direct citation in the PCN if the two patents do meet a second BC

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threshold or a second CC threshold. The second BC and CC thresholds are determined respectively as the mean BC strength of BC pairs with direct citation and the mean CC strength of CC pairs with direct citation.

The importance of a patent then can be approximated by counting its direct and indirect citations in the EPCN, or by counting its direct and indirect citations/links in the supplemented EPCN. Alternatively, a weight mechanism can be used to incorporate indirect citations by modifying the models elaborated by Trajtenberg et al. (1997) and Atallah and Rodriguez (2006) respectively. A case study is conducted using granted patents in a specific technology field retrieved from United States Patent and Trademark Office (USPTO) to demonstrate the feasibility of the research methodology.

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The Optimality Property of C-D Knowledge Production Function

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Introduction

The production function is one of the important concepts in economics, which plays important role in micro as well as macro economic analysis, describing the relationship between input factors and output variable for economic systems. Because of its excellent properties Cobb-Douglas (C-D) production function has got wide spread in economic analysis.

Nowadays production function has been introduced as a tool to analyzing the input and output relationship of knowledge production systems and innovation systems. Here the production function, which regards the R&D expenditure and personal as main input of knowledge production and innovation, papers and patents as its important output, is named as knowledge production function (KPF). The KPF was put forward firstly by Griliches (1979) and modified by Jaffe (1989). Now the KPF with C-D form has been got wide use in the area of investigating the effects of R&D investment at the firm and industry level (Ariel and Griliches, 1980; Acs et al, 1988; Yanbing, 2006), as well as in the evaluating academic productivity in university or government research institute (Anselin, 1997, 2000; Huang et al, 2006; Meng et al, 2006).

Why can the KPF with C-D form be used in the area of quantitative analyses of knowledge production and innovation? Is it quite appropriate to express the relationship between R&D input and output? Is there any another better one which can replace C-D KPF function? These questions are very interesting and difficult to answer. The C-D KPF has got wide spread application mainly because of its excellent properties already known. Besides this there must be other deep reasons. Based on the mathematical optimal estimation theory this paper investigates the pattern of KPF, which is less considered up to now, and try from mathematical point of view to give a theoretical explanation for the questions mentioned above.

Method

S&T system can be measured by two kinds of S&T indicators, one is absolute indicator, and another is relative one i.e. ratio indicator. Absolute indicators reflect the scale of S&T resources or production. It is obvious that R&D input (personnel and expenditure) as well as output (papers and patents) are scale indicators.

Let $x_1, \cdots, x_m$ and y denote R&D input and output scale indicators respectively, Ω stands for an population such as public research institutes, universities, enterprises, scientific fields, industrial branches or regions in the scope of study.

Then $x_1(\omega), \cdots, x_m(\omega)$ and $y(\omega)$ can be defined as multiple random variables over Ω, where ω is individual in population Ω.

The relationship between $x_1(\omega), \cdots, x_m(\omega)$ and $y(\omega)$ is usually stochastic. The stochastic relationship of KPF for $x_1(\omega), \cdots, x_m(\omega)$ and $y(\omega)$ can be generally expressed as

$$y(\omega) = k \cdot F(x_1(\omega), x_2(\omega), \cdots, x_m(\omega)) . \tag{1}$$

where the functional form F is not known and have to be determined, and the coefficient k is also stochastic. Under the logarithmic transformation, we have the following equivalent expression

$$e = \ln y(\omega) - \ln F(\ln x_1(\omega), \ln x_2(\omega), \cdots, \ln x_m(\omega)) . \tag{2}$$

where $e = \ln k$ is random variable over Ω. The mean square error (MSE) Ee^2 is

$$Ee^2 = E[\ln y(\omega) - \ln F(\ln x_1(\omega), \ln x_2(\omega), \cdots, \ln x_m(\omega))]^2 \tag{3}$$

From mathematical optimal estimation theory, a good form of KPF should make the MSE minimum such that the KPF can better approach the real situation.

First, in the paper, based on the earlier work (Bangwen, 2000, 2003) and by empirical analysis with statistical hypothesis testing, we study the joint probability distribution of multiple R&D input and output variables $x_1(\omega), \cdots, x_m(\omega)$, $y(\omega)$, which is very important for next step. Then the method of mathematical optimal estimation theory (Laha et al, 1979; Sage et al, 1971) is used to determine the optimal solution which minimizes the MSE of equation (3), and to prove that the optimal solution determined is the only function that has the property of minimum MSE.

Result

Based on earlier works and empirical analysis, this paper has shown that the joint probability distributions of R&D input and output variables can be approximately described by multidimensional lognormal distribution, i.e. for logarithm of the variables they can be described by multidimensional normal distribution

$$(\ln y(\omega), \ln x_1(\omega), \cdots, \ln x_m(\omega))^T \sim N(\mu, v) \tag{4}$$

where $\mu = E(\ln y(\omega), \ln x_1(\omega), \cdots, \ln x_m(\omega))^T$,

and $v = D(\ln y(\omega), \ln x_1(\omega), \cdots, \ln x_m(\omega))^T$.

Second, the paper has proven that the optimum solution that minimize the MSE Ee^2 has the following C-D form

$$y(\omega) = A \cdot x_1^{a_1}(\omega) \cdots x_m^{a_m}(\omega) \tag{5}$$

where A is a constant and α_i are parameters which can be established from the section data over population Ω. Also, in the case that R&D input and output variables can be

approximately described by multidimensional lognormal distribution, the formulation (5) is the only one that has the optimality property.

Conclusions

Based on the method of mathematical optimal estimation theory, this paper investigated the form of KPF with the minimum MSE property. The results from the paper indicate that C-D KPF is the only production function with minimum MSE. Therefore it may be concluded that from mathematical optimal point of view when variables of R&D input and output are already determined C-D KPF can better express the relationship between these input and output, and is a better one than other forms of KPF. This may be as one of the reasons to explain that the C-D KPF has got wide spread application.

It should be mentioned that R&D activities are very complicated, and can be influenced by many factors which have not been taken into account. However, addressing them is beyond the scope of this paper.

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The effect on the research community of the endorsement of SJR and SNIP by Scopus

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The ranking of journals increasingly affects and drives those in the academic world. The Journal Impact Factor is the most well-known and widely used journal ranking metric, and is regularly used in performance evaluations at various levels. However, ranking that is driven by any single metric cannot effectively represent the concept of 'excellence', which depends on differing factors such as the research field, career stage, and the opinion of the assessor.

Customer feedback received by Elsevier indicated a strong need for another commercial provider to endorse an alternative(s) to the Journal Impact Factor, so as to encourage debate and discussion amongst the research community. The Scopus database was seen as a suitable basis for such an alternative metric(s) due to its dynamic nature, and to the additional content it covers that is not available in Web of Science and Medline, for instance; in particular, its strength in local language publications was seen as attractive. Consequently, in January 2010, Elsevier concurrently introduced two journal ranking metrics within the Scopus platform, and also on the freely accessible site www.journalmetrics.com.

The metrics endorsed by Scopus are the network metric SCImago Journal Rank (SJR) [1], and the impact metric Source-Normalized Impact per Paper (SNIP) [2]. These metrics represent complementary approaches to ranking journals, and together underscore the fact that a single metric can never be a sufficient basis on which to form a judgement. They challenge the user to make up their own mind about which aspects of performance they consider 'excellent'. They also represent a new approach to the frequency and methodology of generating values, in that calculations will be performed twice a year and previous years' valued will be recalculated to ensure they represent the current state of the database.

As with any new approach, it is critical to understand how it is viewed by the community, the effects it can have, and any short-comings that remain to be addressed. We are conducting ongoing research to understand the reactions of our customers and the wider research community to the endorsement of SJR and SNIP by Scopus. We are talking to those whose roles may be affected such as librarians, journal editors, society officials, and end-users. The research encompasses questions such as: what effect this endorsement of SJR and SNIP has had on the individual; how these metrics have contributed to the evaluation of research; how these metrics have challenged the existing mind-set of which journals to publish in, and the perception of journals in the market; how SJR and SNIP have contributed to the understanding of subject fields; and so on. The results of this research will be presented, and some questions that arise from this research will be raised.

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Effects of the durability of citations over the impact of research teams

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Introduction

The effects of ageing of scientific publications have crucial importance for a better understanding and use of bibliometric indicators (Garfield, 1980; Moed et al, 1998; Glänzel et al, 2003). In this study we focus on the effects of durability of citations for the bibliometric analysis at the research team level.

Method

Recently, we developed a bibliometric methodology for the classification of scientific papers according to the 'durability' of their citations (Costas et al, 2010). This methodology classifies papers in 3 durability types:.
- Normal or Standard: publications with the typical (or common) distribution of citations over time according to their disciplines;
- Delayed: publications cited later than normal (as in their disciplines);
- Flashes in the pan: publications early cited but 'forgotten' afterwards (also as in their disciplines).

A total of 18,160 publications published by 158 chemistry research teams at 10 universities in the Netherlands during 1991-2000 and covered by the Web of Science are studied considering two citation periods: 1991-2000 and 1991-2008 (this period implies 9 more years of citations for all the papers).

Results

The teams are classified through the k-means clustering method by the percentages of durability types in three clusters (Table 1). First cluster includes teams with the highest share of delayed papers as compared to the other clusters ("+Delayed"). The second presents the highest share of flashes in the pan ("+Flash in the pan"). The third one includes the teams with the highest shares of normal publications ("+Normal").

Table 1. Description of clusters by durability

		%Delayed	%Flash in the pan	%Normal
Cluster 1 +Delayed N=51	Mean	23.98	13.11	62.91
	Median	23.62	13.85	62.26
Cluster 2 +Flash in the pan N=42	Mean	12.20	21.35	66.45
	Median	12.37	20.79	67.06
Cluster 3 +Normal N=59	Mean	13.36	11.49	75.15
	Median	12.99	12.09	74.76
Total N=152	Mean	16.60	14.76	68.64
	Median	15.54	14.29	68.75

Note: 6 teams didn't have enough data for the durability analysis.

In Figure 2 the three clusters are studied through the distribution of the **CPP/FCSm** (field-normalized impact – **C**itations **P**er Publication/**F**ield **C**itation **S**core **m**ean) of the teams during both citation periods.
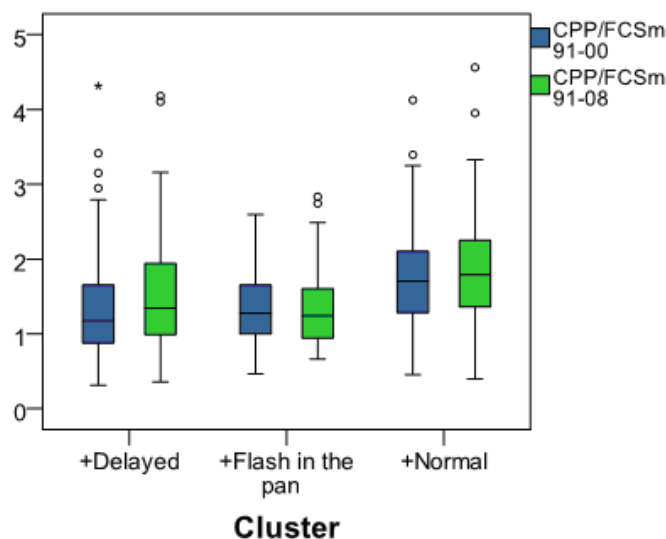
Figure 2. Distribution of CPP/FCSm by clusters (periods 1991-2000 and 1991-2008)

Teams with a "+Normal" pattern present the highest scores of CPP/FCSm regardless the period as compared to the other clusters. "+Delayed" groups improve their CPP/FCSm in the longer period but they do not outperform "+Normal" and only equalize "+Flash in the pan". This means that "+Delayed" teams improve their impact for a much longer period but not sufficiently for significantly outperform their position in the scientific landscape. An important conclusion is that general claims of lack of validity of bibliometric indicators due to being 'ahead of time' are not realistic. Although some teams exhibit a delay pattern, applying a longer period of time does not imply a real improvement.

In any case, the new methodology will allow detecting any potential cases of delayed patterns and make possible to test deeply if this is relevant for the performance of the team. In the full version of the paper more results, the correlation with other indicators and properties of the durability patterns at the team level will be presented.

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Order of authorship: effects of age and professional rank

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Introduction

The main role of authorship is giving credit to the scientific contributions of authors
as well as assigning responsibility for the research. At present, increasing attention is
being paid by journals, associations, institutions and scientists themselves to
authorship issues in order to reduce ambiguity, avoid fraudulent authorship and assign
due credit to authors (Osborne & Holland, 2009).
From a bibliometric perspective, the position of authors in the by-line of publications
is also an issue of great concern. Although signing practices vary between fields, by
and large, the position of authors is related to their role in the research, and it is
widely accepted that in experimental sciences, the most important positions are the
first (experimental work) and the last (supervisory function). Accordingly, the order
of authors can be taken into account in the assessment of scientists' performance (see
for example Hu et al. 2010; Tscharntke et al. 2007) as well as in the study of different
aspects of scientists' behaviour, such as collaboration habits and the roles of scientists
in the production of new knowledge.

Objectives

Our main objective is to study authorship practices in publications having regard to
the order of names in their by-lines. Different questions are addressed: Are there
specific authorship patterns for junior and senior scientists? Is the position of
researchers in the by-line of papers influenced by professional category and/or age?
Are there differences by field in these regards?

Method

A total of 1,064 permanent researchers working at the Spanish CSIC in 2004 in three
research areas (Biology & Biomedicine, Natural Resources and Materials Science)
have been considered for this analysis. Their scientific publications (24,982
documents) recorded on the Web of Science for the period 1994-2004 were
downloaded and assigned to their authors. The position allotted to each scientist in the
by-line of the publications was recorded and the percentages of papers in first, middle
and last position were calculated. The relationship between the position of authors in
publications and the age, professional category and research performance of scientists
was analysed, as well as the interactions between these factors.

Results

Preliminary results concerning the evolution of the position of the signature of
researchers by age are presented (Figure 1, including only results for Biology &
Biomedicine and Materials Science). A clear pattern appears: first-authored
documents predominate among the youngest researchers while this position of

signature is less frequent for older researchers, whose signature is more likely to appear in the closing position. Shift age (the borderline age when researchers become more likely to sign last rather than first) is around 35-36 for Biology & Biomedicine and slightly later for Materials Science (37-38).

Biology & Biomedicine

Materials Science
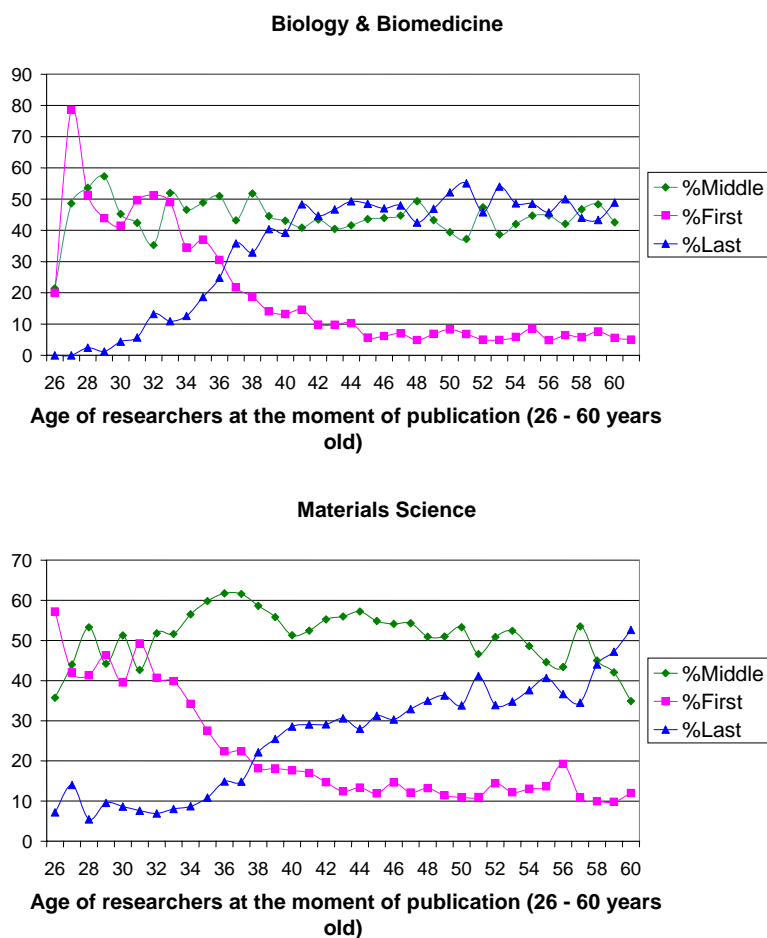
Figure 1. Evolution of the order of authorship by age

In the full paper, the analysis of order of authorship by age, professional category and research performance in the three areas will be presented. The interaction among these variables and inter-area differences will be explored. The results of this study will contribute to further the understanding of authorship practices in connection with the changing role of scientists in research as they advance in their scientific career. Moreover, this paper may arouse keen interest among bibliometricians and policy makers, who need to be aware of the possible influences of age and rank on the order of authorship, both for the design of indicators and for the assessment of research performance of individual scientists.

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Publications profile and international visibility in Communication Sciences in Switzerland

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Introduction

The differences in publication and citation behavior between experimental sciences and social sciences and humanities (SSH) have been intensely debated; nevertheless, often these latter areas continue being evaluated by the criterion of the former using bibliometric indicators based on WoS publications for monitoring and measuring scientific performance (Nederhof: 2006). Due to a considerable part of the output in SSH being oriented toward national or regional topics and local audiences, and frequently published in books, monographs, reports and working papers, the development of new instruments and methodologies for performance measurement is needed (Archambault and Vignola-Gagné: 2004). In general, citation analysis is used as a proxy to measure scientific quality; so how can quality be measured in fields where citation analysis has limitations? In previous work different methodologies to analyze output in SSH have been proposed, (e.g. Nederhof: 2006, Sivertsen: 2010). **Quality** is a difficult concept when there is no agreement on what it consist of. A more feasible option could be to measure **visibility**, based on measurable criteria accepted by the member of the community.

In our paper, we propose a way to analyze publication profiles considering different types of visibility related to different types of audiences. We apply two complementary procedures:

1- the creation of a **journal list** including the characterization of these journals
2- the analysis of **visibility** of publications in international databases

The aim is not to evaluate productivity or to rank output of research units, but to produce publication profiles based on objective criteria.
We present an instrument developed for analyzing output of research units in communications sciences in Switzerland, a context where disciplinary, linguistic and institutionalization differences apply. This contribution is part of a research project funded by the Rectors' Conference of the Swiss Universities aiming at building multidimensional profiles of research units (Probst et al. 2010).

Method

Lists of all publications produced between 2005 and 2009 is collected directly from the units.
From them we create a **journal list** and characterize the international visibility based on objective criteria analyzed through the journals' websites: disciplinary orientation,

place of publication, publisher, composition of the editorial board, coverage in international database, audience.

For each unit, a profile describing the output composition per documental type, language and place of publication is produced. **Visibility** is studied through the coverage of documents and number of citations in Google Scholar, being particularly beneficial to academics publishing in sources not well covered in WoS. The availability of complete publication lists helps developing efficient search and data cleaning strategies.

Results and discussion

5 research units were analyzed. Journal articles represent between 11% and 30% of the output, and their disciplinary orientation corresponds to the institutional mission of each unit. Different types of publishers of these journals (scholarly, private, professional association, non government organization) are detected. Coverage of the journals in international databases is between 0% and 60%. Considering all publications, between 21% and 60% of documents are included in Google Scholar and around 70% of them are cited. Percentage of self-citation is around 8% and 22%. Highest visibility in the database is found for peer-review articles, edited books and monographs. Preliminary results show a clear relationship between disciplinary orientation, documental type used, audience of publications and international visibility: the analyzed research unit working in the German speaking part of Switzerland in mass media communication produces principally chapters in books, published in Germany and for a local and regional audience of professionals or researchers in this field, while the analyzed unit closer to business studies is more internationally oriented, with a higher production of peer-reviewed journal articles, published in English, with high coverage in international databases and for a scientific international audience.

The application of this methodology shows that combining different sources is a sensible strategy to characterize publication profiles of research units considering their different missions and disciplinary orientations.

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Towards Quality Measures for Bibliometric Indicators

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Bibliometric data are a representation of formal communication in science. They represent results of scientific practices. They facilitate analyses of structure and dynamics of scientific knowledge. They provide insights into the social conditions under which it is produced. This potential of bibliometric data and indicators is tempting. It often covers the fact that both have numerous shortcomings and, even though they are frequently presented as such, are far from being objective representations. As all social science data bibliometric data and indicators are strongly dependent on the methods and mechanisms adopted for their production. Consequently, they contain incomplete or imprecise information and in some cases they are simply erroneous (e.g. Glänzel/Debackere 2003, Hornbostel et al. 2008).

However, in contrast to other fields of social science research, the debate on this problem is far from being exhaustive in bibliometric research. It often remains limited to the eclectic description of issues. In many cases, neither any indication on the scope of the problems and uncertainties nor any conclusions on the reliability of the resulting indicators are available. Hence, statements on the quality and limitations of bibliometric knowledge are difficult to sustain. It is left to the user of the data and indicators to decide in which contexts the indicators are reliable enough to be applied.

One reason for this shortcoming might be found in the fact that bibliometric research and knowledge production is a field of research strongly integrated into political and social, i.e. non-scientific, discourses and debates (Glänzel/Schöpflin 1994, Weingart 2005). As a consequence bibliometric knowledge is produced and used in very heterogeneous contexts, each requiring a different notion of quality. For example: an academic study comparing research activities of countries can be performed with data of relatively low reliability whereas a comparison of the research activities of individuals or small research groups with the aim of supplementing funding decisions implies the highest possible quality and precision of the underlying data and methods. Taking this as our departing point we argue that quality in bibliometric research should be defined taking into account both, the process of knowledge production and the context knowledge is produced for.

On the poster we will present "Reliability Tests and Quality Assurance for Bibliometrics", a research project which recently started at iFQ with the aim of providing an empirical foundation for judgments with regard to the quality of bibliometric knowledge. Based on an analysis of Scopus and Web of Science data the scope of data errors will be systematically evaluated in order to provide an elaborate

error calculus and account for reliability measures of bibliometric indicators. The analysis will particularly focus on the comparative evaluation of techniques for relating citing and cited record, of methods in dealing with spelling and coding variances and of the adequacy of citation windows for different disciplines. The project's overall aim is to develop reliability tests which allow assessments of the robustness and validity of bibliometric indicators.

The poster will provide an outline of the project, give insights into our methodology and present first results. It will consist of three parts:

- An in detail description of common problems of bibliometric raw data, data processing and data storage, e.g. spelling variances, distribution of data, the coverage of databases
- the resulting methodological and technical pitfalls in the transformation of bibliometric data into bibliometric indicators
- an outline of the methods applied for developing an error calculus and reliability measures for bibliometric indicators

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Scientometric journals in scientometric databases. Microlevel analysis of lost citations

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Presenter: Vladimir Pislyakov

Introduction

Being the main instruments for scientometric research, international citation indexes have to be thoroughly explored and tested for their completeness and accuracy (Bar-Ilan, 2008; Lopez-Illescas et al., 2008). Since the hegemony of Thomson/ISI citation databases has ended, a number of scholars compared Web of Science (WoS) to its new competitors, Scopus and Google Scholar (Gavel, Iselid, 2008; Jacso, 2008). However, there are not so many in-depth studies that try not only to measure the difference between total numbers provided by these sources, but to identify and to estimate the weights of reasons of these inequalities (e.g. Todd, Ladle, 2008). In this study we aimed to conduct the microlevel analysis of the citation data discrepancy between Web of Science and Scopus, unveiling inner properties of these databases.

Method

We took all documents published during 2006–2007 in 4 journals — *Scientometrics*, *Journal of the American Society for Information Science and Technology*, *Journal of Documentation*, *Journal of Informetrics* (the last was launched in 2007, so we took one year) — and examined all citations received by this set of papers in 2008 according to Web of Science (SCIE, SSCI and A&HCI) and Scopus databases. For every "unique" citation (provided only by one of two databases) we went in depth, obtained the full text of citing paper when necessary and tried to detect the reason why the citation is missing from the other database.

Results

Citations to 759 papers were examined, and we conclude that the Web of Science citation data differ significantly from that of Scopus. Two databases provided 1607 distinct citations to the papers under study. On the Figure 1 one can see how they are distributed among databases. So, three quarters of all citations are "shared" and one quarter consists of "unique" citations, among which "Scopus-unique" are found 6.5 times more often than "WoS-unique".
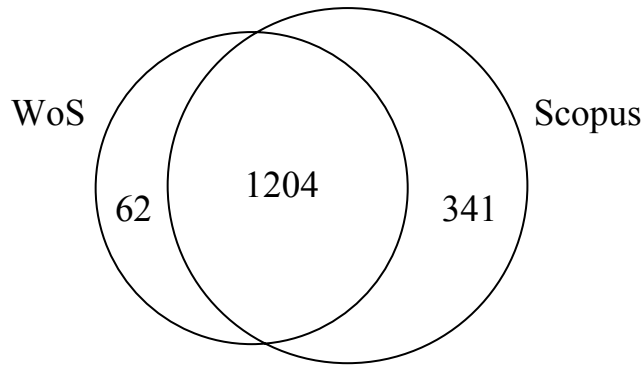
Figure 1. Distribution of the citations derived from Web of Scence and Scopus. Unique and shared citations.

Three of 403 unique citations were erroneous in the sense that database counted citation not existing at all. Exploring each of the rest 400 citations lost by one of the databases we identified reasons for such losses, which can be grouped into two classes — difference in coverage and recognition failure. Table 1 shows weights of each reason in citations' loss.

Table 1. Role of different factors in citations' loss

	Number (%) of citations missed by WoS (total = 339)	Number (%) of citations missed by Scopus (total = 61)	Number (%) of all lost citations (total = 400)
Coverage difference — total	229 (67.6%)	35 (57.4%)	264 (66.0%)
Citing journal is not indexed	221(65.2%)	6 (9.8%)	227 (56.8%)
Citing paper is not indexed	8 (2.4%)	29 (47.5%)	37 (9.3%)
Recognition failure — total	110 (32.5%)	26 (42.6%)	136 (34.0%)
Reference list is absent or incomplete	21 (6.2%)	6 (9.8%)	27 (6.8%)
Accurate citation is not recognized	21 (6.2%)	13 (21.3%)	34 (8.5%)
Inaccurate citation is not recognized	64 (18.9%)	3 (4.9%)	67 (16.8%)
Other and unclassified reasons	4 (1.2%)	4 (6.6%)	8 (2.0%)

We can see that for WoS the main reason why it misses particular citation is that it does not index source journal — 65% of cases. Publications contributing most to coverage-caused discrepancy are *ACIMED, Ethics in Science and Environmental Politics, Library review, New Library World, Revista Brasileira de Botanica* — all are indexed by Scopus and not included in WoS. As for Scopus the main reason of citation loss is coverage gap (when particular paper is not indexed) — 48% of cases.

Probably more interesting is that for 34% of citations missed in one of the databases the reason is recognition failure. It means that the citing paper is included in both WoS and Scopus but one of the products failed to extract the citation from the paper correctly. We observe an advantage of Scopus here — while Scopus failed to recognize 26 citations detected by its competitor, WoS lost 110 citations that Scopus didn't. We should note that more than half of these 110 citations lost by WoS were made inaccurately by the authors of papers — references were incomplete or

contained mistakes, but in all these cases authors' inaccuracy didn't prevent Scopus from recognizing them.

Conclusion

We found that for the same set of papers Web of Science and Scopus provided substantially unequal sets of citations. While the main reason of this discrepancy is the difference in journal coverage, it doesn't explain the whole picture, only 57% of it, so the contribution of other reasons — databases' inaccuracy and their inability to correct authors' inaccuracies — is rather significant. While Scopus indexed more unique citations than WoS did due to broader coverage scope and (according to our sample study) better citation recognition ability, it also has its weak points, for example unexpected gaps in coverage.

To stress the importance of issues raised in this paper, we included to its list of references only items which contained "unique" citations to our sample papers set, so missed by one of the databases. They are:

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A full coverage study of output in the social sciences and humanities (Flanders, 2000-2009)

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Introduction

Achieving full coverage of publication output in the social sciences and humanities (SS&H) is notoriously difficult. Profound insight into the publication cultures of the SS&H cannot be achieved through analysis of journal publications only as other publication types, namely book publications, contributions to national research literatures, and non-academic publications are important too (Hicks, 2004). Hence, research performance indicators for the SS&H are largely underdeveloped, as few databases from which they could be derived are available (Archambault, Vignola-Gagne, Cote, Lariviere, & Gingras, 2006; Huang & Chang, 2008). Among other things, this lack of suitable date was the focus of a recent European scoping project (Martin et al., 2010).

Method

The Flemish Academic Bibliographic Database for the Social Sciences and Humanities (VABB-SHW) is a database encompassing all publications 2000-2009 of SS&H academics, affiliated to a higher education institution in Flanders. As from 2011, the database will serve as a basis for the distribution of research funding over Flemish universities. The records in the database refer to 50.211 journal articles, 12.175 monographs, 7.977 edited volumes, 47.112 bookchapters, and 2.823 proceedings papers. However, not all records have a valid ISSN or ISBN, and there are some doubles due to interuniversity collaboration and mobility. All records have been assigned to one or more of 12 SS&H disciplines on the basis of their authors' affiliations. A descriptive analysis of the published output and the remarkable differences between disciplines will be the focus of the first part of the paper. In the second part of the paper we highlight findings regarding changing publication patterns and their interdependences.

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Why is Europe so efficient at producing scientific papers, and does this explain the European Paradox?

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Introduction

The EU published scientific papers for $1.1 million each in national R&D investment in 2007. It cost the US $1.8 million (and China about the same). That $700,000 difference adds up, since each of the two publishes over 200,000 papers per year. R&D investment produces other benefits, but it is curious why the EU is so efficient in paper publication.

Many measures of national efficiency have been studied, by dividing outputs by population, researchers, GDP, et al. (Rousseau and Rousseau 1998), (Meng 2006), and (Huang 2006). The "relative efficiency," is particularly useful, since it can be a predictor of a nation's world share of scientific publication from its share of world research investment (Shelton 2008). Relative efficiency is the ratio of these two shares, and is also simply the number of papers published per $1 million investment in R&D, normalized by values for all countries with OECD data.

Fig. 1 compares the relative efficiencies of the EU, US, and PRC. In 1990 the US and EU had the same value, but the two curves diverged sharply in the 1990s; now the EU curve is over 60% higher. This caused the EU to pass the US to lead the world in publications in the mid-90s. Analysis of that decade can identify which components caused efficiencies to change, and thus suggest the source of Europe's current advantage.
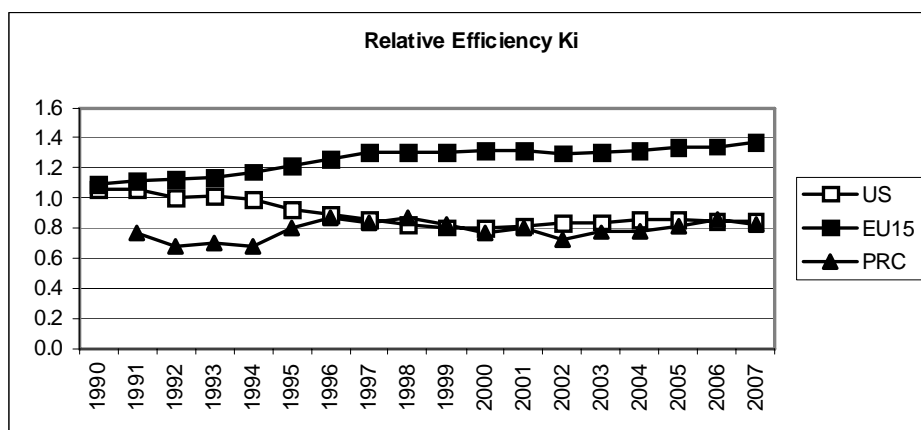
Figure 1. Relative efficiency in producing papers in the SCI per $1 million in national R&D investment (GERD, PPP constant $), normalized by all countries in the OECD database.

Methods

Gross domestic expenditure on R&D (GERD) is from OECD (2010). Publication data is from NSF (2010 and earlier editions), based on fractional counts in the SCI. Shelton, et al. (2009) showed that it is unlikely that these changes are an artifact of the SCI. Here the components of efficiency are analysed.

Findings

1. Multiple linear regression over 39 countries in the OECD data suggests that the government funding component and the university research spending component are much more effective in producing papers than other components. Leydesdorff and Wagner (2009) provide some related analysis.

2. The EU shot ahead in efficiency in the 1990s because its large countries cut back sharply in their increases in R&D investment, while rapidly increasing their papers.

3. The Cold War's end in 1991 decreased motivation for defense R&D, and the EU cut increases in overall R&D much more sharply than the US.

4. During the 1990s the EU sharpened its focus on funding of the components that are most effective in producing papers, while the US did not. Simple regression models with these components as independent variables can then account for Europe passing the US in the mid-90s to lead the world.

5.. The 1990s surge of EU papers not only increased its share and relative efficiency, but also depressed those of the US, since shares are a zero-sum game.

Conclusions

After the Cold War, Europe's large nations reduced their annual R&D increases, and focused on investments that mainly produce papers. Ergo the European Paradox, which is the perception that Europe does not reap the full economic benefits of its leadership in research. Instead of outputs like patents that more quickly create jobs, Europe produces papers. While its efficiency remains high, the EU is now losing publication share to China, and may soon be overtaken (Shelton and Foland 2010).

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Proximity and collaborative Mode 2 knowledge production: The case of non-pharmaceutical Type 2 Diabetes Mellitus research in Europe

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Introduction

If anything characterized the change in scientific knowledge production over the past century, it has been its increasing distributed nature (Wuchty et al. 2007). For research collaborations this rise has not been limited to inter-university research projects. In this respect Gibbons et al. (1994) introduced the distinction between the traditional Mode 1 knowledge production and the alleged increasing new Mode 2 knowledge production.

We propose to operationalize the distinction between Mode 1 and Mode 2 knowledge production for collaborative research using the notion of proximity. Table 1 links five characteristics of Mode 1/Mode 2 knowledge production with five forms of proximity (Boschma 2005) whereby Mode 1 knowledge production coincides with collaborations between proximate partners and Mode 2 with collaborations between less proximate partners.

Table 1. Mode 1 versus Mode 2 knowledge production as operationalized by five forms of proximity

Mode 1 knowledge production	Mode 2 knowledge production	Basic notion of proximity
Mono-disciplinary	Spanning disciplinary boundaries	Cognitive proximity
Local	Diffusion over a range of physical sites	Geographical proximity
Same social context	Flexibility in social relations	Social proximity
Single organization	Wider societal context	Organizational proximity
Pure academic context	University-industry-government relations	Institutional proximity

One question then concerns the actual organization of the sciences, that is, how is science organized if characterized along lines of different forms of proximity? Is science organized in a distributed form alongside each and every proximity dimension (i.e. Mode 2)? Is science organized in a non-distributed manner (i.e. Mode 1)? Or, is

science organized in distributed form alongside some while in non-distributed form alongside other proximity dimensions? This paper is an attempt to assess this issue.

Method

In addressing the organization of collaborative science we restrict our analyses to the collaboration intensity between organizations involved in non-pharmaceutical type 2 diabetes mellitus (t2dm) research in Europe. We choose this aspect of diabetes because we expect that research therein will typically be of the Mode 2 kind. The dependent variable in the analysis describes the number of research collaborations between organizations in non-pharmaceutical t2dm research as measured by the total number of co-publications between each two organisations during the period 2002-2007. As independent variables we included the five forms of proximity. Cognitive proximity is measured by the degree of overlap in the journals in which organizations have published. Geographical proximity is measured by the inverse kilometric distance between the city-level coordinates of the organizations' locations. Social proximity is measured by the number of prior (1987-2001) ties between organizations. Organizational proximity is a binary measure reflecting whether two organizations belong to a single umbrella organization. Institutional proximity is a binary measure reflecting whether two organizations belong to the same institutional sphere.
We estimate gravitation models for both Europe as a whole and individual European countries. Since co-publication data between any organizational pair may deviate from a standard Poisson process, we estimate the parameters using a negative binomial regression model.

Results

Table 2 shows the results for Europe as a whole and the three largest countries in collaborative non-pharmaceutical t2dm research. We find that non-pharmaceutical t2dm research in neither Europe as a whole nor in any individual European country is organized in a Mode 2 fashion. For individual European countries we show that the determinants of research collaboration differ widely among countries. Thus, evidence for Mode 2 knowledge production is rather weak and countries differ substantially in their way of organizing collaborative knowledge production in case of non-pharmaceutical t2dm research.

Table 2. Negbin regression results

	European Union	United Kingdom	Italy	Germany
Cognitive proximity	++	-	-	-
Geographical proximity	++	++	++	++
Social proximity	++	+	++	+
Organizational proximity	++	+	-	-
Institutional proximity	++	+	++	+

+ reflects a positive impact, ++ a positive and significant impact, and – reflects a negative impact of proximity

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The use of bibliometrics to estimate biomedical research expenditure

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Introduction

The Global Forum for Health Research has been making estimates of global health-related research expenditure for some time (Global Forum, 2005; 2007) in an attempt to redress the imbalance between the amount of research in different disease areas and their global burden. We wanted to investigate whether the use of bibliometrics, which has been used with success in mainstream disease areas (Lewison *et al*, 2004), could also be used in less conventional areas such as road traffic accidents (ROTRA) and treatment of infections with drugs (TRINF). The method consists in the application of a subject-based filter to a bibliometric database to determine the annual number of papers world-wide, and multiplication of this number by the average cost per paper, determined from a questionnaire sent to leading researchers. This study reports on the results of the two processes, with particular application to Spain.

Method

The two subject-based filters were developed in consultation with Professor Dipak Kalra of UCL, and consisted of lists of specialist journals (*e.g.*, *Traffic Injury Prevention*, *Antiviral Therapy*) and relevant title words (*e.g.,* automobile + risk + collision*, filariasis + double blind). They were calibrated with reference to eponymous departments (Lewison, 1996) and then applied to the Web of Science (WoS) to generate sets of papers world-wide in the two subject areas. The leading authors of Spanish papers were identified, with their addresses and e-mails, and they were sent questionnaires asking about their research budgets, their sources of funding and their publication practices.

Results

The two subject-based filters, after correction for calibration, gave world outputs of 539 papers per year for ROTRA and 1863 for TRINF, of which Spain contributed (on a fractional count basis) 9.0 (1.7%) and 97.3 (5.2%). Analysis of the responses by the TRINF researchers, after allowing for the amount of effort that did not lead to publications in the WoS, and fractionation of their papers to account for collaborators, gave a mean cost of €279,000 per paper. This indicates a world expenditure of about €520 million on this subject. Responses by the ROTRA researchers were much more varied and some budgets seemed unreasonably low, although the team sizes were much smaller, but if a similar cost per paper is assumed, a world expenditure of about €300 million is estimated. Over half the publications by the ROTRA researchers were not in WoS journals but in "grey" literature.

Conclusions

Telephone interviews with respondents showed that e-mailed questionnaires were the preferred format, and they should be in English rather than the local language as all scientists should be capable of reading English. Financial inducements to return the questionnaires were considered inappropriate. Although the questions were clear, respondents had difficulty in estimating the breakdown of their costs. Nevertheless, the methodology seems to be a good way to estimate expenditures on research in specified subjects, because it can be applied internationally and gives potentially universal coverage.

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Technological Capacities of the European Union, 15 members (EU-15) and its Collaboration Profile with Latin American Countries

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Introduction

The idea that science and technology activities contribute to the development of the economies of the countries is widely accepted for society and academy. In this sense, further knowledge of the strengths and weaknesses of the technological capacities of a country definitively help design and implement public R&D policies, especially in knowledge-based economies.

The European Commission proposed "A strategic European framework for international science and technology cooperation (13498/08(COM(2008)588)" with the objective *"of strengthening the scientific and technological base of the European Union, boosting the competitiveness of its industry and helping to deal with global challenges within a context of "global responsibility"*. To perform this objective it is necessary to identify and to promote the main scientific and technological areas of each European country.

The mapping of the structure of collaborations networks between countries, across patent indicators, and the assessment of the degree of overlap between them may contribute greatly to the design of better policy instruments (Narin, F., 2004; Breschi, S., 2010).

The aim of this study is to analyze the strengths and weaknesses of technological capacities of EU-15 members and to study the collaboration profile with other regions, especially with Latin-American (LA) countries. This study has been carried out within the activities of EULARINET (European Union-Latin American Research and Innovation Networks) inside the VII Framework Programme.

Method

Patents of European and Latin-American countries have been obtained by a search strategy which includes the countries' corresponding codes and the publication years (2000-2008), in EPO and USPTO databases. Data downloaded from EPO database have been used to create a local database, built at IEDCYT-CSIC, for the purposes of this study, while data from USPTO have been analyzed with Matheo Patent® software.

Results

The EU-15 countries represent a 17% of patents registered in USPTO and 43% of applications and patents of EPO. The European countries with higher number of assigned patents, considering both databases, are Germany, France and UK, representing 67% of total European patents, mainly in Human Health sector.

Mexico, Venezuela and Argentina are the countries with more patens, and represent 76% of the total LA patents in collaboration with European countries (USPTO and EPO databases considered together). Medical preparations were the main technological area of collaboration Patents with collaboration between EU-15 countries and Latin-American Countries shows a higher impact, as compare with domestics one, measured in terms of number of cites in other patents.

Previous studies showed important degree of collaboration between LA and European countries in scientific production (Rusell, 2000). In comparison, patent indicators evidence an important gap in technological collaboration during the period analyzed. However, the scientific production indicates that there is a strong base for the establishment of bonds in technological production between LA and European countries. With this aim, there is a need to design new policies for strengthening the technology cooperation between both regions, which is still weak.

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Bibliometrics in the library, putting science into practice

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Summary

The library of Wageningen University and Research centre (Wageningen UR Library) has been involved in bibliometric analyses of various of the institution's research groups since 2004. In preparation for the external peer review of five major graduate schools in 2009 bibliometric analysis tools were implemented in the institution's repository: Wageningen Yield. This implementation facilitated and highly improved the calculation of advanced bibliometric indicators for any unit of Wageningen UR, i.e. institutions, departments, graduate schools, chair groups, projects, down to individual researchers.

The advanced bibliometric indicators computed for the data collected in Wageningen Yield follow Van Raan's methodology (1996) as closely as possible. The citation data are derived from Thomson Reuters Web of Science database, and the baseline values are extracted from the Thomson's Essential Science Indicators. The main difference with the methods of Van Raan (1996) is that we are not able to correct for self citations, another difference is the number of research fields for which we have access to baseline data. However, since we maintain an overview of the complete publication output of Wageningen UR, we are able to indicate the representativeness of our bibliometric analyses for the different groups. The essential part of our method is that the unique Web of Science publication identifiers are included in the metadata collected in the repository. This allows us to update citation data on a regular basis, and compute the bibliometric indicators any moment for any part of Wageningen UR.

Introduction of bibliometrics indicators in the repository has raised library and repository awareness amongst university faculty and staff considerably. The library has been consulted and asked for clarification of bibliometric analyses in the preparation of the external peer reviews on many occasions. The checking of publications lists has resulted in a considerable quality improvement and coverage of metadata collected in the repository. In the aftermath of the peer reviews the library has been asked to advise on the results of the bibliometric analyses, and assist groups in building a coherent publication strategy.

Earlier, the library used Web of Science as a tool for collection development on a small scale as well. The recent coupling of Web of Science identifiers with Wageningen Yield has enabled the library to link the reference lists from articles covered by Web of Science to the individual articles registered in Wageningen Yield, and study journal usage through cited references for chair groups, departments and institutes. These data complement faculty publishing information, and help to attribute

journal download statistics and journal collection costs to the right institutions within Wageningen UR in a more transparent way.

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The historical evolution of interdisciplinarity: 1900-2008

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Introduction

The question of interdisciplinarity has become a much discussed topic over the last decade (see among others, Weingart and Stehr, 2000; Rinia, 2008). The focus has been on the construction of a useful indicator based on addresses, references and citations as a possible measure of the degree of interdisciplinarity of papers (Porter and Chubin, 1985). Also measures of the link between scientific impact and interdisciplinarity have been proposed (Larivière and Gingras, 2010).

In this presentation, we will look at the evolution of interdisciplinarity as well as interspecialty over the entire 20th Century. The first indicator uses the proportion of references to disciplines different from that of the journal in which the paper is published, like references to chemistry or biomedical research in a physics paper, while the second uses the proportion of references to specialties different from that of the journal in which the paper is published but within the same discipline, as when a paper in nuclear physics cites a paper in optics. Distinguishing interspecialty from interdisciplinarity is useful since during the last century many specialties emerged inside the various disciplines, like, for example chemical physics in the 1910s and solid state physics and nuclear physics in the 1930s and 1940s.

Method

This paper uses data from Thomson Scientific's Web of Science (WoS). The classifications of journals used in this paper are those used by the U.S. National Science Foundation NSF). This classification categorizes each journal into one discipline and specialty. For the social sciences and humanities, the NSF categorization was complemented with our own classification – based on that of the WoS – for the humanities (not included in the NSF classification). The final classification includes 143 specialties, which can be regrouped into 14 disciplines. In this paper, these 14 disciplines have been regrouped into 4 broad domains: medical fields (MED), natural sciences and engineering (NSE), social sciences (SS) and arts and humanities (A&H). On the whole, about 615 million references made by about 25 million papers are analyzed here. A citation window of five years is used.

Results and discussion

Figure 1 shows preliminary results. The historical patterns differ greatly whether we look at natural, social or biomedical sciences. In all cases though, interdisciplinarity raises since the 1990s. Interestingly, the proportion of interdisciplinarity diminishes in the period 1945-1975 in the natural sciences. This suggest that the period of the "Thirty Glorious" where funding grew exponentially was accompanied by a

concentration of activities within the disciplines. In medical sciences we see a growth of interspecialty in the first half of the 20th century, while interdisciplinarity remains stable. A&H shows no evolution until the years 2000 which sees a significant growth of interdisciplinarity.
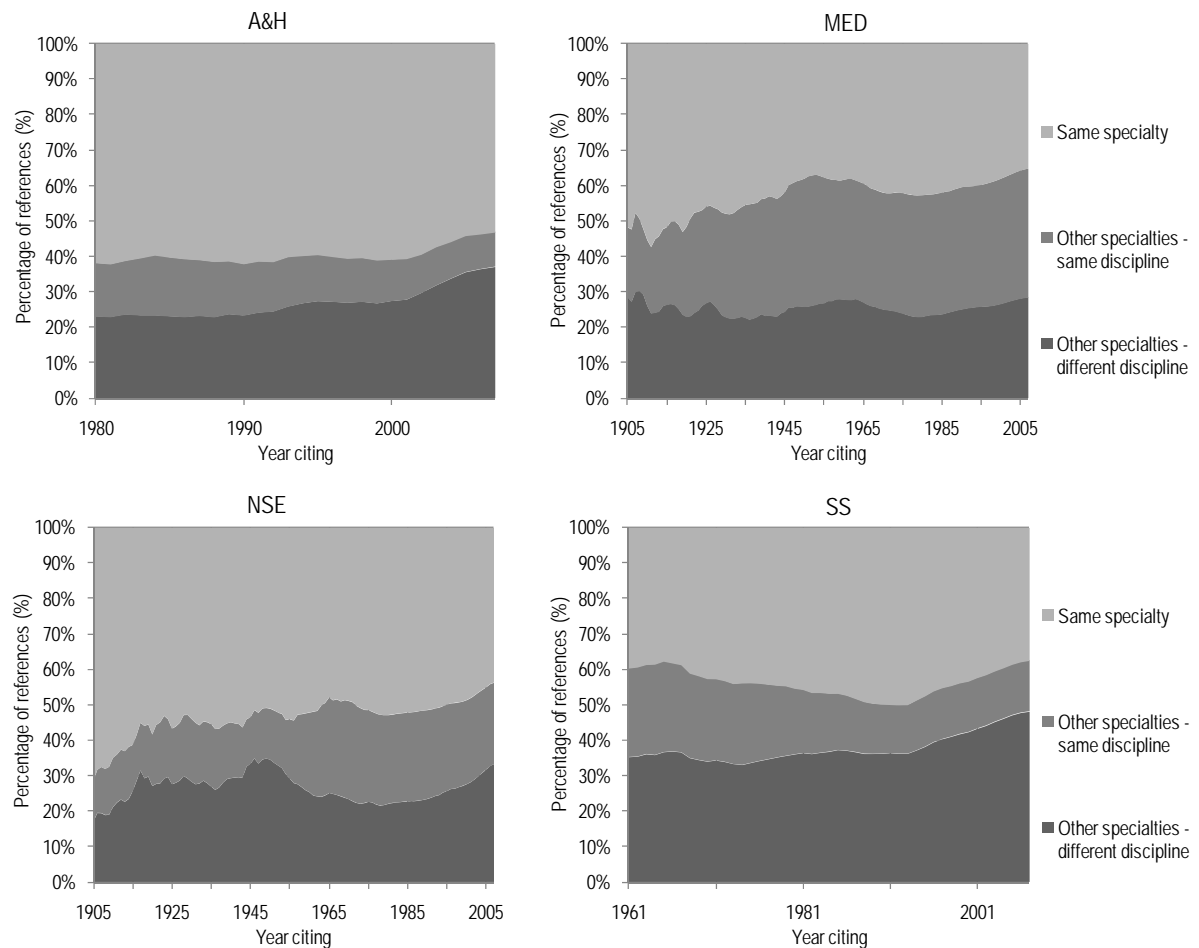
Figure 1. Percentage of references made to journals of the same specialty, in other specialties of the same discipline and in other specialties of a different discipline

After recalling that interdisciplinary talks have been recurrent in the 20th century with peaks in the 1930s-1940s, 1960s-1970s and 1990s-2000s, we will discuss other measures of interdisciplinarity based on an indicator of diversity instead of the proportion of references and compare the results.

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Using 'core documents' for the representation of clusters and topics

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Introduction

Hybrid citation-link and lexical clustering is used to improve the efficiency of both components. In particular, citation-based matrices are extremely sparse and underestimate links whereas text-based methods have usually lower discriminative power, tend to overestimate links and cause "dimensionality" problems. The textual component can be used to label the obtained clusters. While this works well at the global level, local clustering, i.e. cluster analysis of subfields or ISI subject categories, might cause difficulties in labelling the results since a common vocabulary is often used in smaller disciplines. A new method to supplement labels based on best TF-IDF terms by core documents representation is therefore suggested.

Method

The notion of a "core" of literature goes back to co-citation analysis (Small, 1973), where documents belonging to such a cluster, by definition, formed a set of considerably cited papers. The term 'core documents' was anew introduced by Glänzel and Czerwon (1996) in the context of bibliographic coupling to identify those papers which form important nodes in the 'global' network of scholarly communication. The original definition was based on Boolean vector-space model for bibliographic coupling (Sen and Gan, 1983). In the present study, this notion is extended to hybrid methods and applied to the local level.

Since citation-based and lexical similarities among individual documents are based on different cosine measures (binary for citations, measures using weights based on term frequencies for the lexical case) and similarities are usually dominated by the lexical component, a simple linear combination of the two similarity measures does not provide satisfactory results. Therefore we suggest a linear combination of the underlying angles for the identification of the core documents.

In particular, *core documents* papers, which have at least n links of at least a given strength r according to the similarity measure, which, in the hybrid case, is

$$r = \cos(\lambda \cdot \arccos(\chi) + (1-\lambda) \cdot arc(\xi)), \quad \lambda \in [0,1],$$

where χ is the citation-based and ξ the textual similarity. $n \approx 10$ proved an appropriate multipurpose threshold along with $r = 0.25$ ($\cong$ ca. 75°), 0.30 ($\cong$ ca. 72.5°) or 0.34 ($\cong$ ca. 70°). Core documents should ideally represent about 0.1% – 1.0% of the total set. In our case, bibliographic coupling was chosen as citation-based component to improve the applicability to the those fields in the social sciences and humanities where citation rates are otherwise low.

In this study we will provide *core-document* representation at different levels of aggregation, particularly in subfields and those topics within subfields, which have been found by hybrid clustering. In order to obtain consistent results, the *same* similarity measures are used for clustering and for representation. Figure 1 and Table

1 show the *core-document* representation of a selected cluster *within* the ISI Category using "Public, environmental & occupational health" here as an example. The best TF-IDF keywords of this cluster are 'illness; reliability; of-life; quality; care; disorders; satisfaction; quality of life; disability; depression; experience; outcomes; scale. The four unconnected papers in Figure 1 may not be considered 'singletons' since, by definition, they have at least 10 strong links (and consequently even more weaker links) to other papers in the same cluster. Their titles, keywords and abstracts provide substantial information about the clusters and its sub-topics.
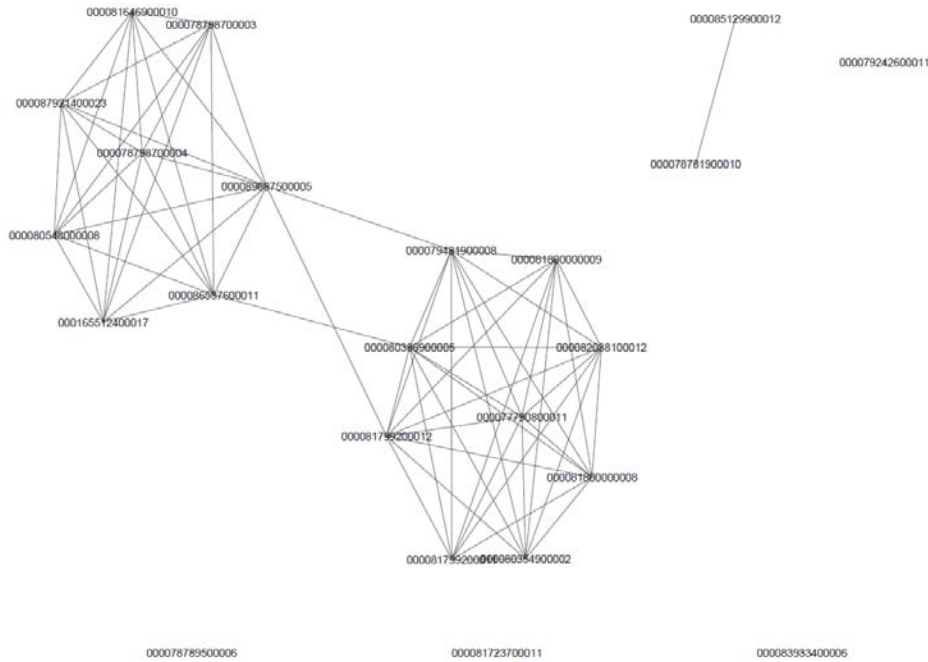
Figure 1. Core-document representation of Cluster#2 in 'Public health' (Pajek; Kamada-Kawai)

Table 1. Titles of selected core documents representing Cluster#2 in 'Public health'

ISI UT	Paper title
000078798700004	Aggregation and the measurement of income inequality: effects on morbidity
000087921400023	Income inequality and health: What does the literature tell us?
000081646900010	Social capital and self-rated health: A contextual analysis
000079481900008	SF-36 scores vary by method of administration: implications for study design
000081800000008	Quality of life and parkinson's disease: Translation and validation of the US Parkinson's Disease Questionnaire (PDQ-39)
000081799200011	A Kiswahili version of the SF-36 Health Survey for use in Tanzania: translation and tests of scaling assumptions
000085129900012	The case for eliminating the use of dietary fluoride supplements for young children
000079242600011	Reproductive health risk behavior survey of Colombian high school students
000078789500006	Varying the message source in computer-tailored nutrition education
000081723700011	Family risk factors associated with adolescent pregnancy: Study of a group of adolescent girls and their families in Ecuador
000083933400006	Prescription patterns for mood and anxiety disorders in a community sample

Discussion

Core documents proved to be more than supplements to the TF-IDF representation of the outcomes of clustering exercises. It was shown that hybrid techniques can smoothly be applied to the definition of core documents. Three parameters (λ, *n* and *r*) can be used for fine tuning. In the social sciences and humanities a lower λ value

can be used to compensate missing citation links. Finally, core documents themselves can be used to identify further relevant documents by simply following their strong and medium-strong hybrid links.

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A new representation of relative first-citation times

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Introduction

Citation mean and quantiles are considered bibliometric measures of impact and reception of scientific information, while first citations can be regarded as measures of response speed. Although the two measures are not independent from each other, their actual functional relationship is not straightforward (Glänzel, 1991, Rousseau, 1994, Egghe, 2000, Burrell, 2001). In the present study we will provide a new representation of first citations which might also help pave the way for subject normalisation of response-time indicators.

Method

In this contribution we consider subfields of science, in particular, the notion of a subfield is operationalised as a JCR Subject Category. Two subfields, mathematics and cell biology, were selected as test cases. Mathematics represents a slowly ageing discipline whereas cell biology is considered to be fast responding. All documents of the type article, letter, note and review published in 1999 were taken into consideration. For each article the year of receiving its first citation was determined. The difference between the year of publication and the year in which it obtained its first citation is known as the response time.

These cumulative distributions are considered to be the field's standard. Individual journals' cumulative distributions are now visually compared with the standard as follows. The cumulative response times for the subfields and journals are denoted by p_k and j_k, respectively. Then data points (p_k, j_k) are drawn in the unit square. If a journal's response times coincide with that of the field, then points move over the diagonal line. If they stay below (above) the diagonal then the journal's response time is slower (faster) than the field standard. Interesting cases may occur when points intersect the diagonal. This happens for *Molecular Medicine*. Also *Acta Histochemica et Cytochemica* is an interesting case in the sense that it starts convexly, but before reaching the diagonal becomes concave. The possible background of these and of other interesting cases are discussed in the study.
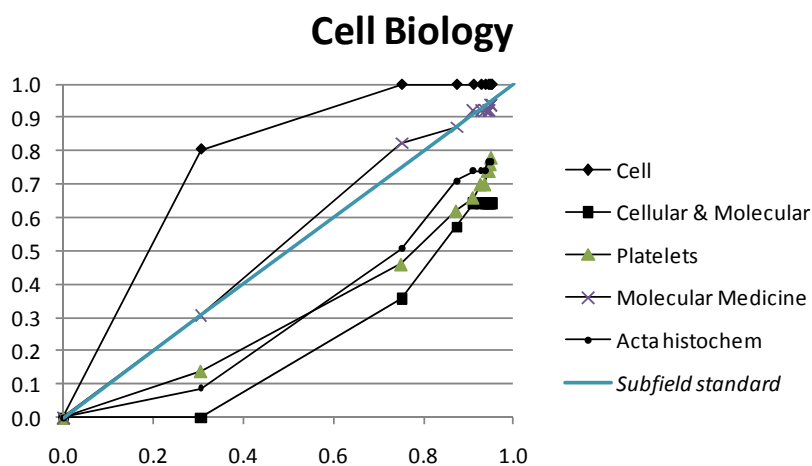
Cell Biology

Figure 1. Relational response-time chart for 'cell biology'

Discussion

While for the field of Cell Biology 95 % of all articles are cited at least once after 10 years, this is the case for only 71% in the field of mathematics. Besides providing a new representation for the response of a journal compared with that of the field, we also calculate and discuss the ln(odds-ratio) as a measure expressing the relation between cumulative response times of a journal and its field. For fast responding journals this measure increases fast and when the journal's articles are all (or almost all) cited, decreases slowly when the field is catching up.

A regression analyses of response time and citation impact shows that both phenomena cannot be considered independent indeed but it also substantiates that response indicators cannot be expressed by any simple (linear) function from citation-impact measures either. Response-time indicators for journals clearly need their own approach and they supplement impact measures by providing deeper insight into the mechanism of citation processes at this level.

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Articles vs proceedings papers: do they differ in research relevance and impact?

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Introduction

In 2008, the label "proceeding paper" was assigned in the WoS database to those documents initially presented at a conference and later adapted for publication in a journal –previously considered as articles- . Although Thomson Reuters states that "we are not in any way commenting on the scholarly status of these documents in making this designation" (WoS, 2009), the risk of these two different documents types being differently considered in research assessment procedures is real.

The objective of this paper is to conduct a comparative study of journal articles and proceedings papers as regards their structure and impact.

Methodology

The study focuses in the Library and Information Science field (LIS). Citable items (Articles, reviews, notes and proceedings papers (PP)) published in LIS journals during 1990-2008 were download from the WoS database. The following aspects were studied:

- Structural features of research. The number of authors, centres, references and pages were analysed as indirect indicators of the complexity of the research.
- Relevance of the papers. The number of citations received by papers from the publication year to the downloading date (for all journals) and with a three-year citation window (for the journals with a higher number of PP) is calculated as an indicator of the impact of the research.
- Rigor of the evaluation process of PP. The time-lag between the celebration of a conference and the publication of the related paper was explored as a potential factor influencing final quality of the PP. The publication of documents in an ordinary journal issue or in a monographic journal issue devoted to a conference was studied.

The data are compared in the whole 1990-2008 period and time differences are explored. SPSS has been used to do statistical analysis (non-parametric tests and multivariate techniques).

Results

LIS journals published a total of 36,524 citable items during 1990-2008. A total of 3,183 PP (9% of citable items) were identified. An irregular distribution of PP by years and journals was observed.

In the whole period, PP exhibits a higher number of authors, centres and references than articles. Concerning impact of research, articles surpass PP in citation rates in those years with a high number of PP in monographic journal issues. In the subset of 8,581 documents published in the ten journals with higher number of PP, theses show less citation rate than articles (3-year citation window), which was again related with the high weight of PP in monographic issues that receive less citations than PP in ordinary issues.

A global analysis of data by means of multivariate statistics techniques is being developed at present. Preliminary data shows that the citation rate of PP increases with the number of references, pages and time-lag between the conference and publication.

Discussion

The key point in the relevance of PP is the quality of the refereeing process, which may differ by disciplines, conferences and journals. Our data on LIS show a lower citation rate for PP in monographic issues devoted to conferences, but only for those published very close to the conference, maybe because they could have been subjected to a less strict evaluation than those published in ordinary issues or time after the conference. Science policy implications of this research are clear, since conclusions about the equal or different relevance of PP and articles could have derived consequences in research assessment processes.

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National Research Performances in Light of the Sixth EU Framework Programme

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Based on data for the Sixth EU Framework Programme for Research and Technological Development (FP6) we aim at identifying the strengths of national research systems in an EU wide comparison. The focus of our analysis is on the relative performances of different types of institutions (higher education institutions (HEIs), non-university research institutions, and industry and commercial companies).

The main emphasis of FP6 which ran from 2002 to 2006 was on the funding of cross-border cooperation and on the networking and integration of research infrastructures in the EU member states. A basic principle of FP6 was the concentration of funding on a limited number of thematic priorities. Altogether, FP6 had a total budget of approximately €17 billion. Since this budget was distributed in a competitive process, the funding volumes are used here as an indicator for research performance.

There are significant differences in the relative shares of FP6 funds allocated to HEIs and non-university research institutions between the European states (see Figure 1). While in the United Kingdom and Sweden, more than half of the funds went to the HEI sector, in France and Spain, for example, the largest shares went to non-university research institutions. In Germany and the Netherlands, HEIs and non-university research institutions were allocated roughly equal funding amounts.

These cross country differences indicate different ways of organizing national research systems. Since existing cross country evaluations usually focus on one type of funding recipient – often HEIs - they are not appropriate to measure the relative performance of whole research systems. In a comparison which is constricted to HEIs, for example, the often cited strength of the HEI sector in the UK becomes apparent: In all priority areas of FP6, HEIs from the UK got the highest funding amounts. A more comprehensive inspection of the engineering sciences which are in the focus of FP 6, however, reveals that in total recipients from Germany acquired more funds. This is mainly due to the strengths of non-university research institutions and of industry and commercial companies.

In spite of the explicit goal to strengthen the cooperation between HEIs, research institutions and businesses, the *Expert Group on the Ex-Post Evaluation of FP6 (2009)* reports that direct industrial participation in the FP is declining. We observe that the share of funds allocated to industry and commercial companies varies between countries but that in all countries it is less than one third. Only in Germany, industry and commercial businesses acquired a similar share as HEIs and non-university research institutions. This might indicate good opportunities for the transfer of knowledge from academia to industry.

Figure 1: R&D funding in the Sixth EU Framework Programme by country per type of funding recipient
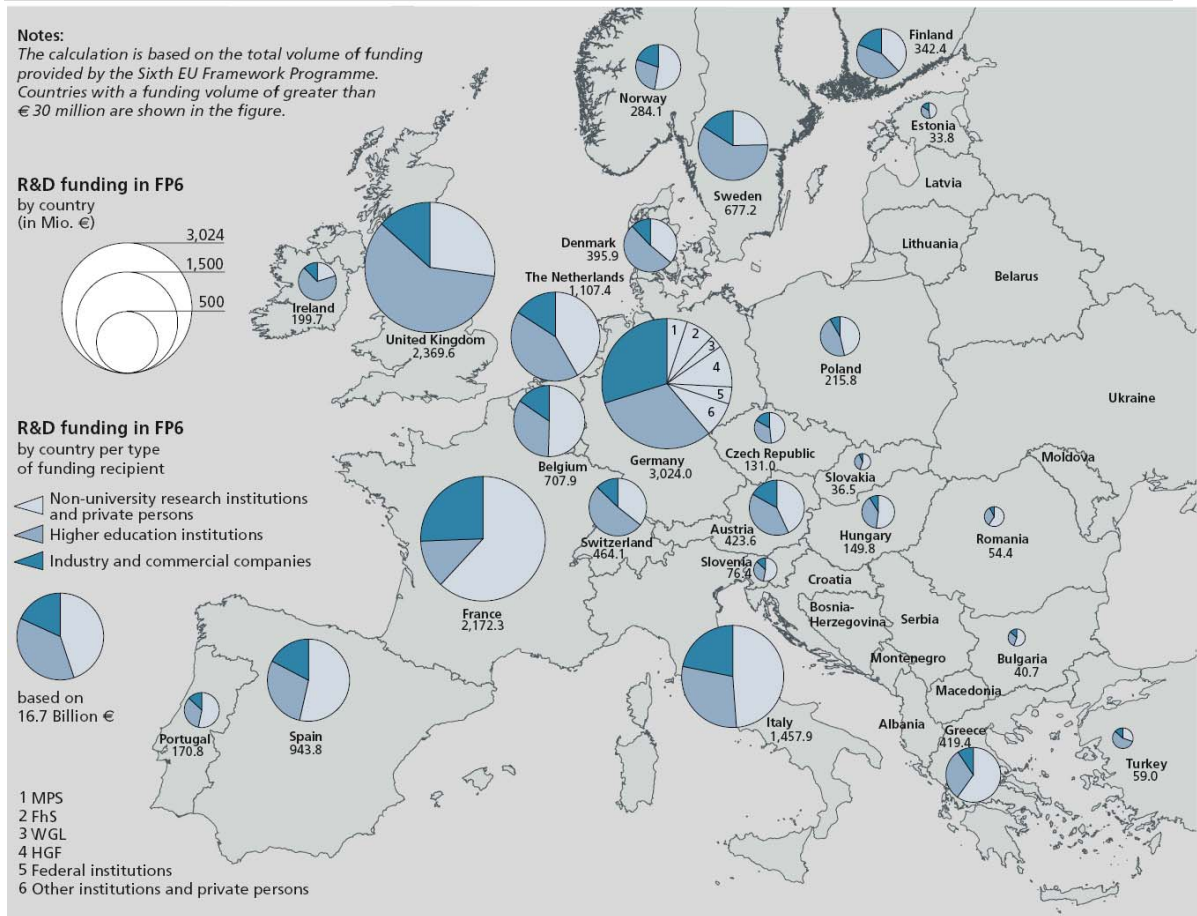
For the case of Germany, we build on *German Research Foundation (2010)* and take a closer look on which regions prove to be especially active in acquiring funds from FP6 and on the thematic priorities set in these regions. By means of an innovative method of visualisation based on a network analytic approach we also illustrate the similarities and differences between the funding profiles of German HEIs.

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A Worldwide Ranking for 28 Scientific Fields Using Scopus Data, The SCIMAGO Ranking of Journals, Mean Citation Rates and High- and Low-Impact Indicators

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The distinctive features of this paper on the ranking of countries and/or geographical areas in terms of the citation impact they achieve are:

1. The database used is Scopus from Elsevier. We study documents published in 2003-2005 in 28 broad scientific fields with a four-year citation window, and three aggregation levels: (i) the most productive 41 countries and four residual regional areas; (ii) ten regions, and (iii) three areas consisting of the U.S., the EU, and the rest of the world (RW). In every internationally co-authored paper a whole count is credited to each contributing country or region.

2. This paper uses the SCImago ranking of journals, the only available ranking built around the idea that citations coming from a highly cited journal should be more highly weighted than those coming from a poorly cited journal, namely,.

3. To describe highly skewed citation distributions, given a criterion for selecting a critical citation level (CCL), we use two families of high- and a low-impact measures defined over the sets of articles with citations above and below the CCL (see Albarrán et al., 2009a).

The research issues are the following:

I. Albarrán et al. (2009b) contains the first empirical application of high- and low-impact indicators for the ranking of the U.S., the EU, and the RW using a dataset acquired from Thomson Scientific. This paper compares the ranking of these three areas with two different databases.

II. We investigate whether countries with a large high-impact index in a given science have also a small low-impact level.

III. Because a single statistic of centrality may not adequately summarize highly skewed citation distributions, we compare the results obtained with high- and low-impact indicators with those obtained with the mean citation rate (MCR). Among the ordinal questions, we ask:

• Does a higher MCR in country A than in country B in a given science always imply a larger high-impact index and a smaller low-impact level in country A than in country B?

• Does a higher MCR in science 1 than in science 2 in a given country always imply a larger high-impact index and a smaller low-impact level in science 1 than in science 2?

We also investigate the quantitative differences in the relative position of any country when using high-impact indicators or MCRs.

IV. There is a long tradition of evaluating publication shares of different countries in a given science, as well as publication efforts of a given country across different sciences. Thus, we ask:

• Does a high publication share for a country in a given science always imply a large MCR or high-impact level and a small low-impact index?

• Does a high publication share for a science in a given country always imply a large MCR or high-impact level and a small low-impact index?

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Representation of scholarly activity as a multi-relational network: A case study

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Introduction

We propose the representation of informetric relations as a multi-relational network, a network with more than one kind of links (links carry a label such as 'cites' or 'has_coauthored_with'). The large-scale implementation of such representations is nowadays practically feasible, mainly due to recent advances in Semantic Web technology (Berners-Lee et al., 2001). Here, we present a multi-relational network of scholarly activity in the field of scientometrics during the period 1990–2009. We discuss both well-known and new indicators in this framework.

Case study

Our case study of scientometrics in 1990–2009 is based on Web of Science data but completely modelled as a multi-relational network using Semantic Web technology. This network summarizes data on different kinds of entities, including 1933 papers, 1234 authors, 46 countries, 199 journals, and 101 conferences, as well as their relations. Virtually all relations are modelled using a few 'standard' vocabularies like Dublin Core, augmented with the Bibliographic Ontology (http://bibliontology.com/). Fig. 1 shows the necessary components of studying journal-to-journal citations.
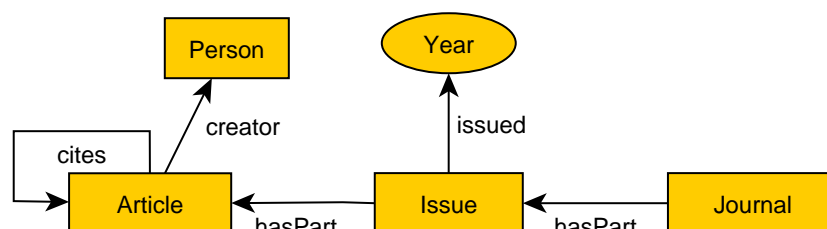
Figure 1. Components of journal-to-journal citations

Indicators

Any multi-relational network can be mapped to the matrices typically used in informetrics (Rodriguez & Shinavier, 2009), such as the publication–citation matrix. This implies that most classic informetric indicators can be determined based on the information in the multi-relational representation. We illustrate this with an example: the 2005 impact factor of journal J. First, one looks up the set of publications P by searching for all articles related to J via issues issued in the year 2005. Second, one looks up the set of articles C that cite at least one element of P and whose corresponding issue is issued in 2006 or 2007. Then $IF_J = |C| / |P|$. Searching can for instance be done with the SPARQL query language.

The multi-relational representation also leads the way to new indicators, such as the ones proposed by (Luo & Shinavier, 2009; Yan & Ding, 2010). In a situation like Fig. 1, reputation or prestige is propagated from one entity to the other. For instance, if article a cites article b, a's prestige propagates to b. The prestige of a also propagates to the journal it is published in. On the other hand, the prestige of the

journal may also (partially) propagate to its articles, – an article in a high-profile journal is likely to get more attention. Luo and Shinavier (2009) outline a framework wherein such considerations lead to a weighted uni-relational network. Table 1 contains the proposed translation rules for the situation in Fig. 1; of course, different rules are possible, depending on the goals and application. One thus obtains a weighted network, to which one can subsequently apply indicators like weighted PageRank. These result in a refined ranking on the basis of prestige, while taking more than just citations into account. One usually ranks per entity type (e.g., all authors or all journals).

Table 1. Conversion from multi-relational network to weighted uni-relational network

Pattern in multi-relational network	Counterpart in weighted network
Article $\xrightarrow{\text{creator}}$ Person	$a \xrightarrow{1} p$
	$p \xrightarrow{0.2} a$
Article $\xrightarrow{\text{cites}}$ Article	$a_1 \xrightarrow{1} a_2$
Journal $\xrightarrow{\text{hasPart}}$ Issue $\xrightarrow{\text{hasPart}}$ Article	$a \xrightarrow{1} j$
	$j \xrightarrow{0.5} a$

Conclusion

We argue that multi-relational networks offer the flexibility to explore both old and new scientometric indicators. Our experience with the case study confirms this and shows that Semantic Web technology makes practical implementation possible.

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Author disambiguation using multi-aspect similarity indicators

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Bibliometric and scientometric analysis is experiencing a rapid expansion in application areas with the rise of computing power. The increased number of practitioners and users is resulting in louder calls for instantaneous scientometrics to, for example, support policy makers decisions. The linking of heterogeneous databases such as patent and publication sources is adding to the usefulness and attractiveness of bibliometric and scientometric methods. Evaluation methods, such as output quantity and citation impact, are also increasingly relying on the extensive use of quantitative information.

anchor of bibliometrics and scientometrics is the identification of the entity under study. As publication counts have grown, the sheer volume of data to be assigned to one entity or another has encountered the problem of identity ambiguity. With ever increasing scopes of study and the resulting datasets, hand cleaning of data is no longer feasible; instead a move to automated processes is required. Common names already pose a problem in western science systems, and the rise of science in Asian countries has pushed the challenge of disambiguation to new heights.

As such, algorithms designed to extract patterns of similarity from different variables, patterns that can set one author apart from his or her namesake, and link to other data sources are required. Current similarity disambiguation methods employed have generally used few or only one indicator to link corpora to single entities such as addresses, citations or topics. These are employed in either one- or two-step approaches with most using graph theory and clustering approaches. These methods are evenly split between supervised and unsupervised processes but success rates reported by current methods have been scattered with few finding high enough values to definitively link corpora to entities.

In this paper we will present our first findings from our attempts to incorporate more indicators and modifications of current methods. We have implemented an unsupervised algorithm using relational, biographical and grammatical data from ISI's WoS and DBLP to disambiguate a test set of known and unknown authors. The algorithm follows a two-step approach, similarity search and clustering disambiguation. In the similarity search phase we utilise the most commonly found data in publication records, namely title, abstract, cited references, coauthorship data, author address and source journal name and category. Our approach combines the biographical, grammatical and content similarity found in known entity corpora, with statistical and probabilistic values of entity resolution. Graph theory approaches will be employed in the clustering disambiguation approach, using proven clustering

algorithms. Additional indicators, such as author position in publication and concurrent research stream resolution, and qualified modifications of the aforementioned indicators will also be presented with statistical analyses of the indicators on a separate and combined basis.

Preliminary results will be presented, highlighting the usefulness of disambiguation processes and indicators, along with comparisons to current methods. These results will include F-measure statistics of precision and recall based on the test set of known authors and results of tests on an unknown data set.

Comments:

It is an overly interesting topic, where sound and useful results are of outstanding significance. The abstract, unfortunately gives few hints on the depth and actual details of the treatment. The reviewer can only suppose that the technicalities can be presented more effectively in poster format than as an oral presentation.

Author disambiguation is a very important problem in scientometrics which needs to be addressed. Unfortunately, the paper does not include any references to prior work. Details on the methodology are also required. Counter examples, where disambiguation fails would also make the paper interesting.

Journal Evaluation and Science 2.0: Using Social Bookmarks to Analyze Reader Perception

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Introduction

Web 2.0 technologies are blazing a trail into science: specialized social bookmarking services allow researchers to store and share literature online [SHNEIDERMAN, 2008]. In science 2.0, academics generate information about resources, i.e. description and usage. Since publishers deny access to global download statistics, we propose the application of social bookmarking data to journal evaluation: the number of bookmarks could function as an alternative indicator of journal usage. Tags assigned to the articles reveal the readers' perspectives on the journal content.

Method

A set of 45 solid state physics journals was defined. The bibliographic data for the 168.109 documents published in these periodicals from 2004 to 2008 was downloaded from the Science Citation Index (SCI). To retrieve bookmarking data, we chose CiteULike.org and BibSonomy.org as data sources. These social bookmarking systems support the sharing of bibliographic references to scientific publications, and, as such, target academic users [HAMMOND et al., 2005].

Since a great share of the metadata of the bookmarks was incomplete or erroneous, we defined three different search strategies to obtain all the bookmarks assigned to our journal set: searching for the titles of the periodicals plus their common abbreviations, ISSNs, and DOIs of the articles. This information was collected for all of the 45 periodicals via SCI, http://zdb-opac.de, Ulrich's Periodicals Directory, http://dx.doi.org and http://crossref.org. In BibSonomy, bookmarks were retrieved in XML-format with a fulltext search via the API. As CiteULike does not offer an API, results were retrieved with field searches (for title, ISSN and DOI) in RIS-format via web search.

Table 1. Indicators for the ten journals with the highest usage ratio

	Publications 2004-2008	5-Year Impact Factor	Number of Bookmarks	Usage ratio	Usage diffusion	Usage intensity
REV MOD PHYS	173	40.395	146	35.26%	98	2.4
PHYS REP	341	16.368	126	19.35%	92	1.9
REP PROG PHYS	220	12.480	62	19.09%	45	1.5
J RHEOL	347	3.008	35	9.51%	5	1.1
ACT CRYST A	326	2.098	30	7.98%	17	1.2
SOFT MATTER	654	4.890	50	6.42%	33	1.2
J STAT MECH	958	2.742	70	5.01%	53	1.5
PHYS REV E	12117	2.566	807	4.93%	291	1.4

EUR PHYS J E	707	2.306	40	4.81%	23	1.2
ANN PHYS	296	1.250	16	4.73%	12	1.1

Results

Checking for duplicates among the user names of our two result sets confirmed the assumption that users bookmark in one service only. Thus, both sets were combined. To analyze the coverage of the set of articles, we matched 3,953 bookmarks to 3,202 articles to our corrected and complemented SCI dataset by their DOIs. We propose the percentage of articles bookmarked as an indication of the *usage ratio* per journal, the number of users per journal as a measure of the *diffusion* and the average number of bookmarks per article as an indicator for the *intensity* of usage of the journal content. Table 1 shows the results for the ten journals with the highest *usage ratio*. The *5-year impact factor* and *usage ratio* correlate very strongly (r=0.937).
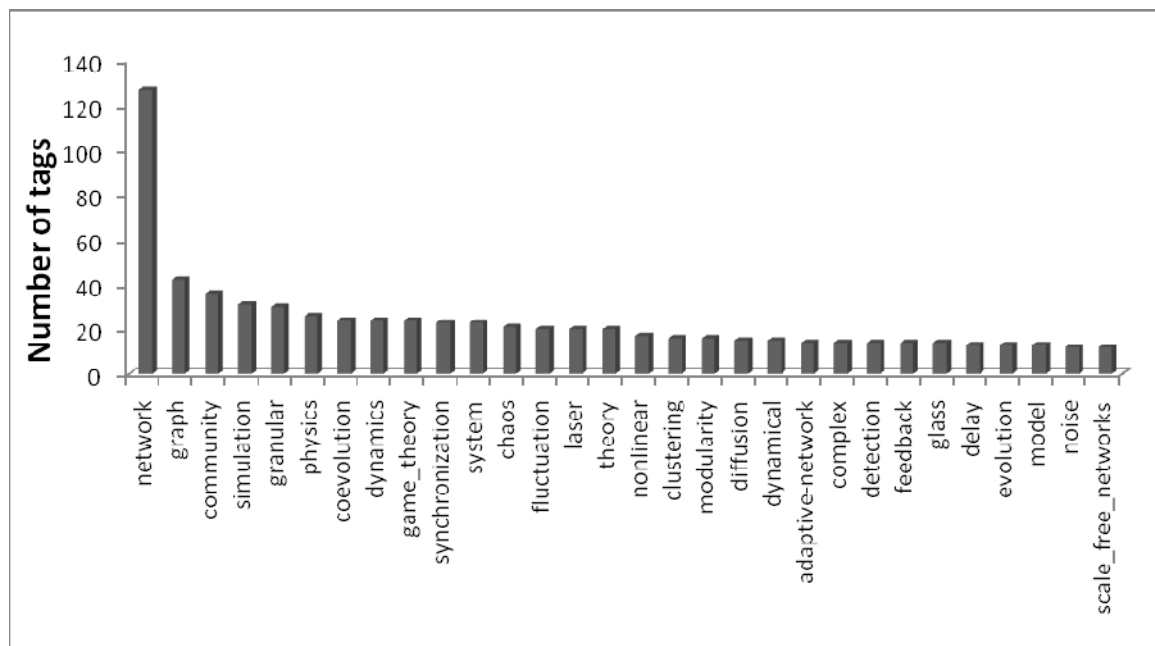
Figure 1. Most used (>11) tags assigned to *Physical Review E*.

The readers' perspectives on journal content can be described by the tags assigned to the articles. For *Physical Review E*, the journal with the highest number of bookmarks in the study, tags were adjusted in terms of merging singular and plural forms, unifying special characters and deleting content-unrelated tags. This resulted in a power-law distribution of 991 tags which were assigned 2.470 times. The first 30 can be seen in figure 1. They reflect several of the focus areas of the periodical: computational physics, granular materials and chaos theory. Thus, tags may serve as a real-time indicator of hot topics published in journals.

Outlook

Scientific social bookmarking is still in its infancy and there are different services competing for user. Bookmarking data needs improvement. Trends show a clear increase in the number of participants [BERNIUS et al., 2009]. Once a critical mass is reached, usage data will gain more significance and make it possible to indicate global reader perception with bookmarking data. The proposed measurements can then be used as supplementary indicators in multidimensional journal evaluation [JUCHEM et al., 2006; ROUSSEAU, 2002].

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Multidimensional Journal Evaluation

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Background

Citation measures alone do not capture all facets of a scientific periodical; there are various other aspects that contribute to a journal's standing. Although a large number of indicators already exists and new ones are presented frequently, they are hardly perceived outside the bibliometric community. New approaches at Thomson Reuters (*5-Year Impact Factor*, *Eigenfactor*[TM] and *Article Influence*[TM] *Score*) and Elsevier (*SJR* and *SNIP*) reveal a certain trend toward a wider range of measurements. However, these approaches hide behind the catch phrase of multidimensionality, when really they are variants of the citation/publication quotient and thus, the *Impact Factor*. Periodicals are limited to a single indicator of one dimension of journal scientometrics. Other dimensions are more or less disregarded. However, only a method incorporating all facets of journal evaluation can represent a serial's true impact in a scientific community [GLÄNZEL and MOED, 2002; ROUSSEAU, 2002].

Methods

Five dimensions are identified that contribute to a journal's standing [GRAZIA COLONIA, 2002; JUCHEM et al., 2006]:

- journal output,
- scientific communication,
- journal perception,
- journal editing, and
- journal content.

Journal output evaluates the periodicals directly. It deals with the number and length of articles and issues, distribution of document types, number and age of references and internationality. *Scientific communication* refers to the traditional analysis of citations and has been intensively explored: a number of measures already exist but detailed analysis and standardization are still needed [BOLLEN et al., 2009; LEYDESDORFF, 2009].
Another crucial factor of a journal's prestige is how often it is read. Traditionally, the number of readers was measured through reshelving [BAR-ILAN, 2008]. In the times of e-journals, usage data can be collected based on the number of downloads [BOLLEN et al., 2005; BROWN, 2003]. However, download data is not made available on a global scale by the publishers. Thus, the author proposes the analysis of data from social bookmarking services like *Bibsonomy*, C*iteULike* and Connotea as an alternative way to measure *journal perception*.
A serial's editorial policy is examined in the dimension of *journal editing* [SCHLOEGL and PETSCHNIG, 2005]. Since the editorial board functions as a gatekeeper of the journal and tries to keep it a qualified publication venue, its composition and the quality of the applied review process have to be considered [BRAUN, 2004]. Cost-performance ratios can be calculated when comparing the

subscription price with the number of papers, received citations or usage data [DAVIS, 2002; VAN HOOYDONK et al., 1993].

When evaluating a journal, its thematic *content* should not be disregarded. Analyzing the keywords of titles, abstracts and full texts or even the tags assigned by users of social bookmarking services will allow an insight into thematic specialties and reveal shifts of emphasis and the development of new research areas.

Results

A set of 45 journals of solid state physics was defined to compare different indicators from each of the five dimensions, i.e. *Impact Factor*, *SJR*, *Uncitedness*, *Citing* and *Cited Half-Time*, *International Collaboration*, usage indicators, pricing etc. Results will be presented in journal maps that include multidimensional attributes of the periodicals and depict complex interrelations and thus help to give a multifaceted insight into the landscape of scientific journals. Figure 1 shows the citation network of the 45 journals with size of vertices corresponding to the number of publications and label size to the *5-Year Impact Factor*. Journal type, which was defined by the periodicals main document type, is indicated by the coloring of the vertices. Herein the advantages in contrast to conventional, unidimensional journal rankings become apparent.
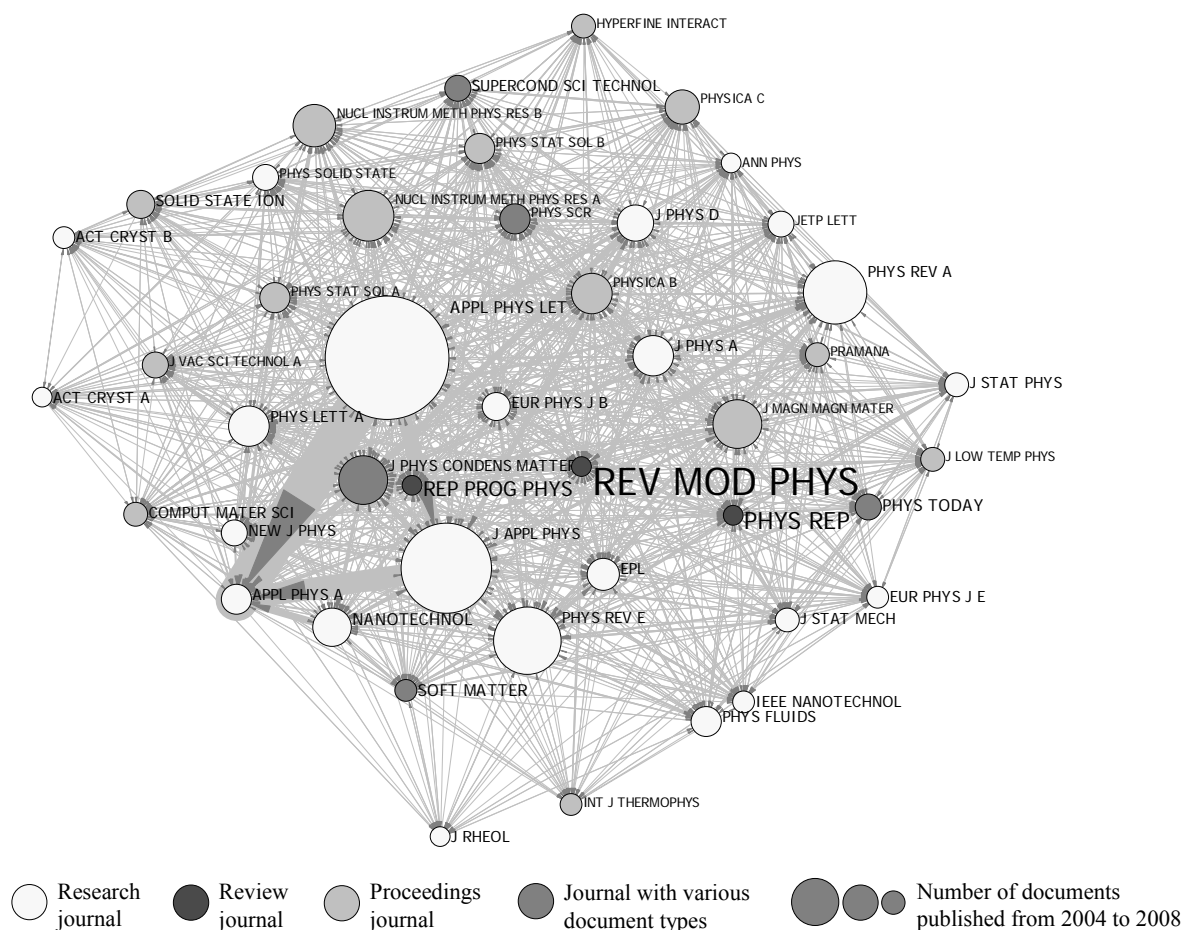
Figure 1. Journal map depicting citation network, number of publications (size of vertices),
***5-Year Impact Factor* (label size) and main document type (color of vertices) of the 45 journals.**

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Measuring the evolution of relational capital of research organizations

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Introduction

Science as well as industry organizations increasingly engage in collaborative innovation activities. This has been related to the growing complexity of innovation processes, the convergence of technologies, globalized markets and the ephemerality of technological expertise. The embedding in collaboration networks constitutes the social or relational capital of organizations, which plays a crucial role in the development and integration of new knowledge in the innovation process. Thus, besides human and structural capital, the relational capital is seen an essential part of the intellectual capital of an organization (Meritum 2002).

The state of the art of research into relational capital is usually based on counting the number of national and international research projects, conference lectures, visiting researchers or teaching and research activities abroad (e.g., Leitner 2005). Thus, the junction of the organization to networks in the outside world is evaluated; however, relational aspects like size and structure of these networks as well as the embedment of the organization in these networks are neglected.

The objective of this contribution is to introduce a new evaluation framework for exploring and assessing the relational capital of an organization and to show its application to the case of a public research organization.

Methodology

The first part of the contribution presents the main elements of this evaluation framework. It is based on different concepts of social capital (Coleman 1988; Burt 1992; Uzzi 1996; Jansen 2007) and social network research (Wassermann and Faust 1994) to analyze the opportunities and constraints of an organization that stem from its embedment in social networks. In order to measure relational capital this study draws on network characteristics (size of network, stability of relations), heterogeneity of network partners (geographical and institutional background), and network embeddedness (interconnectedness/clustering of network partners, structural autonomy, centrality).

The second part applies this evaluation framework in an empirical context. Based on the example of an Austrian research organization and its participation in the European Framework Programmes (EU-FP) over the last 15 years, the evolution of the collaborative research network of this organization - representing one specific aspect of relational capital - is analyzed and discussed. The analysis is based on the EUPRO database on FP projects and their participants (Barber et al. 2008).

Results

The case study reveals a positive development of the relational capital of the Austrian research organization based on research collaborations in the EU-FP. Compared to the majority of participants the research organization is centrally positioned in the FP networks and ranks in FP6 among the top 170 most central actors (Figure 1).
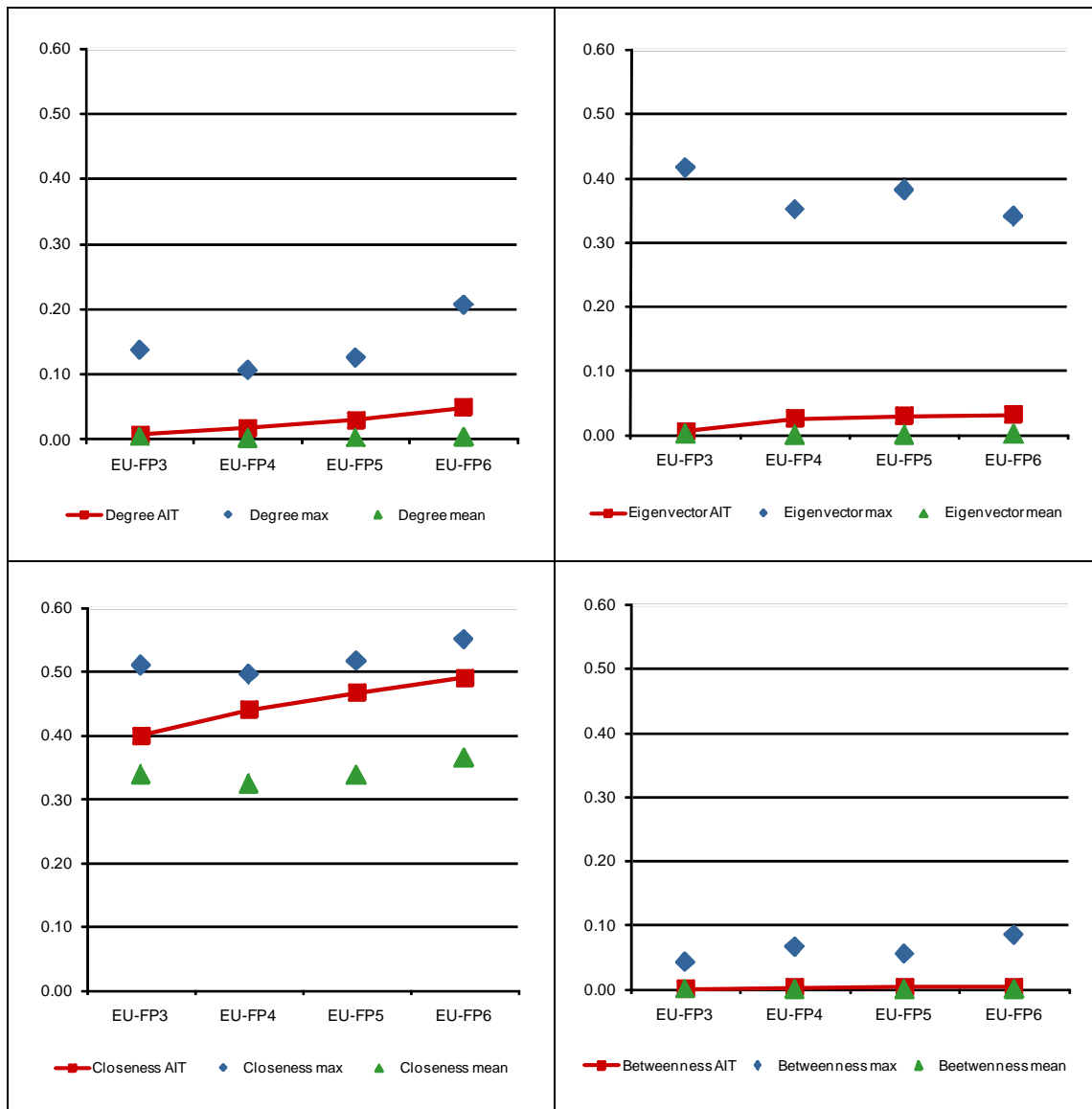
Figure 1. Network position of AIT in the EU-Framework Programmes (Centralities)

The size of the collaboration network of the organization is continuously growing since FP3, but we can state on the other hand that a growing number of existing relations to other research partners is consolidated and stabilized during successive FPs. Thus, the relational capital of the organization is constituted by a balance between social closure of the network on the one hand and openness towards new contacts outside of the existing network on the other hand. Therefore one might conclude that the exploitation of existing knowledge in trustful relations as well as the exploration of new opportunities and resources in new emerging contacts is warranted.

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Allocation and effect of Framework Programme projects: a regional analysis

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Introduction

Notwithstanding the pervasive trends towards globalization of the research system, research policies are still driven mainly by national objectives and agenda's. One of the major exceptions are the EC's series of *Framework Programmes (FPs)* that are specifically designed to pool resources and promote R&D collaboration in pre-competitive research between the EU member states. The overarching goal of the FPs is to improve the communication and collaboration among researchers and to boost Europe's scientific and technological performance. However, despite substantial resources being allocated to the FPs (see for a recent overview: Delanghe et al. 2009), not much is known about the link between the various Framework Programmes and conventional science and technology indicators such as publications and patents. The current study explores a promising direction to fill this gap by focusing on the identification of tangible outputs of FP projects. The objective is to analyze allocation and effect of FP projects by characterizing various FP sub-programmes in terms of publication output and by comparing regional FP participation with regional publication characteristics.

Concordance

In order to compare regional Framework Programme participation with publication patterns we establish a concordance between the various thematic priorities in the FPs and scientific fields. As of February 2009, the indexed publications in the various citation databases that are part of Thomson Reuters' "Web of Science" can be searched on grant activity (i.e. funding agencies and grant numbers) and funding acknowledgements. With the use of unique grant numbers and call abbreviations of FP projects - available in the EUpro database (Scherngell and Barber 2010) - we develop a search algorithm that links funding texts within publications to the various subprogrammes in the Fifth and Sixth Framework Programme. For the year 2009, we find approximately 10,000 scientific publications within Web of Science that are at least partly funded by one of the thematic priorities in FP5 or FP6. Based on this set of publications, the cognitive focus of FP sub-programmes is characterized on the level of journals, ISI journal categories and 35 scientific fields.

Allocation and effect

We subsequently proceed to compare regional FP participation with regional publication and co-publication patterns. The database covers FP-participation counts for all thematic priorities in FP5 (1998-2002) and FP6 (2000-2002) and European publication and co-publication counts (2000-2007) for 35 scientific fields. All data is regionalized into 254 NUTS2 regions in 25 European countries.

We estimate a model in which regional FP participation counts at time t are explained by regional publication characteristics at time t-1. For each thematic priority the established concordance is used to focus on those scientific fields in which participation of actors is to be expected. Our preliminary results with respect to participation suggest that regions with higher shares of international co-publications tend to participate more intensively in FP projects, whereas regions with higher shares of co-publications do not. This conclusion holds across all thematic priorities and after controlling for publication and population counts. We also find that objective 1 regions (i.e. regions that receive money within the structural funds) tend to be highly underrepresented in FP projects. The preliminary results confirm the strong excellence objective across all thematic sub-programmes of both FP5 and FP6. A discussion on the policy implications of our findings follows.

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A Two-Dimensional Temporal Scientometric Analysis of the Fastest Growing Countries in Science

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Abstract

The temporal changes in quantity and quality of scientific output were studied for the ten fastest growing countries in scientific production. The period of study was limited to the recent twelve years. The analysis was based on our new two-dimensional scientometric method, which uses tailored quantity and quality indicators *simultaneously*. Dividing these countries into two main groups, based on their temporal trend in the period of study, the results differ remarkably from those considering the quality or quantity *separately*. It was shown that using single bibliometric indicators is not sufficient to describe, fairly and completely, the temporal changes of the scientific production of countries and the relative positions of them.

Introduction

The scientific production of countries is usually considered every year to monitor the changes in their position in the world of science, and to compare them with their contenders. However, one of the major flaws of these comparisons and rankings is that they concern only a single indicator. Usually, the quantity indicator considered is the absolute number of publications; sometimes, absolute citation number is separately used as a quality measure, e.g. the annual science report of Japan [1] and SEI for USA [2]. Although the time evolution of such indices are approximate estimates of growth/decline of quantity or quality of the scientific production of countries, yet to make a fair assessment, the measures of quantity and quality should be considered simultaneously. The essential idea was first proposed, in a different manner, by Hirsch [3]. Recently, we have shown the validity of this new two dimensional method to evaluate the scientific production of countries, and used it to present a new perspective on the global positions of countries with regards to their scientific output, which is rather similar in the four basic sciences [4]. In this study, considering temporal consequences of our new two dimensional approach, we have investigated the time evolution of the two quantity and quality measures of the explicit scientific output (in the form of journal papers) of the ten fastest growing countries in scientific production in the recent twelve years.

Method

As a measure of the quantity of scientific production of countries, we have used publication per population (PPP), as defined by Rehn *et al.* [5], instead of the absolute

publication number. In this way, the effect of population number is removed when comparing differently populated countries. To have a meaningful comparison among the years, the same scaling is applied to all the years; *i.e.* the PPP data of a year have been divided by their world average of the same year (hence, PPPm).

Our measure of quality of scientific production of countries is citation per publication (CPP), as defined by Rehn *et al.* [5], instead of the absolute citation number. This eliminates the effect of publication number in quality comparisons. Furthermore, since it takes time for a scientific publication to be cited, CPP will decrease as approaching the final years of study and this would conceal the actual trend of the citations. To dispense with this effect, CPP data have been divided by their world average of the same year (hence, CPPm).

The PPPm-CPPm data of the ten fastest growing countries in recent twelve years (1996 – 2007) are represented as points in a single two-dimensional "quantity-quality diagram". In this diagram, time evolution is revealed by the displacement of a country in the PPPm-CPPm plane; moving towards the right implies a growth in the quantity measure, and moving upward means a growth in the quality measure.

The scientometric data have been obtained via the *SCImago* project, which provides classified *Scopus* data [6]. The population data are obtained from the *World Development Indicators* database [7].

Results and Discussion

The time evolution paths of the ten fastest growing countries in the recent twelve years are shown in the quantity-quality diagram (Fig. 1-I). Obviously, their time evolutions are not the same.

More precisely, according to their pathways, the countries can be divided into two classes of almost similar time evolution characteristics:

Group A: Greece, Ireland, Portugal, Singapore and Slovenia.

These countries have had a considerable change in their positions in the studied period (Fig. 1-II).

Group B: Brazil, Chile, Iran, Mexico and Turkey.

These countries have had a slight change in their positions in the studied period, compared to members of group A (Fig. 1-III).

Noteworthy to mention is the utter contrast of these results with the previously published reports like Table 5-20, Chapter 5 of SEI [2], which have ranked these countries as follows: (1) Iran, (2) Turkey, (3) Singapore, (4) Portugal, (5) Brazil, (6) Slovenia, (7) Greece, (8) Mexico, (9) Chile, and (10) Ireland. It seems that the reason behind this contrast is the mere application of naïve quantitative measures such as the absolute number of publications.

Taking a closer look at the time evolutions of countries, some more subtleties are observed. In group A, Singapore has had the fastest growth in quantity; it has also increased its quality relative to the world average. Slovenia and Portugal have had almost the same evolution in a smaller scale. Greece has increased its quantity while maintaining a stable quality. Ireland has been successful in quantity increase, yet it has had fluctuations in its quality level.

As it is evident from Fig. 1, the members of group B have not had a considerable change in their positions relative to group A members. Mexico has decreased its quality with a fixed quantity. Other members of group B (Chile, Iran, Turkey and Brazil) have had an increase in quantity yet their quality levels have lowered. This is more apparent in the case of Brazil.

It seems that this new two dimensional approach, after presenting a new perspective on absolute positioning of scientific production of countries [4], has considerable results in temporal frame too. However, a more practical and, still, precise description of the actual time evolutions of scientometric measures of countries, according to this new approach, is essential for a fair progress assessment usually needed for many people, from scientometric community to policy makers inside and outside studied countries. Further works on extending this new perspective on scientific progress is going on.

Conclusion

Time evolutions of the ten fastest growing countries in scientific production were studied; in the recent twelve years by a novel two-dimensional method using tailored quantity and quality indicators *simultaneously*. The results differ remarkably from the previous ones, and this implies that *single* bibliometric indicators cannot provide a fair and holistic view of the positions of countries in the world of science and temporal changes thereof. The studied countries divided to main groups with different trends in their scientific progress.

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Further information available at: http://www.scimagojr.com Quoted in "Nation Master" website, available at: http://www.nationmaster.com/graph/peo pop-people-population
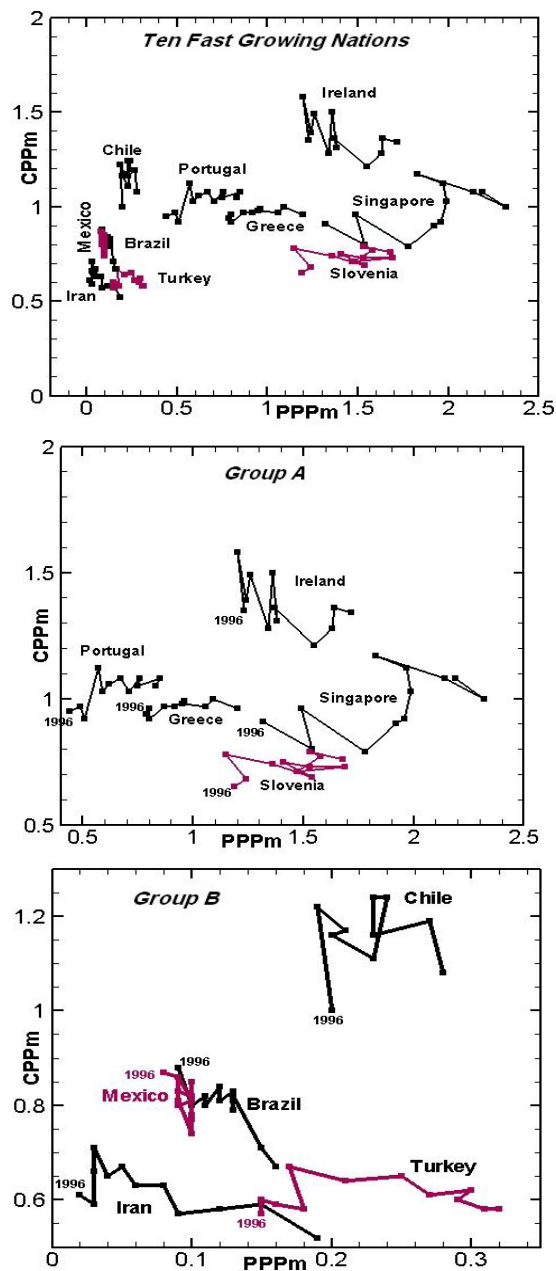
Fig. 1: Quantity-quality diagram of (I) fast growing countries, (II) Group A, and (III) Group B.

Dynamics of Science, an observation based on the Science Map 2002 - 2008

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This study shows empirically how the evolution of science can be described in terms of the mapping of science. The special emphasis is put on the observation of the changing nature of inter-/multi-disciplinary research. To do so, a technique to track the evolution of science by connecting maps in different reference years was adapted. Four science maps, i.e., the science maps 2002, 2004, 2006, and 2008, were connected and the dynamics of science was observed. The research areas in science map 200X were generated through the single-link clustering of the top 1% highly cited papers published from 200X-5 to 200X. Linkages among highly cited papers were determined by the strength of the co-citations. Figure 1 shows the science map 2008. A unit of the mapping is a research area and all research areas obtained by the clustering (647 research areas) were mapped. The map was created by a force-directed-placement algorithm in which attractive forces among research areas were determined by the strength of co-citations.

The science map shows that research areas can be divided into several domains, i.e., the superstructure of research areas. The research domain at the lower right of the map represents "particle physics and cosmology." The domain of "condensed matter physics" spreads out above them. There are two domains at the centre of the science map. The domain of "nanoscience" is at the centre-right, and that of "chemistry" at the centre left. To the left and below the domain of "chemistry" is the domain of "environmental research." Unlike the domain of "chemistry" in which research areas were concentrated close together and form large peak on the map, this domain is spread out on the map. Domains related to life science are at the upper left of the science map. It should be bear in mind that the map shows the trends in research areas in which very active researches are conducted; therefore slow moving/citing domains might be not observed.

Inter-/multi-disciplinary research areas account for about 23% of research areas (151 out of 647 research areas) in the science map 2008. Research areas in which a share of a specific field in research papers is less than 60% are considered as inter-/multi-disciplinary research areas. The ratio remains around 20% from the science map 2002 to 2008, however, the positions of inter-/multi-disciplinary research areas in the map have been changing. Inter-/multi-disciplinary research areas were localized mainly on the research domains of life sciences in the science map 2002 (Figure 2(a)). Their breadth has been growing over time and inter-/multi-disciplinary research areas spread over the map in the science map 2008 (Figure 2(b)). Trends in distances between inter-/multi-disciplinary research areas are shown in Figure 2(d). The distances between inter-/multi-disciplinary research areas in the science map 2008 are about 1.1-1.2 times larger than those in 2002, while the distances between all research areas are almost constant (Figure 2(c)). Furthermore, it was found that the

combination of life and non-life science fields in inter-/multi-disciplinary research areas are increasing. These results registered the qualitative changes of inter-/multi-disciplinary research. They are becoming more pervasive in science and the combination of knowledge in the different field is getting crucial.

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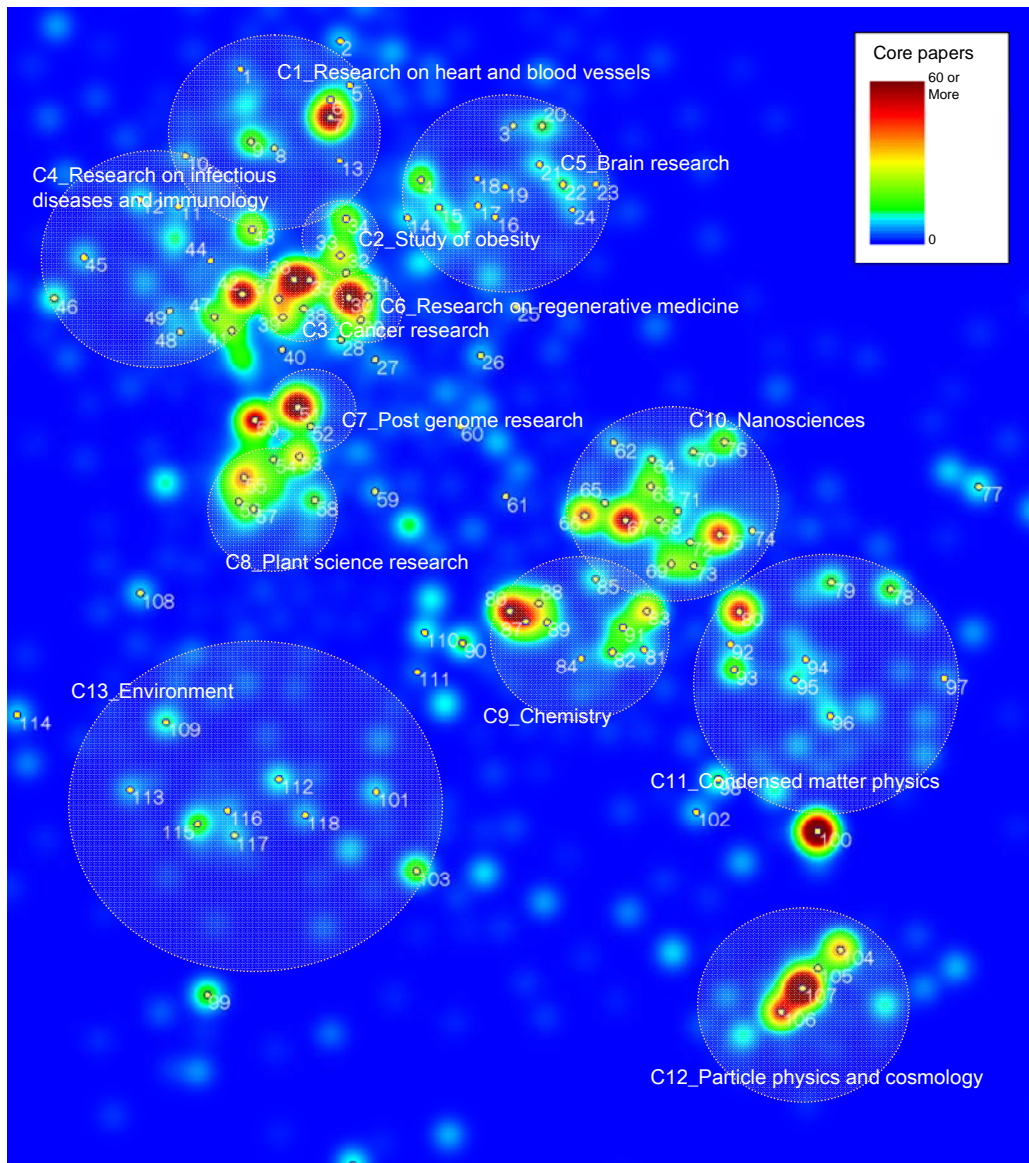
Figure 1.

A colour contour representation of the science map 2008. Yellow circles show central positions of 121 research areas whose names and contents were identified by experts. The list of 121 research areas will be available after the autumn of 2010 on http://www.nistep.go.jp/index-e.html. The numbers provide a unique ID for a research area. Research areas linked by stronger co-citation linkages tend to locate in nearby positions. The gradation in the map shows the density of highly cited papers that make up research areas. Research areas in the same domain are indicated by dotted circles in the map.
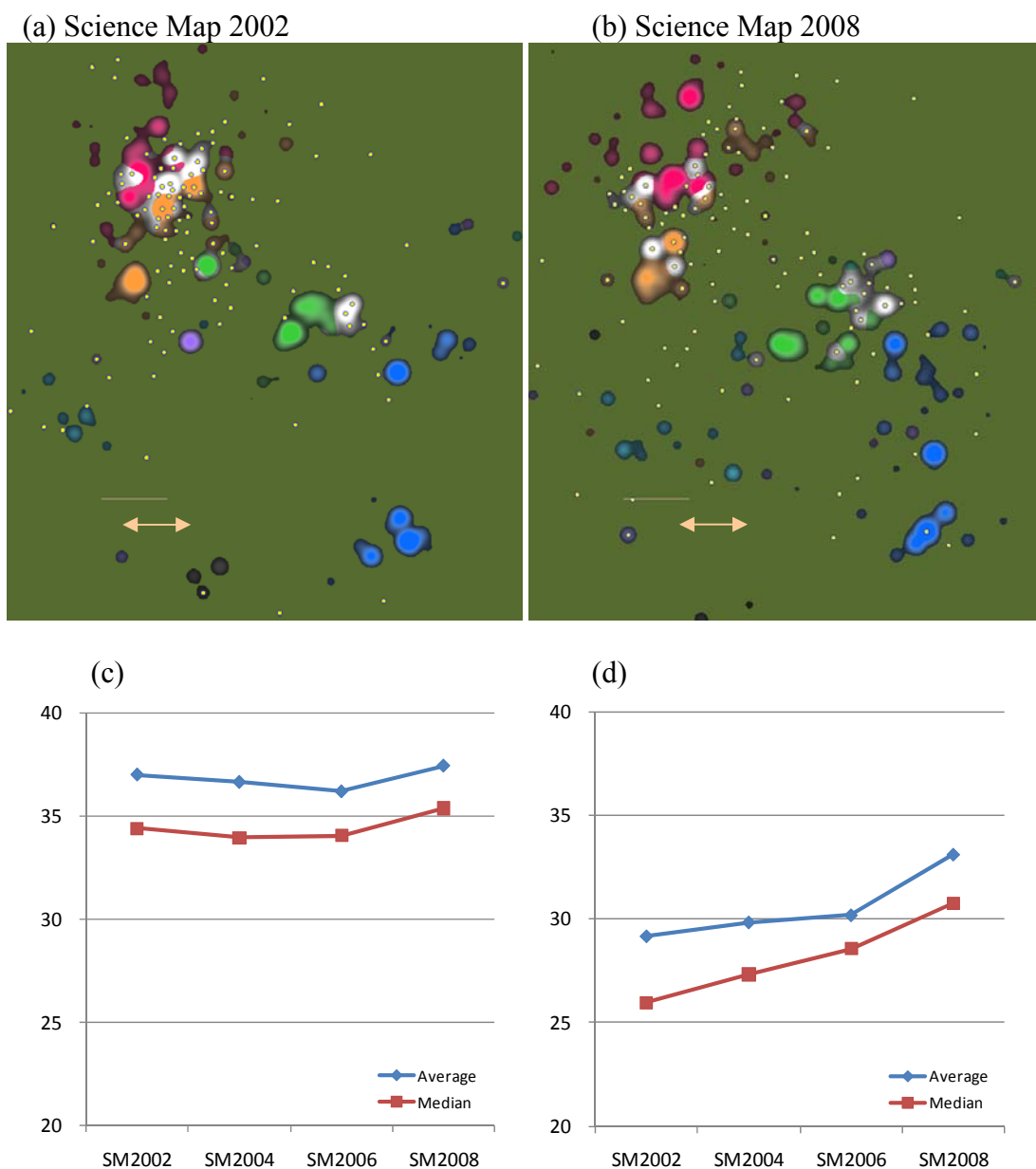
Figure 2.

Positions of inter-/multi-disciplinary research areas in the science map 2002 (a) and science map 2008 (b). Yellow circles show central positions of inter-/multi-disciplinary research areas. Arrows correspond to 10-unit length. Research areas in which a share of a specific field in research papers is less than 60% are considered as inter-/multi-disciplinary research areas. The field of the paper was determined by journals and 22 fields in the ESI were adopted in this analysis. Average and median distances between all research areas (c) and inter-/multi-disciplinary research areas (d).

What kind of political implications can we derive from the Science Map? A challenge in Japan

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The mapping of knowledge fascinates wide audiences and active studies have been being conducted in recent years. In spite of the accumulated knowledge in the mapping, unfortunately, the data is not utilized in the decision making process in Japan. One of the reasons would be the limited linkages between the phenomena in the cognitive space, which is observed in the science maps, and those in the social space such as the status of international collaborations. The interests of policy makers often go to the countries' activities in science, i.e., the phenomena in the social space. This paper intends to contribute to fill the gap between the needs of policy makers and the information we can obtain from the science map. The special emphasis is put on the observation of Japanese activities in scientific research.

The methodologies of the clustering and mapping can be found in our other presentation in reference. One of advantages in our science map is that we can add statistical data onto the map. For example, by putting the information of country's share in research areas onto the map, the map can visualize the breadth and depth of research activities in the specific countries. Figure 1 shows the science map 2008 onto which the information on country's shares in research areas is overlaid. Figure 1 (a) and (b) show results of Japan and Germany, respectively. The region where the share is at least 5% is shown by light blue, and the region where the share is 20% or more is shown by red. Japan has strength in the domains of "chemistry" and "condensed matter physics." The map of Japan also shows that the red regions are scattered over the map. Japan shows prominent activities in some research areas, but the breadth of the activities is limited compared to Germany. Figure 1 (c) shows the ratio of research areas in which country's share is more than zero, i.e., participation ratio. The participation ratio of Japan is about 40% and is smaller than Germany and the UK. It could be said that the diversity of participated research areas in Japan is lower than those in Germany and the UK.

The presence of Japan does not change significantly between the whole and fractional counting (see Figure 2(a) and (b)). In contrast, the shares in whole counting are remarkably larger than those in fractional counting in Germany and the UK. The difference is attributable to the higher ratio of the internationally co-authored papers. This could be a reason why Germany and the UK have the higher participation ratio than Japan. These countries likely utilize the international collaboration as a tool to increase the breadth, i.e., participation ratio, and depth, i.e., countries' share, in scientific research. These results indicate that Japan needs to leverage its research potential not only through fostering research capability within the borders but also utilize the international collaboration as a tool to increase the breadth and depth in scientific research.

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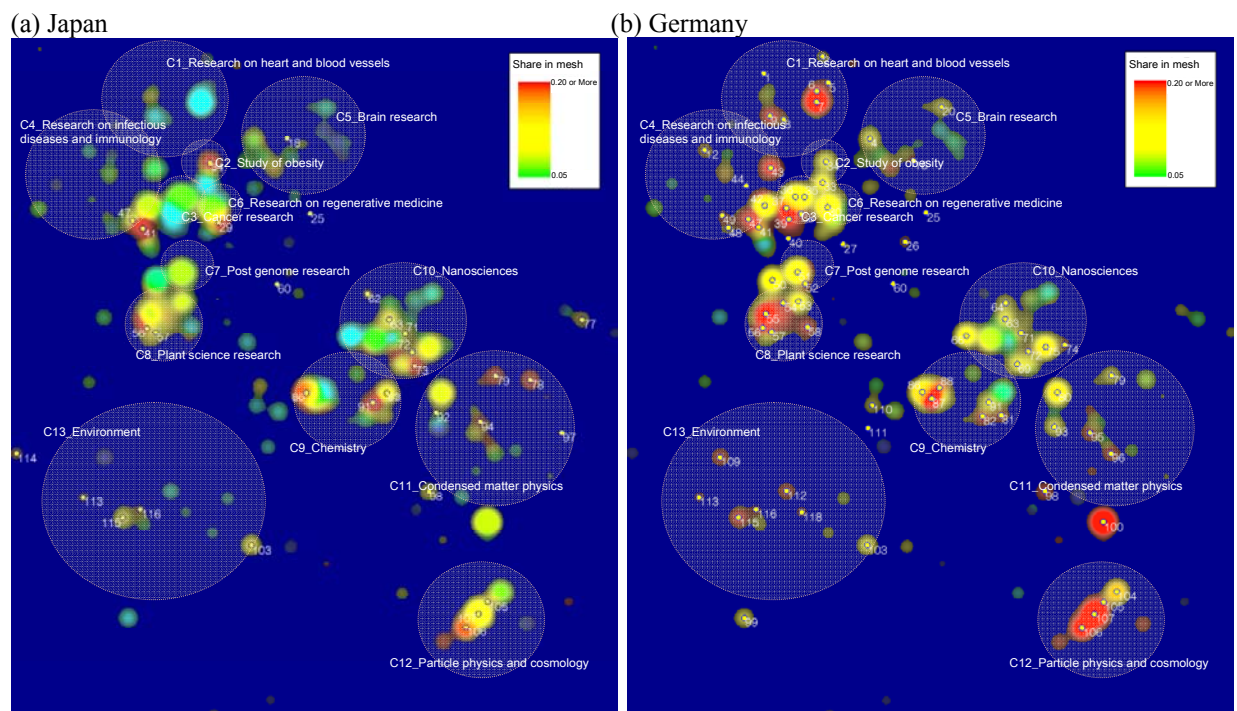
(a) Japan

(b) Germany

(c) Participation ratio of major countries
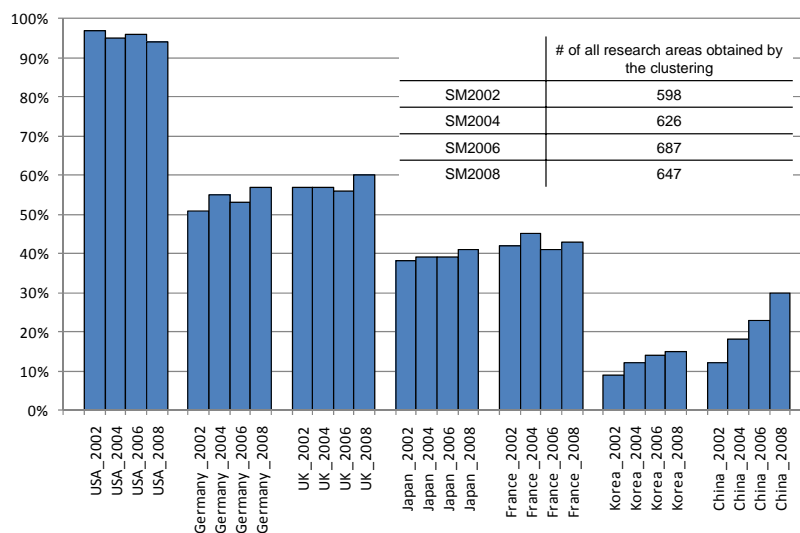
Figure 1.

Science map 2008 onto which the information on countries' shares in research areas is overlaid. Figure 1 (a) and (b) show results of Japan and Germany, respectively. The share was counted by the whole counting method. The region where countries' share is at least 5% is shown by light blue, and the region where the share is 20% or more is shown by red. Participation ratio in major countries (c). The participation ratio is defined as the ratio of research areas in which country's share is more than zero in all research areas obtained by the clustering.

Table 1.

Countries' share in all research areas in the whole counting (a) and in the fractional counting (b).

(a)

Whole counting (%)	USA	Germany	UK	Japan	France	Korea	China
Science Map 2002	62.9	11.1	12.4	8.6	7.0	1.1	1.3
Science Map 2004	61.9	12.1	12.3	8.7	7.2	1.7	2.7
Science Map 2006	61.0	13.5	12.9	8.5	7.5	1.8	4.5
Science Map 2008	57.9	13.9	13.4	8.0	8.4	1.9	7.2

(b)

Fractional couting (%)	USA	Germany	UK	Japan	France	Korea	China
Science Map 2002	51.8	6.7	7.8	6.4	3.9	0.7	0.8
Science Map 2004	49.7	7.2	7.3	6.2	3.8	1.0	1.7
Science Map 2006	47.6	7.7	7.2	5.7	3.7	1.1	2.9
Science Map 2008	43.5	7.4	7.0	5.4	3.8	1.0	5.2

Scientific cooperation in times of unrest: A network-based approach to former Yugoslavia

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Introduction

It is generally accepted that scientific work and scientific cooperation are sensitive to their societal and economic environment. But how strong are they affected by the outbreak of social, economic or ethnic crises? In a recent paper (Jovanovic et al., 2010) we have considered the temporal evolution of scientific cooperation between the successor republics of the former Yugoslavia. Furthermore we have analysed how they were affected by the civil wars and social crises, which took place in that region during the last 20 years. In the present contribution we extend and deepen our previous work by applying methods from network-analysis and a gravity model to the internal and external cooperation network of the republics of former Yugoslavia.

Method

As described in the aforementioned publication we have established a search strategy for the databases *Science Citation Index* and *Social Science Citation Index* which is based on the names of cities within former Yugoslavia. Using the revisited data we analyse the cooperation pattern and their temporal evolution using the *cooperation matrix C_{ij}*, which defines a *weighted network*. We extend the discussion presented in Jovanovic et al. (2010) by additionally considering cooperation with other states all over the world. In doing so, we take into account the different political blocs, viz. western (nations of NATO, EU etc.), socialistic (nations of the former Warsaw Pact) and the Non-Aligned Nations. With this we aim to answer the question whether the scientific communities within the different republics have reorientated themselves in the course of the crises. The time-dependent (weighted) network is analysed by means of standard techniques from network analysis. In particular, we evaluate different measures for the dominance within a network and compare these quantities with our recently introduced *dominance factor* (see Jovanovic et al., 2010).
Furthermore we investigate whether it is possible to quantify the qualitatively observed impact of the civil wars on publication and collaboration activities of the republics of the former Yugoslavia. The first aspect is analysed by defining a suitably chosen trend line for the number of publications as a function of time. This serves as a reference concerning the publication numbers observed for Yugoslavia's successor

states. The observed deviation leads to a quantitative measure for the impact of the civil wars on their scientific activities. The second aspect, scientific cooperation, is investigated by means of a gravity model for cooperation as it has been previously introduced by Frenken et al. (2009). We modify this model in order to take into account tensions between the different republics, by interpreting them as repulsive forces.

Finally the impact of the civil wars on the scientific community in former Yugoslavia is compared with that of other historical events like World War II (see e.g. Cardona & Marx, 2005) or the embargo against South Africa form the mid-1980s to 1994 (Ingwersen & Jacobs, 2004, or Sooryamoorthy, 2010).

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Footprints in the scientific landscape – Comparing metamaterials and fullerenes

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Introduction

Citations to scientific publications can be considered "frozen footprints" which "bear witness to the passage of ideas" (Cronin, 1984). With this in mind we employ a so-called genesis-article, a paper that first described a scientific or technological topic. This we use as a standard reference to examine the traces it has left in the world of publications. The footprint-analysis derives its name from this approach. In this poster contribution we present a complete profiling of two distinct topics (metamaterials and fullerenes) by applying and expanding approaches we introduced previously (Jovanovic, 2007; Jovanovic et al., 2009). Furthermore we compare the profiles of the considered topics and look for typical patterns of the trajectories in the publication landscape.

Method

Central questions being addressed in a footprint-analysis are whether the analysed discovery is a current research topic and whether it is more fundamentally oriented or part of applied science. An analysis of the different types of publishing institutions or the use of the earlier introduced method of subject area - quadrant allocation (SAQA) (Jovanovic et al., 2009) provides partial answers. In this contribution we present a comprehensive footprint-analysis which is composed of the following steps:

1. Identification of the genesis-article and download of all citations this article has received.
2. Analysis of the number of publications over time.
3. Analysis of the different types of publishing institutions (e.g. universities, companies etc.) over time. See fig. 1 for an example.
4. Determination of a technology's subject area – quadrant allocation. See fig. 2. for an example.
5. Keyword analysis that provides a search query for use in the Derwent Innovations Index and the Web of Science to retrieve matching documents.
6. Patent analysis that leads to the number of patents over time and their connection with scientific publications.

7. Pattern recognition (e.g. a double-boom (Schmoch et al., 2006)) of the analysed data.

This course of action leads to a footprint-profile which classifies every analysed topic and describes its different bibliometric aspects. These profiles support policy makers in their decision making process (e.g. when allocating money for application-oriented research) and hint at possible extrapolations of a technology's future (e.g. when hints for a pattern have been found).

Results

First results of the two footprint-analyses suggest that:

1. Both metamaterials and fullerenes are growing research topics, albeit the former stronger than the latter.
2. Both topics have a growing number of publishing institutions which are application oriented, though the growth is not as strong as the growth of the publishing institutions that are oriented towards fundamental understanding.
3. The SAQA shows that metamaterials is closer to application oriented research then fullerenes.
4. There are hints to the possibility that metamaterials follow a double-boom pattern while no such hints could be found for fullerenes for now.
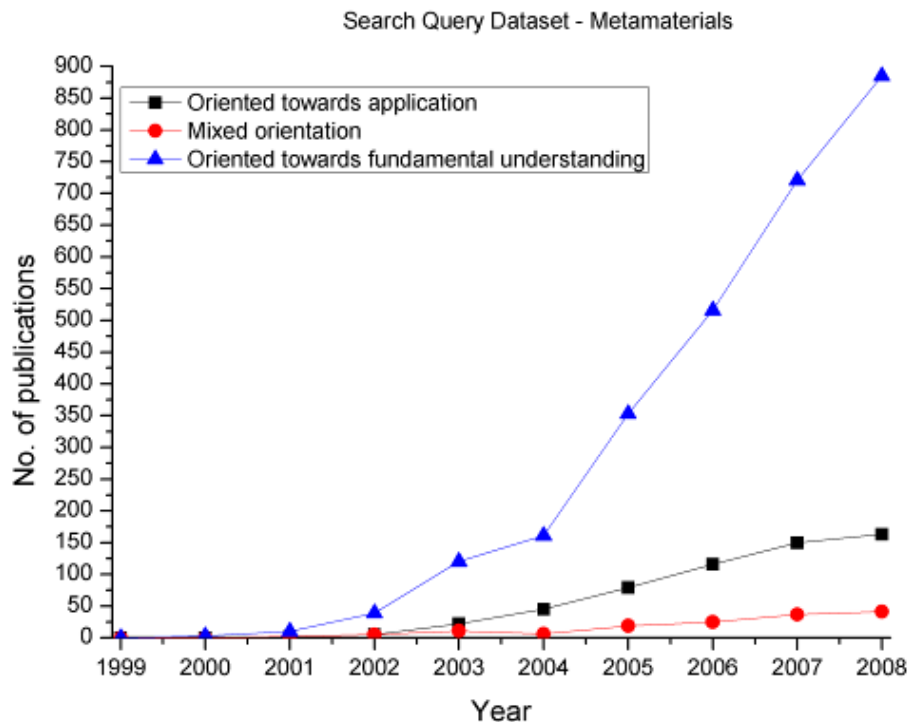
Figure 1. Development over time of the different types of publishing institutions for the topic "metamaterials"
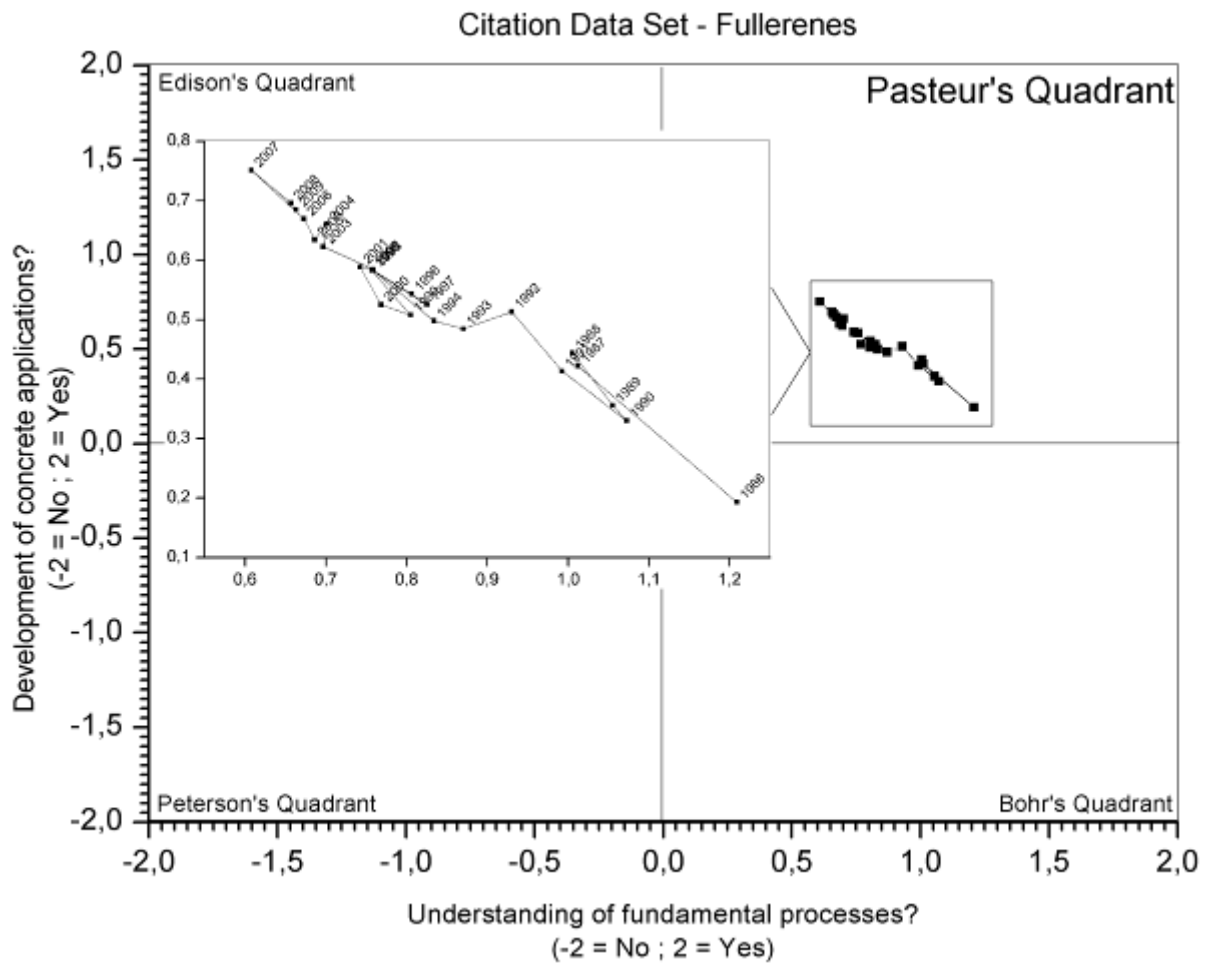
Figure 2. Subject Area – Quadrant Allocation of the citation data set for the topic "fullerenes"

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Benchmarking Science and Technology at the regional level – a case study of Baden-Wuerttemberg, Germany, reflected by SCOPUS and PATSTAT

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Presenter: Judith Kamalski

Policy makers are more and more eager to base their decisions and assessments on sound and reliable empirical evidence. Modern innovation research is able to provide this evidence. Nevertheless, some additions are needed. The concept of the European Research Area has implications on the regionalisation of innovation policy programs, and the relevance of local network policies (e.g. clusters) is increasing. This means that more and more of the bibliometric analyses need to be able to address regional levels in addition to the national level. Analyses at the national level are relatively straightforward, because most statistics are available at a national level and also because cross-border mobility effects play a less important role at the national level than they would play at the regional level. It is therefore imperative that regional studies pay attention to demarcations in advance, both geographical and thematic or methodological demarcations. In this presentation, we will show how this can be done.

Elsevier B.V. and Fraunhofer ISI currently conduct a project on behalf of *the Stiftung Baden-Wuerttemberg* where the scientific and technological capabilities of this region in southwest Germany are benchmarked against Germany as a whole and against a set of selected industrialised countries, as reflected by Scopus and PATSTAT.

In this presentation, we will mainly address methodological issues. First and foremost, the definition of Baden-Wuerttemberg publications or patents needs to be clarified. Aside from the challenge of regionalisation of data as such, this mainly concerns the harmonisation of affiliations and the challenge of headquarter vs. research lab definitions. This latter issue becomes especially apparent when applicant or inventor addresses are used to assign the region. In some technological fields, these methodological decisions can have enormous impacts on the absolute numbers and the structures, and therefore on the conclusions drawn from such an analysis. In the case of Baden-Wuerttemberg this effect is particularly visible in chemistry and pharmaceuticals, caused by border-effects with Switzerland (pharmaceutical industry in Basel) and Rhineland-Palatinate (chemical industry in Ludwigshafen). Further challenges in the course of the project concern finding appropriate ways of integrating and interpreting the different classifications in the patent and the publication databases.

This presentation will offer a discussion of how these methodological challenges were solved and what lessons have been learnt for future analyses on the regional level.

National journals as indicators of state-of-art of social sciences in Ukraine

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Introduction

Problems of transition produced significant changes in Ukrainian social science journals. The aim of this study was to elucidate these changes by extending our previous work (Kavunenko et al., 2006) dedicated to comparative study of the social sciences journals in Ukraine and the world in accordance with the approaches of the social science evaluation employed by the CWTS team (Moed et al., 2000).

Methods

We have studied the national periodicals that were recognized by the government body as the social sciences journals. On the basis of the estimation by experts were created indicators characterizing the Ukrainian social science structure, quality of the information presentation, visibility of examined periodicals in Internet, the usage of literature.

Results

Total number of the Ukrainian social science journals was increased since 1990 till the middle of 2010 in ten times, but the growth of the new journals slow down since 2005. The stabilization of the number of examined journals suggests that the Ukrainian social science systems probably are quantitatively formed till 2010 (Fig. 1).

Dynamics of total number and new established social sciences journals in Ukraine during 1990-2010 years
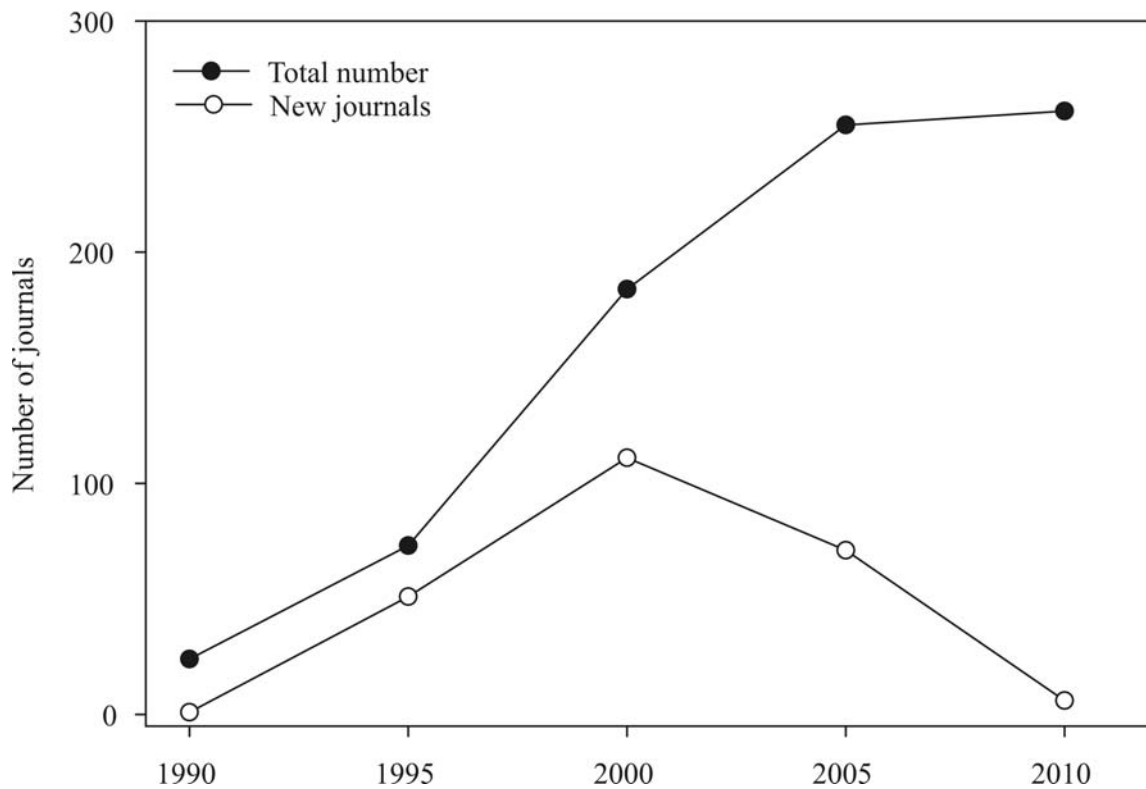
Fig.1

The most increase of the periodical number revealed Psychology, Politics, Economics and Law resulting in convergence of disciplinary structure of Ukrainian journals to the world tendency according the distribution of SSCI journals

Distribution of Ukrainian and SSCI journals on subfields of social sciences

Ⓩ Ukraine 2000   Ⓢ Ukraine2010   □ Journals in SSCI
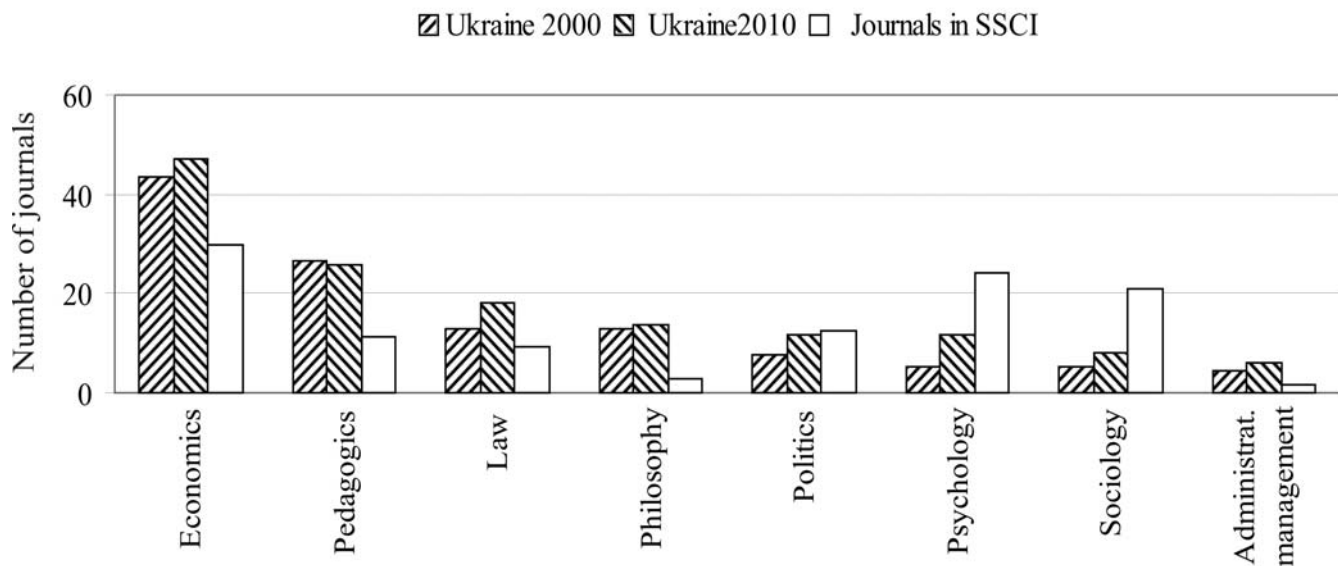
Fig. 2.

The quality of articles improved as a result of the development of peer review system. It was manifested in a more rigid structuring of the articles; inclusion of abstracts in English. The length of articles, number of reference, using of no Cyrillic and journals sources were increased in leading economical and sociological journals. But in general a poor usage of world literature is a distinguished feature of the current situation of research in social sciences in Ukraine, especially in nonacademic sector. Free access to abstracts and full text of examined journals is currently created by two ways: via National scientific library of Ukraine (59.3% and 52.3% of journals, respectively) and website of journal or its editor (43.0 % and 18.4 of journals, respectively).

Conclusion

At the beginning of the nineties there were in Ukraine a couple of political magazines and about 20 of the social science periodicals that were isolated from the world science. During last two decades the Ukrainian social sciences are booming, but our analysis shows that the Ukrainian social science journals are on the initial stage of integration into the world scientific community. The improving of their quality is one of the tasks of Ukrainian science policy.

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Weaving the Fabric of Science

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Introduction

Many people assume that there is a web of science. We illustrate here that the structure of science is much more like a fabric than a web. This conclusion is based on an analysis of the scientific literature; we model how science is structured and how it changes over time. Using co-citation analysis, we create annual models of science (Klavans & Boyack, 2010). Each annual model clusters around two million reference papers, and then assigns the articles from that year and the four previous years to those clusters. Each annual model contains 80 to 90 thousand such clusters, and around 6 million recent articles. Each cluster is called a research community. To create the fabric of science we link or weave research communities in two different ways. First, communities from annual models are linked sequentially in time using overlap of common references. These common references are like fibers that can be twisted together into threads; this is what researchers do inherently through their citing practices. Our time-linked sets of communities are called threads, and are shown as the sequences of linked rectangles in Figure 1. Threads can be thin or thick depending on the citation structure.

The second way we link communities is longitudinally by leading researchers. We identify the leading researchers in each thread. Some researchers remain very focused and are a leader in a single thread for many consecutive years. We call these researchers thread builders. Other researchers are leaders in multiple threads, and change their topical focus over time, moving from thread to thread. These researchers are the weavers who weave the micro-fabrics of science. A full fabric of science is created because many different authors move from thread to thread over the course of their careers.
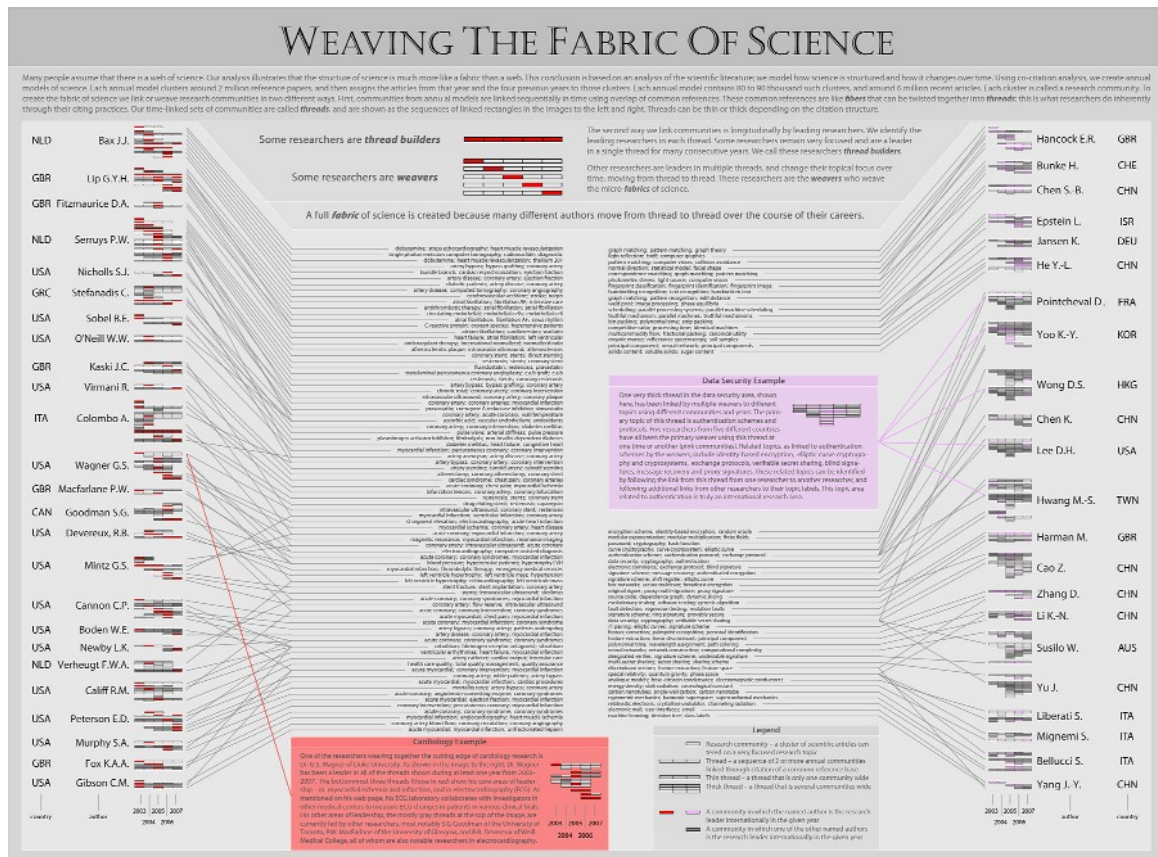
Figure 1. Poster version of the work.

Examples

One of the researchers weaving together the cutting edge of cardiology research is Dr. G.S. Wagner of Duke University. As shown in the image to the right, Dr. Wagner has been a leader in all of the threads shown during at least one year from 2003-2007. The bottommost three threads (those in red) show his core areas of leadership – in myocardial ischemia and infarction, and in electrocardiography (ECG). As mentioned on his web page, his ECG laboratory collaborates with investigators in other medical centers to measure ECG changes in patients in various clinical trials. His other areas of leadership, the mostly gray threads at the top of the image, are currently led by other researchers, most notably S.G Goodman of the University of Toronto, P.W. MacFarlane of the University of Glasgow, and R.B. Devereux of Weill Medical College, all of whom are also notable researchers in electrocardiography.

An example from the data security area is also given in the poster, along with detailed descriptions of the threads.

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Estimating Publication Productivity from a Zero-Truncated Distribution

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Introduction

While methods for citation analysis have developed significantly during the last twenty years, the same cannot be said for publication productivity analysis. "Research (or scientific) productivity", are frequently used keywords in about one thousand articles (WoS) over the years, but, a closer look reveals that there is little of methodological development and few attempts to explicitly contribute to the overall measurement problem.

This paper will address the question of what is required for building a measure of scientific productivity, i.e. the calculation of papers per author. This task, which at first sight appears simple, is often restricted by properties of the data available. Publication databases, such as Web of Science and Scopus, only include information about publishing authors within a given time period, not all "potential authors" [1], i.e. zero publishing authors, that could have produced a paper with timing and resources available.

In a field with low paper "productivity", e.g. the social sciences, the share of potential authors will be high in relation to the total population (actual and potential). In contrast, in fields with high "productivity", such as the natural sciences, the share of potential authors will be low. Comparisons between areas based solely on the actual authors will thus be misrepresentative.

Hitherto, the most interesting discussion on publication productivity has been given within the framework of frequency distributions [1]. Especially the Waring model, a statistical distribution used for describing publication productivity processes [2], seems as a suitable candidate. If a productivity distribution can be characterized as a Waring distribution, the zero class can be estimated using simple statistical methods. The distribution was originally introduced by H.A. Simon [3] as a generalization of the Yule distribution [see also 4] and further analyzed by J.O. Irwin in [5], who gave the distribution its current name.

Testing the Accuracy of Waring Based Estimations

A weakness of previous empirical tests of Waring based estimations of the zero class [1; 7] is the lack of precise test data. The true zero frequencies have not been known which has limited the possibilities of precise results.

In order to produce a satisfactory empirical data set for testing the accuracy of Waring based estimations of the zero class, a known publication frequency distribution that includes zero values has to be created. In the paper, we describe the creation of a productivity data set, based on figures concerning researchers at two Swedish universities.

Employee data concerning the time period of 2004-2007 were obtained from two Swedish universities. Based on official standing the following categories were

selected: professor, researcher, senior lecturer, associate professor, assistant professor, and doctoral student. A collection of 729 and 949 numbers of researchers from the respective universities was hereby obtained.

Publication data was downloaded for each potential author from the Web of Science and compiled into a data set were the number of publications (article, letter and review) associated with each potential author was listed (All). In addition, the number of first author publications (First) and reprint author publications (Reprint) by each potential author was extracted and listed. Furthermore, a random author (Random) was selected for each of the downloaded publications. This was achieved by randomly selecting a single author from the author list of each publication, resulting in a selection of one author per publication.

The zero frequencies in the test data set were removed to form zero truncated productivity samples. The conformity between estimations based on the created samples and the actual (full data) could thus be tested.

Results

For each zero truncated distribution of the potential author data set the population means was estimated using the Waring approach. The results of the estimations and the expected population means are shown in Table 1.

	University 1				University 2			
	All Au	Random Au	First Au	Reprint Au	All Au	Random Au	First Au	Reprint Au
Calculated	6,56	1,55	1,38	1,65	5,43	1,55	1,30	1,68
Estimated	7,26	1,75	1,39	2,04	5,22	1,51	1,17	1,63

Conclusions

Though we use a rather small empirical dataset (<1 000 researchers) from two universities, it can be shown that the Waring model yields fairly good estimates. We propose that colleagues in the scientometric community consider the Waring model for further tests using author name corrected and identified publication data.

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TinEye Searches for Image Impact Assessment

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Introduction

The web includes many academic digital pictures and open access image archives that can potentially be used for research, artistic or social activities. Although most research outputs have a well-accepted metric for their impact assessment (e.g., citation counts), it is not known whether evaluative informetrics can be extended to academic images as a type of non-standard research output. For scholars or institutions publishing such images it is important to know how well used their images are. For instance, there are about "5.2 images per biological article in the journal Proceedings of the National Academy of Sciences" and "43% of the articles in the medical journal The Lancet contain biomedical images" (Rafkind, Lee, Chang & Yu, 2006, p.73). There has been no practical method to assess how and where academic individual images are used or copied. This study explores whether the TinEye (http://tineye.com) image search engine could be used for scholarly image impact assessment. Case studies of images in science, medicine and humanities were used to address the above question. Qualitative methods were also applied to identify common motivations for copying academic images online and to assess aspects of research impact or informal scholarly uses.

Method

We used TinEye to assess how often academic images have been used or copied online. TinEye uses each submitted image as a query and then compares it to the 1.3 billion images indexed to return similar results even if they have been edited. For the TinEye searches, we uploaded sample images from different online image collections in sciences, medicine and humanities. We also classified motivations for copying a sample of 210 NASA pictures from the TinEye searches.

Results

Table 1 reports the results of the study and includes similar statistics for three datasets from (Kousha, Thelwall & Rezaie, in press).

Table 1. Descriptive statistics for TinEye searches of different image types

Image database	Subject coverage	#images	TinEye unique results	Mean	Median
HubbleSite	NASA observational astronomy pictures	260	9,580	36.84	11
Botanical Society of America's image collection	Botanical images and plant anatomy	70	30	0.42	0
Protein Data Bank	Molecular structures (proteins and nucleic acids)	96	64	0.87	0
WebPath	Microscopic pathology; radiology imaging	190	58	0.44	0
NLM Online Medical Encyclopaedia	Medical images from cancer, HIV, asthma, heart diseases etc.	60	410	6.83	3
Historical Anatomies on the Web	Historical image collection of human anatomies	80	320	4	1
The Art Gallery	Paintings from eight world famous painters	240	10,786	44.94	8

The NASA picture classification showed that only 1.4% were from academic publications reflecting research impact, and the majority were used for educational reasons or for informal scholarly communication (37%).

Conclusions

The results show that it is technically possible to track image impact to assess the value of academic digital pictures and online images archives. Hence, the applied method can in practice be used either by scholars and artists or by developers of image databases or archives to track how their visual outputs are being used elsewhere on the web. Nevertheless, the results are far from uniform and TinEye does not guarantee to index all online images nor to accurately match images if they have been extensively edited.

A qualitative analysis suggests that image types and their online availability for public use are important factors in their popularity and for the motivations for using and copying them. Online academic images seem to be copied for reasons typically related to informal scholarly communication and education rather than direct research impact in the traditional sense. Hence, image impact indicators should not be used as evidence of direct contributions to research findings, but as contributions to the infrastructure of research and education.

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On the shoulders of students?
A bibliometric study of PhD students' contribution to the advancement of knowledge

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Introduction

Graduate students are an important part of the academic workforce. In the Canadian province of Quebec, about 27,500 distinct students were enrolled in doctoral programs at some point in the province between 2000 and 2007, and about 8,500 graduated during the same period (GDEU database). Still, apart from a few micro-level bibliometric studies (Cursiefen & Altunbas, 1998; Lee, 2000) or surveys (Nettles & Millett, 2006), very little is known on graduate students' contribution of the creation of new knowledge. In order to shed light on this question, this paper presents the results of the first large-scale survey of PhD students' publication activity, using the whole population of PhD students enrolled in Quebec's universities between 2000 and 2007 (N=27,393). It provides a measure of the extent to which graduate students participate in the publication process during their studies and as well as the percentage of the province's paper to which they contributed. It also assesses the effect of this participation to papers on students' ulterior careers in research and degree completion.

Method

Papers authored by Quebec's PhD student were retrieved from Thomson Reuters' Web of Science (WoS) by matching the names of all of Quebec's PhD students with the names of authors of papers with at least one address from Quebec. False positives—i.e. papers authored by homographs—were removed using both manual validation and an algorithm.

Results and Discussion

Figure 1A presents the percentage of Quebec's university papers to which at least one PhD student contributed as well as the percentage of PhD students who published at least one paper during their doctorate. It shows that 63% of PhD students in health and 40% of those in NSE have contributed to at least one paper during their doctorate. On the other hand, about 10% and 4% of students in SS and AH, respectively, have done so. The tendency is similar in terms of their overall proportion of the output of the province. Indeed, for both health and NSE, about 30% of all Quebec university papers have PhD students as authors or co-authors. On the other hand, a smaller proportion of the province's papers are authored by PhD students in SS (19%) and AH (13%). Several factors explain these differences, among which the different formats of doctoral theses (article-based vs. monograph) as well as research collaboration with faculty members are the most important.

Figure 1B presents the number of papers by doctoral students of the 2000-2002 cohorts, for those who completed their doctorate as well as those who had not completed it as of the end of 2007 (N=6,596). It clearly demonstrates that, in each of

the disciplines, those who had completed their doctorate published a higher number of papers than those who had not completed the program. These data provide strong evidence of the links between participation in research and degree completion. Indeed, an important aspect of the doctorate is to contribute to the advancement of scholarly knowledge in a discipline. It is thus normal that, by publishing papers—which are contributions to knowledge—doctoral students increase their chances of completing their doctoral degrees.
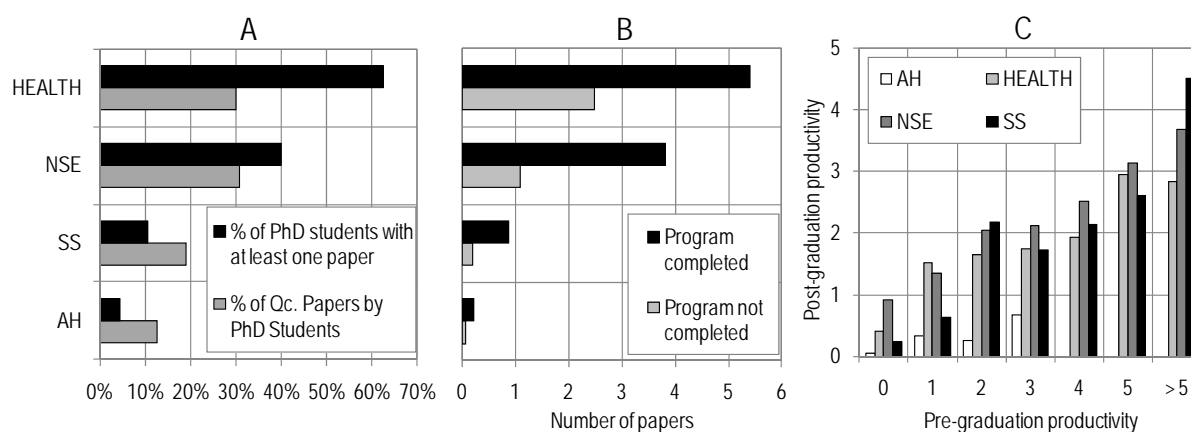
Figure 1.A Percentage of Quebec's university papers co-authored by PhD students and percentage of PhD students who published at least one paper during their studies, B. Average number of papers by doctoral students having completed their program and by doctoral students that have not completed their program as of the end of 2007, for 2000-2002 cohorts (N=6,596), C. Relationship between pre-graduation productivity and post-graduation productivity, for the subset of doctoral students who graduated in 2003-2004 (N=2,319)

Finally, Figure 1C shows that those who publish more during their doctorate are more likely to publish more afterwards. This is indisputably an effect of socialization and integration into research: students who are more involved in research during their doctorate are socialized to the publication *habitus* (Bourdieu, 1980) and keep it after graduation, when they themselves become members of the scientific community. This also suggests that those who have been involved in research during their doctorate are more likely to obtain research positions after graduation.

Conclusion

Taken altogether, these figures show the essential role of doctoral students in the research system, as they also contribute to a considerable proportion of the new knowledge being created. Similarly, these original data also highlight the relationship between PhD students' socialization to research – as measured by their participation to peer-reviewed papers – and both degree completion and the likelihood of pursuing a career in research. By extension, the fact that the almost all PhD students' papers are authored with faculty members underlines the central place of research teams in reducing time to completion and increasing degree completion. Though no panacea can solve the problem of time to completion, our results show that a better integration of doctoral students into the collective dynamics of research yields better individual and collective results.

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Regionalization and internationalization of public-private research cooperation: a comparative study of Sweden and the Netherlands

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Introduction

This empirical study deals with the public-private realm of scientific knowledge production and the companies engaged in joint research with public sector partners. This is done by analysis of local, national and international Private-Public Co-authored research papers, abbreviated to 'PPCs'. The author address information in PPCs of individual companies contains information on the names of their partner organizations: universities, other companies, as well as other research and technology organizations.

Earlier studies have focused their analysis of Swedish regional university-industry collaboration in the context of the triple-helix with analysis of the interaction between academia, government and the private sector (Danell and Persson, 2003) and collaboration involving research institutes (Larsen and Bienkowska, 2009). The urban setting also has an influence on the type and extent of international collaboration since many foreign firms choose to have a presence in capital regions, which could give a different pattern with regards to internationally co-authored papers. With an increasingly global market for research and development (R&D) that both public and private research performers are facing and importance of companies' search for external scientific knowledge and technical skills, due to downsizing of their own research labs. Research universities, and other public sector research institutes, have become an increasingly important research partners and sources of knowledge, skills and R&D facilities (Tijssen, 2004; Tijssen et al., 2009). Studies of internationalization of industry based R&D add a regional dimension by emphasising knowledge capabilities of specialized firms and research institutes in regions (Cooke, 2005) and studies of co-authored knowledge production in regions can reveal international R&D ties (Larsen 2008). In this paper we focus our analyses of regional and international co-production of knowledge through the following elements:

 I. General trends in the volume of public-private co-production of knowledge;
 II. Profiling Swedish urban regions in comparison to Dutch regions;
 III. Case studies with PPC examples from industrial research institutes in Sweden

Method

PPC co-occurrence data, i.e. the count data on pairs of co-publishing organisations within a single PPC, is analysed to capture the extent of research cooperation links,

and associated the knowledge sharing and exchange. We focus on publications that were co-authored by private sector organizations (mainly business companies) with public actors. The count data refer to PPC occurrences: the pairs of PPC co-occurrences between a companies and non-private research partners in the same country (national PPCs) and those abroad (international PPCs). Based on their author address information each company is assigned to a geographical region using EUROSTAT's NUTS classification system (EUROSTAT, 2008). For each of the firms represented in PPC in the region analysed a row will be created in the matrix used to capture the interaction through co-authorship ties.

Results

The volume of public-private research cooperation seems to be on the rise - regionally, domestically and globally. Figure 1 captures the domestic, European and global trends. We find an increase in the numbers of PPCs that outpaces the growth rate of science, as far as represented in the research publication output indexed by the Thomson Reuters's *Web of Science database* (TR/WoS). The numbers of national PPCs are growing faster than international PPCs, both within the EU27 and worldwide. The increases of national and international PPCs in Sweden however are less than the worldwide and European growth rate. The same applies to national PPCs in the Netherlands. The Netherlands shows an exceptional strong rise of international PPCs in more recent years.
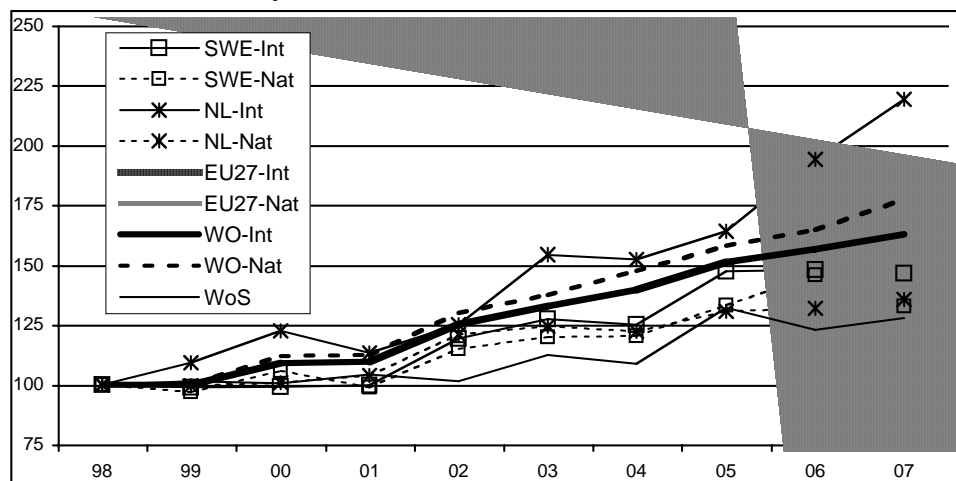
Figure 1. General trends in PPC occurrences: worldwide, EU27 countries, Sweden (SWE) and the Netherlands (NL). International vs. national non-private research partners (1998-2007). Source: TR/CWTS Web of Science database.

Table 1 takes a closer look at one recent year, 2007, at the two most PPC-active regions within Sweden and Netherlands. The two Swedish regions (basically the cities of Stockholm and Göteborg) account for a larger share of the national total than their two Dutch counterparts, indicating stronger PPC concentration effects in Sweden. The two Dutch regions differ: NL414 comprises an 'electronics/ICT R&D' cluster with collaborative links between a very large technology company (Philips), Eindhoven University of Technology and other smaller companies; NL221 encompasses Wageningen University and the large and divers cluster of companies and private research institutes that are active in biotechnology and life sciences, many of which are located within the so-called *Food Valley* region. These differences are reflected in the degree of foreign partners and their partner country profiles.

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Table 1. International PPC collaboration of Swedish and Dutch companies: overall and by major NUTS3 county (2007).*

	Total Sweden	Stockholm (SE110)	Västra Götaland (SE232)	Total Netherlands	Zuidoost-Noord-Brabant (NL414)	Veluwe (NL221)
National PPCs	1092	352	302	1272	178	135
Partner countries:						
United Kingdom	147	38	59	135	35	8
Germany	112	29	37	118	27	12
USA	110	42	27	82	19	11
France	58	27	17	79	18	9
Norway	49	11	21	7	1	1
Finland	42	18	10	20	9	3
Netherlands	55	11	32	-	-	-
Sweden	-	-	-	30	5	1
Denmark	54	11	16	23	3	4
Italy	29	7	12	52	10	8
Spain	40	14	17	25	7	7
Canada	33	11	9	14	5	0
Switzerland	36	6	14	31	2	4
Belgium	22	8	7	50	21	10
Australia	16	5	7	15	2	3

* Includes multiple counting of PPCs within the same publication referring to partners in different countries. Source: TR Web of Science database.

The Swedish case studies - including research institutes STFI (paper-pulp and packaging technology) and Acreo (electronics and fiber optics) - show strong national co-publication patterns with universities, while they also differ with regards to the level of 'europeanization' versus 'globalization'. The Acreo case shows more global internationalization patterns, while the private sector STFI research institute has a stronger European and national profile.

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The Emergence of Translational Research.
Patterns in its current advances

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Introduction

Bibliometric evidence and case studies have shown how fields of science change over time regarding their level and type of multi-disciplinarity (Morrillo, Bordons, & Gòmez, 2003). These changes are driven both by shifts in societal needs and by science-internal dynamics (van Raan, 2000; Klein, 2004; Barry, Born, & Weszkalnys, 2008; Bonaccorsi, 2008). The field studied in this paper exemplifies change driven by science-internal mechanisms brought about by adoption of Generic Research Technologies (GRTs) (Shinn, 2005) emerging from underlying, more fundamental disciplines.

Research questions

We examine this adoption process from 1980 onwards, identifying first if there are *stages* in the absorption and deployment of GRTs; second if GRTs are adopted homogenously across the recipient field, or only by portions, giving rise to cognitive segmentation. Thirdly, finding a fairly strong segmentation, for a recent four year period we zoom in on key differences between adopting and non-adopting segments so as to bring out the nature of the inter-disciplinarity that has emerged in the adopting segment. We take our case from the discipline of oncology, focusing on breast cancer (BC) diagnosis and treatment. From ISI-Web of Knowledge we retrieve bibliometric data on all articles published in this field1980–2008.

Results

To bring out the evolution of inter-disciplinarity we distinguish between three elements of BC research, referring to i) Clinical Practices (e.g. surgery); ii) Application Domains (e.g. obstetrics); iii) GRTs (e.g. genetics and molecular biology). Three distinct stages appear in the way these elements combine with the oncology core of the field. First, during the 1980s, the field was dominated by oncology combined with various elements of its clinical practice. Second, the early 1990s witnessed a remarkable expansion of BC research, associated with the adoption of new GRTs. For part of the field this adoption involved a change from *multi*-disciplinarity to a more integrated *inter*-disciplinary pattern, which subsequently has become referred to as *translational research* (TR). A third stage begins at the end of 1990s, when the rate of adoption of GRTs stabilizes.

To undertake more detailed study of interdisciplinarity in TR in this third stage, for the period 2003-2006 we generate a smaller sample of 139 journal articles clearly representing this approach, along with a control sample of similar size representing traditional clinical research. With this data we first observe that referencing *within* the two groups is significantly more frequent compared to cross-group referencing. Far

from being homogenously adopted, TR is in fact a strategy of interdisciplinary research associated with a clear segmentation of the field of BC.

This segmentation, we submit, is fuelled by notable cognitive differences between TR and more traditional clinical research. Applying the measure of distance between scientific disciplines introduced by Porter et al. (2007) we calculate the diversity of the references cited in each focal paper (referred to as its level of Backward Integration) and of the papers citing the focal paper (its Forward Integration). In both respects the average translational paper represents integration of disciplines of much higher diversity as compared to the average clinical paper, not least due a much stronger presence of GRT elements.

On this basis, finally, we analyze what it means in the two segments to have a particularly high level of inter-disciplinarity compared to the overall median value. In traditional clinical research scientists add to cognitive integration by the application of GRTs to their area of research, reiterating the model of development characterizing the whole field since the Nineties. Reflecting the stronger role played by the more basic disciplines of molecular biology, genetics etc. we refer to this pattern as "*vertical learning*".

By contrast, the TR community develops "*horizontal learning*" processes, drawing on the way GRTs are applied across multiple domains. This learning is based on analogy and isomorphism between phenomena studied in otherwise disconnected application domains, and it is enabled by the widespread use of GRTs that offer a "connective fabric" to multiple application sites. This pattern of collective learning about the usefulness of fundamental new technologies resembles the argument on the role of "templates" suggested in the theory on General Purpose Technologies (Aghion & Howitt, 1998; Bresnahan & Trajtenberg, 1995).

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Mapping Science and Technology Structures by Keyword Co-occurrence and Citation- The case of Electrical Conducting Polymer Nanocomposite

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This study aims to quantitatively and visually understand science and technology structures of electrical conducting polymer nanocomposite by social network analysis. The structure of science is obtained by keyword based social network analysis on scientific papers, and the structure of technology is obtained by citation based social network analysis on patents.

The structure of science is obtained by integrating keyword analysis and social network analysis on scientific papers. The method proposed in this study is capable of creating three-dimensional "Research focus parallelship network" and "Keyword Co-occurrence Network", together with two-dimensional knowledge map. The networks and knowledge maps can be depicted differently by choosing different information as network actor, i.e. country, institute, paper and keyword, to reflect knowledge structures form macro, meso, to micro levels. A total of 223 highly cited papers published by 142 institutes and 26 countries are analyzed in this study. It is found that, China, US and are the two countries located at the core of knowledge structure and China is ranked No. 1. The quantitative exploration provides a way to unveil important or emerging components in scientific development, also to visualize knowledge and thus an objective evaluation on scientific research is possible for quantitative technology management.

The structure of technology is obtained by constructing and analyzing patent citation network and patent citation map. A total of 1421 patents are retrieved from USPTO patent database and patent citation network is established by combing both patent citation and social network analysis. Network properties, e.g. Degree Centrality, Betweenness Centrality, and Closeness Centrality, are calculated for representing several technology evolution mechanisms that first proposed in this study. Also, a distance-based patent citation map is constructed by calculating relative distances and positions of patents in the patent citation network. Quantitative ways of exploring technology evolution are investigated in this study to unveil important or emerging techniques as well as to demonstrate dynamics and visualization of technology evolutions

Mapping the European Higher Education Landscape. New Empirical Insights from the EUMIDA Project

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Introduction

This paper contributes to the current debate on mapping the European higher education landscape (van Vught et al. 2008; Huisman et al. 2007) by providing for the first time a complete census of all higher education institutions in the European Research Area as well as their characterisation based on a number of descriptors and statistical data. Going beyond the core of research-intensive universities as covered by most university rankings (van Raan 2007) it is critical to understand the overall structuring of higher education, the division of tasks between higher education sectors and the spread of the research and educational mission (Kyvik 2009; Lepori 2009). This work significantly extends previous work in the AQUAMETH project for the coverage of the database and the level of standardisation of the collected data (Bonaccorsi and Daraio 2007).

Method

The database has been developed in the framework of the EUMIDA project under contract of the European Commission and includes more than 2 500 institutions in 29 countries, covering more than 98% of the total number of students in tertiary education (ISCED 5 and 6 level). For these institutions, a core set of indicators has been developed which includes some basic descriptors, as well as descriptors for dimensions of classification of higher education institutions as identified in the U-MAP project (van Vught et al. 2008).

The strategy for choice of indicators gave the priority to the use of data available at the National Statistical Institutes, to get a broad coverage and to reduce data collection burden. For the purposes of data collection, a methodological handbook has been developed and discussed with EUROSTAT, which is heavily based on the Educational statistics manual, as well as on the Frascati manual (OECD 2002; OECD 2004). All data have been integrated in an Access database for easy handling and are fully annotated with metadata explaining methodological problems and departures from standard definitions.

Table 1. List of variables

Dimension	Indicators
Identifiers	• Institutional code • name of the institution
Basic institutional descriptors	• country • legal status • foundation year • current status year • university hospital • total staff
Educational activities	• number of students at ISCED 5 and ISCED 6 level • specialization in subject domains • distance education institutions • highest degree delivered
Research activities	• research active institution • number of doctorates awarded
Knowledge exchange	• no indicator yet
International attractiveness	• number of international undergraduate students • number of international doctoral students
Regional engagement	• region of establishment

Analysis

On this dataset, we will perform following analysis.

a) A broad descriptive characterisation of the European higher education system looking for example to following items and to the distribution on the whole population, as well as by country:

- age and size distribution of institutions.
- regional distribution (using NUTS2 codes).
- public vs. private institutions.

b) A characterisation of individual institutions alongside following dimensions:

- the *educational mission*, measured through the number of students, the highest degree delivered and the subject domains covered.
- the *research mission*, measured through the number of PhD degrees for 100 undergraduate students as in the Carnegie classification.
- *internationality*, as measured by the share of undergraduate students (education) and PhD students (research).

Following the literature on higher education diversity (Meek et al. 1996), we assume that there are three main dimensions explaining differences in higher education institutions, namely subject specialisation (Lepori et al. 2010), country and specific characteristics of the individual HEI (like status, age, history, size).

Besides purely descriptive analysis, the size of the dataset will allow for the use of statistical techniques to look systematically for correlations between these variables and explaining factors, as computing different types of diversity indexes across the whole sample as well as selected sub-populations (Huisman et al. 2007; Rossi 2009).

c) Identifying institutions with similar characteristics in the population. Beyond the easy identification of specific subsets of institutions – private institutions, specialised institutions, distance education institutions -, it will be possible to use clustering

techniques to group institutions with similar characteristics and to identify specific classes (see Bonaccorsi and Daraio 2009).

Some preliminary finding on system characteristics

Table 2 demonstrates a few characteristics of the European landscape by country. There is for example considerable variation in average institutional size measured by number of undergraduate students. Looking closer at institutional data reveals however that systems often are characterized by relatively few larger institutions, while the bulk often consists of smaller institutions. Further it is revealed that while public institutions is still the predominant type in most countries, there is a considerable number of private (or legally private but economically dependent on government) institutions in many countries. Especially some of the eastern countries have a large number of private institutions.

Table 2. Characteristics of national HEI landscape

	No of HEI	Avg no of underg. students	Legal status			Highest degree awarded		
			Public	Private	Private, government dependent	Diploma or Bachelor	Master or pre-Bologna equivalent	Doctorate
Austria	68	3 774	46 %	25 %	29 %		62 %	38 %
Belgium	85		51 %	22 %	27 %	8 %	68 %	24 %
Bulgaria	59	4 837	73 %	27 %		19 %	22 %	59 %
Czech Republic	73	4 851	38 %	62 %		38 %	23 %	38 %
Estonia	34	1 935	56 %	44 %		56 %	21 %	24 %
Finland	49	5 745	78 %		22 %		57 %	43 %
Germany	406	4 725	67 %	29 %	4 %	58 %	11 %	30 %
Hungary	72	5 345	42 %	58 %		51 %	20 %	30 %
Ireland	21	6 473	100 %				5 %	95 %
Italy	243	9 102	60 %	40 %		11 %	56 %	33 %
Latvia	61	1 810	61 %	39 %		46 %	21 %	33 %
Lithuania	46	5 261	61 %	39 %		57 %	11 %	33 %
Luxembourg	1	3 276	100 %					100 %
Malta	4	2 608	75 %	25 %		50 %		50 %
Netherlands	59	10 717	20 %	8 %	71 %	32 %	36 %	32 %
Norway	68	3 261	65 %	7 %	28 %	26 %	47 %	26 %
Poland	457	4 221	29 %	71 %		51 %	25 %	25 %
Portugal	138	2 592	29 %	71 %		70 %	14 %	17 %
Slovakia	33	5 958	70 %	30 %		13 %	17 %	70 %
Spain	47	23 578	100 %					100 %
Sweden	49	7 106	73 %	27 %		12 %	45 %	43 %
Switzerland	34	4 503	94 %	6 %		24 %	41 %	35 %
United Kingdom	150	11 923	99 %	1 %			12 %	88 %
Totalt	**2257**	**5 955**	**56 %**	**39 %**	**6 %**	**35 %**	**28 %**	**37 %**

Another structural feature relates to the level of education provided measured by the highest degree awarded by institutions. Overall in the European system there seems to

be a relatively equal distribution along this dimension; approximately one third of the institutions awards bachelor as the highest degree, one third master and one third the doctorate. There are however large country variations, e.g. Portugal were the majority of institutions are providing bachelor degrees. Dimensions like these will in the full paper be analysed at instuitional level together with subject mix, number of students, number doctorates awarded etc for identification of institutional patterns. For example, the share of PhD students in the student population shows large variations at national level (Figure 1) and is expected to be even larger at institutional level, thus illustrating variations in the education/research balance of the institutions.

Figure 1. PhD/doctorate students of total number of students
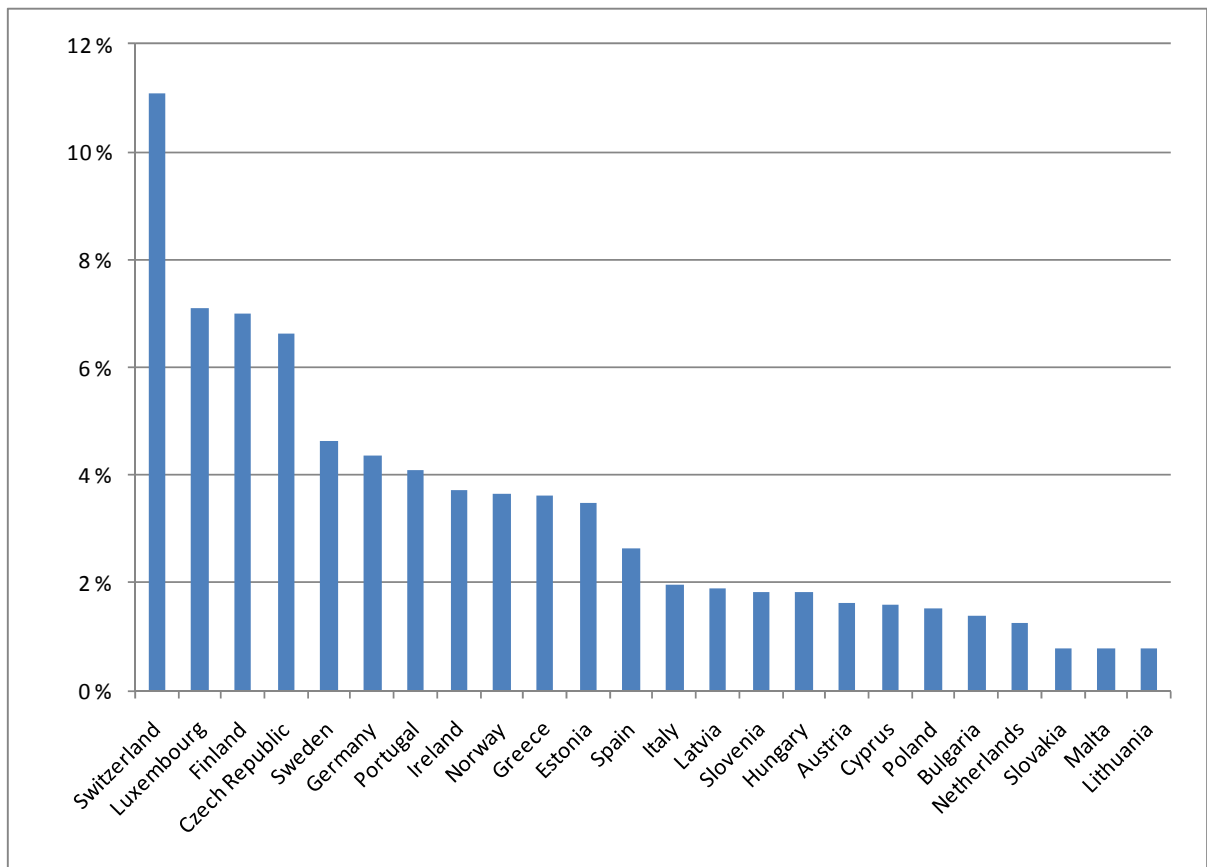
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Investigating changes in the level of inter-disciplinarity of social science between 1980 and 2000

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Background

Science policy documents have stressed the expected benefits of inter-disciplinary research (Rinia, Van Leeuwen, Bruins, Van Vuren & Van Raan, 2002) and some studies have described the recent focus of science policy of encouraging multi-disciplinary or cross-disciplinary research (e.g., Bordons, Zulueta, Romero & Barrigon, 1999; Rafols & Meyer, 2007; Moed, 2005). Schroeder (2008) suggested that research has become more inter-disciplinary. But little research has been conducted to establish the extent to which research has become more inter-disciplinary. In response, this paper presents preliminary findings on the following research question: How has the level of inter-disciplinarity of social science changed between 1980 and 2000?

Methodology

This study uses cross-disciplinary citation to gauge level of inter-disciplinarity. It evaluates the cross-disciplinary citation of the twelve SSCI (Social Science Citation Index) subject categories for which at least 1,500 articles were published in each of 1980, 1990 and 2000. As described in the Conclusions, the categories designated by Thomson-Reuters have the limitation of being coarse-grained. However, these categories are widely known and have been used, over time, in numerous studies (e.g., Porter & Chubin, 1985; Cronin & Meho, 2008).

This study uses, as its indicator of cross-disciplinary citation, the percentage of the documents citing the category that are *not* in the category. These percentages, presented in Table 1, were obtained by first, isolating all the articles in the category in the year (General Search and Refine Results), next, isolating all the documents citing the category (Create Citation Report), and finally, quantifying the number of citing documents in the category (Refine Results).

Results

The research question is investigated by comparing, for the twelve categories, the extent to which the percentage of citing documents not in the category varies with the year of publication. The findings are presented in Table 1.

Table 1: The percentage of the citing documents that are *not* in the category (years 1980, 1990 and 2000).

Category	% for 1980	% for 1990	% for 2000
Business	48.9	51.4	58.7
Economics	31.3	32.0	43.1
Education & Educational Research	43.0	41.1	50.7
Information Science & Library Science (IS&LS)	19.5	26.3	57.8
International Relations	58.2	55.2	60.9
Law	62.3	23.5	42.8
Management	52.7	49.5	55.4
Political Science	53.6	51.5	55.1
Psychiatry	48.6	46.9	53.2
Psychology	74.3	74.7	81.5
Social Sciences, Interdisciplinary	78.3	82.4	82.0
Sociology	58.5	62.0	66.9
Mean	52.4	49.7	59.0
Median	53.2	50.5	56.6

From Table 1, although the mean and median levels of cross-disciplinary citation rose between 1990 and 2000, they had both fallen between 1980 and 1990. Moreover, the lowest level of cross-disciplinary citation rose from 19.5% in 1980 to 23.5% in 1990 to 42.8% in 2000. The changes in cross-disciplinary citation also varied considerably from category to category; for articles published in 1980, 1990 and 2000, for Information Science & Library Science (IS&LS) the percentages were 19.5%, 26.3% and 57.8% and for Law the percentages were 62.3%, 23.5% and 42.8%.

Conclusions

One limitation is that that all articles of a journal are designated to the same category (or categories), and a consequence of this coarse-grained categorisation is a loss of precision in the findings. A second limitation is that the subject designation does not distinguish between articles solely in a subject and articles that are in more than one subject. Nevertheless, this study produced some interesting broad findings.

The results indicate that, on average, inter-disciplinarity, when measured by cross-disciplinary citation of social science, rose substantially between 1990 and 2000. The results also indicate that the increase in cross-disciplinary citation of IS&LS between 1990 and 2000 is over three times the average increase across the subjects. One possible factor may be changes in the set of IS&LS journals; we intend to investigate this to complete the current study. The methods can also be applied to investigate inter-disciplinarity at the article or journal level.

Acknowledgements

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Identifying research strength that is not assessed in the UK's 2008 Research Assessment Exercise: A pilot investigation

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Background

The planned UK Research Excellence Framework (REF) will explicitly assess "impact", probably using bibliometric data for some subject areas (HEFCE, 2010). This paper suggests that a simple productivity calculation can reveal information about departmental strength that was not evident in previous UK Research Assessment Exercises (RAE). Its focus is on supplementing, rather than replacing, the peer review assessment of departmental strength. This focus contrasts with several studies on the RAE that investigate the correlation between RAE rating and citation level (e.g., Oppenheim, 1995; Norris & Oppenheim, 2003).

Methods

The method used here is to calculate the average number of Social Science Citation Index (SSCI) publications per member of staff. Our intuition for using this simple indicator is that research assessment restricted to considering the top four publications per member of staff may penalise the more productive departments. This method is tested for the case study of Economics. Articles in the SSCI category of 'Economics' were identified for the staff members assessed in the RAE category of 'Economics and Econometrics'.

Results

In Table 1, 'Average RAE rating' denotes the average RAE panel rating of the assessed items; panels gave each research activity a rating of 4, 3, 2, 1 or 0 (4 the highest). In the 'Articles/Staff' quotient, 'Articles' denotes the number of SSCI Economics articles published during 2001-2007 by the staff who were evaluated at RAE 2008 and 'Staff' denotes the number of economics staff at the institution evaluated at RAE 2008. 'Percent articles' denotes the percentage of the assessed items classified as 'articles'; of these classified as 'articles', 82.1% are in the SSCI category of 'Economics'.

Table 1: Comparing the two indicators of impact with the average rating of RAE submissions.

Institution	Average RAE rating*	Articles/ Staff	Percent articles
London School of Economics and Political Science (LSE)	3.55	5.5	88.1
University College London (UCL)	3.50	5.7	81.2
University of Oxford	3.35	2.7	76.4
University of Essex	3.35	3.3	83.8
University of Warwick	3.35	3.4	87.8
Queen Mary, University of London	3.15	2.6	92.4
University of Bristol	3.15	3.4	87.7
University of Nottingham	3.15	5.1	89.4
University of Manchester	3.05	3.6	82.9
University of Cambridge	3.05	3.6	81.6
Manchester Metropolitan University	3.00	1.5	47.8
Royal Holloway, University of London	3.00	2.1	95.2
University of Glasgow	3.00	2.2	86.4
University of Edinburgh	2.95	2.4	57.4
University of Exeter	2.95	4.4	96.1
University of Kent	2.90	2.4	87.2
University of Leicester	2.90	3.9	90.5
Birkbeck College	2.85	2.8	81.5
University of Aberdeen	2.85	3.3	92.0
University of Sheffield	2.80	4.1	94.2
University of Surrey	2.80	4.1	84.5
Loughborough University	2.75	2.7	88.9
University of York	2.75	3.3	85.5
University of Birmingham	2.75	3.8	80.5
University of East Anglia	2.75	4.3	88.0
University of Stirling	2.75	5.9	100.0
University of St Andrews	2.70	1.6	78.8
University of Sussex	2.70	3.1	89.6
City University, London	2.65	1.6	85.0
Swansea University	2.65	2.8	93.8
University of Dundee	2.45	1.6	81.5
University of Southampton	2.45	2.8	70.9
London Metropolitan University	2.25	1.6	100.0
Kingston University	2.00	1.5	65.0
Brunel University	1.70	2.9	94.2
Median	2.85	3.1	87.2

* The data in this column is not precise, as the information from which it is derived is provided only to the nearest five-percent.
Data sources: RAE (2008) and Web of Knowledge online.

In Table 1, amongst the five institutions with average RAE ratings of at least 3.35, Articles/Staff ranged from 2.7 to 5.5. Surprisingly, an institution with a RAE score

below the median had the highest Articles/Staff (University of Stirling): one author, Nick Hanley, wrote 57.8% of their SSCI Economics articles.

Discussion

Some of the differences in the findings for average RAE rating and Articles/Staff can be explained on the basis of a low percentage of articles amongst the items assessed in the RAE 2008 (e.g., Manchester Metropolitan University).

The number of citations per article, for the five institutions with the highest average RAE ratings, ranged from 7.1 to 11.4 (LSE, 11.3; UCL, 11.4; Oxford, 10.9; Essex, 7.1; Warwick, 9.9). In view of this relatively small range and the fact that it does not make allowances for year of publication or for one institution that published only 7 SSCI Economics articles, we focused on Articles/Staff.

A low Articles/Staff ratio compared to RAE score could be explained by a department conducting humanities-oriented or science-oriented research and mainly publishing outside the SSCI. In contrast, a prolific academic could account for a department having a low RAE score despite a high Articles/Staff ratio. Moreover, 'Articles/Staff' is an imprecise indicator; for instance it measures only articles in the SSCI Economics category.

Conclusions

The results show that departments can be quite productive in SSCI terms, yet still be assigned a low score, suggesting that departmental research strength can be more effectively evaluated by using both the RAE rating and a productivity indicator than by using solely the RAE rating. It would be interesting to apply statistical tests to the data.

Acknowledgement

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How does the BBC report mental disorders research?

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Introduction

There appears to be no previous study of how mental disorders research is described and presented in the mass media, although there are a few reports on the stigma attached to these disorders as portrayed. In view of its increasing importance and interest to the public, particularly for Alzheimer's disease, but also various addictions, this is surprising. The study to be described was carried out for the Mental Health Research Network (Lewison, 2009), which is part of the National Institute of Health Research (of the Department of Health), and examined the BBC's website for the ten years 1999-2008. The objectives were to compare the numbers of stories on different mental disorders with their disease burden in the UK, to see what type of story was written (*e.g.*, causes, treatments) and to compare the cited research papers with the totality of mental disorders research output.

Method

Stories were sought by means of a series of individual search statements containing "research or study" with the name of some 30 mental disorders in turn. Their titles (hyperlinks), brief synopses and dates were downloaded to a spreadsheet, and the many duplicates removed. Only those (about two thirds of the total) that appeared to cite to a research paper were retained, and these were individually read and coded for subject and story type. The names and affiliations of commentators were also recorded. Nearly all the stories gave enough detail of the cited paper (author, institution, journal) for it to be identified and its full bibliographic details, including addresses, downloaded to file. For comparison purposes, the numbers of mental disorder research papers from leading countries during the study period were determined from the Web of Science by means of a special filter based on journals and title words.

Results

Over the 10-year study period, there were 1052 mental disorder research stories citing to papers. The main subject was Alzheimer's disease / dementia, followed at some distance by addiction (mainly to drugs), depression and unspecified disorders. This contrasts with the disease burden, which is much greater from depression than from dementia. Alcoholism also causes a heavier burden both in illness and to society than do drug addictions. Most of the stories concerned methods of diagnosis and the epidemiology of mental illness. Of the methods of treatment pharmaceutical drugs were overwhelmingly the most often mentioned. Three quarters of the stories had

commentators, and representatives of Alzheimer's charities were the most prominent. One third of the cited papers had a British address; this percentage was three times the UK presence in mental disorders research. US and Swedish research was also over-cited in relation to their presence, but that of Germany, Spain and Japan was almost ignored by the BBC journalists. There was also a tendency to over-cite UK research from London at the expense of that from Scotland, Wales and Northern Ireland, and to give preference to papers with specific funding, mainly from the Medical Research Council and the Wellcome Trust.

Conclusion

Unlike many media reports of mental illness, the BBC tends to be sympathetic or neutral in its portrayal of patients and the need for research. The amount of coverage is about 40% less than that given to cancer research, but there are also many stories (not analysed here) covering basic neuroscience research. As with the cancer stories (Lewison *et al,* 2008), many focus on possible means of prevention (by choice of lifestyle) and on new drugs. This may give the false impression that they are the only form of treatment available. The excessive attention given to Alzheimer's disease, with partisan commentators, may not reflect actual public concern as evidenced by data on a small sample of stories featuring research either on this disease or on depression; the latter ones received ten times as many "hits" in the first days after publication as did the former.

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Indicators of the Interdisciplinarity of Journals: Diversity, Centrality, and Citations

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Introduction

A citation-based indicator for interdisciplinarity has been missing hitherto among the set of available journal indicators despite the high policy-relevance of "interdisciplinarity" (Laudel & Origgi, 2006; Wagner *et al.*, 2010). None of the more recent additions to the set of journal indicators has focused specifically on interdisciplinarity (Zitt, 2005). Leydesdorff (2007) experimented with betweenness centrality as an indicator of interdisciplinarity in aggregated journal-journal citation networks.

Stirling (2007; cf. Rao, 1982) proposed a diversity measure as part of "a general framework for analyzing diversity in science, technology and society" (Rafols and Meyer, 2010). The indicator integrates the (in)equality in a vector with the distance metrics of the network. In this study, we compare (*i*) this indicator with (*ii*) betweenness centrality as a network indicator, and (*iii*) the Gini and probabilistic entropy as vector-based indicators of specificity/diversity for the case of journals.

Method

The analysis is based on the aggregated citation matrix among the 8,207 journals contained in the JCRs of the Science and Social Science Citation Indices 2008. This asymmetrical matrix is normalized using the cosine, both cited and citing. Euclidean distances were normalized as *relative* frequencies in order to prevent effects of differences in size causing spurious distances. Additionally, (1 – cosine) can be used as a measure of dissimilarity.

The three sets of indices—(*i*) Rao-Stirling diversity, (*ii*) matrix-based, and (*iii*) vector-based—are evaluated against one another. The structure of the set is explored using factor-analysis, and in relation to other journal indicators (e.g., the impact factor).

Results

On the citing side, one expects peripheral journals such as Chinese university journals to integrate different knowledge bases and thus to rank high on an indicator for "interdisciplinarity." On the cited side, a crucial question is how and to which extent an indicator corrects for the size effect of multidisciplinary journals such as *Science* and *Nature.*

The results based on Euclidean distances *versus* (1 – cosine) were not or negatively correlated: the diversity measure is highly sensitive to the choice of similarity

criterion. The results using Euclidean distances were difficult to interpret; the results based on (1 – cosine) were size-dependent despite the normalization implied.

Table 1: Top 10 journals in the ISI-category Library and Information Science (*N* = 61) sorted on betweenness centrality in the being-cited patterns after normalization.

	Diversity (*cosine*)	Diversity (Euclidean)	Betweenness (not-normalized)	**Betweenness (normalized)**	Gini	Entropy
J Am Soc Inf Sci Tec	33	1	1	**1**	18	8
Scientometrics	48	9	2	**2**	33	24
Int J Geogr Inf Sci	2	32	4	**3**	17	5
MIS Quart	10	38	3	**4**	3	1
Inform Manage-Amster	5	28	6	**5**	8	3
J Am Med Inform Assn	4	51	7	**6**	22	4
J Manage Inform Syst	13	35	8	**7**	5	2
Inform Process Manag	31	4	5	**8**	19	9
J Inf Sci	41	6	11	**9**	28	16
Soc Sci Comput Rev	7	24	12	**10**	26	13
(…)	…	…	…	**…**	…	…
J Informetr	51	40	48	**51**	49	51

The top 10 journals in the ISI-category Library and Information Science (*N* = 61) are listed in Table 1 sorted on betweenness centrality in the being-cited patterns after normalization. We added the *Journal of Informetrics* as a lower-ranked journal. With the exception of diversity measured on the basis of (normalized) Euclidean distances, all other indicators rank this journal between 48 and 51 on a list of 61. The journal therefore is ranked as disciplinary, and is in this respect very different from *JASIST* or *Scientometrics*.

Conclusion

The factor analysis teaches us that betweenness centrality and Rao-Stirling diversity indicate different aspects of interdisciplinarity (Wagner *et al.*, 2010). The Gini coefficient does not qualify as an indicator of interdisciplinarity since the latter is not just the opposite of (disciplinary) specificity. Although sensitive to size, the journals top-ranked by the entropy measure are recognizable as intuitively the most interdisciplinary among the journals. An algorithm that would weigh the cosine values as a basis for the computation of betweenness centrality would perhaps improve our capacity to indicate interdisciplinarity (Brandes, 2001).

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The Framework of Indicators Formation of S&T Programs: The case in Taiwan[3]

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Introduction

The more S&T budgets government agencies allocate, the more important S&T evaluation government agencies emphasize on, such as the United States, Japan, Korea, United Kingdom, etc. Government agencies in Taiwan, National Science Council, Industrial Development Bureau, Ministry of Economic Affairs, etc., also make S&T related evaluation standards to claim that most agencies who submitted S&T programs proposals must follow these standards. That is, these agencies need to write four-years plans of S&T programs to explain their strategic directions. These strategic plans will show how they form programs' goals and make reasonable indicators, so as to respond to initial resources allocation. But S&T programs' reviewers in Taiwan also found that government agencies are hard to define their programs' outputs, even emphasize on their prominent outcomes and form these measurable indicators. Therefore, in order to assist government agencies' S&T programs effectively form their programs' goals, make performance indicators, and monitor their outputs & outcomes, the paper mainly develop the content of S&T programs through systematically combining the concepts and methods of strategic planning, so as to logically connect problems' identification with measurable indicators' development. And the paper have three purposes: (1) to emphasize on the importance of "ex ante evaluation" in S&T programs' proposal writing; (2) to derive the ex ante evaluation experiences of countries worldwide as a reference of S&T programs' proposal writing in Taiwan; (3) to combine some programs' planning tools, Fishbone diagram, SWOT analysis, with Logical framework approach (LFA), and demonstrate the example of Council of Agriculture's S&T program. The paper hopes to provide the references of writing S&T programs' proposals for Taiwan government agencies in the future.

Method

In order to strengthen the structures and present the kind of logical relationship of S&T programs' proposals or plans, the paper mainly combines LFA model, Fishbone diagram, and SWOT analysis to show the effectiveness and efficiency of government agencies' strategic thinking and planning presented in S&T programs' proposals or plans. According to the requested standards and formats of S&T programs, some

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information produced by the "combinative approach" will be summarized in each section of the requested formats, illustrated in figure 1. Program related stakeholders are involved in the whole process. Differenced with the "combinative approach", figure 2 shows the "traditional approach." The approach is not systematic. No matter which problems government want to solve or goals/objectives they hope to achieve, programs' contents are always generalized from several documents, S&T policy, foreign trends, statistics, research projects, etc., The traditional process is done by program promoter himself. Therefore, the improved model will hope : (1) to collect stakeholders' opinions and assistant to achieve the consensus of stakeholders through the combination; (2) to use the resource-based SWOT analysis to improve the choices of strategies; (3) to emphasize on the top-down mechanism in Taiwan S&T environment. Therefore, by using the combinative approach to demonstrate Council of Agriculture's S&T program, the main contribution is to emphasize the importance of "ex-ante evaluation" concept in Taiwan government, and provide them with "new thinking" of logically forming some "new" measurable indicators from the developing process of the unspecific problems, the concrete goals, the priority of the strategies, and the action plans.

Fig. 1 S&T Program Format—Combinative Approach

Traditional approach

Taiwan S&T Program Format

BOTTOM-UP MECHANISM

Program promoter

Foreign Trends

Policy Documents

Research Projects

Related Statistics

1.Program goals & objectives

2.SWOT analysis

3.Expected outcome & KPI identification
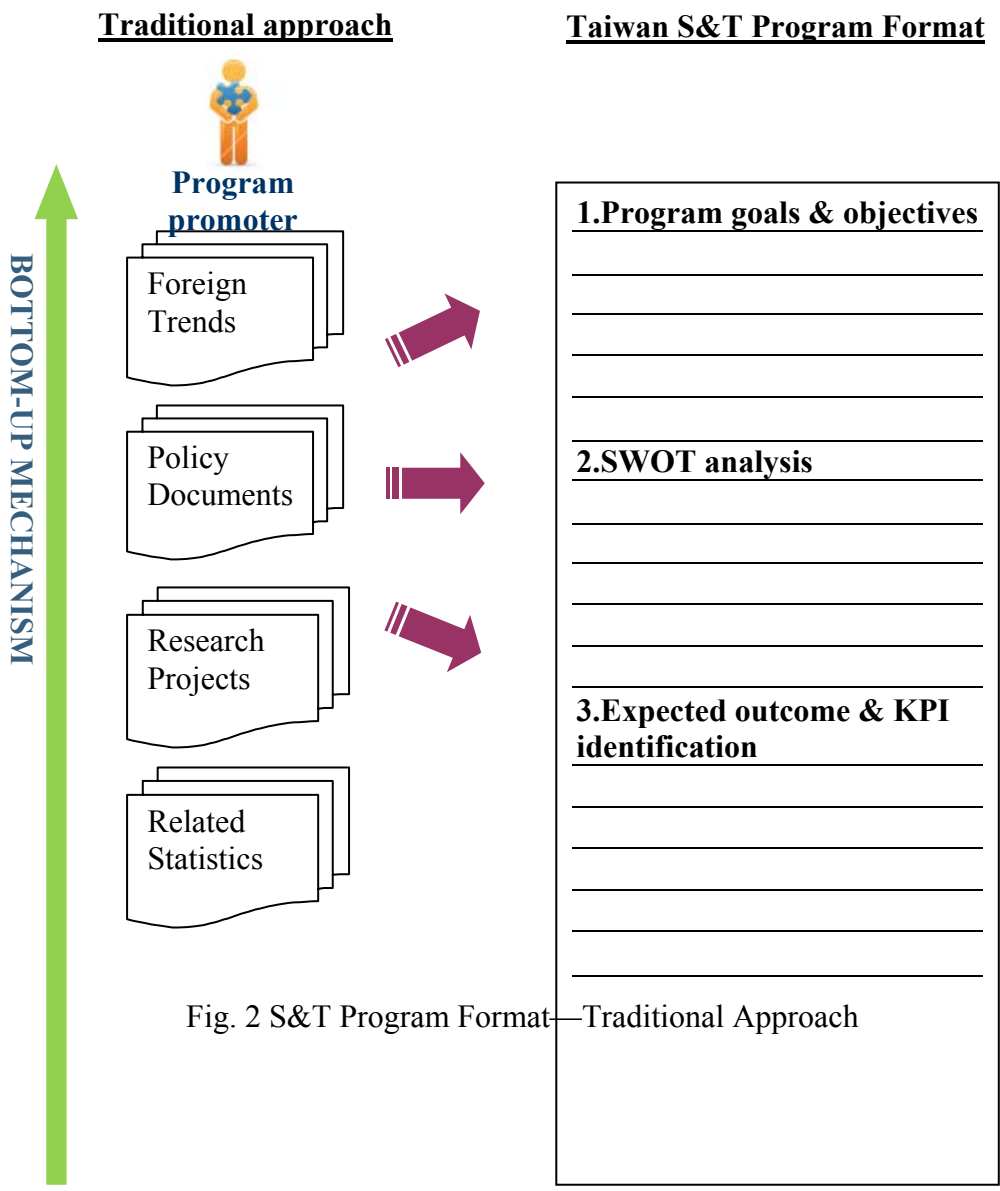
Fig. 2 S&T Program Format—Traditional Approach

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A bibliometric analysis of the history of the International Conference on Science and Technology Indicators 1988–2008

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Introduction

Over the last twenty five years with the emergence of the knowledge based economy bibliometrics has begun to flourish into a well established research field with a strong management and policy significance. A bibliometric analysis of the proceedings of the ten editions of the International Conference on Science and Technology Indicators so far, hereinafter called the STI Conferences, reveals important characteristics of this process. Particularly at the eve of a 'merger' with the ENID meetings it is interesting to evaluate the achievements of more than 20 years of the STI Conferences.

Method

The bibliographic data of the oral presentations at the STI Conferences were collected from the books of abstracts. The presentations were assigned to institutes and countries according to the addresses in the corresponding extended abstracts (Clausen & Wormell, 2001).
To investigate the stability of the research community participating in the different STI Conferences a survival analysis was performed (Visser, Luwel, & Moed, 2007). The extended abstracts of the oral presentations at the 2002, 2004, 2006, and 2008 editions were used to construct bibliometric maps showing relations between important terms in the abstract as well as relations between authors (Van Eck & Waltman, in press).
Finally for all STI Conferences, we identified the articles based on the oral presentations and published in journals covered by the Web of Science. The oral presentations were classified into three groups: published in a dedicated special issue of a journal, published otherwise, and not published.

Results

The books of abstracts contain a total of 560 contributions of the oral presentations. The number of abstracts remained fairly constant around 35 in the 1990's editions and rose in the more recent editions attaining 74 in 2008.
492 authors contributed to the extended abstracts. The distribution of abstracts per author is highly skewed with 74% of the authors having only one abstract. The two most prolific authors have 18 and 19 abstracts. An abstract's average number of authors is fairly constant around 2.2. The survival analysis shows that the percentage of an edition's authors contributing to the next edition fluctuates between 20 and 40%. The number of countries in the authors' institutional addresses increased by 40% to around 25 for the most recent editions. The Netherlands has the largest number of oral presentations (16%), followed by France and Germany. The number of internationally co-authored oral presentations increased to 20% for the more recent editions. The Relative Attractivity Index (Glänzel, Schlemmer, Schubert, & Thijs, 2006) shows that from the organizing countries the UK, followed by Germany and the Netherlands,

attracts the smallest number of oral presentations relative to what it contributes abroad.

The bibliometric mapping analysis shows the current structure of the field (see http://www.vosviewer.com/maps/sti2010b/). The important terms used in the extended abstracts group into three clusters: research performance evaluation and indicators; science mapping and classification; and science policy and innovation. Figure 1 shows the relations between contributing authors based on coupling by common terms.

Conclusions

As one of the most important scientific meetings on bibliometrics, the STI Conferences show the growth of the discipline and especially over de last ten years its internationalisation. However the fraction of internationally co-authored presentations is rather low. Next to performance evaluation studies and indicators, mapping studies and patent-based innovation studies have become important conference topics during the last ten years.

Some of the techniques used and results found in this study are useful to structure the next editions of the STI Conference and to position it in relation to other conferences. Comparisons with other conferences are needed to highlight its special character and added value.
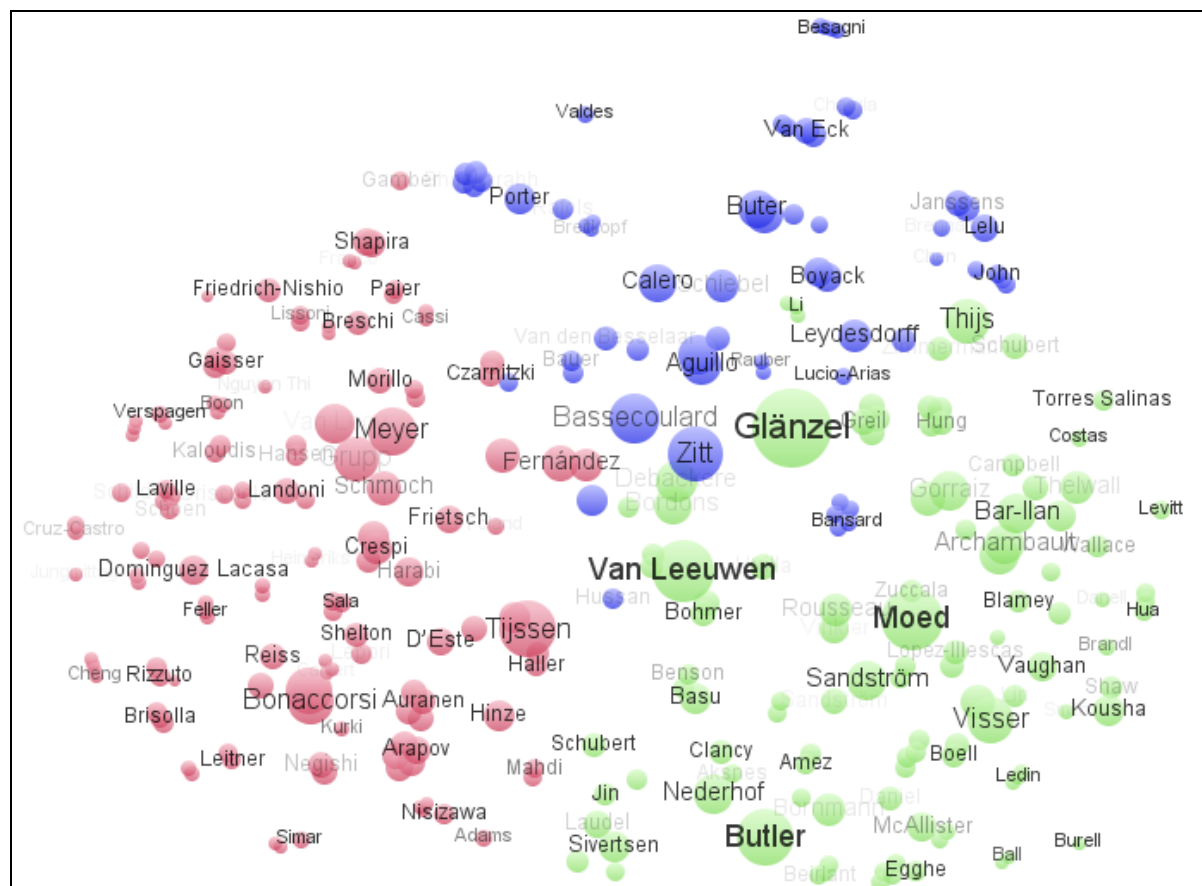
Figure 1. Author map based on coupling by common terms in the authors' extended abstracts.

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Bibliometric Indicators and their Impact on Russian University Rankings

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Introduction

Globalization has a significant impact on higher education. We observe an increased competition between universities for the most promising students and highly qualified faculty, nationally and internationally. The Russian higher education system went through a notable transformation after the collapse of the Soviet Union. Universities were mainly involved in teaching and played an insignificant role in research, with the exception of Moscow State University and St. Petersburg State Universities.
Student numbers have grown significantly from 2.7 million in 1992 to 6.8 million in 2006, in spite of the fact that students increasingly have to pay for higher education. Our previous research showed increasing involvement of non-metropolitan universities (NMU) in basic research. Several initiatives to boost research in NMU were announced recently.
Our analysis was focused on research activity in non-metropolitan research activities in the periods 2004-2006 and 2007-2009 and provides an overview of Russia's position in global university rankings in 2009.

Methodology

To obtain the knowledge on research activity in provinces, we based our analyses on grants supported in 1997-2008 by the Russian Foundation for Basic research (RFBR). The WOS option "research analysis" was used to collect statistics on NMU research output and funding agencies. We also analysed various global rankings including those from British-QS-THES, Shanghai, Taiwan, combined with statistics from the Science Citation Index, Essential Science Indicators (ESI).

The following indicators were used for evaluation:
- Distribution of grants by field of science
- Total number of grants for each university
- Number of researchers who awarded a grant in each region
- Demographic statistics (age, gender)
- Research output for top ten by number of grants
- International collaborative output (CO) by each university, region and country

The top ten of NMU by number of grants were analyzed by field of science, research performance, international and domestic collaboration, and funding agencies.

Discussion

The number of grants increased from 381 in 1997 to 1318 in 2008. In all NMU mathematics and physics are the strongest fields; a few are active in life sciences due to the Russian-American joint programs to fight bioterrorism. The research output for 2004-2006 and 2007-2009 was fairly stable, except for the growth of 25% at the Novosibirsk State University (NSU) and 15% at the Voronezh State University. The Russian Academy of Sciences is the main domestic partner; its share varies from 25% (Saratov State University) up to 70% (NSU). We observed a growing collaboration between universities situated in the same city or in the proximity. An analysis of age distributions shows that the more active researchers are leaving the universities, mostly to other economic sectors with higher wages. The correlation between number of grants, research performance and collaboration (domestic as well as international) will be investigated using Pearson's theory of correlation.

There are two main international partners - Germany and USA. However the share of NMU international collaboration is much lower than in the whole RFBR grantees' pool. Recently China became more active in the Siberia area. Using a new WOS option "funding agencies" we found that many collaborative papers in 2009 were supported due to joint programs of the RFBR with various German agencies, the National Science foundation (USA), or the National Institutes of Health. We present a detailed analysis of international collaboration in a full paper.

In the foreign rankings four Russian Universities are among the top 500: Moscow, St. Petersburg, Novosibirsk and Tomsk State Universities. The low scores of (in total 354) non-metropolitan universities are an inheritance from the Soviet research system. Only six non-metropolitan universities were able to publish papers in "Nature" and "Science" in 2000-2008 and are included in ESI for 1998-2008.

Conclusions

Government policy to encourage basic research in non-metropolitan universities had a positive impact. However, focus is needed on stimulating young researchers to stay with the university (housing, higher salary) instead of moving into other sectors.

Participation of Russian universities in global rankings requires encouragement from science policy and monitoring of faculty's publication activity and their global impact. Up-to-date university websites and a unified English spelling of institutional names are essential.

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Potential of Russian Research Personnel in Nanotechnology

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Introduction

The dissolution of the former Soviet Union greatly impacted the Russian science community. Research personnel were reduced by a factor of three to 302.8 thousand in 2007. The model of Russian science remained unchanged: the main research body is still the Russian Academy of Sciences (RAS) with its 150 research institutes.
The initiative "Strategy of nanotechnology development", adopted as a priority program in 2007, supports President D. Medvedev's wish to transform Russia into an knowledge-based society.
This paper discusses the results of an empirical study regarding the present personnel in nanotechnology and draws some conclusions about future staff in nanotechnology research.

Methodology

We performed a search in Web of Science (WOS) using the following key words: nanoparticles or nanosized particle; fullerene*; quantum dot*; nanotube*; dendrimer*., excluded terms: nano-gramm, nanosecond etc. A total of 256,000 records (articles, reviews and etc) with address "Russia" were downloaded and analyzed. Statistics on grantees in nano research was derived from the national database of the Russian Foundation for Basic Research (RFBR). Variables used for analysis included: number of research grants; demographic statistics and qualification skill, professional rank, year of obtaining degree (PhD or Dr.Sci.; Russia follows the German system of advanced degrees: first the Ph.D.; subsequently Dr.Sci. for more advanced achievements), occupation; research output; citation score.

Findings

For both the periods 1990-1999 and 2000-2008 Russia was among the top ten most productive countries in nano research. Russia's share in research output reached a maximum in 1997 (8.1%), then declined (3.7% in 2008). Twelve Russian researchers (mainly from Nobel price winner Z.Alferov's school) were among the 100 most productive authors in 1997. In 2008 no Russians were among 250 most productive authors.
It is well known that Russian publications' citation score per paper are low; Russia is in 38th place concerning the average number of citation per paper on nano. Our analysis showed that Russian papers in the top ten international journals on nano were cited 23.11 times on average compared to an average citation score of 30.35 for all ten

journals. During 2006-2008 107 researchers published more than ten papers; their average age was 50.9.

We observed a significant growth of nano-projects; 8.7 thousands individuals participated. The list of leading research organizations will be included in a full paper. We found no significant difference in the average age (43.5) among the whole pool of RFBR grantees and those involved in nano research. However, there are geographical differences - the youngest nano researchers work in Tatarstan (average age 39.5). For 2008 we found 2.3 thousand new nano grantees, 51.1% of which had a scientific degree. Half of these PhD grantees is young enough to contribute during the next 20 years. Even more interesting considering future research is the group of grantees which did not yet obtain their degree. From the labor market perspective we assume that monitoring a group of "new comers" among the grantees in 2008 could provide powerful predictive indicators.

In 2008 the High Qualification Committee of the Russian Federation introduced a new specialty 'nanoscience and nanotechnology' for obtaining a PhD or Dr.Sci. It should attract a flow of new researchers in this area. Considering the substantial amount of money the Russian government is investing in nano research, quality control is essential. During the last five years, the second-generation share of Russian publications of nano was only 2.1%.

Conclusions

Russian nanotechnology research has become less influential over the last decade. We identified a cohort of grantees on nano technology with the potential to be productive the next 20 years. We plan to monitor a group of these young researchers in order to provide essential data for policy makers on nanotechnology.

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Women involvement in scientific journals: editorial boards and authorship

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Introduction

In most of the countries, the progress obtained by women in higher education or science and technology is not reflected in their presence in high responsibility positions and decision making bodies such as scientific committees and editorial boards (She Figures, 2009). Editorial boards of scientific journals play a crucial role in science, since their members decide what deserves to be published and may influence research trends in their disciplines (Braun, 2004). This study, financed by the Institute of Woman in Spain, aims at analyzing the presence of women in editorial boards of high quality Spanish research journals covered by the Web of Science as well as their contribution as authors to the production and diffusion of knowledge in the respective journals.

In Spain, the application of the Law for the Effective Equality between Women and Men (3/2007) seeks to advance towards gender equality and to guarantee the parity in all levels of science and in decision making. The present research establishes mechanisms for collecting journal-related gender disaggregated statistics, which will contribute to the better knowledge of the participation of women in research, and may support decisions of the Spanish government oriented towards gender parity in science.

Method

This study focuses on the analysis of 21 journals edited in Spain and covered by the Web of Science database concerning three different areas: social sciences, chemistry and mathematics.

Three main aspects are studied for each of the areas:
a) Editorial boards: male and female presence in the editorial boards of the Spanish research journals; b) Authorship: male and female presence as authors of documents and inter-gender differences in collaboration habits. The percentage distribution of male, female and cross-gender documents as well as the percentage of male and female authors is studied; c)Comparison of the Spanish journals with top-tier international journals in their corresponding fields. Time trends from 1998 to 2008 are analysed. Differences by disciplines within each area are explored. Inter-gender differences are analysed with SPSS.

Results

A total of 7, 800 documents are being studied. In April 2010, the area of Social Sciences has been fully analysed while only preliminary data of the other areas are

available. Concerning Social Sciences, the percentage of women in the editorial boards of journals shows an upward trend from 19% in 1998 to 24% in 2008. In the eleven-year period 39% of the authors were women; and they increased from 29% to 41% over the years. Documents signed only by men (50%) predominate over cross-gender (21%) and only female documents (29%), but the percentage of only male documents tended to decrease across years while cross-gender documents rose from 18% to 40%.

Discussion

Differences between women's representation on editorial boards and authors of documents will be discussed and compared with the percentage of female researchers in academy in each of the three areas under analysis. Differences by disciplines and journals will be pointed out. Data obtained for Spanish journals are being compared with international ones of high prestige. Main difficulties in obtaining sex-disaggregated indicators will be described and recommendations for authors and journals will be drawn from the study.

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Societal quality: knowledge dissemination and use of health research

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Introduction

The last decade evaluation of health research pays more and more attention to societal use and benefits of research in addition to scientific quality, and thus health research has a dual mission, a scientific and a societal one, the latter referring to the mutual beneficial interactions between scientific and societal systems.

A first attempt on how to assess and compare scientific and societal quality of (health) research within one integrated framework has been put into practice in a pilot study within the Leiden University Medical Center (LUMC) in 2007. The pilot study fits the objective of the Executive Board to make the societal profile of the LUMC explicit in accordance to its mission statement. The framework is based on the concept of communication, and the quality and quantity of the communication to and interaction with (i.e. outreach) with relevant target sectors. As societal sectors (or stakeholders) we distinguish the general public, healthcare professionals and the private sector

Method

The pilot study consisted of a thorough, guided and semi-structured inventory among 43 departments to deliver societal outreach data, such as numbers of specified talks, meetings, lay publications, patents, guidelines, advisory committees etc). Subsequently, all data was lumped into 23 indicator categories. Per indicator category an adjustable weighing factor was introduced in order to differentiate between the importance of the chosen indicators. Finally, the societal quality of the outreach of the departments was quantified. Quantification essentially included: 1. Indicator occurrences; 2. Defining relative weighing scores; 3. societal quality per indicator; 4. Societal quality per target sector and total societal quality (the average of the three sectoral societal quality scores). Society quality scores were then plotted against scientific quality scores (CWTS).

Results

The response rate was 19/43 (45%) of the departments, representing approximately 60% of the LUMC research population. The robustness of the quantification system increases because the weight of all indicators is related to the number of occurrences as well as a ranking of all indicators. Because of the weighing of indicators, the method can also be adjusted to the objectives of the research group. It should be noted that in the quantification process, the size of a research group is not included.

The 19 LUMC departments show great variation in societal quality, both between sectors and in total (see Figure 1). When comparing the total societal quality of each of the 19 departments to its scientific quality scores, it is shown that the correlation between the two is weak. This suggests that high scientific quality of research groups is not necessarily related to communication with society. Therefore societal quality is not simply the consequence of high scientific quality, and requires additional activities.

Conclusions

The methodology for societal ex-post evaluation on research group level is still in an early stage. Follow up research is needed to reduce the extensive set of indicators used in this pilot study to an internationally accepted and less laborious set, which allows for automation of data collection. The discussion on metrics and indicators typical for a quantitative approach conceals the fact that this method may involve a qualitative phase as well (e.g feedback to the research groups. We seek to maintain a balanced approach.

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Measuring and Analyzing National Innovation System Functions and Indicators:
A Comparative Model and Lessons for IRAN

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Introduction

Based on the Lundvall definition, NIS is consists of the elements and relationships which interact in the production, diffusion and use of new, and economically useful knowledge . . . (Lundvall 1992). But a main question in this regard is: How we can define different elements of NIS that suitable for policy analysis? Based on the literature, we can use two different approaches for defining different elements of NIS. The first approach uses actors and interaction between actors as main elements of NIS. But in the second approach the concentration is on functions or activities of NIS rather than the actors. The functions approach to innovation systems implies a focus on the dynamics of what is actually "achieved" in the system rather than on the dynamics in terms of structural components only. This is, indeed, its main benefit: It allows us to separate structure from content and to formulate both policy goals and policy problems in functional terms (Bergek et al. 2005 & 2008). There are three reasons for adopting the functions approach (Hekkert et al. 2007): First, this perspective makes comparison in terms of performance between innovation systems with different institutional set-ups more feasible. Second, the functions perspective permits a more systematic method of mapping determinants of innovation. Third, the functions perspective has potential to deliver a clear set of policy targets as well as instruments to meet these targets. There are a few researches about functional approach of NIS, like: Galli and Teubal (1997); Johnson (1998); Bergek et al. (2005, 2008; Edquist (2004, 2006, 2008); Ørstavik (1997), chang & shih (2004); Hekkert et al. (2007, 2009). There are also different approaches for measurement and comparison of national innovation & technology capabilities based on different indicators, like: UNIDO (2001), Archibugi & Coco (2004, 2005), World Bank (2006), Godinho (2003, 2006), European commission 2006, Nasierowski & Arcelus (1999 & 2003), Niosi (2002).

In this paper the functional approach used because of some reasons: first, this approach is more useful for policy analysis; second, this approach is more useful for international comparison of different NISs; third, this approach is in early phases of its development and has opportunities for more general developments.

Method

The main question in this research is: How we can define an overall model that represents different elements (functions) of NIS to evaluate Iran National innovation system and compare it with other countries? We developed a conceptual model based on 6 functions of NIS: Function 1) Policy, regulation and institutional development;

Function 2) Financial Resources for Innovation; Function 3) Developing Human Capital; Function 4) Knowledge Creation & Development; Function 5) Knowledge Transfer and Diffusion; Function 6) Entrepreneurship and Utilization of Innovation. In each function, We used several indicators for measuring & analyzing NIS in different countries and comparing them with Iran. In this conceptual model, We also used some indicators as contextual factors of NIS, like: Development status of a country, size of country, geographical location of country. Therefore, the main arguments in this research are: 1) We can analyze the development of NIS in each country, by clustering all countries with regard to their performances in NIS functions; 2) Cluster position of each country correlated to their contextual factors (Development status, size, geographical location); 3) In each cluster, the importance & interrelationships of NIS functions are different; 4) By analyzing Iran cluster position and its contextual factors, we can propose a development path for Iran NIS. Based on this conceptual model, We gathered data of 32 indicators (of all 6 functions), for a large number of developing & developed countries and from different regions (more than 80 countries). The main international databases that We used are: World Bank; UNESCO, WEF, UNCTAD, WITS, HF, Doing Business.

The model Validated based on some interviews with policy analysts in Iran and also by comparing the results with other empirical models. We used cluster analysis and correlation & regression analysis for analyzing different NISs and determining Iran NIS cluster position for comparing to similar countries. Based on these analyses, some preliminary results about strengths and weaknesses of Iran NIS functions are extracted and also some policy recommendations extracted for developing Iran NIS based on its contextual factors like size, development status and geographical location. The importance and interactions of different functions are also determined based on cluster analysis.

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From global village to safari research

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Introduction

Several authors (Boshoff, Binka, Dahdough-Guebas, Jentsch, Mir) have raised such issues as „*knowledge imperialism", „neo-colonial science", „safari research", „North–South research collaborations".* The objective of this paper is to examine to which extent the countries which were incorporated to Soviet Union have been involved in research which has been performed about their countries since 1990s.

Methods

We used Thomson Reuters WoS (SCI, SSCI, A&HI) data for gathering information about target countries: Estonia, Latvia, Lithuania, Moldova, Ukraine, Belarus (Byelarus, Byelorus, Belorus), Kazakhstan and Uzbekistan. Searches were made by subjects for the years 1990, 2000, and 2009, only articles were selected.
In order to analyse results by science category, we classified all articles according to the Estonian Research Information System classification (www.etis.ee):

- Biosciences. Environment (BIO)
- Natural Sciences. Engineering (NAT)
- Health (HEALTH)
- Culture. Society (CULT).

Co-authorship relations were grouped into three categories – collaboration inside target country, collaboration with target country, collaboration without target country.

Findings

In total 2227 articles were published (in 1990 – 83 articles, in 2000 – 630 articles, and in 2009 – 1514 articles).

Table 1. The number of articles published in 1990, 2000 and 2009 on the subjects of Estonia, Latvia, Lithuania, Moldova, Ukraine, Belarus, Kazakhstan, and Uzbekistan (WoS)

Country Year	Total 1990	Home	Foreign	Joint	Total 2000	Home	Foreign	Joint	Total 2009	Home	Foreign	Joint
EE	12	5	6	1	126	46	50	30	309	135	112	57
BY	0	0	0	0	63	20	26	17	94	21	48	19
KZ	30	10	20	0	96	6	81	9	138	4	104	19
LT	8	0	6	2	71	13	36	21	315	175	74	57
LV	6	0	6	0	39	3	27	9	129	18	82	25
MD	2	1	1	0	8	0	7	1	34	0	26	6
UA	20	15	4	1	198	39	115	30	405	104	177	50
UZ	5	1	4	0	29	1	23	5	90	4	58	24
Total	**83**	**32**	**47**	**4**	**630**	**128**	**365**	**122**	**1514**	**461**	**681**	**257**

As we see from Table 1, target countries were not attractive subjects in 1990. The majority of articles were published by authors either inside target country or by scientists outside the country. The number of articles increased by a quarter in the subsequent years. At the same time the proportion of articles by co-authorship categories has not changed so dramatically during the years (Chart 1). Comparing data of 2000 and 2009, we can see that the proportion of jointly published articles has stayed more or less on the same level, co-authorship inside country has increased significantly in all science categories. The latter is mostly caused by the addition of a number of national journals in the WoS list (ten Lithuanian journals contain 58 articles on this subject, the authors of 50 of them were from Lithuania; eight Estonian journals contain 35 articles on this subject, the authors of 26 of them were from Estonia; three Ukrainian journals contain 114 articles on this subject, the authors of all of them were from Ukraine). This trend raises several questions; one of them is the capability of editorial boards to make their journals actually international.

Chart 1. The proportion of articles by year, co-authorship and science categories.
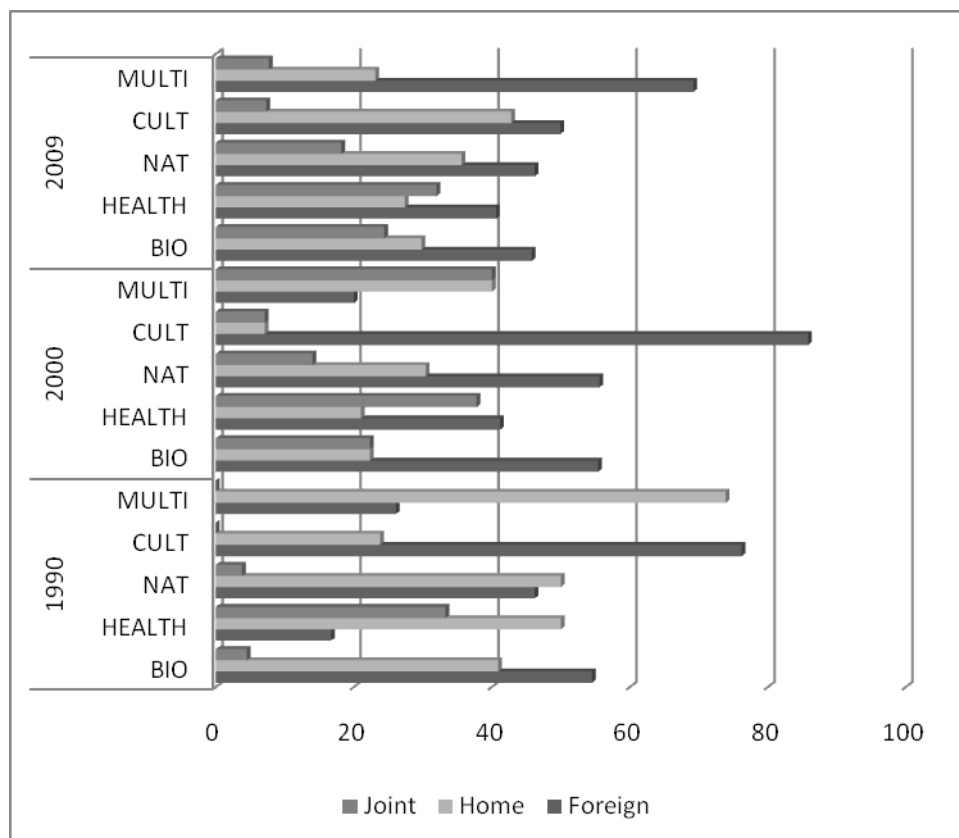
During the whole period, articles published without the involvement of researchers from targeted countries constituted the highest proportion of the selection. Central Asian countries – Uzbekistan and Kazakhstan – are considerably different from others. Most articles published without local researchers belonged to natural sciences.

This may be partly related to the geo-strategic significance of the region's oil, gas and other mineral resources (just a couple of examples from the titles: *Prospects of export routes for Kashagan oil; Gold in the weathering crust at the Suzdal' deposit (Kazakhstan); The Trans-Caspian energy route: Cronyism, competition and cooperation in Kazakh oil export).* The majority of authors were from Russia and also from the U.S.A.

In the area of political sciences it was evident that neighbouring countries expect to be experts also on their neighbouring area (some examples: *Moldova's "Twitter Revolutions"* – authors from Germany and Romania; *A Close Encounter of the Worst Kind? The Logic of Situated Actors and the Statue Crisis Between Estonia and Russia* – author from Finland*; Motor of Europeanisation NATO and Ukraine* – author from Germany).

Conclusions

- During the years under review, articles were predominantly published without the involvement of authors from the target country. Continuation of this practice may cause difficulties for the future of free scientific collaboration, especially in geo-politically sensitive regions.

- With the addition of national journals to the WoS the proportion of jointly published articles decreased. This trend raises the question of the capability of editorial boards to make their journals actually international.

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Funding Effects or Selection Effects?
How to measure the Outcome of Funding Programs for Young Scientists

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Introduction

In evaluations of funding programs for young scientists comparisons of publication performance between funded and not funded applicants are common. The 'success' of the funding program or the 'validity' of the selection process is assumed as proven when funded applicants show higher values of h-indices, citations per publication (CPP), Journal Impact factors (JIF), etc. than rejected applicants. But in most cases no conceptual distinction is made between funding effects and selection effects. As long as the review and selection process of the funding program itself is under scrutiny, and publication performance *before* the funding decision is compared, that lack of conceptual distinction seems to be no problem. But when the applicants' performance *during/after* the funding period is used as an indicator for the predictive validity of reviewer judgments, the two effects might get mixed up. Furthermore for the measurement of funding effects, the objectives of the program under study as well as its implications for the grantees have to be taken into account. Against this background, relying on bibliometric (standard) indicators alone shows to be insufficient and other/additional indicators have to be considered.

Method

In the present work we introduce our approach of measuring and differentiating between funding and selection effects on the basis of bibliometric data of applicants in the fields of medicine (n = 131) and biology (n = 85) of the Emmy Noether-Program (ENP). The ENP was set up by the German Research Foundation (DFG) in order to prepare young scientists for a professorship by giving them the opportunity of leading a research group at an early stage of their career.

In a first step we operationalized the objectives of the funding program by "customized" indicators beyond bibliometric standard indicators (citation rate, publications, etc.). One of those indicators is constructed as follows: In the fields of medicine and biology the position of an author's name in the list of authors provides information about his role or contribution regarding a given publication. The last position in the list of authors usually indicates the research group leader. Therefore, when funded applicants become research group leaders, their names should appear on the last position of the author list during/after the funding period more often.

We found that in the period before funding decision just two out of 85 applicants in biology (one funded and one not funded) show at least one publication (article with more than three authors) with "last-authorship". During the period after the funding decision (up to four years), 21 out of 53 funded applicants (39.6%) show at least one "last-authorship" in contrast to just 5 out of 32 not funded applicants (15.6%). This indicates a clear funding effect – at least on an aggregate (group) level which is our focal point. However, the question arises why 60.4% of the grantees do not show any last-authorship, especially as grantees 'independence' is a crucial intention of the ENP.

In contrast to the occurrence of last-authorship in the grantees' group, the development of the citation rate turns out to be quite unaffected by a positive funding decision (Figure 1). In the group of funded as well as not funded applicants there are "winners" and "losers". A possible explanation is that "high" bibliometric performance in the period before funding decision can hardly be exceeded. Furthermore funding by the ENP requires the formation of a new research group in a new institution and often in a new research field. This can even induce a transitional decline of the publication performance.

In a next step we conduct multivariate analyses. In this analyses we try to identify subgroups of applicants showing specific 'development patterns'. The hypothesis is that 'being funded' *allows* for specific (desired) development patterns but does not *cause* them. The subgroup of funded applicants showing these patterns could provide useful information for the improvement of funding conditions and selection processes.
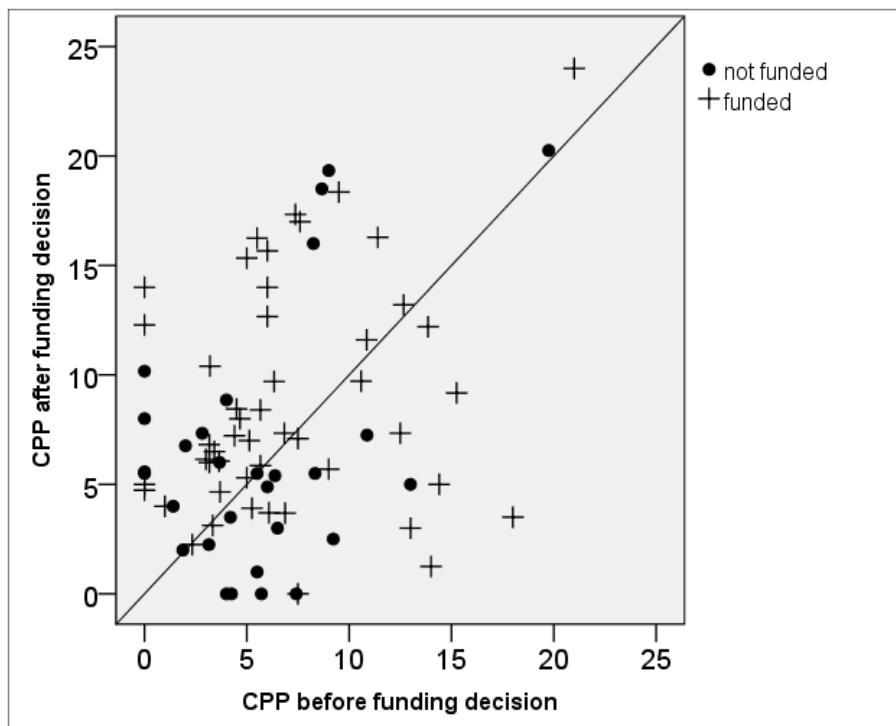
Figure 1. Citation rate of applicants of the ENP before and after funding decision. Extreme values/outliers are not displayed. Citation window: publication year plus two subsequent years. Research field: Biology.

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Patents and the competitive advantage of firms – an analysis based on stock market data

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Introduction

The value and the competitive advantage of companies depend on a large number of different factors. One of these factors, which is especially emphasized by economic innovation research, is a firms' innovative capability. In this context, the present article examines the question, if and inhowfar intellectual property rights - which can be seen as an output measure of innovation - influence a companies success represented by its (stock) market value.

The basic underlying assumption is that increased innovative capability leads to competitive advantage, as new or further developed products can be a key to open new markets or increase market share, and new processes often result in the reduction of costs. In this sense, innovative capability and its display serve as a differentiating factor in the innovation process.
The following article systematically analyzes the question, inhowfar the results of R&D and its protection – or so to say, the technology base of a firm - can influence its market value. According to the theoretical assumptions it is hypothesized, that large and highly valuable patent-portfolios of firms have significant effects on their competitiveness in the long run.

Method

For the empirical testing a panel dataset including 479 firms from 1992 to 2006 based on the DTI Scoreboard is used, that contains data on R&D expenditures, market capitalization, turnover etc. and structural information like firm-size and industry sector. To this database the relevant informations on patenting behavior and stock market prices are added so correlations with firm characteristics can be calculated.

Hereby, the analysis is based on patent portfolios of firms not on stand-alone patents, which accounts for the fact that technological products rarely are stand-alone products but depend on other previous technologies. Therefore patents are often components of larger systems - which could be described as patent clusters or patent architectures - that can lead to to increasing returns through positive feedback effects at the product markets.

To assess the value of a firms' patent portfolio different quality measures like the number of received patent citations are being applied. To test the hypotheses in more

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detail, besides the overall effect of patents on market value also single top performing firms – in terms of stock prices and patenting - are compared to the rest of the industry, to see if the effect holds at the micro level too. Additionally, it can be compared if taking into account the family size of the patent affects the association of stock market prices and patent output, which could lead to the conclusion that securing international markets has an effect on the value of the firm in the home market.

Assessing research performance of research groups by field-normalized citation counts

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Introduction

For the assessment of research performance of universities, comparative analyses of research groups are particularly revealing, because performance differences *within* universities are often greater than performance differences *between* universities. Comparing absolute publication and citation counts is, however, quite meaningless, as publication and citation habits differ considerably among research fields. For this reason, the average citation rate of a research group is usually normalized with the expected impact by virtue of papers published worldwide in the same field(s). The normalization with an expected value places the absolute numbers in a frame of reference and reveals whether the impact of a research group is above or below the international average in the field(s). The fields are usually delimited by assigning journals as a whole to one or several subject categories. Such journal classification schemes as developed by Thomson Reuters are simple in application and have generally proved to be useful in research evaluation. They are, however, fraught with problems in the case of (a) multidisciplinary journals and general journals and (b) highly specialized research fields.

Method

To overcome the shortcomings of journal classification schemes we propose a new reference standard (also called baseline or reference value) for chemistry and related fields that is based on the sections of the *Chemical Abstracts* (CA) database. Unlike journal classification schemes, CA places each paper published in multidisciplinary and general journals to a specific subject category. Furthermore, the specificity of the subject classification schemes in CA (e.g. *Mammalian Biochemistry*) is considerably greater than that of the journal classification schemes in the *Science Citation Index* (SCI; e.g. *Biochemistry & Molecular Biology*).

Results

We determined the values of the reference standard for research articles classified in the biochemistry sections of CA. The results show that citation habits vary extensively not only *between* fields but also *within* fields. On average research articles in biochemistry are cited 11.6 times over a 5-year period, but the differences between the sections are considerable: The average citation rate ranges from 2.4 in section 5 (*Agrochemical Bioregulators*) to 19.7 in section 6 (*General Biochemistry*). Taking some research groups of ETH Zurich as an example, we can show that the assessement of research performance depends on the frame of reference. In 21.4% of the cases included in our study, the normalization with reference standards based on

the subject categories of the SCI results in a poorer rating than with the reference standards based on the sections of CA (Figure 1).

Conclusions

The assessment of research performance is context-sensitive and adequate reference standards allow not only for *cross-field* comparison, but for *cross-scale* comparison.
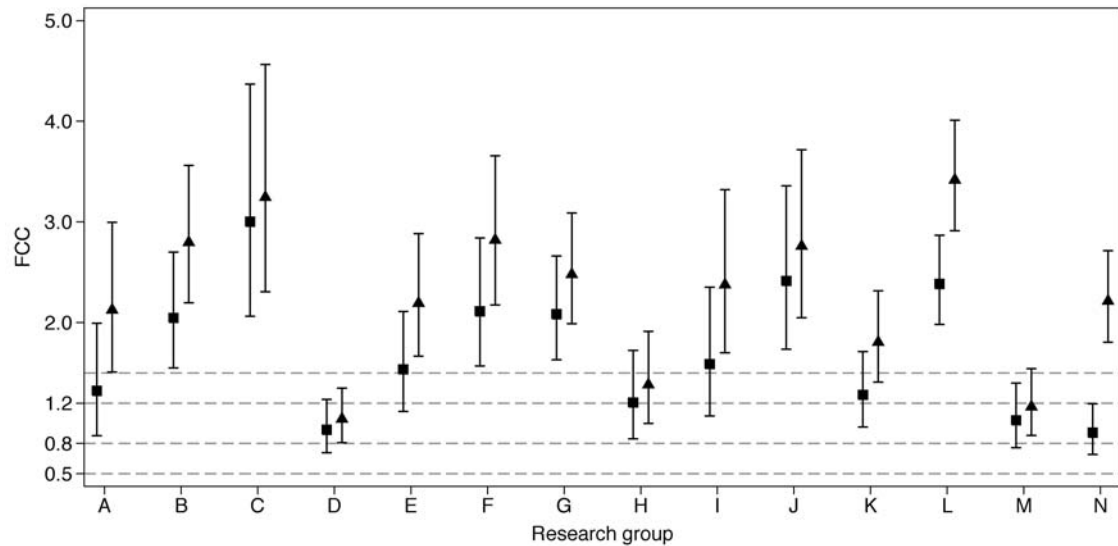
Figure 1. Field-normalized citation counts (FCC), applying reference standards based on the subject categories of the SCI (squares) and the sections of CA (triangles). The points represent the mean estimated by negative binomial regression, and the vertical lines show the corresponding 95% confidence interval. The horizontal lines show the ranges of values for an impact *below* (0.5-0.8), *about* (0.8-1.2), *above* (1.2-1.5), and *far above* (> 1.5) the international average of the fields.

Developing a comprehensive Scopus journal classification scheme using bibliometric data

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Introduction

Since the introduction of Scopus, there has been much debate on all aspects of such an ambitious competitor of Web of Science, which is often perceived as the 'golden standard'. One particular aspect that has been discussed is the journal classification scheme. Although not visible or useful for all users, this scheme plays an important role in the background of the database itself and for advanced users in bibliometrics. To address shortcomings in the present classification scheme, which was created based on intellectual assessment, we took up the challenge to develop a new scheme based on bibliometric data. The new scheme was required to have two levels (main fields and sub fields) and needed to be constructed in a transparent way, so that it can be explained and defended towards users and bibliometricians.

Method

Although journal classification schemes are heavily criticized, both conceptually and content wise, users attribute great value to such schemes. In multidisciplinary databases such as Web of Science and Scopus, classification schemes are of major importance to help users find the proper information and to generate the right context for journals and publications.

The subject categories in Web of Science are often criticized, but a better classification scheme has not yet been proposed. There are suggestions for improved schemes based on citation data, but these suggestions do not take journals as the smallest entity (cf, Garfield, Malin, & Small, 1975; Janssens et al., 2009).

We created a journal classification scheme based on bibliographic coupling data for publications from the period 2005–2008 and their cited references going back no more than 10 years. Multidisciplinary journals such as *Nature* and *Science* were identified using an algorithm but were also checked manually. These journals were assigned to a special multidisciplinary category. Journals in the arts and humanities turned out to be especially difficult to classify, due to the very limited amount of bibliographic coupling data available. We therefore relied heavily on an existing expert-based classification scheme for arts and humanities journals, namely the European Reference Index for the Humanities developed by the European Science Foundation. The labeling of the fields in our scheme was done manually with the help of expert advice.

The following stages in the development of our journal classification scheme can be discerned:

1. Construction of a first version scheme of over 14,000 journals;
2. Feedback on the first version scheme from about 100 reviewers/users with different backgrounds and user needs at four different levels of the scheme (overall, main fields, sub fields, and journals);

3. Construction of a second version scheme of over 18,000 journals based on improved algorithms;
4. Feedback on the second version scheme;
5. Construction of the final version of the scheme.

The final version of the scheme is expected to be finished in the second half of 2010. The clustering algorithm used to create the second version scheme employs principles of the VOS mapping technique (Van Eck et al., 2010) and requires relatively few manual adjustments. Manual interference was necessary to handle regional and national journals as well as non-English journals. Clustering based on bibliographic coupling tends to group such journals together, which for our purpose was not desirable. Furthermore, the parameters of the algorithm needed manual fine tuning to improve the quality of the results. For more details about the clustering algorithm that we used, we refer to Van Eck, Waltman, and Noyons (2010).

The feedback on the first version scheme was structured and categorized according to user groups and priority. The second version scheme was tested against the feedback on the level of main fields and sub fields. We received over 1600 entities of feedback, distributed over the different levels of the scheme as shown in the table below.

Table 1. Distribution of feedback over the different levels of the scheme

Main fields	33
Sub fields	295
Journals	1305
Total	1633

Results

We have the following main fields in the second version scheme (number of sub fields reported between parentheses):

1. Arts and humanities (11);
2. Chemistry (12);
3. Computer science (8);
4. Earth sciences (15);
5. Engineering and materials science (30);
6. Life sciences (37);
7. Mathematics (9);
8. Medical and health sciences (85);
9. Physics (10);
10. Psychology (9);
11. Social sciences (42);
12. Multidisciplinary.

The map shown below visualizes the overall structure of the second version scheme.
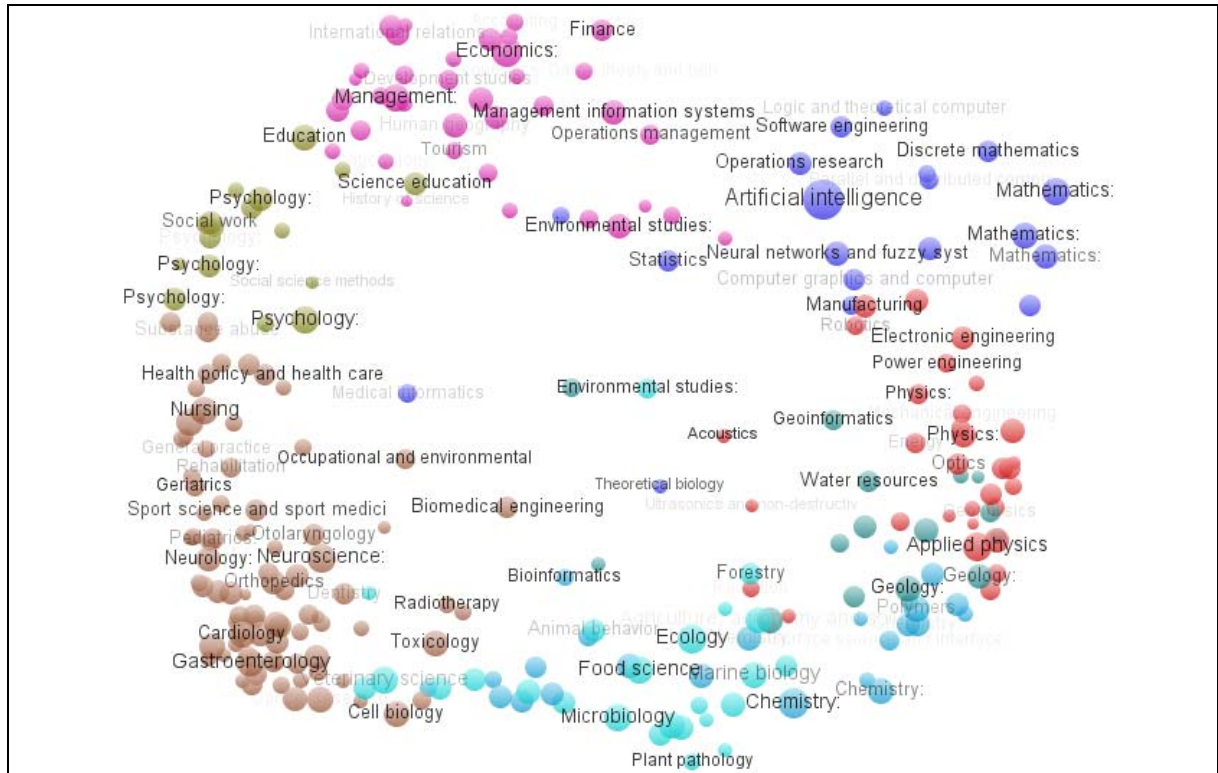
Figure 1. Map of the overall structure of the proposed journal classification scheme

Conclusions

We have developed a new journal classification scheme based on bibliometric data. Our approach is transparent and requires relatively little human interference. The resulting classification scheme may therefore be regarded as more objective than existing schemes on this scale.

Although the whole project of developing a new classification scheme has not been completed yet, the present version looks promising. The coherence of keywords in the titles of the journals in a category is a clear indication. Also, many categories in our scheme match quite well with categories in Web of Science and in other classification schemes.

We realize that any journal classification scheme has its weaknesses, for example because journals differ in the broadness of their scope. Also, for bibliometric purposes a classification at the level of individual publications is preferable in many cases.

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Industry orientation as a determinant of public research participation in the European Framework Programmes

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Presenter: Manfred Paier

Introduction

The European Framework Programmes (EU-FP) are a key policy instrument for strengthening the knowledge infrastructure, improving industrial competitiveness, and generating network externalities in Europe. A recent evaluation of the Sixth Framework Programme (FP6), however, finds a 'limited extent in bringing the new knowledge all the way to the industrial sector' (Rietschel, Arnold et al. 2009). This judgement alludes to the clear downward trend in industrial participation that was already an issue under FP5, and continued under FP6.

As we argue, the sheer number of industry participations in the EU-FP may not reflect its industrial relevance with full adequacy, especially in the long run. Additionally, much of public research is relevant for or even directed towards industrial application, since only a small minority of the projects is run without industry participation. We find, however, considerable variation in the share of industry partners in the project consortia. This leads to the assumption that the industry orientation of public research participants can be associated with the number of their foregoing collaborations with industry partners.

The objective of this contribution is thus to determine the influence of industry orientation of public research on its participation in the EU-FP. If a strong ex-ante industry orientation of universities and public research organisations turns out to be favourable for their participation in FP6, then this will alleviate the verdict of declining industrial relevance of the EU-FP. As a consequence, we may assume that industry oriented public research is able to compensate for industry absence.

Method

In order to address this issue, we adopt an econometric approach. By employing Poisson regression models we estimate the influence of industry orientation on the participation of universities and public research organisations in FP6. In order to account for sector-specific differences, we analyse FP6 sub-programmes separately. For selected sub-programmes, the dependent variable is the observed number of project participations of the organization. The core independent variables are indicators of industry orientation (as outlined above).

Among the control variables we take into account: a) indicators of scientific excellence (number of publications, cites per publication, journals´ average importance, field normalized citation scores), b) other organizational characteristics (size, organization type, EU-FP experience), c) alternative funding opportunities (availability of national public R&D funding in the country of origin), and d)

characteristics of geographical location (core-periphery situation, pervasiveness of English language in the country, regional technology intensity).

We use data from the EUPRO database on FP participations (Barber, Heller-Schuh et al. 2008), from a recent joint ranking of universities and public research organizations (SCImago 2009), the Main Science and Technology Indicators (OECD 2009), and the Eurydice network (EACEA 2008).

Results

First results indicate that there are sector differences regarding the issue of industry orientation versus scientific excellence. We find evidence for high industry orientation of public research in the case of Aerospace and Information Society Technologies, and a stronger role of scientific excellence in the field of Life Sciences and Food. While this is what one could expect, our results allow for clarifying the extent of industry orientation also in cases where the participation numbers of firms and public research are relatively balanced.

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The use of multiple bibliometric indicators in science policy to support the development of collaboration strategies

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Presenter: Michelle Picard-Aitken

Introduction

Government agencies with a stake in science and technology (S&T) are increasingly seeking out opportunities to pursue international collaboration as a means to increase the quality and reach of their country's research (Sonnewalk 2007). In response to policy needs, Science-Metrix uses customized approaches that incorporate the analysis of collaboration indices with other bibliometric indicators to identify fields in which different countries could develop mutually-beneficial S&T collaboration. Studies to support collaboration strategies have been conducted for two Canadian government departments: Fisheries and Oceans Canada (DFO) and Foreign Affairs and International Trade Canada (DFAIT).

The DFO study was designed to inform its International Science Strategy, by providing insight into its past collaboration practices, as well as bibliometric data to support the identification of countries for collaboration in its 12 priority research areas. Another study was undertaken to support the development of DFAIT's bilateral S&T collaboration agreements under the Global Innovation Strategy through the production of indicators on Canadian collaborations with other leading and emerging S&T countries in subfields of the Natural Sciences and Engineering (NSE).

Method

Both studies were performed using the Scopus database. DFO's research areas were delineated using keyword searches in the titles, abstracts and author keywords of papers. In the DFAIT study, papers were classified into NSE subfields based on the US National Science Foundation's journals taxonomy.

In both studies, multiple indicators were used: number of papers, average of relative citations (ARC), specialization index (SI), and affinity index (AI). The latter compares the number of observed bilateral collaborations to that expected under neutrality. Areas prone to mutually beneficial collaboration were identified as those in which both countries had strengths, based one the first three indicators. The collaboration patterns of both countries were then examined in these areas using the AI to establish the appropriateness of further collaboration.

Seeing the policy-makers' need for high-level and practical information, such as to support policy justifications (including funding submissions and the development of bilateral S&T collaboration agreements), the analysis needed to clearly identify and prioritize the countries and/or research areas in which Canada should pursue strategic collaboration. In the DFO study, countries were identified as having high, medium or low potential for mutually beneficial collaboration in each of the 12 priority research areas based on a multi-criteria analysis of their respective strengths and weaknesses (number of papers, ARC and SI). Countries were then listed alongside the AI with DFO and their number of co-authored papers with DFO in the previous 10 years (Figure 1). Based on a similar approach, the DFAIT study identified subfields in which collaboration would be mutually beneficial or mainly beneficial to one of the partners; the AI also helped prioritize collaboration with specific countries.

Rank	Country	PAI-DFO	No. Coll
High Potential	United States	↑ (green)	232
	Norway	⇨ (yellow)	19
	Australia	↓ (red)	23
	France	↓ (red)	29
	United Kingdom	↓ (red)	62
	Netherlands	↓ (red)	14
	Denmark	↓ (red)	7
	Germany	↓ (red)	49
Medium Potential	New Zealand	↑ (green)	10
	Belgium	↓ (red)	2
	Sweden	⇨ (yellow)	13
	Spain	↓ (red)	13
	Japan	↑ (green)	54
	Portugal		
	South Africa	↓ (red)	2
	Italy	↓ (red)	7
	China	↑ (green)	29
	Chile	↑ (green)	8
	Switzerland	↓ (red)	1
Low Potential	Russian Fed.	↑ (green)	50
	Greece	↓ (red)	1
	Mexico	↑ (green)	8
	Taiwan	⇨ (yellow)	5
	Rep. of Korea	⇨ (yellow)	9
	India	↓ (red)	4
	Poland		
	Finland	↓ (red)	5
	Argentina	↑ (green)	3
	Ireland	↓ (red)	2
	Turkey	↓ (red)	2
	Brazil	↓ (red)	1
	Iceland	↓ (red)	1

Note: Justification for sustaining or increasing collaboration is indicated by the AI: green arrows indicate whether DFO and the country collaborated more than expected; red arrows indicate the reverse. For example, DFO could pursue additional collaboration with Australia, which has strengths in this research area but with which DFO has a negative affinity.

Figure 1. Prioritization of countries for collaboration in operational oceanography research based on multiple indicators.

DFO and DFAIT have used the studies' findings to develop their collaboration strategies. This work illustrates that tailoring both the method and communication of results to the needs of policy-makers is necessary to support government in science policy planning.

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Who is the best partner, and where?
International collaboration of Russian scientists

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Introduction

It is widely accepted that international collaboration in writing scholarly papers generally results in increasing citation rates (e. g. Glänzel, 2001; Katz, Hicks, 1997; Narin et al., 1991). Some other researchers recently questioned this statement (Schmoch, Schubert, 2008; He, 2009). Although there were extensive studies considering international collaboration of Russian scientists (e. g. Wilson, Markusova, 2004), no-one focused on citation "added value" gained by Russian authors from such collaboration. This is the aim of the present paper, and we identify the "most preferred partners" for Russia in three scientific disciplines.

Method

For estimating "added value" of the collaborative publications the "citation gain" indicator was used, the increase in the average citedness of internationally co-authored paper compared to the average Russian one, divided by the average citedness of Russian paper.

Thomson Reuters *Web of Science* product was used on the *Web of Knowledge* online platform, only documents of the type Article were taken into study. Papers published in 1999 and 2004 were considered and all citation indicators (citation gain, uncitedness factor) were counted on 1999–2003 and 2004–2008 intervals. Paper's country attribution was made by "whole counting" method. Each journal's subject category based on ESI broad field classification was assigned to all its papers.

Five countries most actively involved into co-authorship with Russian scientists were taken into study: Germany, USA, France, UK and Italy. Scientific fields we focused on are those traditionally strong for Russia — physics, chemistry, and mathematics.

Results and conclusion

International co-authorship proved to be very "profitable" in terms of citations: while average Russian paper published in 2004 received 4.5 citations in five years, the co-authored publications were cited from 12.5 (with Germany) to 16.4 (UK) times, this corresponds to 180%–260% citation gain. Uncitedness factor of collaborative paper varies between 9.5% (UK) and 14.4% (France), while this indicator for average Russian paper exceeds 39%. Chances for Russian paper to remain uncited are 3–4 times higher if it is not written in collaboration with the leading Western countries.

When three disciplines are considered separately, wide variation of gain over countries and scientific fields is observed (Figure 1). Being relative indicator, "citation gain" may be correctly compared across disciplines. In general Russian scientists receive the most (relative) citation gain from their international colleagues in chemistry, the least in mathematics. USA and UK are the most preferred partners

among five countries in physics, Italy and USA in chemistry, Italy and Germany in mathematics.
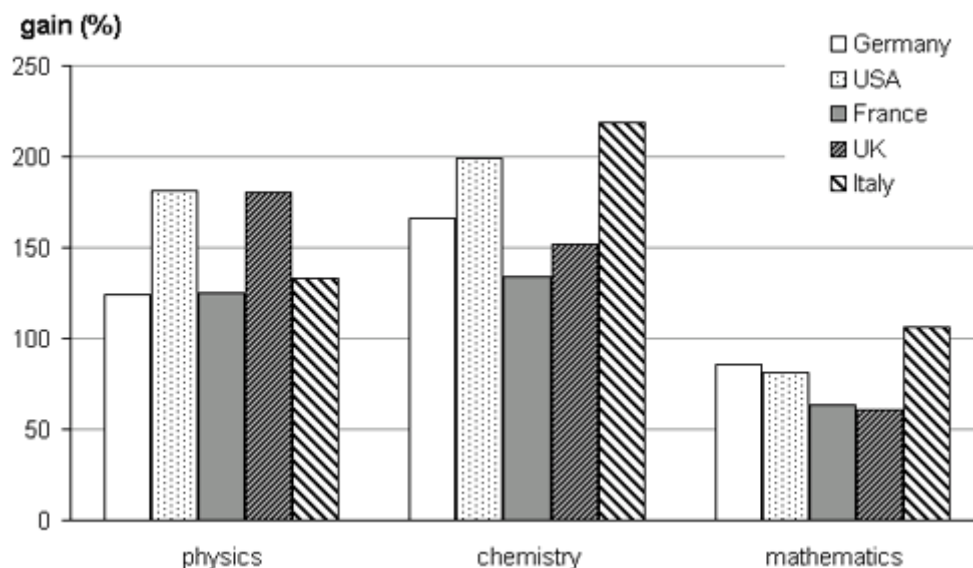
Figure 1. "Citation gain" from international collaboration of Russian scientists. Papers published in 2004, citations 2004–2008

To test how much partner countries change their positions over time, their 2004 ranks were compared to those for papers published in 1999 (Table 1). In physics distribution of positions in partners' ranking was most constant, only the first rank changed places with the third and the forth with the fifth. In chemistry the picture was less stable, e. g. with UK dropping four positions. In mathematics no stability was found.

Table 1. "Best partners": five countries ranked by "citation gain" brought to co-authored Russian papers

Rank	Physics		Chemistry		Mathematics	
	1999	**2004**	**1999**	**2004**	**1999**	**2004**
1	Italy	USA	UK	Italy	UK	Italy
2	UK	UK	Italy	USA	USA	Germany
3	USA	Italy	USA	Germany	Germany	USA
4	Germany	France	France	UK	France	France
5	France	Germany	Germany	France	Italy	UK

We proved that international collaboration is "profitable" for Russian scientists, there exist specific sets of preferable countries for co-authorship in each scientific field, but one should keep in mind that these may change with time.

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Tracking the Integration and Diffusion of Knowledge: The Case of Nanotechnology Risk Research

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Introduction

We seek to measure the extent of cross-disciplinary research knowledge dissemination. Research policy interests seek to bolster such dissemination to enhance scientific advance and societal payoff.

Research observers, funding agencies, and policy-makers applaud interdisciplinarity. The US National Academies Keck Futures Initiative (*www.**keckfutures**.org*) is a 15-year, $40 million program designed to bolster interdisciplinary research. Two interdisciplinarity metrics that were derived to facilitate tracking how interdisciplinary particular bodies of research are:

- Integration gauges the diversity of references upon which a publication or body of publications draw

- Specialization measures the diversity of disciplines addressed by a body of publications.

These metrics find strong conceptual footing in Stirling's diversity framework that weighs variety, balance and disparity of entities.

This study addresses nanoscience & nanoengineering risk research (Environmental, Health & Safety – "**nano-EHS**" for short). Since 2005, nano-EHS has been an express priority of the US National Nanotechnology Initiative, to which it has dedicated some 2.9% of its research budget (or, some $480 million through 2011 -- www.nano.gov/html/society/EHS.html). Asian and EU nations have also invested substantially.

The research questions driving our analysis focus on:

- How interdisciplinary is nano-EHS research, and is this changing over generations?

- Are the resulting research publications influencing nano S&T research widely?
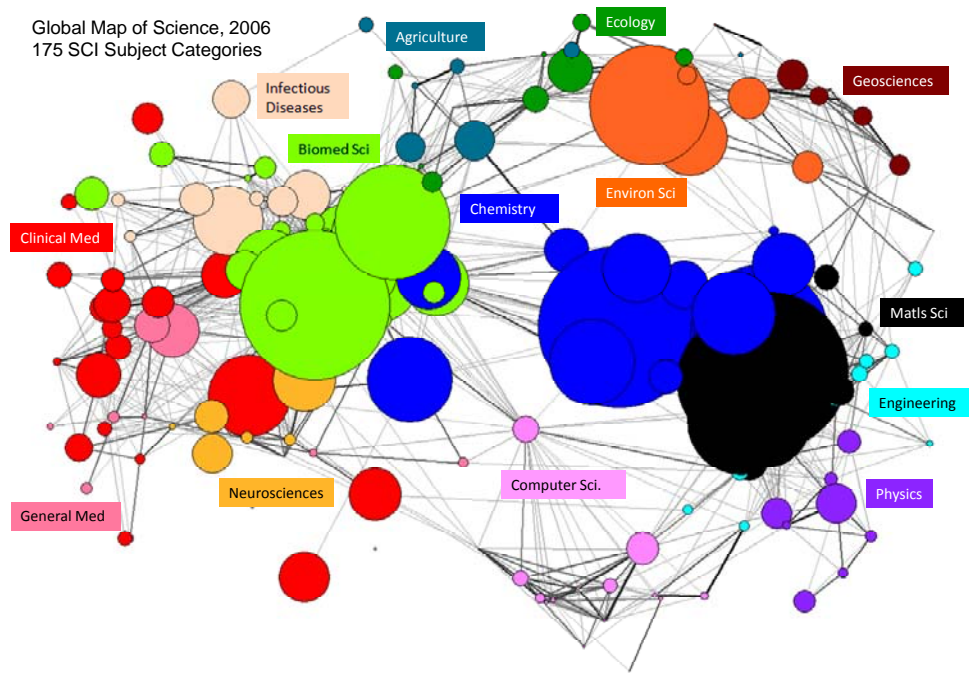
Method

We have devised an Internet macro to expedite collection of "multi-generational" citation data. We herein apply this tool to explore three generations of nano-EHS information research:

- We start at the 3d tier – 2,758 nano-EHS publications based on a complex Boolean search of the Web of Science ("**WOS**") covering 1990-2009.

- We then apply a macro to download 21,349 WOS records *citing* those nano-EHS papers – i.e., yielding the 4th tier.

- The 3d tier records contain Cited References in abbreviated form (2d generation).

- We selectively apply a version of our macro to obtain the full abstract records for selected 2d generation papers, including those publications' cited references that constitute the 1st generation.

We derive the indicated interdisciplinarity metrics for the core (3d tier) nano-EHS publications. By drawing upon the earlier generations, we explore ways to assess the extent to which select "highly integrative" nano-EHS papers bridge separate research communities. Second tier bibliographic coupling analyses provide a useful means to estimate the degree to which the papers integrate previously disparate research streams.

We proceed to the "4th tier" to examine the diffusion of nano-EHS research. Science overlay mapping helps gauge the extent to which nano-EHS research influences various fields. In so doing, we use the WOS Subject Categories -- as well as "macro-disciplines" (based on factor analyses) -- to ascertain affinities. We are especially interested in the degree to which non-EHS researchers cite nano-EHS results. Preliminary results suggest that nano-EHS research is being increasingly picked up by the broader nano S&T research community. Figure 1 (below) suggests significant diversity among articles citing nano-EHS publications.

Figure 1: The Position of Articles Citing nano-EHS on the Map of Science

and economics of new technologies. Survey results also illustrate how
particular research themes are investigated with specific analytic tools
borrowed from various disciplines.

The bibliometric mapping of SPRU's publications showed that SPRU is a
highly interdisciplinary department, publishing over a very wide range of
disciplines or journals with relative balance and high coherence. This
combination of diversity and coherence may be the source of distinctive
SPRU's research capabilities.

Both the survey and bibliometric mappings are portrayed over science maps,
which facilitate the comparison and potential integration of these different
types of data. The comparison shows insightful similarities and differences
between the cognitive perception of researchers (survey) and their publication
and citation behaviours (bibliometrics).

We propose that these type of analyses can be useful for research evaluation
and management, in particular for research organisations, given the increasing
perception that the science indicators conventionally used are not able to
capture the richness and complexity of research practices.

The full paper is available at arXiv:
http://arxiv.org/abs/1007.4625

pharma and health, and energy. The bibliometric analysis showed that SPRU has unique interdisciplinary publication behaviour, with publications and citations criss-crossing between its social science domains and the natural sciences, where its empirical areas of study are located (See vertical linkages in Fig.1). Not only is SPRU portfolio very diverse, but it is coherent in that it integrates extremely disparate disciplines. The survey also reveals that expertise most shared within SPRU is neither disciplines nor empirical foci, but conceptual frameworks such as *Innovation Systems*, *Technological Transitions* or *Foresight*. This suggests that these interdisciplinary frameworks play a key role in facilitating internal interactions and the construction of a shared identity.

We propose that this mixed method can be used as a general tool for knowledge mapping in interdisciplinary organisations –with the crucial advantage of allowing triangulation and maps obtained from survey and bibliometric approaches and the use of different types and levels of knowledge domain categories, including some specific to the organisation under study.
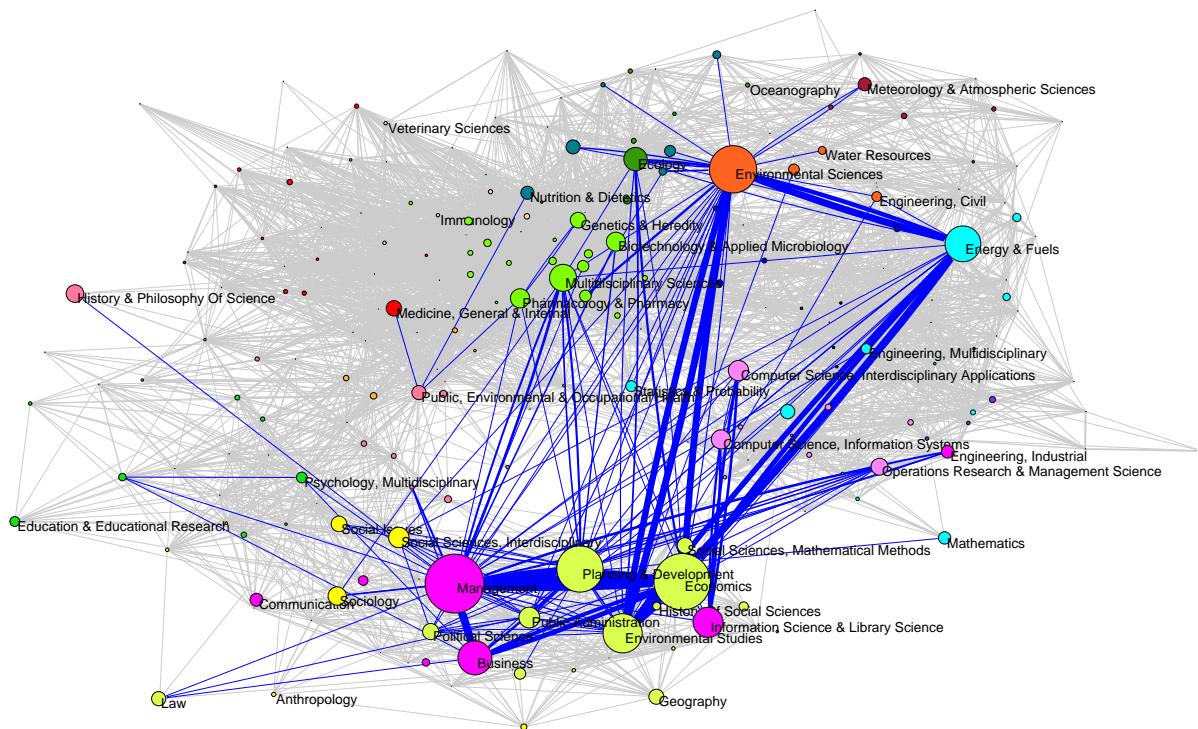
Figure 1. Citations between ISI Subject Categories (disciplines) in SPRU publications 2006-2010, overlaid in the map of science. Size of nodes and lines is proportional to number of citations.

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The anatomy of citations to UK cancer research papers

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Introduction

The number of citations obtained in a given time-window to a group of papers depends on many factors, and the problem of identifying which ones are important is in some ways similar to that faced by epidemiologists. For example, it has been known for some time that papers with authors from multiple institutions, or countries, are published in higher impact journals because they usually have received financial support from more sources, each of which will have taken a decision to fund the work, and that this effect counters the negative effect of collaboration at a distance, other things being equal (Lewison & Dawson, 1998; Lewison, 2003). But which other things have to be equal? In this study, we investigated by means of multiple regression analysis the individual effects of over 70 possible factors, including the countries or world regions with which UK cancer researchers collaborated, the cancer sites and types of research involved, and cities in which the work was conducted. Over 30,000 papers from 14 years formed the population, so it was possible to investigate for the first time the relative importance of many influences on the papers' actual citation impact, ACI.

Method

Cancer papers were selected from the Web of Science for 1988-2001 by means of a special filter based on journals and title words, and downloaded, together with their five-year citation scores. They were matched to papers in the Research Outputs Database all of which had been examined to determine their funding sources (Webster, 2005). The journal name was used to establish its mean citation score (potential citation impact, PCI) and research level (from clinical to basic, Lewison & Paraje, 2004), and also, with selected words in each title, to allocate the paper to one or more of 18 cancer sites (*e.g.*, breast, prostate) and 11 research types (*e.g.*, genetics, surgery, palliation). Geographically, each paper's fractional contribution from 13 leading countries and six world regions, and from each of 26 leading UK cities, was also marked on the spreadsheet. A linear multiple regression analysis using the SPSS program then gave the degree of association (and statistical significance) of citation score (the dependent variable) on each of the independent variables selected.

Results

It was immediately clear that the PCI had a major influence on ACI, more than doubling the amount of variance that could be explained by the independent variables and altering the coefficients of many of them, notably that of research level, which became *negative* when PCI was included. More funding always had a positive effect on ACI, but for small numbers of authors and addresses the effects of more of them were initially negative. Collaboration with the US had a very positive effect on ACI, and papers from Dundee, London WC and Oxford also did so. Among cancer sites, breast and colorectal cancer research led to higher ACI values, but work on leukaemia and liver cancer had the opposite effect. Of the types of cancer research, that on prognosis had the highest association with more citations.

Conclusion

Several of the associations differed markedly from those apparent from a simple cross-plot without account taken of the confounding effects of other independent variables. This suggests that reliance on these plots can give misleading information on which factors give rise to highly-cited cancer research papers, and by extension, in other areas of science.

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Output and citation impact of interdisciplinary networks: Experiences from a dedicated funding program

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Introduction

In a context of ever more specialized scientists, interdisciplinarity receives increasing attention as innovating ideas are often situated where the disciplines meet. In many countries science policy makers installed dedicated funding programs and policies. This induces a need for specific tools for their support. There is however not yet a generally accepted quantitative method or set of criteria to recognize and evaluate interdisciplinary research outputs (Tracking and evaluating interdisciplinary research: metrics and maps, 12th ISSI Conference, 2009). Interdisciplinarity also takes on very different forms, as distinguished in overviews from the first codifications (Klein, 1990) to the latest reference work (Frodeman et al., 2010). In the specific context of research measurement and evaluation, interdisciplinarity was discussed e.g. by Rinia (2007) and Porter et al. (2006). This empirical study aims to contribute to the understanding and the measuring of interdisciplinary research at the micro level, in the form of new synergies between disciplines. Investigation of a specialized funding program shows how a new interdisciplinary synergy and its citation impact are visible in co-publications and co-citations, and that these are important parameters for assessment. The results also demonstrate the effect of funding, which is clearly present after about three years.

Method and material

The 'Horizontal Research Actions' program was set up at the Vrije Universiteit Brussel in 2002. It supports collaborations joining expertise from different disciplines around topics proposed by the applicants. On average, an application involves four applicants from three departments. Funding is spent primarily on researchers embodying the link between the disciplines. The program was evaluated when the first four generations of 36 applications (incl. 3 resubmissions) could be followed for three years after start of funding. The evaluation used an author-centered approach, based on the applicants and their affiliated departments. Co-publications, defined as joint publications by applicants from different departments, were monitored as an indicator of interdisciplinary output. Co-citations, defined as publications citing applicants from different departments, were monitored as an indicator for citation impact. The basis for analysis was the on line Web of Science. Applications completely situated in the Social Sciences and Humanities (4 out of 36) were excluded due to the insufficient coverage for such networks and remain out of scope of the discussion that follows.

Results and conclusions

The results provide information on the program's success as well as on potential indicators for evaluation of interdisciplinary research. The majority of funded applications (9/12) successfully generated both co-publications and co-citations, while about half of the unfunded applications (8/17) showed neither. Despite not being

funded, about one third of the unfunded applications (6/17) did also lead to co-publications and co-citations. In the subset of newly activated networks, i.e. where co-publications were not yet present before application, the effect of funding is visible in more strongly rising co-publications and co-citations (Figure 1; 73% citing co-publications; 13% itself co-publications) from the third year.
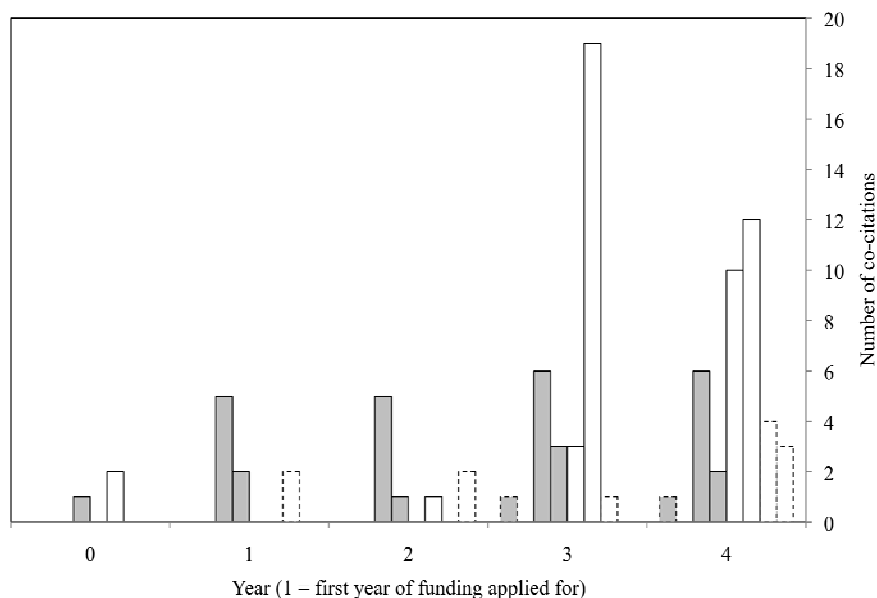
Figure 1. Co-citations to partners of newly activated interdisciplinary networks

networks funded for 4 years (white) and unfunded (gray), from corresponding generations
dashed border = with partner in social sciences and humanities

A survey of the five earliest funded networks, all newly activated, confirmed that in line with the program's goal, the large majority of the co-publications represent a synergy of expertise related to the topic (23/28). The remaining concerned rather an application of results from one discipline in another (2/28) or were not related to the topic (3/28). Overall also the majority of the co-citations monitored was related to the topic (83/130), with considerable differences between networks. The non-related co-citations indicate that new collaborations funded by the program may in addition lead to new interdisciplinary combinations of knowledge on another topic, in or outside of the initial network. The survey also showed that the monitored co-publications and co-citations contain the majority of the interdisciplinary output and impact generated by the networks in relation to the topics. This indicates that co-publications and co-citations are important parameters for the assessment of interdisciplinary synergies, e.g. in intermediate evaluations for funding programs after three or more years.

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Quality related publication categories in social sciences and humanities, based on a university's peer review assessments

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Introduction

Bibliometric analysis has firmly conquered its place as an instrument for evaluation and international comparison of performance levels. Consequently, differences in coverage by standard bibliometric databases installed a dichotomy between on the one hand the well covered 'exact' sciences, and on the other hand most of the social sciences and humanities with a more limited coverage (Nederhof, 2006). Also the latter domains need to be able to soundly demonstrate their level of performance and claim or legitimate funding accordingly. An important part of the output volume in social sciences appears as books, book chapters and national literature (Hicks, 2004). To proceed from publication data to performance measurement, quantitative publication counts need to be combined with qualitative information, for example from peer assessment or validation (European Expert Group on Assessment of University-Based Research, 2010), to identify those categories that represent research quality as perceived by peers. An accurate focus is crucial in order to stimulate, recognize and reward high quality achievements only. This paper demonstrates how such a selection of publication categories can be based on correlations with peer judgments. It is also illustrated that the selection should be sufficiently precise, to avoid subcategories negatively correlated with peer judgments. The findings indicate that, also in social sciences and humanities, publications in journals with an international referee system are the most important category for evaluating quality. Book chapters with international referee system and contributions in international conference proceedings follow them.

Method and material

Ratings by peers and publication counts per full time equivalent leading staff (linked to promoter and funding opportunities) were collected from assessments per discipline by international expert panels at the Vrije Universiteit Brussel (Rons et al., 2008). The evaluations in social sciences and humanities involved 6 disciplines, 56 teams, near 500 full time equivalent researchers and 58 experts from 10 countries, and were conducted between 1999 and 2009. The 23 available publication categories span the total range from scientific publications to categories aimed at a professional and a broad audience. Categories that are only present for a minority of the teams in a discipline are not taken into account to avoid accidental occurrences. The 8 collected, interrelated peer rating categories are the overall evaluation score and scores on scientific merit, planning, innovation, team quality, feasibility, productivity and scientific impact. Correlations for the social sciences and humanities as a whole are calculated after normalization per discipline. The same methodology has been applied before to a different set of disciplines and also to other types of performance measures (Rons and De Bruyn, 2007).

Table 1. Significant correlations with peer ratings per scientific publication category

Medium: *Scope:*	Book	Chap *Int*	Jour *Int*	Chap *Nat*	Jour *Nat*	Chap *no*	Jour *no*	Edit	Conf *Int*	Abst *Int*	Conf *Oth*	Abst *Oth*
Social Sc. & Humanities			8+	4-	7-	1-	6-				-1-	
Psychology & Educat. Sc.	2-		7+	2-								
History					3-		8-	8-				
Political & Social Sciences	1+		3+							1+		
Philosophy & Letters	3-	3+	5+			5-	4-		5+	1-		6-
Economics			5+	2-	8-							
Law (particular categories)	3+		6+									

Number of peer rating categories (out of 8), per discipline, and for all social sciences and humanities disciplines combined, for which significantly positive or negative correlations are found with the publication category.

Medium & scope: **Book**s, book **Chap**ters and **Jour**nal articles with ***International, National or no*** *referee system*; **Edit**ed books or journals; Communications at ***International or Other*** *conferences*, integrally published (**Conf**) or published as abstract or not (**Abst**). Exception: particular publication categories for Law.

Observations and conclusions

Table 1 highlights significantly positive and negative correlations with one or more peer rating categories at a 5% confidence level, for publications in books, journals and conference proceedings. Publication categories with an international dimension, in particular journal articles, show no other than positive correlations, while no other than negative or mixed correlations are found for the other categories. This indicates that in social sciences and humanities these 'international' publication categories can be used as legitimate general counterparts for the international journal publications focused on in exact sciences, with the intrinsically largely locally oriented discipline of Law as the exception to the rule. This also pinpoints the international dimension as an important criterion for selection or weighting of publication categories in performance based funding or evaluation systems, in order to stimulate quality as perceived by peers. In a context of best practices, it supports the rationale that, regardless of the discipline, high quality research performance requires that results be submitted to a sufficient extent to the scrutiny of the international research community. The particularly strong correlations with peer judgments found for the category of international journals suggest that this is the most effective publication medium for this purpose.

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Spline fitting tool for scientometric applications: estimation of citation peaks and publication time-lags

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Introduction

Bibliometric data are often hard to describe using theoretical models. Non-parametric regressions represent a powerful alternative to extract the system's constants. This paper presents a method for the implementation of such a tool using natural cubic splines (NCS) and their application in scientometrics.

Method

Using NCS to fit and interpolate bibliometric data, information such as the citation peak of journals and/or papers can be extracted. This approach gives a small interpolation error with low order polynomials thereby avoiding Runge's phenomenon.

To build a cubic spline on $n + 1$ data points, n cubic polynomials P_i are required. Their four coefficients are determined using interpolation and continuity conditions. This leaves $4n$ unknowns to be calculated using $4n-2$ equations. To obtain an NCS, two additional equations are introduced (Green & Silverman, 1994). This system is solved using linear transformations.

With a dense set of data, it is not optimal to have a perfect fit as data fluctuations might have an impact on the shape of the fitting curve. These fluctuations can be damped using a linear smoothing which associates each data point with its "damped image", creating a damped dataset $\hat{g}$. This smoothing results from a compromise between the residual sum of squares and the roughness of the function using the penalized sum of squares:

$$Pss(g) = \sum_{i=1}^{n} \{Y_i - g(x)\}^2 + \alpha \int_{a}^{b} (g''(t))^2 \, dt$$

Given a smoothing parameter α, the damped dataset $\hat{g}$ is determined by minimising Pss over g:

$$\hat{g} = (I + \alpha K)^{-1} Y$$

Where I is the identity matrix and K is a n-by-n matrix obtained from the dataset and its second derivatives at each point.

Application

Using NCS, the citation peak of three journals was estimated (Figure 1A). The red lines represent the fitting obtained with the NCS ($\alpha = 0.5$). Unlike the traditional method, which takes the highest data point as the maximum, we extract it from the general shape of the curve. If one removes the highest data point for the journal *Blood*, the peak with the former method is shifted from 3 to 4 years whereas it remains the same (i.e., 3.4 years) using NCS. Thus, the method is robust against missing information and fluctuations which are frequent with small journals. Figure 1B summarizes the results of this application to citation peak calculation for 12,130 journals. Based on this figure, using a fixed 2-year citation window as is common usage clearly introduces a bias.
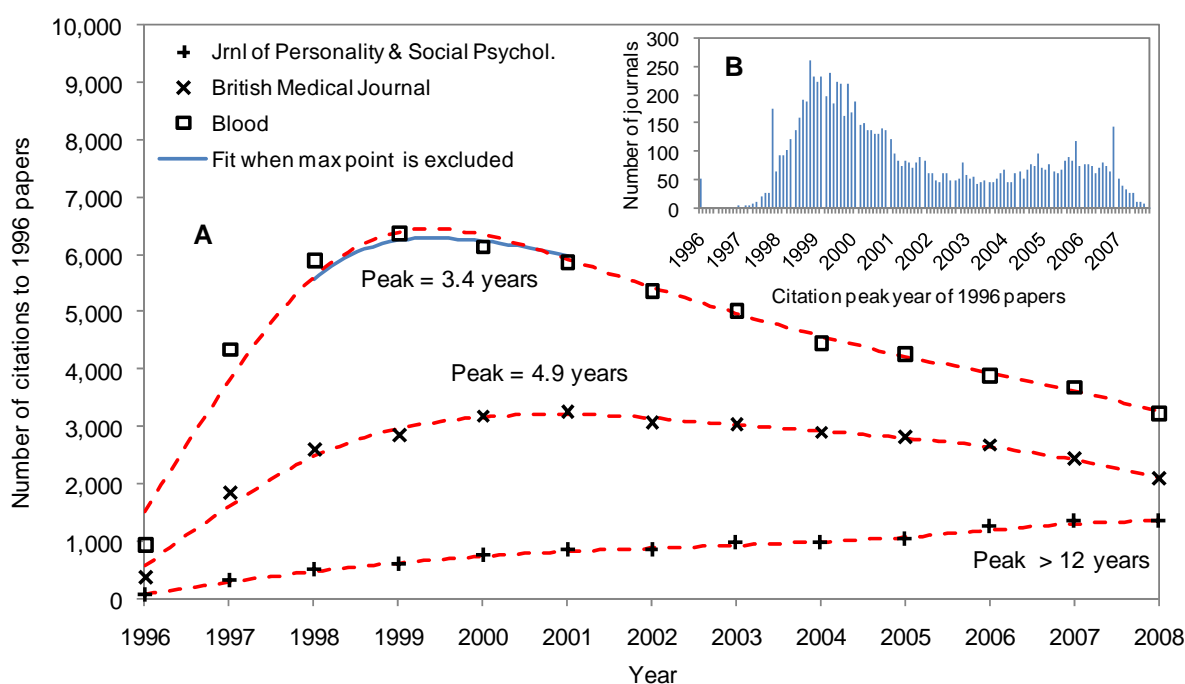
Figure 1. Number of citations per year for three journals

Identifying papers published with a given grant is an important challenge for research evaluation (Campbell *et al.*, 2010). One can use a publication window which includes the peak in the number of papers associated to a grant; this maximises the recall of supported papers while minimizing false positives. Based on experimental data, the publication peak for the Social Sciences and Humanities (SSH) in Canada was estimated to occur 2.75 years following the first year of funding using NCS. Yet, variations in the peak among subfields can have profound impact on the conclusions of evaluations. These variations will be analysed for the SSH and the health sciences.

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An Analysis of the Independence Processes of Researchers in Japan
Academic career paths and research environments

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Introduction

The 3rd Science and Technology Basic Plan in Japan (FY2006–FY2010) recommended increasing the mobility of the researchers and the transparency of career paths for an independent researcher. Though previous studies have focused on mobility of researchers, internal promotion occupies a high share in the career path of researchers.[4] For this reason, we collected quantitative data of career paths, including internal promotion and research environment, from 4,521 researchers. With the help of this data, we quantitatively analyze the independence processes of researchers.

Method

Through a survey of researchers in 1,384 scientific research organizations, we had collected mobility data from 9,369 researchers in 2008.[5] In November 2009, we sent an additional questionnaire in Excel format to 6,716 of the respondents who answered an E-mail address in the first questionnaire. The additional questionnaire asks the following questions related to specific aspects of the researcher's position in his or her research career:

- ◆ internal promotion and change in employment status

- ◆ actual condition of fixed-term employment
- ◆ term of dispatch and sabbatical
- ◆ consciousness of independence

- ◆ research environment
  - · independent laboratory/room
  - · budget decision-maker of research group
  - · budget decision-maker of assignment
  - · immediate supervisor for subordinates or graduate students
  - · corresponding author

We received responses to the additional questionnaire from 4,521 researchers. Table 1 shows the response by the institution/research field.

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[4] According to Hosotsubo (2010), internal promotion comprises 964 (76.8%) among 1,256 people who became professors at national universities in Japan from 2005 to 2006.

[5] We had asked 1,384 organizations to select researcher in a random manner. The breakdown of organizations is as follows: 663 graduate schools, 11 university joint-use facilities, 160 research organizations in independent administrative institution, 26 national research organizations, 355 public testing organizations, and 169 public-interest corporations for scientific research. NISTEP (2009) presents the method and its results in detail.

Table 1. Response Rate by Institution/Research Field

		Number of Distributions	Number of Responses	Response Rate
By institution working as a full-time researcher in 2008	National university	2,604	1,778	68.3%
	Public university	369	249	67.5%
	Private university	2,173	1,357	62.4%
	University joint-use facilities	85	56	65.9%
	Independent Administrative Institutions	632	475	75.2%
	National research organizations	113	83	73.5%
	Public testing organizations	581	412	70.9%
	Public-interest corporations for scientific research	159	111	69.8%
By research field of last academic degree	Science	1,553	1,098	70.7%
	Engineering	1,707	1,208	70.8%
	Medicine	1,605	969	60.4%
	Agriculture	848	611	72.1%
	Social science and Humanity	160	100	62.5%
	Multiple field	562	395	70.3%
	Unknown	281	140	49.8%
Total		6,716	4,521	67.3%

Results of Fulltime Researchers in Universities

This survey reveals the research environment in each research field. For example, Figure 1 shows by research field the 'share of the researcher who is the corresponding author in the current position' and 'the share of the researcher who has an independent laboratory/room'. Researchers in the engineering field become corresponding authors earlier than those in other fields. It is revealed that 90% of the researchers aged 50 and over in the engineering field have independent laboratory/rooms. On the other hand, researchers in the medical field generally take more time to become independent.
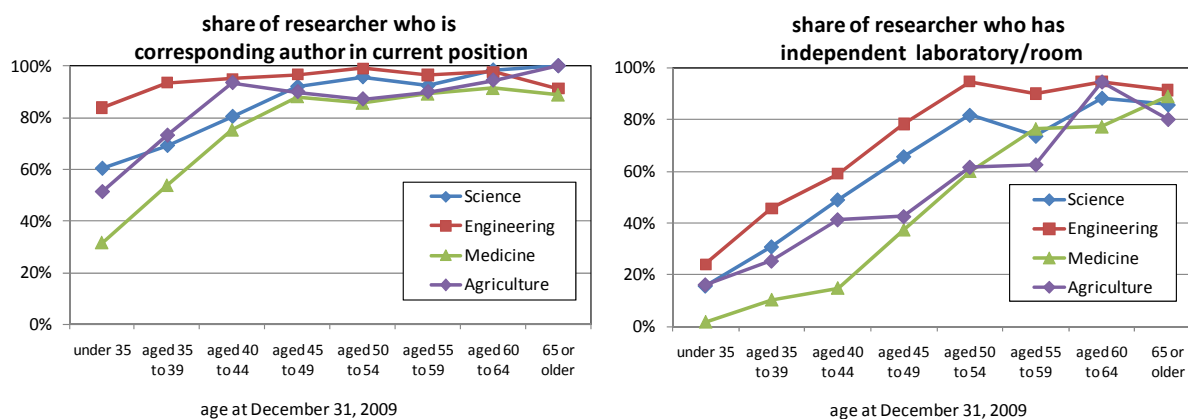
Figure 1. Research Environments of Full-time Researchers in Universities

This survey asked researchers to indicate their career path from the beginning of their research career to their respective current positions. We analyzed the change in research environments over generations. In the engineering field, 53% of the researchers born in the 1950s have independent laboratories/rooms at the age of 40. This percentage increased to 55% among researchers born in the 1960s. On the other hand, the percentage of those who acquire independent laboratories/rooms at the age of 40 had decreased from 25% to 12% in the medical field.

Concluding Remarks

With the help of data about career paths and research environments, it will be possible to quantitatively assess the independence processes of researchers. We have illustrated the degree of independence levels and changes, which decisively depend on research fields. In order to formulate an effective policy for fostering and securing young researchers, it is important to assess independence processes using quantitative data.

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Arena for dialogue of scientists:
A Web survey based on the Science Map 2008

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Analysis of scientific publication is superior as a quantitative approach for understanding the circumstance of science. Recently the various methods including the science map that visualizes the circumstance of science has advanced. However, these techniques show the past circumstance because they use bibliographical information. Hence, there are methodological limits to capture the latest development in science. In order to fill the gap (e.g., time lag), it is necessary to grasp emerging research topics and present trends that only scientists conducting research can recognize.

Our strategy is to combine the results of quantitative analysis with recognition of prominent scientists (i.e., authors of Top 1% highly cited papers). We showed the science map to scientists and asked them to write their opinions about emerging research topics or present trends considering the position on the science map. This survey was conducted on the Web. Scientists can change the position and name of research topics referring to the topics written by other scientists. We refer to the map as an "interactive science map," an arena for dialogue of scientists. As compared to a traditional questionnaire survey, this method has a merit in that we can do away with the step of classification of responses by similarity of content.

In all, 121 scientists responded to the interactive science map and 170 emerging research topics were obtained. Many respondents wrote their topics on "cancer research" (C3), "regenerative medicine research" (D3), and cells (F6, G6), which are a crossover between "chemistry" and "nanosicences." Intriguingly, some immunologists placed the topics of "Development of the visualization technology of DNA and the cancer cell using chemical probe" and "The visualization of the life phenomenon by the chemical probe" under "nanoscience" (G4). Moreover, an economist filled in "neuro-economics" on "brain research" (F2). They wrote emerging research topics on cells that are not their professional discipline. This suggests that they think that the knowledge in different disciplines will bring tremendous advancement in their research. Moreover, research topics about "optogenetics," which is an interdisciplinary research topic between optics and genetics, are written in the E2 cell and the E4 cell. This shows that respondents selected the cell depending on where respondents stand: establishing the optogenetical method or the analysis of brain functions using this method.

This survey revealed that our methodology is workable when assembling collective knowledge of prominent scientists. One of the advantages in the methodology is that scientists can write their emerging research topics interactively referring to the position on the science map and the opinions of other scientists. Our study confirmed

that the interactive map could be an arena for a dialogue of scientists to grasp emerging research topics and present trends in science.

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Figure 1. Interactive map based on the science map 2008. Yellow circles show central positions of 121 research areas whose names and content were identified by experts. The numbers provide a unique ID for a research area. Research areas linked by stronger co-citation linkages tend to locate in nearby positions. The gradation in the map shows the density of highly cited papers that make up research areas. Research areas in the same domain are indicated by dotted circles in the map. Science map 2008 is divided into an 11*10 cell grid, and is designed in such a way that the cell can be selected. When cursor is placed on a cell, the reply of the other researchers can be verified. The number of dolls gives the number of respondents.

Interactive Science Map
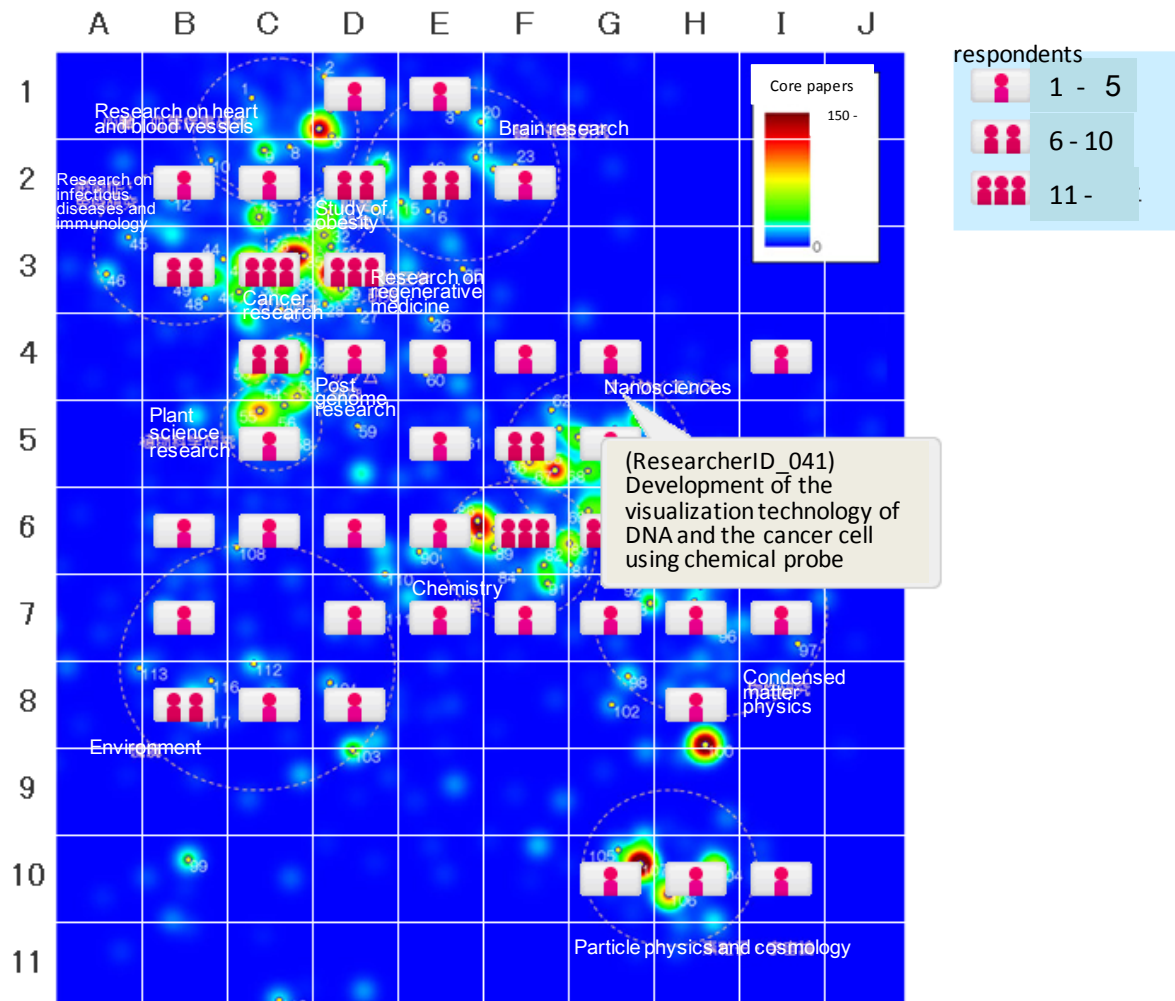
Quantitative Comparative study
of the Constructions of Japanese and UK University Systems

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The purpose of this study is to clarify the distinctive features of the Japanese university system through a comparison of groups of universities (hereinafter, university systems) in Japan and those in United Kingdom through time. The United Kingdom is chosen as a as a target for comparison because the United Kingdom is reported as having high performance in research [1]; the input data of each university is obtained from HESA. The university system includes universities and junior (short-term) colleges. To compare the characteristics of Japan and United Kingdom university systems, data sets were constructed by linking input data (no. of researchers and R&D expenditures) and output data (no. of published scientific papers and no. of highly cited scientific papers) in each university.

Japan has a total of 1,096 national, public, and private universities (including junior colleges); the number in the United Kingdom is 170. The number of universities in Japan with a certain degree of participation in scientific paper production in the natural sciences (called research universities in this analysis) was somewhat less than 20% (179 universities) of all universities; participation in the United Kingdom was on the order of 60% (95 universities). Regarding the share of papers, these universities account for 97% in Japan and 99% in the United Kingdom. Similarly, R&D budgets received from external sources accounted for 88% in Japan and 96% in the United Kingdom. These data show that research outputs in Japanese universities systems are more localized in specific universities as compared to the United Kingdom universities systems.

Using the share of the no. of published scientific papers in each university in each country, we classified universities into Group 1 (>5%), Group 2 (1-5%), Group 3 (0.5-1%), and Group 4 (0.05-0.5%). Universities with share of papers <0.05% were not considered in this analysis. In Japan, quantitatively, Group 1 and Group 2 have roughly equal shares of scientific paper production (Figure 1). In the qualitative aspect (i.e., highly cited papers), Group 1 holds the largest share. Group 1 accounts for large percentages, both quantitatively and qualitatively, followed by Group 2. In the United Kingdom, quantitatively, Group 2 universities have a share of more than 50% of scientific paper production. Qualitatively, Group 2 also has a similarly large share. Thus, both quantitatively and qualitatively, the shares of Group 2 exceed those of Group 1. These results reveal that in the United Kingdom, Group 2 contributed a major part of the output.

Looking at the changes over the past 10 years, the number of universities moving to other groups is larger in the United Kingdom than in Japan. As part of this trend, in particular, a large number of universities have moved from Group 3 to Group 2. In Group 2 in the United Kingdom, there are several universities with total research

expenditures in all fields equal to or greater than those of the Group 1 universities. Group 2 in the United Kingdom is characterized by dynamism.

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Figure 1. Shares of groups in research universities in each country. This figure shows the distribution of inputs (no. of researchers, total expenditure, R&D funds received from outside) and outputs (no. of scientific papers, no. of papers in top10%, no. of times paper cited) in groups in Japan (A) and the United Kingdom (B).

(A) Japan
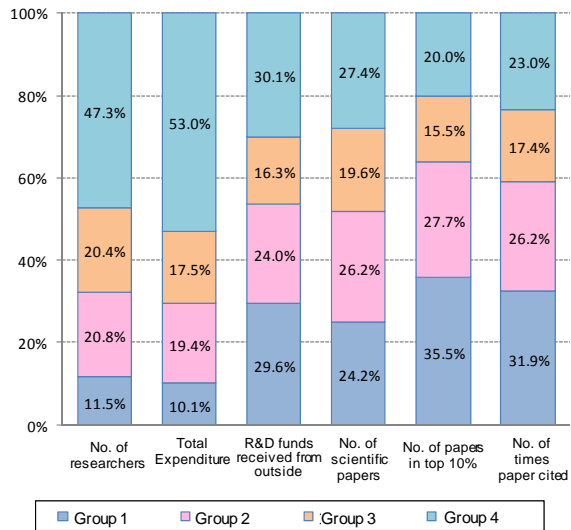
(B) United kingdom
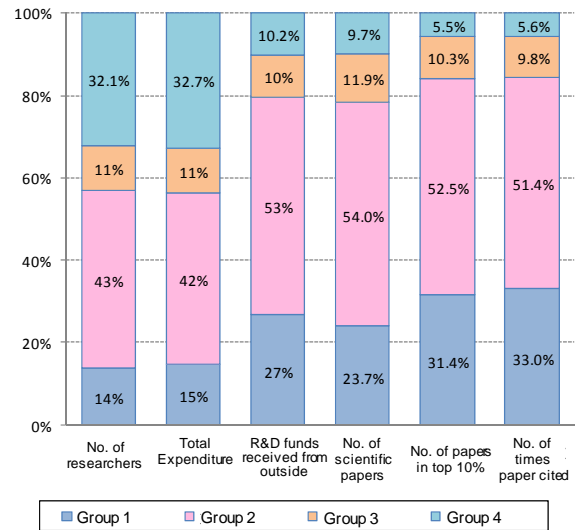
Assessing Peer Assessment from a Bibliometric Perspective

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Introduction

For different reasons bibliometric experts are quite defensive in relation to peer review. Typically, it is pointed out that bibliometrics cannot stand alone but should be used alongside with peer assessment. (e.g. Moed, 2009). Despite the inconsistencies and shortcomings of occasional peer review, the majority of senior researchers trust collegial processes and, therefore, believe that peer assessment is the one best alternative for identifying "quality" in science.
Typical critical remarks towards peer assessment are the low reliability (although peers might agree on the "best" and the "worst"), huge costs and low robustness (HEFCE, 1997), cognitive bias (Wessely, 1998; Travis & Collins, 1991), and conflicts of interest (Wenneras & Wold, 1997; Sandström & Hällsten, 2008). Aksnes and Taxt (2004) report and discuss some of the "mistakes" done by peers in assessments of Norwegian research groups. There are, of course, limitations to the bibliometric indicators as well, but nowadays bibliometricians have a better case as they can rely on normalized indicators and advanced statistical measures.

Data and Method

This paper aims at contributing to the ongoing debate on peer review and bibliometrics. Five sets of data used in recent projects will be exploited (of which only the first is reported here):

- Peer judgement and bibliometric performance from a number of research assessment exercises at Swedish and Finnish Universities, (from Sweden: Uppsala, Lund, KTH, SLU, MiUN, ORU, JH and from Finland: Aalto University in Helsinki).
- Evaluation data from five area evaluations organized by the Swedish Research Council in 2001-2003 (chemical engineering, biotechnology, meteorology, plant science and theoretical chemistry).
- Data on cognitive distance in several of the mentioned evaluations between evaluators and the evaluated researchers (Sandström, 2009)
- Data on the bibliometric performance by panel members of Swedish Council of Medicine (SCM).
- Data on peer assessment and bibliometric performance for applicants to the Swedish Medical Research Council comparing grading of competence to bibliometric performance.

Research Assessment Exercises

The Swedish RAE:s (and the Finnish) have produced evaluation data for almost 335 research units (≈ research groups). Peer judgements have been transformed to a unified grading score in five categories from Outstanding (5) to insufficient (1). In parallel all units have been scrutinized by bibliometric performance measures. Uppsala and Lund bibliometrics was done by the Leiden group. All the others were done with slightly different methods (Opthof & Leydesdorff, 2010, van Raan et al.

2010) by the author and his team. Figure 1 show the bibliometric performance (NCSf=field normalized citation score) as a distribution over citation classes. As expected we find that it approximates the normal distribution (c.f. van Raan, 2006) and we can put in grades according to bibliometric performance using a standard deviation of 1. This gives the thresholds for a five graded system just as the one used for peer assessments.
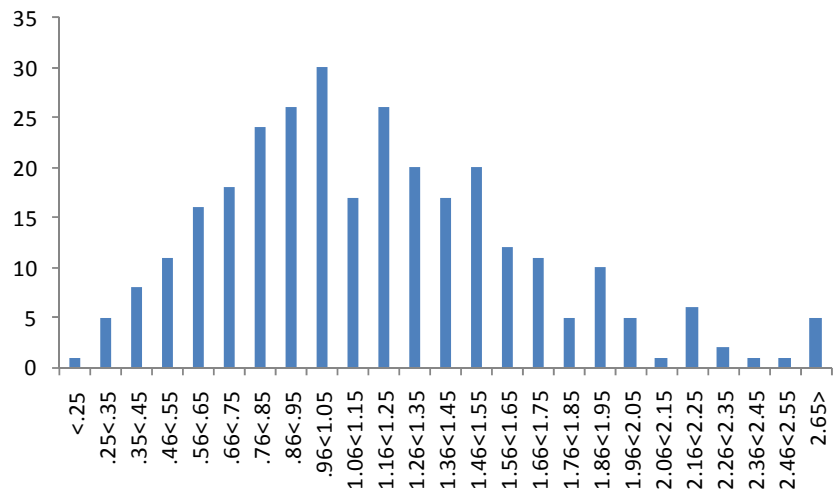
Figure 1. Distribution over citation classes (NCSf) for 298 units of assessment

When comparing the two different assessment methods – peers and metrics – we find that there is a considerable mismatch, se Table 1. Not more than 31 per cent of cases have an identical evaluation, and if we accept a peer assessment of +-1 we receive a figure of 73 per cent. Still, accepting quite a large variation we find that only three out of four cases show similarity between metrics and peer assessment. Obviously, one explanation to this result is the positive bias in peer assessments. The typical grade given by peers is "Excellent" (i.e. grade 4).

Table1. Comparison between peer assessment and metrics

Field Normalized Bibliometric Performance						
Peer Assessment	**1**	**2**	**3**	**4**	**5**	**Total**
1	**4**	6	1			11
2	4	**11**	9	3	1	28
3	4	17	**36**	16	3	76
4	6	26	43	**22**	6	103
5	1	5	24	13	**10**	53
Total	**19**	**65**	**113**	**54**	**20**	**271**

Note: Comparison based on 271 units visible in ISI.

Results and Conclusion

The full paper will extend the analysis to the projects mentioned above (bullet points). Results indicate that there are systemic problems regarding peer review: Firstly, a positive bias in university assessments (but no robust benchmarks). Secondly, the role

of cognitive distance points at the power mechanisms for selecting reviewers. Thirdly, the low levels of peers performance (in bibliometric respect) indicate that selection of peers is no longer to search for the best possible peer, but instead, the pragmatic peer. Finally, it seems impossible for peers to avoid conflicts of interest.

Indicators in the field of Genetics with special reference to India and China (1982 – 2009)

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Introduction

Genetics is one of the youngest and the fastest growing disciplines of science. Knowledge of Genetics is basic to progress in agriculture, biology, medicine, biotechnology and forensic sciences. Genetics, in fact, provides the modern paradigm for whole of biology. The Science of genetics deals with the principles that explain the similarities and differences between parents and their progeny among individuals of a single species. In other words, genetics is the science of inheritance and variations. In the last few decades, the science of genetics has pervaded all aspects of biology, so that it has assumed a central position of great significance in biology as a whole. Consequently today every biologist should be a bit of a geneticist. In this paper, an attempt has been   made to identify the indicators on genetics as a whole as well as on its subfields at the global level with specific reference to Indian and Chinese output.

Methodology

For the present study the data has been collected from the Genbank. The GenBank sequence database is an open access, annotated collection of all publicly available nucleotide sequences and their protein translations. This database is produced at National Center for Biotechnology Information (NCBI) as part of the International Nucleotide Sequence Database Collaboration, or INSDC. The INSDC consists of DDBJ (DNA Data Bank of Japan), GenBank (USA) and EMBL (European Molecular Biology Laboratory). These three databases exchange new and updated data on a daily bases to achieve optimal synchronization. Hence, the database has been chosen to be the source database of this study. Genetics, broadly classified into 15 areas has been taken for the convenience of study. Related data regarding the branches on Genetics has been searched using Entrez, an integrated, text-based search and retrieval system used at NCBI for the major databases.

Findings

1) The World's total output on Genetics has doubled approximately over 18 months since 1982 to 2009. Further, the graphs (see appendix) also shows the exponential growth.

2) Contributions of total output on genetics cover its 15 branches. The data in the table clearly indicates the largest contribution in the branch of 'Genomics' with a total of 27133443, followed by Human Genetics (4585709); Behavioral Genetics (2179390); Genetics of Intelligence (2171008); Molecular Genetics (1500821); Evolutionary Genetics (1411076); Medical Genetics (1137159); Genetic Engineering (330821);

Population Genetics (252193); Quantitative Genetics (164665); Conservation Genetics (140768); Psychiatric Genetics (72764); Ecological Genetics (55837); Microbial Genetics (54680); and Classical Genetics (53156). India's research focus also seems to be on Genomics.

3)   For the period from 1982-2009 there are 18997997 research articles on genetics taking the world as a whole. With 8468364 articles, the American continent leads the world forming 44.58%, followed by Asia with 6454983 forming 33.98%; Europe with 3822372 forming 20.12%; Africa with 855216 forming 4.50%; and closely followed by Australian continent with 848826 forming 4.47%. A comparison between India and China reveals that India has 763322 articles forming 4.02% and that China has 701817 articles forming 3.69%.

4)   The co-efficient of correlation is calculated between the block period and found that there is highly positive degree of relationship observed between five pair of years, among the 15 branches of Genetics.

Conclusion

Science indicators are used both for descriptive as well as analytical purposes. On the one hand, these indicators identify trends, make comparisons or give explicit information on specific science policy issue; while on the other hand, these are used as an aid to theoretical understanding of casual structure related to science and technology systems. These indicators have certain limitations in identifying/mapping science and technology systems, still these science indicators help in the achieving the developmental goals of developing countries.

Scientometric designs for advanced information retrieval on innovation's literature

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Introduction

Traditional document retrieval techniques applied to large collections of bibliographical data are ineffective in capturing the trends and development of scientific and technical knowledge. Scientometric techniques are promising alternatives for conducting 'state of the art' studies, assuring reasonable degrees of recall and precision.

Some articles have already approached the study of '*innovation*' related constructs: Meyer (2006), Schildt and Zahra (2006), Calero-Medina and Noyons (2008), Estabrooks and Derksen (2008) and Crossan and Apaydin (2009), but there are no studies conducting a more comprehensive analysis on the 'innovation' scientific domain. This paper aims at dealing with this gap.

In this sense, this study presents an overall 'picture' of the academic research on "innovation" by retrieving the core articles on the field from the Social Sciences Citation Index (SSCI) – ISI Web of Knowledge.

Method

To conduct the study on the innovation domain, the Social Sciences Citation Index (SSCI)6 of the ISI Web of Knowledge from Thomson Scientific was used to retrieve citation data which covers 2,474 of the world's leading Social Sciences journals across 50 Social Sciences disciplines. This makes the SSCI one of the most important sources for extensive bibliometric/scientometric analyses of the Social Sciences (van Leeuwen 2006).

We searched for all articles with the word 'innovation' in their abstract, title, or keywords from the ISI Social Sciences Citation Index published as an 'article' during the 1945 to 2009 period. This resulted in a data set of 24.392 articles with over 500.000 cited references.

The results are presented in graphical representations of the most expressive researchers and journals on the subject domain. Journals are then clustered and represented in a dendogram, mapping sub-areas inside the domain of 'innovation'.

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[6] http://thomsonreuters.com/products_services/science/science_products/a-z/social_sciences_citation_index

Results and Discussion

The data set is comprised of 32.618 authors, 2.911 journals and 134 countries. It is worth mentioning that due to the nature of ISI Web of Knowledge, there is a predominance of articles written by United States researchers, counting for a total of 10.778 articles, approximately a 44% of all articles.

Among the journals with most cited papers, we found Research Policy (8.166 citations), Strategic Management Journal (5.750 citations), Administrative Science Quarterly (4.428 citations). Research Policy is also the journal with the larger amount of papers on the subject.

Fig. 1 shows a dendogram of peer reviewed journals clustered by their proximity in relation to the keywords used in the papers. Some areas were identified: Innovation in sectors of the economy, Innovation influence on society, Entrepreneurship and technology transfer, Economics of innovation, Management of innovation, Regional development, Organizational innovation, Innovation policy.

This clustering representation brings forward some interesting conclusions. First, Innovation Policy relate to all other areas and links with the second largest cluster (Economics of Innovation, Management of innovation and Regional development). Entrepreneurship then, opens up to other related areas: innovation influence on society and the impact of innovation on sectors of the economy.

This short paper limits itself to show the relevance advanced visualization techniques might have to analyze scientific domains. In this sense, a dendogram is presented exemplifying this issue.

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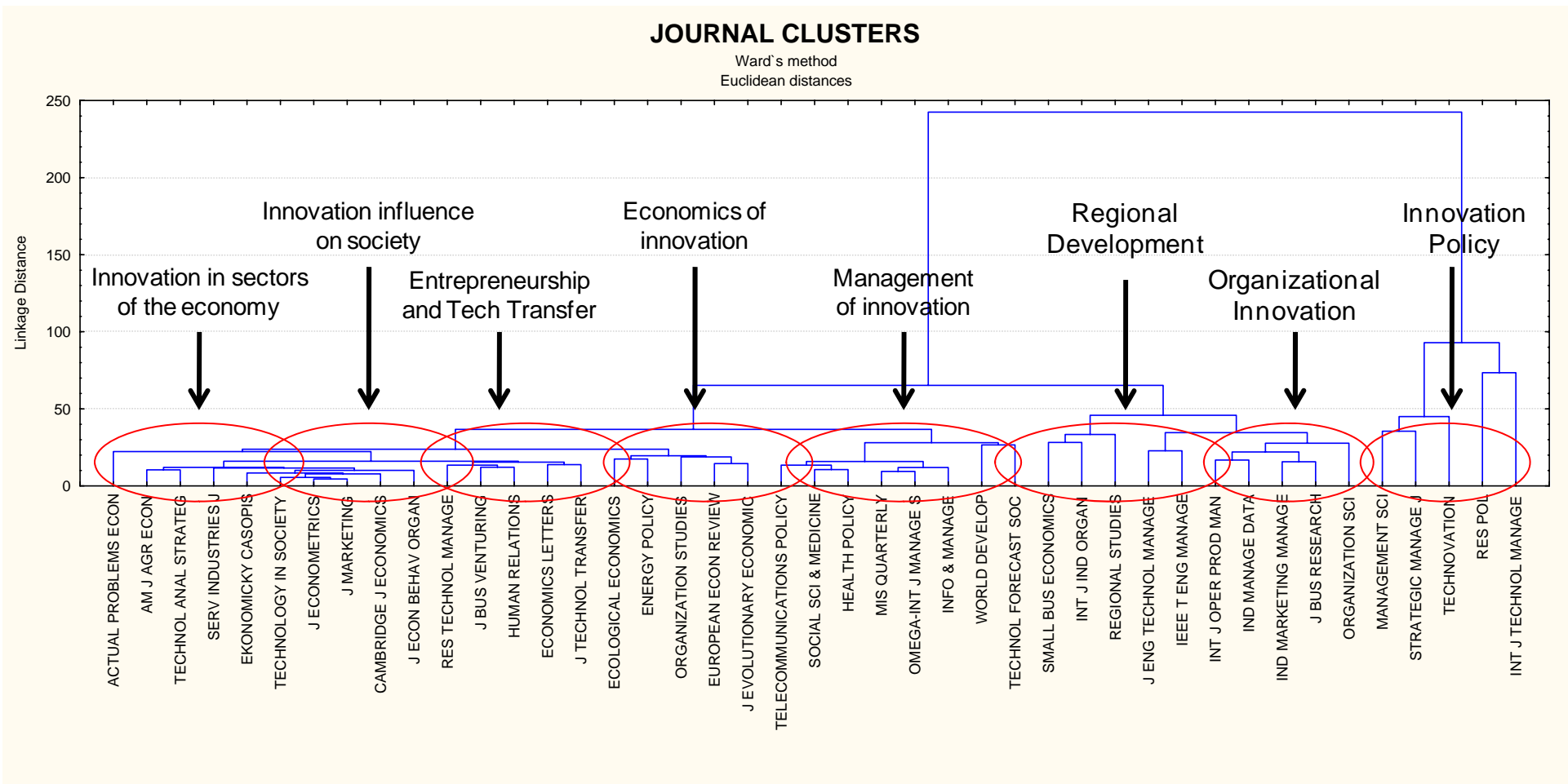
Figure 1. Dendogram of peer-reviewed journals clustered by the proximity of keywords.

The search for "hidden" university patent

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Introduction

Patents applications based on university research are increasingly used as indicator for technology transfer from university to industry. At first sight, the search for university patents seems to be quite simple by looking for applications with universities as applicants. However, many patents based on university research are not applied by universities, but either by the inventors as individuals or by enterprises where the university staff only appear as inventors without institutional information. These cases, where universities are not the applicants, are quite frequent even in countries with a legal framework which obliges the university inventors to report their inventions to the universities. If the university is not registered as applicant, it is impossible to identify the university as initiator of the patent directly in patent database searches. Due to this fact such patents may be called "hidden university patents". The aim of the analysis is to determine these hidden patents for international comparisons of quantities and trends of university patents. We assume that the share of hidden university patents is substantial and that comparisons on the bases of "visible" university patents possess a strong bias.

Method

We matched inventor names of databases with European patents and author names of publication databases, as in the latter the institution of the author is indicated. In the case that the author is affiliated to a university, we also link the corresponding inventor name to the university and register the related patent as university patent. We found out that the searches with the multidisciplinary database SCOPUS are more productive than with the database Web of Science (WoS), as in SCOPUS the author names are generally registered with the full first names and not only the initials. Furthermore SCOPUS covers engineering fields substantially broader than WoS which is relevant for identifying inventors in engineering. Some conditions have to be fulfilled for achieving reliable matches of authors and inventors:
- The patent applications and the publications have to refer to a similar publication year. This criterion is important, as scientists are quite mobile and frequently change the institution.
- The patent application and the publication must refer to a similar field for excluding misleading matches of inventor and authors with identical names, but working in different fields – the homonym problem.
A certain number of wrong or missing matches can not be avloided. In particular homonyms can be found in the same field or the inventions and publications of a researcher can refer to different fields. For instance, a researcher with publications in electrical engineering can have an invention in medical technology.

Test with samples of "correct" university patents show that it is possible to reduce the error rate to a low level (about 2 %). The share of hidden university patents within all university patents proves to be quite high with about 40 percent on average.

The approach was already used in 2003 for the fields of life sciences and nanotechnology (Noyons et al. 2003 a/b). However, at that time only limited fields in the natural and life sciences were analyzed and not all fields of technology including engineering. For this broader coverage, new matching criteria have to be used.

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Ranking national research systems by citation indicators. A comparative analysis using whole and fractionalized counting methods

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Introduction

Recently we have seen a revitalisation of the debate concerning methods for measuring scientific performance bibliometrically. One issue is the adequacy of various methods for calculating publication indicators (Gauffriau & Larsen, 2005). Another topic concerns the methodological basis for journal and field normalisations of citation indicators (Lundberg, 2007; Opthof & Leydesdorff, 2010, *in print*). This presentation adds to the discussion by analysing the difference between whole and fractionalised counting of publications in the construction of citation indicators at the country level.

Citation indicators play a prominent role in assessing the scientific strength of national research systems. These indicators are based on the set of publications that have at least one author address from the respective countries. Most producers of bibliometric analyses apply whole counting of publications in the calculation of citation indicators, which means that each country in internationally co-authored articles receive full credit for its participation. In contrast, fractionalised publication counting, i.e. a country is credited a fraction of a publication equal to the fraction of the author addresses from this country, is only rarely applied. We will analyse and compare the results of these two alternative methods for calculating citation indicators at country level. Since a large and increasing share of the publications involve international co-authorship, this is an issue which is important to address.

Data and methods

We use bibliometric data from the Thomson Reuters database at the Swedish Research Council (SCI, SSCI and A&HCI) It has been restricted to include only articles, letters and reviews published from 2004 – 2007.

We have calculated overall field normalized citation rates for all countries for the period 2004–2007. We have used open-ended citation windows. Citation rates are normalized according to publication type, citation year after publication, and field specific citation rates. Notice, normalization is done on publication level, i.e., the number of citations for each paper from a given country is divided by the average citation rate for the field of that paper (Lundberg, 2007). This approach is different

from the one that is applied in the "crown indicator" where normalization is done on aggregated levels (Moed, De Bruin, & Van Leeuwen, 1995).

Results

Two sets of relative citation scores are calculated, i.e. relative citation scores based on whole and fractional counts, respectively. The scores are compared by subtracting fractional from whole counts, resulting in a difference score. This is illustrated in Table 1 for 23 of the 209 countries investigated. Not surprisingly, the relative citation scores based on fractionalized counting generally yield lower values compared to whole counting since the internationally co-authored publications generally have higher citation rates than the nationally authored publications (e.g., Persson, Glänzel & Danell, 2004).

Table 1. Difference in relative citation scores and ranks among selected countries due to whole and fractionalized counting schemes. The last columns shows each country's share of international publications among its total publication output[7].

Country	Citation scores based on		Difference between scores	Changes in rank order	Share of int. co-publications
	Whole counting	Fractionalized counting			
Iceland	1.56	1.15	-0.41	-4	68%
Belgium	1.24	1.05	-0.18	-3	55%
Denmark	1.39	1.22	-0.17	-1	55%
Ireland	1.19	1.02	-0.17	-2	50%
Norway	1.23	1.07	-0.16	-1	52%
Switzerland	1.46	1.30	-0.15	0	60%
Austria	1.16	1.01	-0.15	-1	55%
Israel	1.11	0.96	-0.15	-1	41%
Sweden	1.25	1.11	-0.14	-1	51%
Finland	1.16	1.03	-0.14	0	47%
Netherlands	1.36	1.23	-0.13	1	49%
Italy	1.03	0.90	-0.13	0	39%
Canada	1.20	1.08	-0.12	2	43%
France	1.08	0.96	-0.12	1	47%
Germany	1.14	1.03	-0.11	3	45%
Australia	1.12	1.01	-0.11	0	41%
UK	1.23	1.13	-0.10	3	42%
Spain	0.99	0.88	-0.10	0	38%
Brazil	0.68	0.58	-0.10	-1	28%
Japan	0.85	0.78	-0.06	-1	23%
India	0.65	0.61	-0.04	1	19%
China	0.84	0.81	-0.03	1	22%
USA	1.35	1.33	-0.01	4	27%

[7] Source: Table 2.2 In: Gunnarson, M., Aksnes, D.W., Faubærk, L. Finnbjörnsson, Þ.; Fröberg, J., Karlsson, S., Kronman, U, Lehvo, A., Nuutinen, A., Schneider, J.W., Sivertsen, G., Sveinsdóttir Morthens, S.G. (2010).). *International Research Cooperation in the Nordic Countries. A publication from the NORIA-net "The use of bibliometrics in research policy and evaluation activities"*. Noria-Net Report 2. NordForsk, Oslo.

Table 1 is ordered according to column four, showing the difference between scores for the selected countries. This rank order corresponds strongly with the proportion of internationally co-authored publications (Column six). Countries with high proportions of foreign co-authorship benefit more from a whole counting method than countries with low proportions.

A general pattern is that large countries (in terms of number of publications) have lower proportions of international co-authorship than small countries. Thus, the difference between the two calculation methods is generally largest for the smaller nations. Countries, such as Iceland, Belgium, Denmark and Ireland are relatively small countries; whereas Japan, India, China and USA, at the bottom of the table, are large countries. The mutual relation between size of differences, size of countries and share of international co-authorships are depicted in Figure 1.
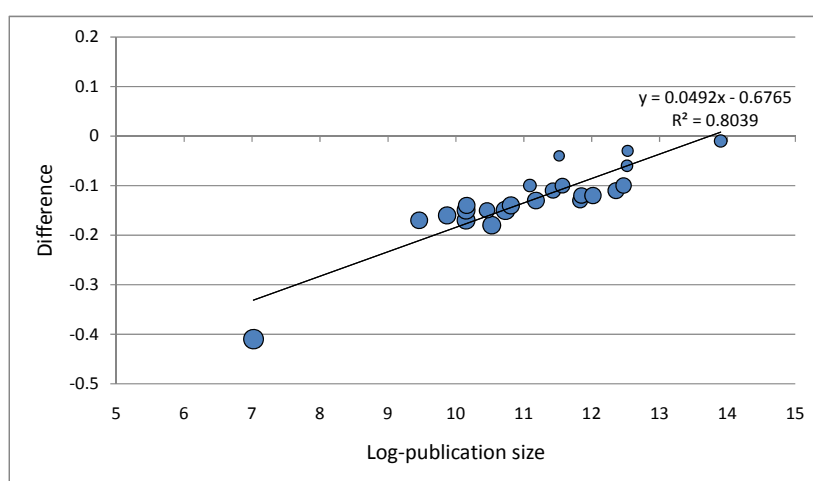
Figure 1. Differences in citation scores as a result of whole and fractionalized counting (y axis) plotted against publication size of countries (log-normalized) (x axis), where the size of circles is proportional to the share of internal co-authorships; *N* = 23.

It is clear from Figure 1 that differences increase when country size decrease and that the smallest circles (share of international co-authorships) are located close to zero difference among the largest countries (highest log-publication sizes).

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Critical issues in science mapping: Delimiting fields by journals and the influence of their publication activity

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Introduction

Journals are the preferred units when fields, disciplines or similar constructs are delimited *a priori* in research evaluation and mapping studies. The *modus operandi* in mapping studies most often resembles the approach outlined in White & McCain (1998). This presentation focuses on two intimately related methodical issues in mapping studies, publication and reference characteristics of selected journals and their authors. Like so many others, we discuss these issues in relation to the field of "information science" (IS), and we focus upon the journal *Scientometrics*. Obviously, the selection of some journals and not others eventually affect a mapping result. However, the influence is more subtle than just the choice of journal. It is essentially rooted in the classical phenomenon of skewed distributions of bibliometric (social) entities. The publication frequency of journals is skewed. The publication frequency of authors within these journals is also skewed. Publication frequency determines reference activity. It is after all authors who write publications, and it is their choice of journals, and not least reference behaviour, which eventually will determine mapping results. As White (2001) has shown, after relatively few publications, authors establish a stable "citation image", which is a skewed distribution of idiosyncratic and domain specific references. Usually we find the author among the few relatively highly cited in his or her "citation image". Further, most authors tend to publish in relative few journals. Hence, the distribution of authors among publications selected for mapping studies are most likely also skewed. We therefore end up with a number of skewed phenomena, which *ceteris paribus*, will influence mapping results, i.e., a few journals will contain the majority of publications used as basis for mapping, and within these publications a restricted core set of authors will dominate. They will dominate because the highly cited part of their "citation images" will be visible due to their higher publication activity, contrary to most references given by less productive authors – it is a self-perpetuating process. In this respect, it should be noted that self-citations are seldom addressed in mapping studies.

Method

Figure 1 shows a multidimensional unfolding of cross-reference activity between IS journals (Schneider, 2009). Cross-reference activity is the odds ratio of mutual reference activity between units such as journals or authors. According to these and related results (e.g., Schneider & Borlund, 2009), *Scientometrics* is a highly specialized journal that do not belong to the cited core of IS journals, located at the origin of the map. By correcting for main effects, it turns out that *Scientometrics* is self-centred in its reference behaviour among the investiagted IS journals.
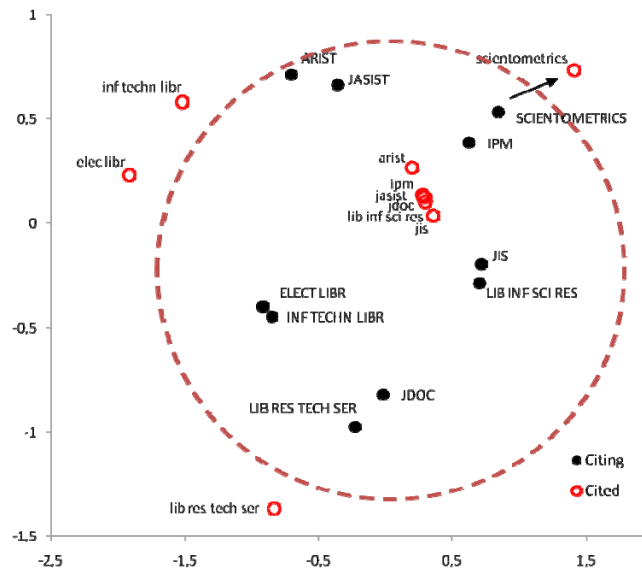
Figure 1. Multidimensional unfolding of cross-reference activity between IS journals measures as odds ratios. Open and closed circles correspond to journals cited and citing profiles. The dotted circle indicates an outer ring where cited journals on the outside are considered specialized journals. The arrow indicate main citing direction for the journal *Scientometrics*, which means odds ratios ≥ 1; notice this is the only odds ratio of cross-reference activity for *Scientometrics* on or above 1 in the current data set.

Selecting *Scientometrics* for a mapping study of IS, which is often done, has important consequences. First it is a specialized journal and will obviously reflect this specialization in the mapping structure. The question is to what degree? A lot it turns out. Table 1 shows some notable publication characteristics concerning *Scientometrics*

Table 1. Publication characteristics of *Scientometrics* and its authors in a comparative study with 11 core IS journals (see Schneider, 2009) from 2000 – 2009.

Share of publications		Number of unique authors	
IS journals (*n* = 6670)	85%	IS journals	5656
Scientometrics (*n* = 1212)	15%	*Scientometrics*	1161
		Overlap	354
Number of unique authors who have published			
only in *Scientometrics* in the current data set (*n* = 1161)			77%
also in other IS journals in the set during the 10-year period (*n* = 354)			23%
Share of publications in the present data in the journal *Scientometrics* by three prominent Scientometricians most often represented in IS maps			
Glänzel (*n* =61)			88%
Van Raan (*n* =20)			70%
Moed (*n* =21)			61%
Share of received citations from the journal *Scientometrics* in the given period for three prominent scientometricians most often represented in IS maps			
Glänzel (*n* =424)			67%
Van Raan (*n* =271)			56%
Moed (*n* =308)			59%

Of the 12 journals studied *Scientometrics* contributes with 15% of the publications. Only *JASIST* has a higher share with 23%. Only 23% of the authors who have published one or more articles in *Scientometrics* have also published one or more articles in one of the other IS journals in the 10 year period. Conversely, 77% of the unique authors in *Scientometrics* have not published in any other IS journal – they publish in other fields.

The unique authors who only publish in *Scientometrics* constitute 20% of the unique authors in the set. It is claimed (e.g., Åström, 2007) that the large "informetric" cluster visible in mappings of IS contains three sub-clusters including "scientometrics". The prominent scientometricians mentioned in Table 1 constitute some of core scientometric authors in these maps. However, it is questionable whether they would appear as prominent or at all in the intellectual base for IS if *Scientometrics* were not selected *a priori* for analysis. These authors both publish the majority of their articles in *Scientometrics* and they receive a majority of their citations from authors publishing in *Scientometrics*, authors that most likely do not publish in other IS journals.

The highly specialized character of *Scientometrics* compared to the other journals in this set, i.e., a larger share of publications and the large number of unique authors that only publish in the journal, obviously exacerbates the influence of this journal to the arbitrary construct named IS. This raises some important questions on how fields ought to be delimited if at all and how publications should be selected for mapping purposes. It is first of all a sampling problem rather than a normalization problem. It is not a question of right or wrong. It is the simple fact stemming from the phenomena of skewed distributions. Very few mapping studies address this issue.

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Network characteristics of highly co-active researchers

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Introduction

Co-activity, defined as a researcher joint production of scientific articles and patents of invention, is an interesting focus for studying how scientific ant technological research networks connect.

Building on Stefano Breschia and Christian Catalini's approach, this study analyses the research networks linking scientists working in an open science environment and researchers involved in the private technology domain. As the study previously mentioned, it combines data on scientific co-authorship with data on patent co-invention, at the level of individual researchers, for two science-intensive technology fields: heterogeneous catalysis and pharmaco-genomics. But this research departs from Breschia and Catalina's work in the process chosen for setting up of the body of data: i.e. in the delineation procedure.

This research characterises at a finely grained level the scientific papers and patents produced by a group of core researchers, highly visible in their respective field, that are selected through an expert-based process.

Method

These research aims are modest in scope – focusing on a limited research fields – but ambitious methodologically. Two robust data sets have been produced after a thorough manual cleaning that aimed at disambiguating researchers' identities within and across corpora and at identifying the proper documents - articles from the Thomson Scientific Web of Science and priority patents from docDB accessed through the Espacenet online platform or the corresponding Patstat off line patent data base, both collecting data from more than 80 national patent offices.

This research has already carried out the network-based analysis of research collaborations tied by these 16 central actors in the field of heterogeneous catalysis. In a nutshell, these core researchers have produced 3510 papers and 344 priority patents, involving 1792 co-authoring researchers and 429 co-inventing researchers. The academic patenting activity has produced 270 publicly owned patents (with a public

research organisation as applicant) and 61 privately owned patents (with a firm as applicant).

This research characterises two different networks structure for the scientific and technological networks. The scientific networks - where links connect co-authors - is a highly connected graph with a giant component: scientific knowledge is produced globally through collaborations that cross largely national and institutional boundaries. The technological network – less crowed (3510 papers versus 344 priority patents) – is less connected with many unconnected sub networks of co-inventors: technological knowledge is produced more locally. The hybrid graph based on the data presented below connects these core researchers with the institutions (firms and PROs) that have applied for patenting the novelties they have been inventors of.

Our first findings show for the field of heterogeneous catalysis a strong coactivity and an intensive connectedness / overlap among scientists and inventors networks. The core researchers we started from act as gatekeepers and bridge the boundaries between the two domains. Finally, our results do not confirm that in the field of heterogeneous catalysis maintaining a very central position in the scientific network come at the expense of being able to fill a similarly central position in a technological network (and vice versa). The 16 core researchers score high in terms of centrality, in both scientific and technological networks.

Fig1: Institutional scientific collaborations (academic and firms) for the top 16 researchers in heterogeneous catalysis

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Bibliometric Productivity: The Role of University-effects on the Research Group Level

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Introduction

The call for legitimacy, transparency and efficient use of scarce resources in the public research sector has given rise to an increased interest in the analysis of scientific production, the latter being often modelled in terms of an input-output framework (e.g. Schubert 2009).

Due to a lack of multi-level data, scientific research units are often treated as autarkic units whose outputs only depend on their direct inputs and other micro-level characteristics. This may be too simplified because it neglects the macro-organisational environment. In this context it seems obvious that not only direct inputs and other micro-level characteristics of the research group but also the characteristics of the university where the group is located have profound influence on its output.

In this paper we empirically investigate the scientific production processes of individual research groups in a broader fashion by looking also at features of their environment (e.g. size of the university). Special interest lies in the latter class of variables.

Data

We generate a unique data-set by combining a micro-level survey from 2007/2008 on 329 German university research groups from astrophysics, nano and biosciences, and economics (compare Schmoch and Schubert 2009a, 2009b) and university-level data that originates from the EUMIDA database that is an extension of the AQUAMETH database (Bonaccorsi and Daraio 2007). We augment this data-set by adding bibliometric data for the respective research groups from Web of Science® (WoS). For all fields including economics, we expect the WoS to give a good description of the bibliometric activities, because all disciplines are highly oriented towards an international community.

Method

We work with the concept of the knowledge-production or innovation function (Griliches 1979, Mairesse and Mohnen 2002), which allows analysing input-output models by the use of regression approaches. In particular, we explain bibliometric output of the research groups (citation measures, publication counts) by its direct inputs (staff, capital equipment), variables that describe the governance of the research group, and macro-variables that measure features of the university that the research groups belong to. We account for a variety of econometric difficulties (limited dependent variables, heterogeneity, and over-dispersion). To achieve this we make use of appropriate Tobit and Count-Data Models.

Results

The results show that additionally to the level of direct research inputs, features of the university have pronounced effects. In particular, we find that research groups tend to be more productive in bibliometric terms, if they belong to a large university. Furthermore, we find that the degree of internationalisation in teaching (measured by share of foreign students) significantly increases bibliometric productivity. These results hold irrespective of whether we use more quantity-oriented measures of bibliometric productivity (e.g. number of articles in the WoS or "publication productivity") or quality-related measures (e.g. received citations or "citation productivity").

Table 1: Research output (Negbin/ Tobit regressions)

	#Publications	#Citations	#Publications per scientist	#Citations per scientist
Governance framework				
Influence of university presidents	0.2394 ***	0.0898	0.2874	0.1109
Influence of deans	-0.0519	-0.0011	-0.6013	-0.2458
Bibliometric performance indidators used	0.4144 **	0.2484 **	3.6385	0.5741
Regular evaluations	0.2032	0.2145	3.4250	1.2422
Rigid personel quota	0.0033	0.0058	0.0850	0.0134
University council present	-0.1578	-0.1551	-8.7504 ***	-1.4920 *
Research group characteristics				
Astrophysics	3.9319 ***	2.0620	36.7498 ***	6.3378 ***
Nano	3.0080 ***	1.7040 ***	24.4970 ***	5.4909 ***
Economics	3.3049 ***	1.8605 ***	32.3311 ***	6.6492 ***
# Scientists	0.0621 ***	0.0596 ***	-0.6375 ***	-0.2375 ***
# Scientists²	-0.0003 ***	-0.0003 ***	0.0031 **	0.0012 ***
Satisfaction equipment	-0.0903	0.0098	-1.0855	-0.0156
Time share research	0.0037	0.0041	-0.0810	-0.0183
Year of PhD-thesis	0.0009	-0.0045	0.0736	0.0163
University characteristics				
University staff (FTE)	0.0001 **	0.0001 *	0.0019 ***	0.0005 **
Students per university staff	-0.0179	0.0034	-0.4947	0.0520
PhD-students per	1.6603	0.3498	30.5693	11.2888
# subjects covered	-0.0628	-0.0303	0.3943	-0.0170
Distance education	0.0476	0.2195	-0.4625	0.1895
Internationalisation in PhD-training	3.4089 **	2.3476 **	30.3954	10.7256 *
Year of founding	0.0001	-0.0003	0.0007	-0.0023
University hospital present	0.0488	-0.2404	-6.6033	-2.0152
Constant	-2.9276	9.3009	-159.9582	-31.2282

* significant at 10%, **significant at 5%, *** significant at 1%

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Institutional identifiers as potential tool for bibliometric studies

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Introduction

Almost all bibliometric studies on an aggregation level anywhere between countries and persons have to deal to a certain extent with institutional dynamics as well as fuzzy boundaries and manifold relations between organizational entities. Beyond a "natural" rate of change in the landscape of research institutions (figure 1, examples 1-6), given by founding of new organizations, diversification on the department level, or merger of entities, there is an increasing development of new forms of organizational structures which are more flexible, unsettled and diffuse (figure 1, examples 7-9). These often politically programmatic trends to networks, virtual centres and mergers which are domain-, area- and sector-transcending can be very challenging for bibliometrics, especially when confronted with the requirements of a long range monitoring of institutional research performance. In this paper some aspects of a flexible management of the relevant data and underlying relational table structures for bibliometric studies will be discussed. The approach is designed to help overcome the major problems of the attribution of publications to institutions.

Method

Starting point is an exercise to attribute all 2008 publications with at least one corporate address record from Germany as covered by the Web of Science, to real life existing german research institutions. This task requires a clear and selective description of the addressed entities at least on the main level of autonomous organizations identified during the process of address coding. Enriched by relational information this can be seen as a snapshot of the institutional landscape represented in the total publication output as far as covered by the sources in Web of Science. To make this data collection usable over time and to prepare it for different needs in the context of research evaluation the possible structural changes over time are considered and mapped into an appropriate data base structure (figure 2). All types of organizational entities are identified by an institutional code and their relations are mapped with begin and end dates. The main concept is the introduction of institutional identifiers independent from the different types of relations and their duration.

Results

By implementation of unique institutional identifiers it is possible to reduce the complexity of address record variants. An observed status of the institutional landscape becomes reproducible at any time later and the system can deal with special structural aspects focused in political contexts of bibliometric studies. The application of the generated institutional identifiers is not limited to address records from Web of

Science. It can also cover address data from other sources like PubMed (Medline), Elseviers Scopus (which carries an own type of affiliation ID for part of its records) etc. as well as several open archives.

Conclusion

Universal identifiers are becoming more and more important for bibliometric applications. The Digital Object Identifier (DOI) as a tool for unique identification of publications plays already a major role not only for reference linking. Currently, the ORCID initiative (2009) carries a substantial effort to establish an independent „Open Researcher and Contributor ID" which can be used globally to unify author and contributor identification in any scientific publication databases (GEN2PHEN 2009).

Most recently the I^2 working group started developing a standard for an institutional identifier that can be implemented in all library and publishing environments (Needleman 2009). If bibliometric research groups are willing to adopt these approaches they will be able to join efforts in address unification and to exchange validated data through open standards (Bouquet et al. 2008). This would help to decentralize the work to be done and share the results within the scientific community.

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Figure 1: Types of organizational change

A ⇒ B C	A B ⇒ C	A B ⇒ A
Division	Merger	Incorporation
A / B C ⇒ A | B C	A B ⇒ A | B	A / B C ⇒ A | B | C
Separation	Vertical Integration	Regrouping
A B C ⇒ B / A····C	A B C ⇒ ⌐D⌐ A B C	A / B C D | E ⇒ A / B C D ⋰ E
Networking	Subsumption (Umbrella organization)	Multiple Affiliation
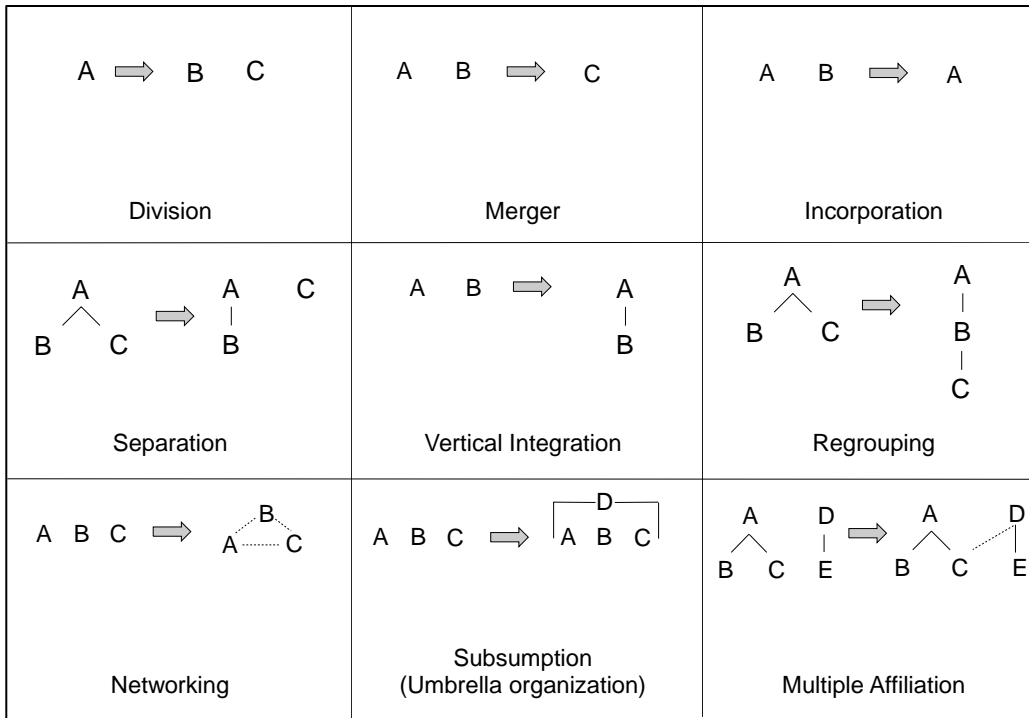
Figure 2: ER-Diagramme of the bibliometric database

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Results

In order to establish technological features, derived from the analysis of this scientific activity, it is possible to design a research agenda to guide the activities of CENIVAM in the search of new products that, in turn, contribute to the strengthening of a productive sector based on the exploitation of essential oils and medicinal plants.
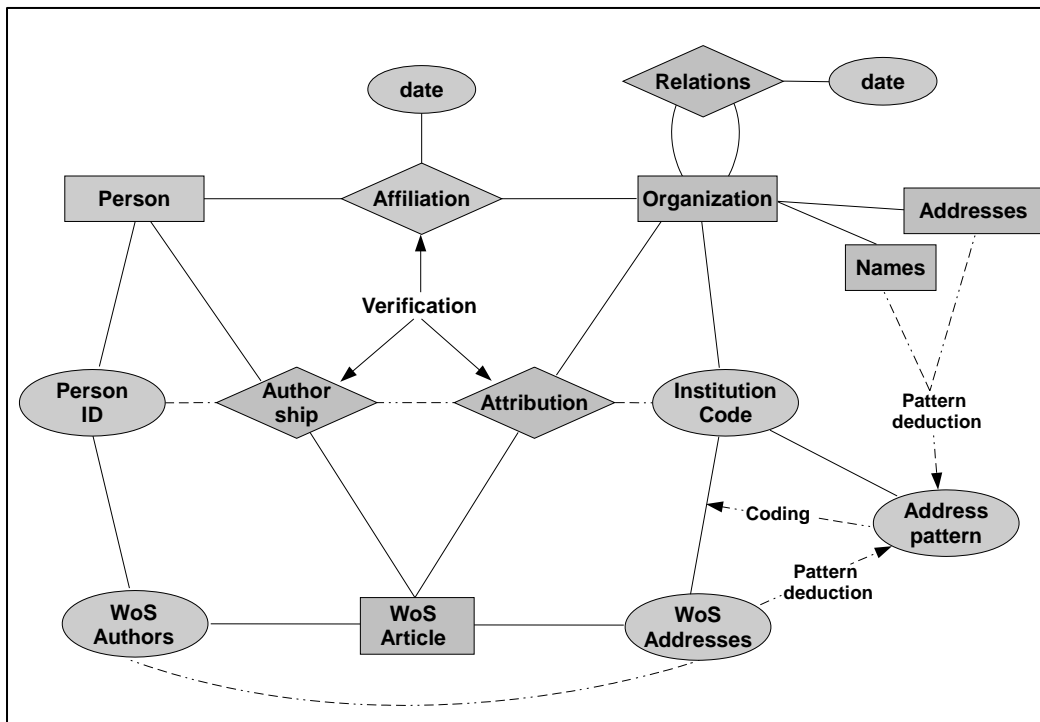
A wide range of applications and final uses for essential oils and medicinal plants was identified as shown in Table 1.

Does Commercialization Impact Academic Collaboration?
The Usefulness of Sensitive Science and Technology Indicators

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Introduction

Commercialization has become a high priority in research funding strategies around the globe, all the while funding programs continue to encourage research networks and collaborations. However, evidence increasingly suggests that commercial activities of academic scientists undermine academic collaborations, resulting in secrecy and withholding of materials and data (Walsh et al., 2005; Hong and Walsh, 2009).

Commercialization activity (patenting) has recently been shown to have a negative impact on scientific knowledge in the public domain, e.g., human gene patenting on follow-on citations to a corresponding academic paper in a patent/paper pair (Huang and Murray, 2009). Here, we show that there is a negative impact of patenting on academic collaboration measured through co-authorship.

Thus, we find that sufficiently sensitive science and technology indicators applied to high-quality datasets can elicit clear S&T policy effects, and that knowledge domain visualizations can illustrate and underline these effects.

Method

We studied a Canadian Network of Centres of Excellence to explore the potential for conflict between its networking and commercialization mandates. We collected information on all the publications it funded, as well as biographic, bibliometric, and patenting activity data on its 83 active science Principal Investigators (PIs). The data was obtained from the Network itself (publications and PIs), ISI (bibliometric summary data), the web (biographies), and the USPTO and CIPO databases (US and Canadian patents).

Combining PubMed and Scopus, we delineated a research area that was closely related to this highly interdisciplinary Network (Strotmann, Zhao and Bubela, 2009a), gathering full author lists for almost all its literature. An extensive coauthorship network model (visualized in part in Figure 1) was constructed from this literature after automatically disambiguating author names (Strotmann, Zhao and Bubela, 2009b).

Generalized linear models were constructed to see whether (and if so, to which degree) the commercialization activities of a PI had a measurable effect on that PI's coauthorship network characteristics, after taking into account several different metrics for the PI's seniority, research productivity, research impact, geographical location, institutional affiliation, and research subfield membership.

Three co-authorship network metrics were employed in these models. Two were local in nature: (a) number of distinct coauthors (degree centrality); and (b) number of

distinct co-authors of the PI's coauthors (neighbourhood size). One metric was of a global nature: the collaboration link strength at which the co-author network's connected component of which the PI is a member is no longer a major network component when only co-author links with a number of at least that many papers co-authored by the linked authors are considered.

Findings

The local collaboration metrics both produced clear evidence of a subtle negative effect of commercialization activity on academic collaboration behaviour (Bubela et al., 2010). The simpler of the two metrics (degree centrality) was more sensitive in that it produced a result with higher statistical confidence. The global metric, on the other hand, was too coarse to capture this subtle effect, even though a closely related knowledge network visualization (Figure 1) proved to be well suited to illustrate it.
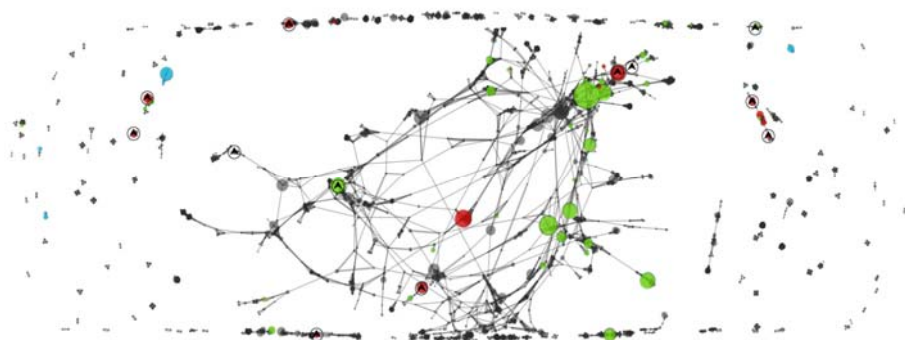
Figure 1. Top patenters (red), startup founders (symbol), and humanities PIs (blue) tend to be more peripheral than "normal" science PIs (green) in their field's multi-co-authorship network.

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Multi-Database Field Delimitation: ISI vs. Scopus

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Introduction

Field delimitation is a complex problem, and can be very difficult to do in the case of highly interdisciplinary research field (Zitt and Bassecoulard, 2006). In the case of biomedical research field delimitation, we previously found that performing the actual field delimitation itself in PubMed/Entrez can work very well (Strotmann, Zhao and Bubela, 2009; 2010). In this case, the problem of field delimitation for citation analysis boils down to a problem of mapping citing papers and cited references between those identified in PubMed to comprise the research field and the corresponding records in one of the citation indexes.

For a number of reasons, Scopus and ISI citation indexes pose very different challenges with respect to this mapping process. Scopus, for example, supports large and complex search strategies (and more recently, even a PubMed ID field) that help map a PubMed record to its Scopus counterpart with high confidence. ISI, on the other hand, allows automated interactions with its databases.

In this paper, we compare the methods we developed for mapping between PubMed and ISI with those we previously reported for mapping between PubMed and Scopus.

Method

Scopus

For mapping PubMed records to their Scopus counterparts, a complex Scopus query was constructed from each record, and about 500 of these complex queries were submitted at a time. Scopus licensing conditions required these queries and corresponding result downloads to be performed manually. The mapping of retrieved Scopus records back to their PubMed counterparts was done using a series of PubMed Batch Citation Matcher queries.

ISI

Mapping PubMed records to their ISI counterparts was considerably more difficult, as ISI does not support the search fields that we used with Scopus. Instead, the following procedure was followed:

1. Exact title match search for PubMed records in ISI, in blocks of about 50 titles per query and about 500 per result download (90% recall).
2. Map retrieved results back to PubMed as above for Scopus to identify matches at this stage and to filter out false positives.
3. Search for remaining records by combining publication year and up to three author names into a query, 10 records at a time (high recall, 50% false positives).

4. Map results back to PubMed as above to identify matches and filter out false positives.

Findings

In both cases, about 98% of the PubMed records comprising the original field delimitation were matched to corresponding records in the citation indexes. The error rate is estimated in both cases at about 1%.

There were significant differences in the details of the search procedure, however.

It took almost 20 times as many ISI queries than Scopus queries on average to identify the same number of PubMed records in the citation index.

About ten percent of the search results downloaded from ISI was filtered out as false positives, compared to less than 1% from Scopus.

Matching retrieved ISI records to the original PubMed ones required significantly more programming to achieve the 98% mark than it did for Scopus.

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Comparing the hardly comparable? - Quantitative research assessment exercise at the Social and Economic Sciences Faculty of the University of Graz

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Introduction

The Faculty of Social and Economic Sciences at the University of Graz includes the three main departments of economics, business administration and sociology and a total of 17 institutes. Though being one organizational unit, the faculty is more heterogeneous as one would think. Parts of the sociology department are still rooted in a humanities tradition. A certain level of heterogeneity can also be found within the economics department and the business administration department. Besides core institutes like accounting or marketing, there are also institutes with a broader focus like information science and business and economics education. An important general framework is the high teaching load of the faculty, in particular the business administration department. In April 2010 nearly 7500 students were subscribed to the faculty who were served by 104 FTE academic staff.

Method

Since 2006 academic staff members of the University of Graz must document their research achievements (publications, presentations, membership in editorial boards, organization of conferences, reviews/expert opinions, etc.) in the so-called "Performance Record" (PR).

One problem is that an extensive documentation of research performance does not necessarily mean a high research quality, i.e. quantity cannot be equated with quality. As a consequence, it was the goal of the study described in this contribution to define several indicators on the basis of PR data and to analyse their effects on subsequent rankings in a first step.

Table 1 shows the institute rankings[8] on the basis of the number of book publications and the number of publications in Web of Science (WoS), WISO[9] and Publish or Perish. Furthermore the number of publications and citations per article in WoS and Publish or Perish, h-index (only Publish or Perish), the number of journal publications, and the number and type of journal publication according to VHB journal ranking[10] were regarded. Besides PR we used WoS, WISO and Publish or Perish as data sources. The investigation period included the publication years 2003-2007.

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[8] The rankings were also performed at the level of researchers.
[9] WISO is an assortment of nearly a dozen bibliographic primarily German-language databases which provide approximately 6.5 million articles.
[10] VHB-JOURQUAL represents the official journal ranking of the German Academic Association for Business Research.

Results

As can be seen in Table 1, even simple indicators like number of publications in different "occurrences"/data sources show quite different results. There was only one institute (I:TIM) which placed in three rankings in the top-2. At the level of researchers most but not all top scientists could be found on the top of each quality-related ranking. However, only a small proportion of PR journal publications (20% of journal articles) were covered by WoS and published in high quality journals (15% appeared in A, B or C journals according to VHB journal ranking). Publish or Perish has the advantage that it does not only cover journal articles. However, its general coverage of PR records is too low to guarantee a reliable analysis.

Table 1. Number of monographs and number of (S)SCI, WISO and Publish or Perish papers per full time equivalent (FTE) for each institute

| Institute | FTEs | Monographs | | Articles | | | | | | | | |
| | | | | WoS | | | WISO | | | Publish or Perish | | |
		per FTE	rank	absolute	per FTE	rank	absolute	per FTE	rank	absolute	per FTE	rank
I:IWI	4	0.00	11	5	**1.25**	**3**	2	0.50	8	9	2.25	9
I:BF	4.17	0.00	11	1	0.24	11	2	0.48	9	2	0.48	13
I:FIWI	4.83	0.00	11	8	**1.66**	**1**	6	1.24	5	15	**3.11**	**3**
I:HAM	4	1.00	4	0	0.00	13	9	**2.25**	**3**	11	2.75	4
I:IFW	4.5	0.22	9	2	0.44	8	3	0.67	6	3	0.67	12
I:IM	4.33	**1.39**	**3**	2	0.46	7	2	0.46	10	7	1.62	10
I:IUF	2.67	**2.25**	**1**	2	0.75	5	4	1.50	4	16	**5.99**	**2**
I:NM	3.69	**1.90**	**2**	1	0.27	10	1	0.27	15	4	1.08	11
I:OPM	3.2	0.00	11	0	0.00	13	0	0.00	16	0	0.00	15
I:RLS	3.42	0.00	11	1	0.29	9	10	**2.92**	**2**	8	2.34	7
I:SOR	6.5	0.15	10	7	1.08	4	3	0.46	11	16	2.46	6
I:SOZ	13	0.54	6	3	0.23	12	5	0.38	14	30	2.31	8
I:TIM	2.75	0.36	7	4	**1.45**	**2**	12	**4.36**	**1**	20	**7.27**	**1**
I:UWP	5	0.00	11	0	0.00	13	2	0.40	13	0	0.00	15
I:VWL	12.25	0.90	5	6	0.49	6	7	0.57	7	32	2.61	5
I:WIP	2.33	0.00	11	0	0.00	13	1	0.43	12	0	0.00	15
I:WSG	3.25	0.31	8	0	0.00	13	0	0.00	16	1	0.31	14

Due to the strong variance among the different rankings, a point-based rating system developed by the university was also applied. This system considers the following main research output categories: monographs, collected editions, journal publications, presentations, and networking. For each category between 5 and 50 points are assigned according to the quality of the research output (see Table 2 for the category presentations). However, when applying the point-based system to the first institute, it turned out that is not feasible.

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Table 2. Point-based ranking system, category presentation

Presentations	
Keynote speaker at international conferences	50
Invited speaker at international conferences	40
Presenter at international conferences	25
Presenter at national conferences	15
Poster presentations	5

Future research

The issue how to identify research excellence at the faculty (and the university) has not yet been solved. So far, in our opinion the following options seem possible:

1. Considering only WoS/Scopus publications and citations.
2. Taking into account discipline specific journal ratings (for business administration, economics, sociology, information science, etc.) or more comprehensive publication ratings (for instance, an adaptation of the Norwegian bibliometric model).
3. Comparing departments with similar research units from other universities (benchmarking).

How academic are pharmaceutical companies?

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Introduction

Pharmaceutical and biotech companies take a special place in the science landscape. These firms invest a lot of resources and time in basic research and in the publication of their results. (Leten et al, 2010). As a result these commercial organizations produce more scientific output than many publicly funded organizations like government agencies or universities. Sometimes, they produce even more than a middle sized European country. From a market failure perspective it seems unreasonable for companies to devote time and money on basic research This paper has two main research goals? First we want to examine on a large scale the scientific performance of pharma and biotech companies compared to other organizations. Secondly, we want to investigate the place or role that these companies take in the landscape. Do they participate in a large network? Do they collaborate with other companies? Is their work visible and used by other organizations? For both research questions the changes over time are an important issue.

Method

A list of 75 large pharma and biotech firms was compiled and for each of them a set of subsidiaries is identified. This list allowed us to create sets of publications from 1995 onwards in which these companies appear as a co-author. Institutions or universities with a likewise research profile (Thijs, 2008) are selected for comparison. For the same period, publications of US and European research institutions and for countries were collected.

Several bibliometric indicators are calculated to describe the performance of the firms and the other entities. These indicators include not only publication counts but also standardized citations scores like the Relative Citation Rate or the Normalized Mean Citation Rate (eg. Glänzel et al. 2009). Ratios between these standardized scores will also be used to identify publication strategies. Statistical test will be applied. Special attention goes to the field differences. Because of the large time window of data available an analysis of the evolution of the firm performance is possible.

In the second part of the paper we want to create a network around these companies to map their relations with each other and other institutions. Tijssen (2009) showed the

cooperation patterns of 10 European companies for 2005-2006 publications. This paper tends to describe a much broader network between European and US companies at one side and universities and agencies at the other. We use co-author links between the organizations to measure the strength of the cooperative relations. Pajek is used for the network analysis and the drawing of the maps based on these links.

Maybe even more than the links with co-authors, the impact of the research by pharma and biotech companies on other organizations describes the position of the firms in their network. We will detect the type of the organizations citing work of the companies and compare this use profile with the work of universities or government agencies.

Results

The first results of the analysis show the prominent role that these firms take in the science landscape in the field of pharmacology and biotechnology.

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Detecting emerging clusters: ART, WARD or k-Means

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Introduction

A hybrid clustering based on the combination of a lexical distances and a citation links between documents has been used for the identification of different topics within a field or subfield. This clustering was successfully applied on bioinformatics and library and information science (Glänzel et al. 2009, Janssens et al. 2008). However, for the detection of new or emerging topics within a field this clustering over one time window needs to be extended. We propose three different approaches and describe benefits and pitfalls.

Methods and Results

When applied to a set of publications over a long period of e.g. ten years, several problems surface. The large publication sets, obtained from large time windows, cause an increasing complexity of calculations. Furthermore, as topics evolve, new vocabularies are adopted in overarching fields as well and the dimensionality of the lexical component increases.
The problem of dimensionality is reduced by applying Singular Value Decomposition on the document by term matrix. But this is a knife that cuts at both ends, a SVD can also remove important information about these small changing topics.
Another disadvantage of this large window approach is the lack of extensibility. It is, practically, a static analysis that does not allow for subsequent years to be added.
We propose three different solutions for these problems.
In the *first approach* we apply the clustering agglomeration method (WARD's method) to a much smaller time window of 3 or 4 years. Clustering is repeated over a shifting time frame. The set of publication is much smaller in each step and it is less likely that SVD removes important new concepts or topics and more likely that the cluster analysis detects different or new topics. The evolution of the clusters can be described by looking at the different classification of publications in overlapping runs.
The *second approach* adds the property of 'memory' to the consecutive cluster analyses. We do this by using a k-means approach. The starting number of clusters for each run will be decided based on the previous time frame. Each run on a time frame consists of three phases. First k-means cluster analysis maps all publications with the themes that were identified in a previous run. In the second phase the consistency of each cluster is checked. Clusters with high inconsistency will be split up and new centres are calculated. In the third phase a new k-means clustering is performed with these additional centres.
The advantage of this approach is that it is quite easy to see the evolution of each cluster; it can readily be detected when it is split up and changing labels of clusters can be recognised as well.
The *third approach* is an implementation of the Adaptive Resonance Theory (Carpenter and Grossberg, 1991). This neural network version of a leader-follower clustering has especially been developed for the detection of new patterns in the data. This does not imply that all data are available at the time of the learning stage. At a

later point in time the new data are compared with the expectations which are obtained as the result of all previous runs. If needed new classes are created in the memory of the network.

Figure 1 presents, as an example, the result of the first approach in the field 'Energy & Fuels'.
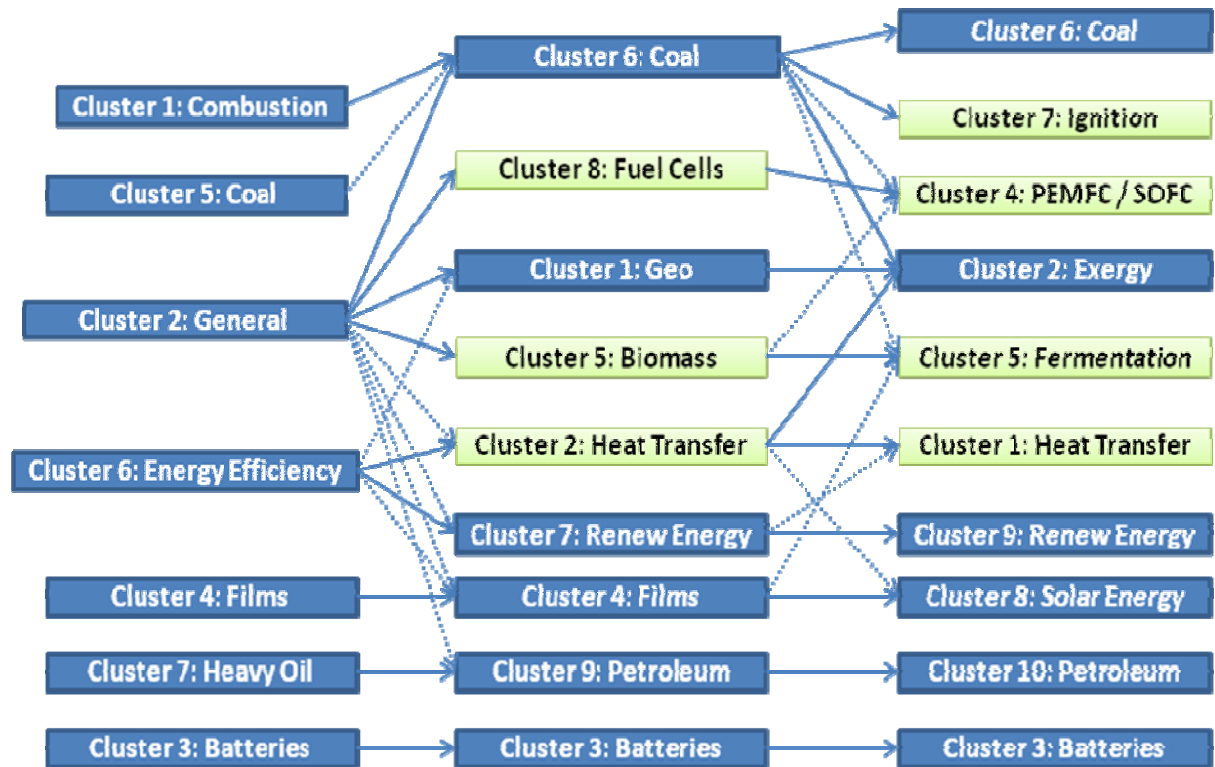
Figure 1. The changing cluster structure of 'Energy & Fuels' using three sub-periods (1999-2003, 2002-2006 and '2004-2008).

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Performance Indicators for Humanity Institutes – A Preliminary Study

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Introduction

Institutes in humanity face the same evaluation problem as those in science and technology. However, suitable indicators are still in question. This article aims to explore some performance-related rankings which may be potential components in the final indicator for humanity Institutes.

Method

As a preliminary study, we use three rankings at hand for institutes in Taiwan. The first is based on academic articles in Taiwan Humanity Citation Index (THCI), from which we calculate the number of papers, citations, and impact factors for most universities in Taiwan. The second is based on webometrics, where we mimic the webometrics rankings proposed by (Aguillo, Granadino, Ortega, & Prieto, 2006). The third is based on human resource, where the number of full-time faculties (professors/researchers) is counted.

THCI is a relatively complete index for arts and humanities research in Taiwan. More than 300 domestic journals were included, covering various disciplines such as (Chinese and foreign) literature, history, philosophy, arts, linguistics, religion, library and information science, and general humanities. Use of the THCI as a research tool is the core philosophy behind the creation of THCI (Chen, 2004).

Based on the rankings resulting from this index, selected departments/institutes from the top ranked universities were subjected to the webometrics ranking and human resource ranking. Correlations among these rankings were computed and the ranking results were interpreted for some selected fields.

Result

Table 1 shows a ranking example for the discipline of Chinese literature, where P^{11}, C, Cx denote the number of papers, citations, and non-self citations, respectively, and CPP denotes citations per paper, CxPP is non-self citations per paper, PS is percentage of self-citations relative to all citations, F is the number of faculties of the department of Chinese literature, FR is the ranking of F, and finally WR is the ranking resulting from the webometrics considering the department's web pages, visibility, rich files, and scholar documents. The institutes in Table 1 are ordered by P and this ordering does not (statistically) correlate to FR, nor does it correlated to WR. FR and

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[11] The idea of using P, C, Cx, CPP, CxPP, and PS is from http://conference.cwts.nl/projects/leiden-ranking-2009/show?page=ranking_legend

WR are not correlated either. This means that the larger faculty groups do not guarantee the better performance in terms of P or WR. It also means that these three rankings are quite independent of each other and can be combined in some way to form a composite performance indictor for the Chinese literature discipline. We have also ranked universities in Taiwan for the disciplines of foreign literature, history, philosophy, and library and information science. Similar conclusions were obtained among these five disciplines.

Table 1. An Example of University Rankings in Taiwan for Chinese Literature

University	P	C	CPP	Cx	CxPP	PS	F	FR	WR
Natl Taiwan Univ	283	459	1.622	335	1.184	0.270	53	1	4
Natl Taiwan Normal Univ	233	230	0.987	151	0.648	0.342	51	2	6
Fu Jen Catholic Univ	108	61	0.565	49	0.454	0.194	16	10	1
Natl Chengchi Univ	102	114	1.118	98	0.961	0.139	33	3	2
Natl Cheng Kung Univ	87	73	0.839	56	0.644	0.230	29	4	3
Natl Chung Hsing Univ	84	27	0.321	20	0.238	0.250	18	7	9
Natl Sun Yat-sen Univ	76	34	0.447	21	0.276	0.371	18	7	5
Natl Chung Cheng Univ	74	68	0.919	42	0.568	0.377	20	6	10
Natl Tsing Hua Univ	41	65	1.585	45	1.098	0.303	18	7	7
Natl Center Univ	29	34	1.172	31	1.069	0.086	25	5	8

Implication

The performance of scholars in humanity institutes are hard to evaluated, since their achievements are not limited to academic papers, but also in the forms of monographs, books, artworks, presentations, exhibitions, and public influence, most of which are quite subjective. However, by use of as many objective indicators available at hand as possible, we believe that their values can be more visible than otherwise were not evaluated at all. The ranking results in this work can serve as component indices in the final indictor. Moreover, the unveiling of these ranking results may cause further discussions, from which more suitable indicators may be suggested for humanity scholars or institutes.

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Does an Asia-Pacific Research Area Exist from a Bibliometric Point of View?

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Introduction

This contribution focuses on eleven countries[12] in the Asia-Pacific region by evaluating their national research output with the help of bibliometric indicators. Over two million journal articles published by these countries between 1998 and 2007 in ISI-listed periodicals are analysed (HAUSTEIN, MITTERMAIER AND TUNGER, 2008). Further it describes the different forms of international scientific collaboration in general and tries to give reasons for them (HAUSTEIN, S., TUNGER, D., HEINRICHS, G. AND BAELZ, G, to be published in Scientometrics).

Method

Consideration is given to the following aspects in order to reveal the strengths and weaknesses of countries in the different research disciplines:

- International comparison of publication activity
- Co-publications between the countries studied
- Discipline-specific publication and citation profiles making use of a global benchmark

With the aid of the publication profiles it can be shown that China, for example, displays a high degree of publication activity in the materials sciences and is involved in about 30 % of all research articles and reviews published worldwide in this field in 2007. China is also very active in the field of chemistry, and contributes about 20 % of articles produced worldwide in 2007. However, China has a very low proportion of medical publications, which represent a major focus in the Science Citation Index and account for about one third of the database. Altogether, the publication profiles provide detailed insights into a country's major scientific priorities[13] (GLÄNZEL, DEBACKERE AND MEYER, 2008; LEYDESDORFF AND WAGNER, 2008; LEYDESDORFF AND RAFOLS, 2009).

The present contribution focuses on addressing the question of whether scientific cooperation intensified in the Asia-Pacific area from 1998 to 2007. In order to answer this question, in addition to the aspects mentioned above, co-publication networks are generated among the eleven countries to observe the development of cooperation

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[12] This contribution focuses on the following countries: Australia, China, Indonesia, Japan, Malaysia, New Zealand, Singapore, South Korea, Taiwan, Thailand and Vietnam.
[13] It has been discussed, that the measured increase in Chinese publication output is caused by recent changes in Thomson Reuters' WoS coverage policy only. However, a general increase of Chinese publications can be observed in well-established ISI journals as well.

bonds in the region. A strengthening can be observed in the network diagrams. The lines indicate the number of co-authored journal articles in 1998 and 2007 within the eleven countries analysed. The number of joint publications has been normalized with respect to the total output of the two countries by applying Salton's measure of *international collaboration strength* (GLÄNZEL AND SCHUBERT, 2007; SALTON AND MCGILL, 1986). Thus, the strengthening of the network cannot be explained by the overall increase in scientific output. Comparing the co-publication network of the Asia-Pacific countries to a network for a set of sample countries, it was confirmed that inner-Asian scientific collaboration has developed more extensively than the global average.

Results

The results of all aspects studied finally permit the conclusion to be drawn that scientific work and also scientific collaboration within the Asia-Pacific area has intensified in the period under observation from 1998 to 2007. The present contribution provides details of the corresponding priorities and actors on the level of the individual countries.
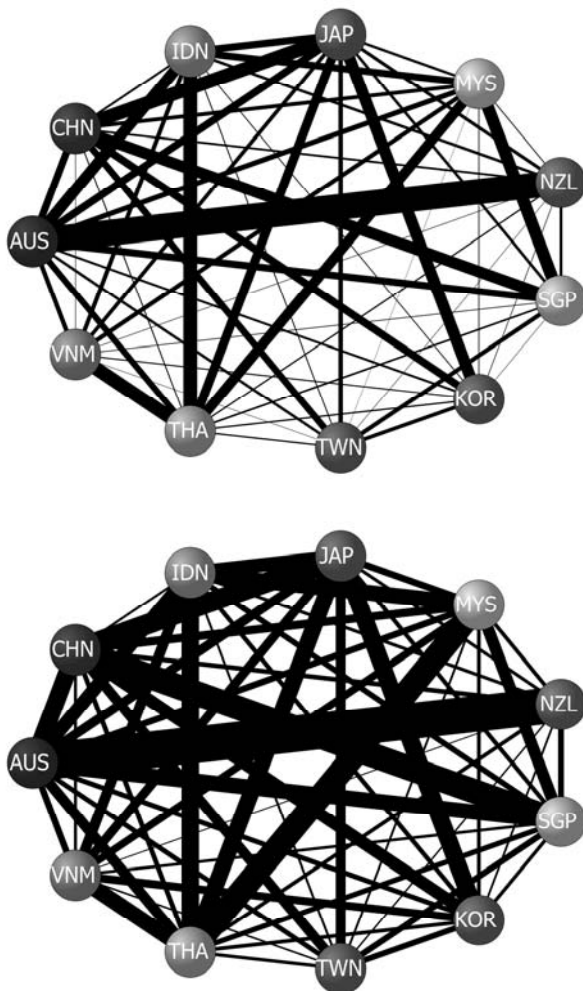
Figure 1. Co-publications between Asia-Pacific Countries in 1998 and in 2007 normalized with Salton's international collaboration strength.

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"The Delphic Oracle" - An Analysis of Potential Error Sources in Bibliographic Databases

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Introduction

To an increasing extent, decisions with far-reaching consequences, such as the funding of scientific research, are being made on the basis of bibliometric data. Data from one of the two big scientific databases, "Science Citation Index" or "Scopus", usually forms the basis for such bibliometric evaluations. In view of the far-reaching consequences of the decisions the question arises of how reliable the original data sources are.

Method

In order to give a concrete answer to this question, the authors performed a study based on publications in 8 physics journals in the year 2007. Due to the considerable manual effort involved in data cleansing, only a sample of this size could be processed in the study.

Table 1. Share of erroneous articles and lost citations for a sample of eight physics journals

	Number of publications in 2007	Share of erroneous articles	Share of lost citations
Journal of High Energy Physics	1247	8.0%	3.9%
Nature Physics	307	9.8%	5.2%
Physical Review A	2356	7.9%	13.7%
Physical Review Letters	3817	6.1%	19.2%
Physics Letters B	861	8.0%	7.2%
Physics of Plasma	834	3.7%	16.4%
Reports on Progress in Physics	40	2.5%	3.5%
Reviews of Modern Physics	34	0.0%	13.3%

The figures show the total number of documents from 2007, the percentage of documents with at least one error in the bibliographic data and the percentage of lost citations in the respective journal. The evaluation is subdivided into two phases. In the first phase the bibliographic data of the original publications are compared with the corresponding entry in the Science Citation Index. In the second phase, a search is then made for any lost citations with the aid of the cited reference search.

Results

The results of the two evaluation phases provide material for discussion since the error rate for the bibliographic data is almost 7 % and for the citations about 15 %! The error rate for the individual journals varies quite considerably in both phases so that possible disadvantages may depend on the journal used. However, the error rate does not depend on the size of the journal. With respect to the bibliographic data, the major error with 384 occurrences in a total of 651 erroneous documents is related to "Chinese given names". Instead of one initial for the given name, which would be logical according to the style in the original articles, in the Science Citation Index in some cases two initials are used for the given name (thus, for example, in the Science Citation Index Zhang, Hongbao becomes Zhang, HB, instead of Zhang, H, as would be expected). This means that in a search using the author's name with just one initial the document would not be found since the author's name is indexed with two initials. Other very frequent errors were that the authors' names and affiliations were missing altogether or spelt incorrectly. The nature of the misspellings (e.g. rn instead of m) lead to the conclusion that these are OCR errors. Errors of this type mean that publications are swallowed up by the database and cannot be taken into consideration for bibliometric analyses if the search uses the names of these persons or their institutions. However, errors do not exclusively occur on the bibliographic side, citations are also lost. A citation is created by matching a publication entry with the footnotes of all database entries. Each footnote that includes a publication is a citation. The problem is to be found in the matching. If the name of the lead author or the journal is misspelt then this is one reason for lost citations as is the switch from two- or three-figure page numbers to six-figure article numbers and the associated notation errors in citing the documents.

Discussion

This paper provides an impetus for a very important discussion. How valid are the big citation databases, where are the problems in the production workflow of the database providers and approximately what level of error must be taken into account in interpretations? Only when these parameters have been clarified will it be possible to ensure that bibliometric data are handled correctly. It is therefore certainly worth considering how the community can work together with the database providers in addressing this problem.

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A unified approach to mapping and clustering of bibliometric networks[14]

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Introduction

In bibliometric research, a lot of attention is paid to the analysis of networks of, for example, documents, keywords, authors, or journals. A large variety of mapping and clustering techniques are being used to study such networks. Mapping and clustering techniques both aim to provide insight into the structure of a network. However, despite their close relatedness, mapping and clustering techniques have typically been developed separately from each other. This has resulted in techniques that have little in common. That is, mapping and clustering techniques are based on different ideas and rely on different assumptions. In this abstract, we propose a unified approach to mapping and clustering of bibliometric networks. We show how a mapping and a clustering technique can both be derived from the same underlying principle.

Mapping and clustering: A unified approach

In bibliometric analyses, mapping and clustering techniques are used to address questions such as:

- What are the main topics or the main research fields within a certain scientific domain?
- How do these topics or these fields relate to each other?
- How has a certain scientific domain developed over time?

To satisfactorily answer such questions, mapping and clustering techniques are often used together. Clustering techniques for example serve to identify the main topics within a certain domain, and mapping techniques serve to visualize the relations among these topics. In our view, when a mapping and a clustering technique are used together in the same analysis, it is generally desirable that the techniques are based on similar principles as much as possible. This enhances the transparency of the analysis and helps to avoid unnecessary technical complexity. Also, inconsistencies between the results produced by the techniques can be avoided. We now show how mapping and clustering can be performed in a unified and consistent way.

Consider a network of n nodes. Suppose we want to create a mapping or a clustering of these nodes. c_{ij} denotes the number of links (e.g., co-occurrence links, co-citation links, or bibliographic coupling links) between nodes i and j ($c_{ij} = c_{ji} \geq 0$). s_{ij} denotes the so-called association strength of nodes i and j and is given by

$$s_{ij} = \frac{2mc_{ij}}{c_i c_j}, \tag{1}$$

where

$$c_i = \sum_{j \neq i} c_{ij} \qquad \text{and} \qquad m = \frac{1}{2}\sum_i c_i. \tag{2}$$

In the case of mapping, we need to find for each node i a vector $x_i \in R^p$ that indicates the location of node i in a p-dimensional map (usually $p = 2$). In the case of clustering, we need to find for each node i a positive integer x_i that indicates the cluster to which node i belongs. Our unified approach to mapping and clustering is based on minimizing

$$V(x_1,\ldots,x_n) = \sum_{i<j} s_{ij} d_{ij}^2 - \sum_{i<j} d_{ij} \tag{3}$$

with respect to $x_1, \ldots, x_n$. d_{ij} denotes the distance between nodes i and j and is given by

$$d_{ij} = \left\| x_i - x_j \right\| = \sqrt{\sum_{k=1}^{p}(x_{ik} - x_{jk})^2} \tag{4}$$

in the case of mapping and by

$$d_{ij} = \begin{cases} 0 & \text{if } x_i = x_j \\ 1/\gamma & \text{if } x_i \neq x_j \end{cases} \tag{5}$$

in the case of clustering. We refer to the parameter γ in (5) as the resolution parameter ($\gamma > 0$). The larger the value of this parameter, the larger the number of clusters that we obtain.
In the case of mapping, it has been shown that the above approach is equivalent to the VOS mapping technique (Van Eck, Waltman, Dekker, & Van den Berg, 2010), which is in turn closely related to the well-known technique of multidimensional scaling.
In the case of clustering, it can be shown that minimizing (3) is equivalent to maximizing

$$\hat{V}(x_1,\ldots,x_n) = \frac{1}{2m}\sum_{i<j} \delta(x_i, x_j) w_{ij}\left(c_{ij} - \gamma \frac{c_i c_j}{2m} \right), \tag{6}$$

where $\delta(x_i, x_j)$ equals 1 if $x_i = x_j$ and 0 otherwise and where

$$w_{ij} = \frac{2m}{c_i c_j}. \tag{7}$$

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Interestingly, if the resolution parameter γ and the weights w_{ij} are set equal to 1 in (6), then (6) reduces to the well-known modularity function introduced by Newman and Girvan (2004). This shows that our proposed clustering technique can be seen as a kind of weighted variant of modularity-based clustering. However, unlike modularity-based clustering, our clustering technique has a resolution parameter γ. This parameter helps to deal with the resolution limit problem (Fortunato & Barthélemy, 2007) of modularity-based clustering.

Applications

The clustering technique that we propose is currently being used to develop a new journal classification scheme for the Scopus database of Elsevier. We have employed the technique to produce a clustering of over 12,000 journals from this database. The clustering, which is based on bibliographic coupling links between journals, consists of approximately 250 clusters. We refer to Noyons, Waltman, Kähler, and Van Eck (2010) for more details on this project.

In Figure 1, we show a combined mapping and clustering of the 1242 most frequently cited publications that appeared in the field of information science in the period 1999–2008. The mapping and the clustering were produced using the unified approach proposed above. The relatedness of publications was determined based on a combination of co-citation data and bibliographic coupling data. The results shown in Figure 1 can be examined in more detail at www.vosviewer.com/maps/sti2010a/.
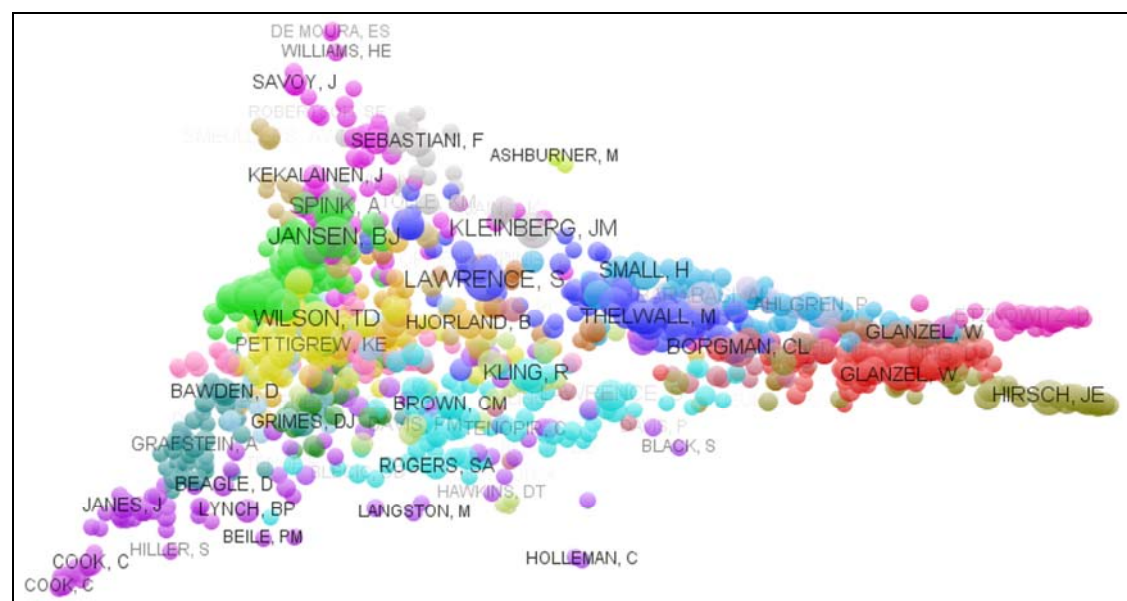
Figure 1. Combined mapping and clustering of the 1242 most frequently cited publications that appeared in the field of information science in the period 1999–2008. Publications are labeled with the name of the first author. Colors are used to indicate clusters.

Software

We have incorporated our unified approach to mapping and clustering in our freely available VOSviewer software (Van Eck & Waltman, 2010; see www.vosviewer.com). Open source algorithms to be run in MATLAB are available at www.ludowaltman.nl/unified_approach/.

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Does steering on publication behavior, by stimulating the publishing in high impact journals, influences impact scores ?

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Introduction

In the science system, on many occasions journal impact measures are used for evaluation and allocation practices. And although the bibliometric community warns for already a long time of the usage of these specific bibliometric indicators for particularly the case of applying them in evaluation practices (Seglen 1997, Schoonbaert & Roelants 1996, van Leeuwen & Moed 2002, and Pendlebury 2009), these practices still continue today.

Background

In this study the focus will be on the application of journal impact measures in allocation models of research funding. A request was made by a director of the Dutch genomics initiative to think about the possibilities to explore the effects of applying an allocation model in which publishing in high impact journals was rewarded.
This analysis focuses on the output of four centers of research excellence in the Netherlands in genomics, which are partially consortia structured groups, partially fully academic. Next, we focus on the Dutch academic medical centers, as a comparison group. This second set of publications covers a much larger body of journal publications, thereby contributing to the robustness of the results of the analysis, while on the other hand we know journal impact measures are used within these medical centers to a certain extent.

Methodology

The analyses conducted focus on a simulation, in which we compare the actual impact of the two sets studied, with the journal-to-field impact level of the journals of choice. We make these comparisons for two different periods, both a longer period stretching over ten years, and seven four year periods (to be able to analyze time effects), in combination with two different important bibliometric indicators often applied in our studies, the ***CPP/FCSm*** (the field-normalized score for actual versus expected impact, an average based indicator) and ***Top 10% MHCP*** (which stands for Most Highly Cited Publications, the indicator focusing on the top of the citation distribution per field), to be compared with the ***JCSm/FCSm*** (the oeuvre based journal-to-field impact indicator, indicative of the quality of the journal in the field(s) to which the journal belongs, which can be considered as a substitute for the ***JFIS***, see van Leeuwen & Moed, 2002). An additional analysis will focus on the share in the journal for each center, as the journal scores are often projected as a suggestion of the actual output of researchers and/or research groups. This analysis will show the relative

contribution every single unit makes to a journal, and the difficult relation to journal impact measures.

Results

The analysis based on choice of journals, and the relation between journal choice compared to the total volume of publications available in the journals of choice indicates that only in a few journals, the genomics research centers contributed more frequently. In most journals of choice, the contribution is only a small one, when compared to the total volume of publications. This indicates that journal impact measures should better not be extrapolated to the output of actors in the journals of choice. Next, the first analyses conducted so far, only based on the output of the genomics centers of research excellence showed that when we compare the level of impact (of the journals in which the genomics centers published their results in) with the actual impact, both over a long and a short period, taking into consideration the average impact as well as the MHCP, Pearson rank correlations are relatively low. Correlations between journal impact and actual impact scores are higher when we take into account longer citation windows. At the conference, more results on similar analyses for the Dutch academic medical centers will be presented.

Figure 1. Pearson rank correlation between various bilbiometric indicators, journal and output based, long term citation applied (1997-2003)
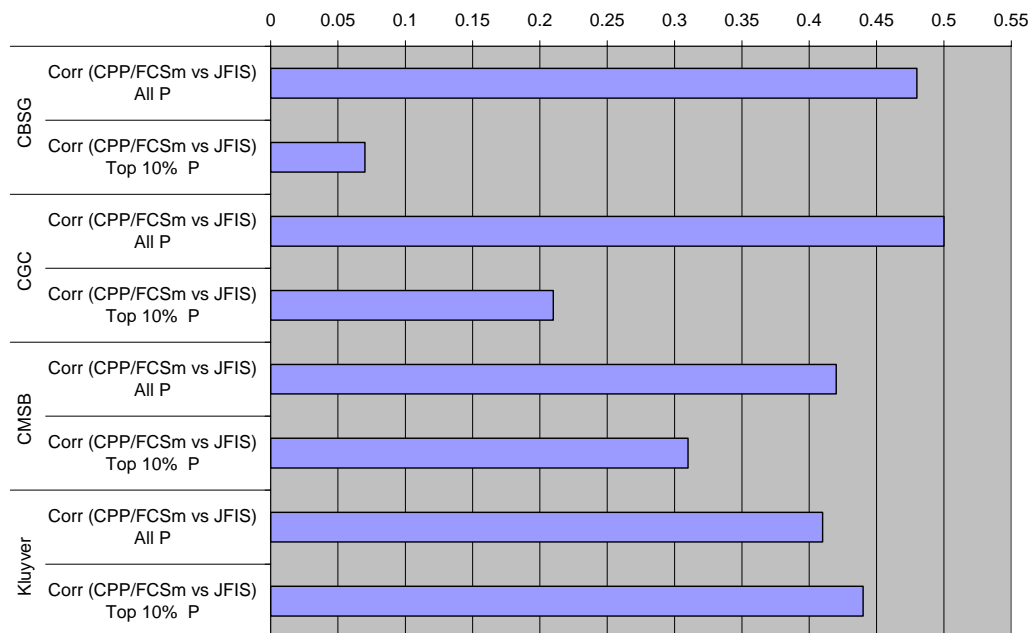
Table 1. Distribution of output over journals used, and the share in the journals used

	Class							
	% > 5		2.5 >= 5%		1.0 >= 2.5%		<1%	
	# Jnls	% Jnls	# Jnls	% Jnls	# Jnls	% Jnls	# Jnls	% Jnls
CBSG	2	0.9	6	2.8	28	13.0	179	83.3
CGC	0	0.0	2	0.9	10	4.5	211	94.6
CMSB	3	0.3	8	0.8	68	7.2	865	91.6
Kluyver	1	0.5	4	2.0	13	6.5	181	91.0

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The new set of bibliometric indicators of CWTS

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Introduction

At the Centre for Science and Technology Studies (CWTS) of Leiden University, we have a standard set of bibliometric indicators that we use for research performance assessment purposes (Van Raan, 2005). We are currently working on a major revision of our indicators. In this abstract, we briefly discuss the new set of indicators that we are planning to adopt in the near future.

Indicators

In Table 1, we list our new set of bibliometric indicators. We also show for each new indicator the old indicator (Van Raan, 2005) that it replaces. The MNCS indicator, where MNCS is an acronym for mean normalized citation score, can be regarded as the most important indicator in the new system. This indicator is therefore intended as the new crown indicator of CWTS. The MNCS indicator replaces the CPP/FCSm indicator, which is the old crown indicator of CWTS.

Table 1. The new set of bibliometric indicators of CWTS. (Indicators for highly cited publications are not shown.)

	New indicator	Old indicator
P	Number of publications	P
MCS	Mean citation score	CPP
MNCS	Mean normalized citation score	CPP/FCSm ('crown indicator')
MNJS	Mean normalized journal score	JCSm/FCSm
MNCS/MNJS	Mean normalized citation score / mean normalized journal score	CPP/JCSm
TCS	Total citation score	C
TNCS	Total normalized citation score	P×CPP/FCSm ('brute force indicator')
TNJS	Total normalized journal score	

The main difference between the old and the new indicators is the way in which normalization is performed. In the old indicators, normalization is performed by first calculating the sum of the actual citations of all publications and the sum of the expected citations of all publications and by then taking the ratio of these two sums. In the new indicators, normalization is performed by first calculating the ratio of actual and expected citations for each publication separately and by then taking the average of the ratios. The normalization mechanism employed in the new indicators was first proposed by Lundberg (2007) and later by Opthof and Leydesdorff (2010; see also Van Raan, Van Leeuwen, Visser, Van Eck, & Waltman, 2010).

There are various other issues to which we pay special attention in our new indicators:

- The way in which overlapping fields are handled (Waltman, Van Eck, Van Leeuwen, Visser, & Van Raan, 2010a).
- The way in which recent publications are handled (Waltman, Van Eck, Van Leeuwen, Visser, & Van Raan, 2010b).

- The way in which different document types (e.g., article, letter, and review) are handled.
- The distinction between full counting and fractional counting in the case of collaborative publications.
- Confidence intervals.

Due to space limitations, we do not discuss these issues in more detail here.

Comparison

We compare the old and the new indicators both theoretically and empirically. We focus in particular on the old and the new crown indicator.

From a theoretical point of view, an important advantage of the new crown indicator over the old one is that the new crown indicator weighs all publications equally regardless of the field in which they were published. The old crown indicator gives more weight to publications from fields with a high expected number of citations. Another advantage of the new crown indicator is that this indicator has a so-called consistency property. Basically, this property ensures that a ranking does not change when everyone makes the same improvement in terms of publications and citations. The old crown indicator does not have this important property. For a detailed theoretical comparison of the old and the new crown indicator, we refer to Waltman et al. (2010a).

Empirically, the differences between the old and the new crown indicator turn out to be larger at lower aggregation levels (e.g., individual researchers and research groups) than at higher aggregation levels (e.g., institutes and countries). At higher aggregation levels, almost no differences between the indicators can be observed. At lower aggregation levels, the differences between the indicators are typically fairly small, but they can be quite substantial in exceptional cases. To illustrate this, we show in Figure 1 an example of the relation between the old and the new crown indicator at the level of research groups. An extensive empirical comparison of the old and the new crown indicator can be found elsewhere (Waltman et al., 2010b).
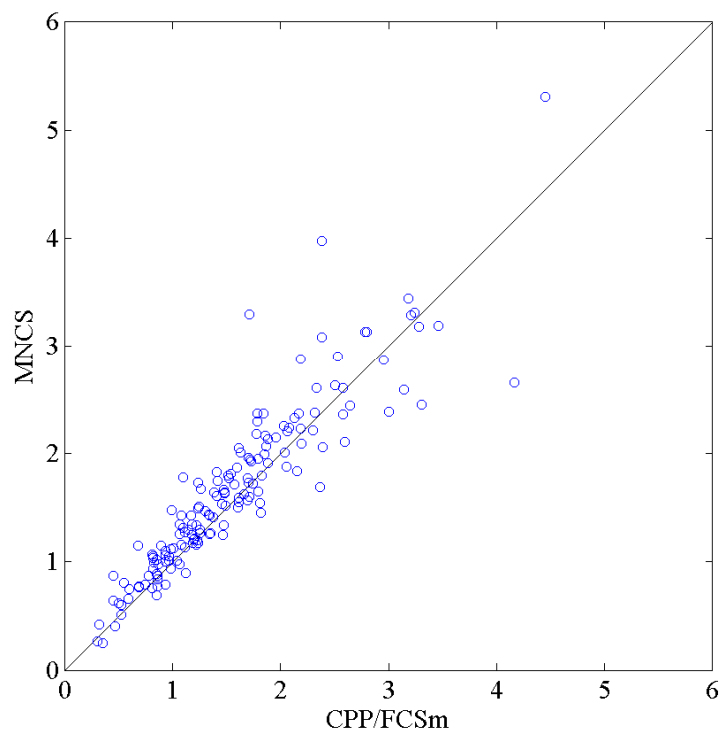
Figure 1. Relation between the CPP/FCSm indicator and the MNCS indicator for 158 Dutch research groups in the field of chemistry and chemical engineering.

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Patenting Abroad: Evidence from OECD Countries

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Background

Patent-based indicators at the country level are frequently used to assess countries' innovation performance, see Guellec and van Pottelsberghe de la Potterie (Research Policy, 2001); Khan and Dernis (OECD Science, Technology and Industry WP 2006/3); Léger (DIW DP 696, 2007); van Pottelsberghe de la Potterie and de Rassenfosse (Intereconomics, 2008). The gravity model is one of the popular models in the empirical trade literature. It usually relates the bilateral trade between countries to the distance between countries and a gravity variable e.g. GDP; see Anderson (1979, American Economic Review), Bergstrand (1985 & 1989, Review of Economics and Statistics), Smith (1999 & 2001, Journal of International Economics). Even though the application of gravity has a long history in trade literature, its use in other international flows is limited. Archontakis and Varsakelis (2010, Journal of Technology Transfer) and Picci (forthcoming, Research Policy) provide a theoretical justification for using the gravity model in knowledge diffusion.

Objective

We apply a gravity model, following Archontakis and Varsakelis (2010) who test the gravity model using US data, in order to make an international comparison of patenting activity between OECD countries. The questions we are interested in are: a. how is the number of patents, from source country j, distributed among the destination countries i; and b. whether the gravity model holds and what are the similarities/differences given the source country?

Data and Methods

For the dependent variable we used the number of patents granted to residents in countries of the OECD for the period 1995-2005. Data on patents are from the WIPO database. The main gravity variables considered are: the total number of patents country's j residents registered in the rest of the OECD countries and the patents of residents outside the country. Amongst the regression variables we used: the distance between the economic centres (data from the CEPII database); the business cycle, i.e. the difference between trend and current growth rate (data are from OECD database); the IPR regime (data from the World Bank database).

For the econometric model estimation we used panel data regressions and applied a model selection procedure. For each country we chose between the random effects (RE) and fixed effects (FE) models, given the specific model validations.

Results and Conclusion

This exercise reveals some common features regarding patenting abroad activity between OECD countries. Preliminary analysis indicates that the gravity model holds, since most of the estimated coefficients of gravity variables are significant and have the correct positive sign according to the gravity model. There are further results regarding the Distance and IPR variables but no concrete evidence so far. In particular, Distance variables are usually negative or non-significant and the impact of IPR is usually negative; only in one equation is positive and in some cases is zero. Regarding policy implications, assume that patenting abroad is a way of knowledge diffusion from the source to the destination country; the latter, in order to assimilate more and better knowledge created by the former, should augment its absorptive capacity. Therefore, a country through educational, technological and industrial policies should fund and pursue more and better research, improve education and incentivize entrepreneurial activity. Follow up studies could investigate further various broader "distance" measures, i.e. cultural distance and governance (corruption, rule of law).

The Journal Relative Impact: an impact index for scientific journals

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Introduction

Great effort has been dedicated in the last few years to the construction of impact indicators for scientific journals that allow for comparisons across areas (Bollen, Rodriguez et al. (2006); Sombatsompop and Markpin (2005)). Librarians use them to decide on subscriptions; scientists use them to choose the channel of publication of their research; governments use them to value comparatively the CV of researchers and institutions. However, this is a difficult task as these indicators are normally based on citation counts and the citation culture varies widely across areas (Moed, Debruin et al. (1995)). Not only the number of citations a paper gets varies widely from area to area but also the time lag between publication and citation does also vary. In counting citations, fixed windows are usually selected. The consequence is that short time lag areas are better represented than long time lag areas and these may be assessed by a rather small (and possibly not significant) share of the citations they will collect along their full lifetime.
The aim of this work is to develop a citation-based impact indicator for journals that will allow comparisons among different subfields.

Method

The basic hypothesis is that each Web of Science (WoS) subfield contains a large and homogeneous set of journals that represent well a scientific community in the sense of a large set of researchers that share the same citation culture. We define the Journal Relative Impact (JRI) as the ratio between the average number of citations per document for a certain journal and the average number of citations per document for all journals in a given WoS subfield. For each subfield, we consider the document types that generate more than 5% of the total citations of all documents in the subfield. In this way, the decision to consider a particular document type of a journal depends on its yield of citations and not on any preconceived idea of the citation relevance that is impossible to generalize. Another important factor is the observation window. As the citation time lag varies widely, we use a window length chosen to contain for each subfield at least 15% of the citations collected in the entire life (here taken to be between 15 and 20 years) of the documents published in a chosen 5 years period. The comparison of journals across subfields is made through the ratio defined above that gives the relative position of the journal among those considered in the subfield. The ratio of one means that the journal performs as the average in the subfield; values higher than one are associated with journals performing better than the average while values lower than one are associated with poorer performances. When a journal is listed in more than one subfield the JRI is taken as the simple average of the ratios calculated in the interested subfields.

Table 1. Values of the JRI, considering the documents published in 2002-2006 in journals that belong to Computer Science, Interdisciplinary Applications (CSIA) and Statistics & Probability (SP).

Journal	Subfield	Variable citation window (years)	Constant citation window (years)	Document type	JRI (Variable citation window)	JRI (Constant citation window)
Computational statistics & data analysis	CSIA	6	6	Articles, review articles and proceedings paper	0.512	0.512
	SP	7			0.596	0.566
Journal of statistical computation and simulation	CSIA	6			0.213	0.213
	SP	7			0.242	0.235

The results show that when a constant citation window is used, the values of the JRI for the journals in the SP subfield are lower than those obtained using a variable citation window. In SP a citation window of six years represents about 12% of the total citations, obtained by the documents published in 5 years. These results show the relevance of using an indicator that considers a percentage of the total citations collected in the entire life of the documents.

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A general source normalized approach to bibliometric research performance assessment

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Introduction

In bibliometric research performance assessment studies, it is crucial that the number of citations of a publication is corrected for the field and the year in which the publication was published. To perform such a correction, one typically uses a classification scheme for assigning publications to fields. The subject categories of the Web of Science database are a well-known example of such a scheme. Of course, a classification scheme will never provide a perfect representation of the structure of scientific fields. This is because in reality there are no clear-cut boundaries between fields. Also, in reality fields can always be split further into subfields. For these reasons, the use of a classification scheme inevitably introduces some arbitrariness into the analysis that one performs.

Recently, two journal performance indicators were introduced that take into account differences among fields but that do not rely on a classification scheme. These indicators are the audience factor of Zitt and Small (2008) and the source normalized impact per paper (SNIP) of Moed (2010). Unlike more traditional indicators, the audience factor and the SNIP indicator normalize citation counts based on the characteristics of citing (rather than cited) publications. Moed refers to this idea as source normalization.

In this abstract, we propose a general source normalized approach to bibliometric research performance assessment. We present an indicator, the mean source normalized citation score (MSNCS), that unlike the audience factor and the SNIP indicator is intended to be used not only for the assessment of journals but also for the assessment of, for example, research groups and institutes. The MSNCS indicator corrects both for the field and for the year in which a publication was published. The indicator has various attractive mathematical properties.

Mean source normalized citation score

The MSNCS indicator is a kind of generalization of the audience factor. The indicator is defined as

$$\text{MSNCS} = \frac{1}{n} \sum_{i=1}^{T} \sum_{j=1}^{n_i} \sum_{k=1}^{c_{ij}} \frac{1}{r_{ijk}},$$

where

T length of the publication window,
n total number of publications,
n_i number of publications of age i,
c_{ij} number of citations of the jth publication of age i,
r_{ijk} average number of references per publication, taking into consideration only references of age 1, …, i, in the journal issuing the kth citation to the jth publication of age i.

Essentially, the MSNCS indicator calculates the average number of citations per publication. However, citations are weighed differently depending on the citing journal. More specifically, citations are weighed inversely proportional to the average number of recent references per publication in the citing journal. The definition of recent references is chosen in such a way that the MSNCS indicator corrects both for the field and for the year in which a publication was published. We note that, unlike the audience factor and the SNIP indicator, the MSNCS indicator takes into consideration all citations received by a publication, not just the citations received in a particular year.

Mathematical properties

The MSNCS indicator has various attractive mathematical properties:
- The MSNCS indicator has a so-called consistency property (Waltman, Van Eck, Van Leeuwen, Visser, & Van Raan, 2010). This property ensures that a ranking does not change when everyone makes the same improvement in terms of publications and citations. We note that the SNIP indicator does not have this property.
- Assuming fields to be in a steady state and assuming the absence of inter-field citation traffic, the average MSNCS value of a publication is the same for all fields and all publication years. This property provides a strong justification for the way in which the MSNCS indicator normalizes citation counts. We note that the audience factor has a similar property, but only for fields, not for publication years (Waltman & Van Eck, 2010). The SNIP indicator does not have a similar property.
- Assuming fields to be in a steady state, assuming the absence of inter-field citation traffic, and assuming perfect homogeneity of fields, the MSNCS indicator is equivalent to the mean field normalized citation score indicator discussed by Waltman et al. (2010). This property clarifies the relation between source normalization and normalization based on a classification scheme.

Empirical analysis

An empirical analysis of the MSNCS indicator is currently under way. We focus in particular on comparing the MSNCS indicator with the mean field normalized citation score indicator.

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An agent based model of scientific and scholarly research – modeling the peer review process

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In this paper we present an agent-based model which addresses the tension between the peer review process, the life cycle of journals and the research practice of individual researchers. The peer review process has been described as the core activity in academia. It is the major selection mechanisms, and aims to guarantee quality. It also guarantees the autonomy of the science system (which often has been described as self-organizing) and its "core code or value" truth. Peer review has the goal to improve scientific quality and to contribute to accumulate knowledge. Eventually it is also assumed to guarantee the accountability of the publicly funded research system. The growing size and complexity of the scientific and scholarly system has increased the pressure on the existing forms of quality control and evaluation. Qualitative evaluation tends to break down in large systems. The increasing need of high quality referees for journal manuscripts and grant applications can in some cases no longer be met. In many fields, this is aggravated by the increasing number of submissions to top journals. Increasing complexity and specialisation of research makes it moreover difficult to find the right experts. There have been different proposals to prevent or overcome the "crisis" of the peer review system, including efforts to replace or complement the existing peer review system by open-peer-review systems.

The peer review process has been the object of different modeling approaches. Peer review decision have been validated using bibliometric indicators and stochastic models (Bornmann, Daniel 2006; van den Besselaar, Leydesdorff 2009). Models have also been proposed to optimize the selection process of reviewers (Rodriguez et al 2006). In this article we approach the peer review system from the perspective of the individual researcher. In particular we address the interplay between researchers and journals and the double role of researchers as peers reviewing others and as authors being reviewed. This dual role is mapped to a non-linear feedback in an agent-based model.

We focus on the most basic processes and simplest possible assumptions in defining our model. We base our choice of processes in the model on the evidence from science and technology studies, sociology of science and communication theory. We include least amount of processes and parameters to allow us to investigate the resulting model thoroughly and understand the core mechanics and laws, instead of trying to justify large amount of assumptions and fixed parameter values. The "scaling-down" and simplification is a reductionist methodology used in physics, that allows for a more comprehensive understanding of each process in the model and their interactions. Thanks to it, it is possible to identify which parts of the model are responsible for observed model behaviors and obtained results.

The model proposed is set up as a test bed for different theories about the function of peer review in the science system. In other words, the model is set up to test theories rather than to test empirical material. Empirical facts (qualitative as well as quantitative) are used as stylized fact information to justify parameter settings in the model. The main aim of the modeling process is to demonstrate the ability of mathematical models to compare and test theoretical hypotheses about a process. By

transferring these qualitative hypotheses into assumptions of interactions in a dynamic process and by simulating different scenarios we are able to compare the dynamic implications of some social-science based pre-assumptions. The paper aims to contribute to the debate about improving peer review as well as about using mathematical models as methodological tools and innovative heuristic devices.

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H-family: from H-index to H-mixed Indices

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Introduction

Let us call the h-index and its variants, h-type indices and the newly introduced ones the h-family. All these indices are empirical indicators, not theoretical ones. Who knew the h-index before Hirsch proposed it? Yet, it is an easy and simple indicator. We never found it just because it is only an empirical one. Now that we have come to realize its usefulness, we are interested in its studies. Similarly, we are convinced that expanding the h-family with h-mixed indices will introduce some new ideas for further research.

Method

We propose the product of the *h*-index and CPP (citations per paper) as a new index. It combines output and impact (as measured through citations). In a normalized form we propose: $S = 100 \times \log_{10}(h \times CPP)$. Multiplying S by the R-index (the square root of the total number of citations received by articles in the *h*-core) yields another mixed-type indicator, denoted as T: $T = 100 \times \log_{10}(R \times h \times CPP)$.

The new indices were calculated at the journal, institution, and author levels with data from ISI Web of Science (WoS) and Essential Science Indicators (ESI) and at the assignee level with data from Derwent Innovations Index (DII). Data were collected for diverse groups—journals, universities, authors, and assignees.

Results

Table 1. Sampling Results obtained by using two h-mixed synthetic indices (1998-2008)

Journal	CPP	h	S	T
Nature	49.90	486	438.48	720.27
Automatica	11.75	65	288.28	485.64
Lithos	10.03	47	267.33	446.81
Scientometrics	5.333	31	221.83	378.89
Economica	2.565	19	168.78	306.12
University	**CPP**	**h**	**S**	**T**
Stanford	19.24	325	379.61	646.91
Cambridge	14.34	261	357.31	613.87
Kyoto	11.91	217	341.22	587.34
Heidelberg	12.32	169	331.85	571.38
Zhejiang	4.037	69	244.49	441.52
Author	**CPP**	**h**	**S**	**T**
Jones JDG	74.48	47	354.41	546.40

Assignee	CPP	h	S	T
Bennett CL	46.29	47	333.76	543.48
Kroto HW	28.92	34	299.26	466.39
Kalnay E	38.67	15	276.34	441.41
Egghe L	5.09	11	174.81	296.70
Assignee	**CPP**	**h**	**S**	**T**
Motorola	6.205	75	266.78	460.85
AT&T	7.343	64	267.21	455.56
Siemens	1.941	50	198.69	377.67
Boeing	2.346	29	183.27	339.05
Volkswagen	1.806	27	168.81	323.32

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Does interdisciplinary research lead to higher scientific impact? A research group based analysis

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Introduction

A variety of science policy instruments aim to foster Interdisciplinary Research (IDR) since it is perceived as more successful in achieving scientific and technological breakthroughs. However, there is little evidence showing that interdisciplinarity systematically leads to achievement, although there are plenty of historical studies suggesting that interdisciplinary research environments play a key role in scientific breakthroughs (e.g. Hollingsworth, 2006).

Some recent studies have obtained conflicting results on this issue, looking at the impact in terms of citations, and using as units of analysis the paper (Adams et al, 2007; Lariviere and Gingras, 2010) or the journal (Lewitt and Thelwall, 2008). In this study we investigate the relation between interdisciplinarity and scientific impact, bringing in two methodological contributions. First, we use the research group as unit of analysis (c.f. Rinia et al, 2001); second we use both established and novel measures of diversity as indicators of interdisciplinarity (Porter et al, 2007; Rafols and Meyer, 2010).

Method

The analysis is based on the publications generated from 1990 to 2003 by 62 research groups of the Spanish Council for Scientific Research (CSIC) that were funded by the Spanish Food Technology Program.

Two sets of data were used. The first set refers to research projects and the second to the publications produced by groups involved in these projects. Data about projects include the number of researchers taking part in each project and affiliation of the principal researcher. Publications were retrieved from Science Citation Index (SCI). All the information in the database for each publication was downloaded, including all the references. The publications were linked to research projects matching author names with names of researchers in each project (Yegros-Yegros, 2010). Publications and references were classified into disciplines according to ISI Subject Categories.

Impact of publications is measured by number of received citations normalized by field and publication year. Degree of interdisciplinarity is measured through indicators of disciplinary diversity (Rafols and Meyer, 2010).

Results

We find that different measures of diversity show different influence on citations. For instance, Figure 1 presents the influence of Shannon diversity or entropy on the scientific impact of research groups. Diversity was calculated over the whole set of references of each research group, i.e. $-\sum_i p_i \ln p_i$, (where p_i is the proportion of references in discipline i). Preliminary regression results corroborate an inverted u shape dependence of impact on diversity at the group level (c.f. Larivière and Gingras, 2010). Further analyses explore in detail the different influence on impact of the various aspects of diversity, namely the variety or number of disciplinary categories, the balance or evenness of the category distribution and the distance or disparity between categories.
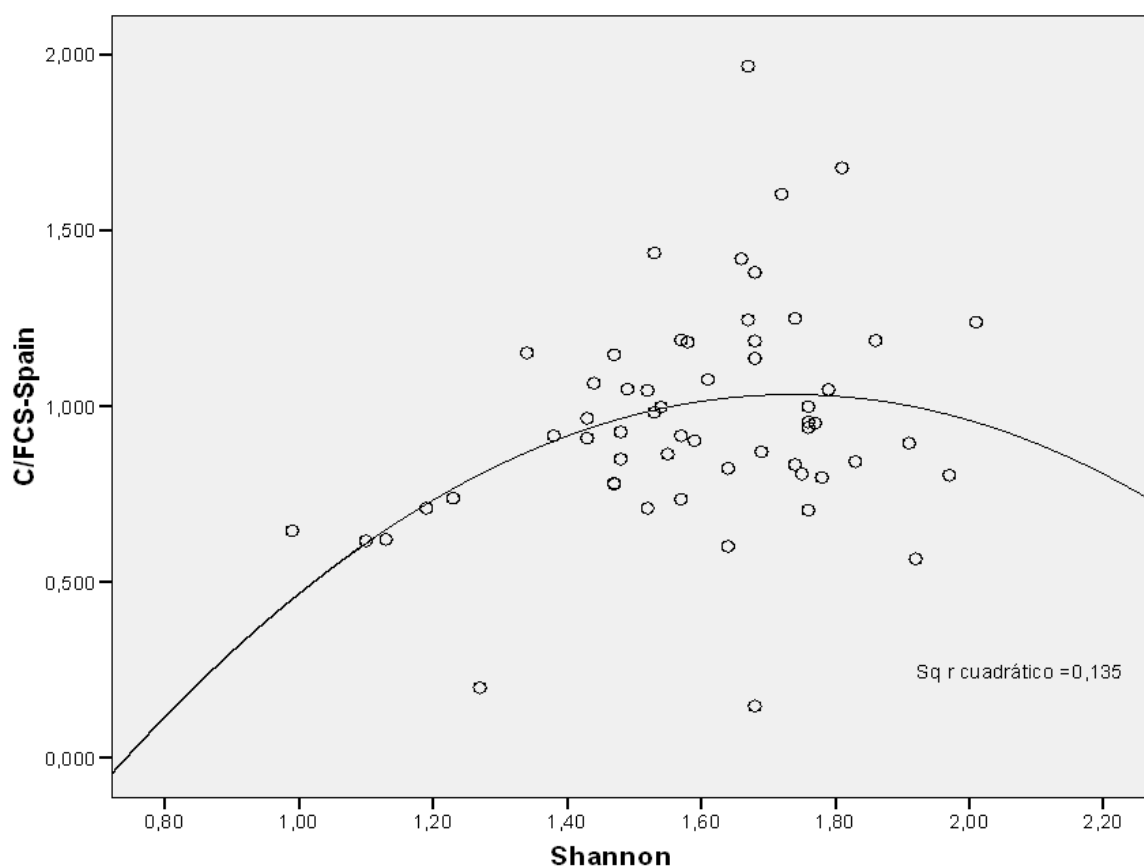
Figure 1. Average impact per paper vs Shannon diversity of disciplines in references, per group

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Bibliometric Analysis of Turkey's Recent Social Science Publications

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Introduction

Turkey is one of the most dynamic countries in terms of the increase in scientific publications (Glänzel, W.). Turkey jumped from 38th in 1991 to 18th in 2009. Similarly, the Turkish social sciences and humanities publication share has grown impressively in the last decade (Önder et al.). In this study we compare the increase of the publications and citations, and we analyze patterns of international and national collaboration between 2000-2009 using *Web of Science* and *Scopus.*

Method

The results of the paper are based on the *Social Sciences Citation Index, Arts & Humanities Citation Index* of ISI and the *Social Sciences & Humanities Index* of Scopus. Only journal articles are taken into consideration. In Scopus, there are currently 6216 journals, about 85% of which are also included in WOS.

The number of Turkey's publications in *Science Citation Index Expanded* of ISI and the *Life, Health and Physical Science Indexes* of Scopus tripled from 2000-2009. In the same period, the share of articles in the social sciences within the total publications from Turkey are doubled in both databases (see Table 1). There are several reasons for this change: the researchers in social sciences prefer to publish in international journals rather than monographs or in Turkish journals (Al, U., et al). The change in publication habits is also related to recent regulatory and organizational changes, and to performance evaluations (Önder, Ç. et al.).

Table 1. Share of Articles in Social Sciences

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
WOS	4.2	4.7	4.2	4.3	4.0	4.5	5.8	8.0	7.6	8.4
SCOPUS	4.2	3.9	3.8	4.0	4.0	4.5	6.0	6.8	6.7	8.0

Similarly the average number citations per article in increased in both databases (Figure 1)
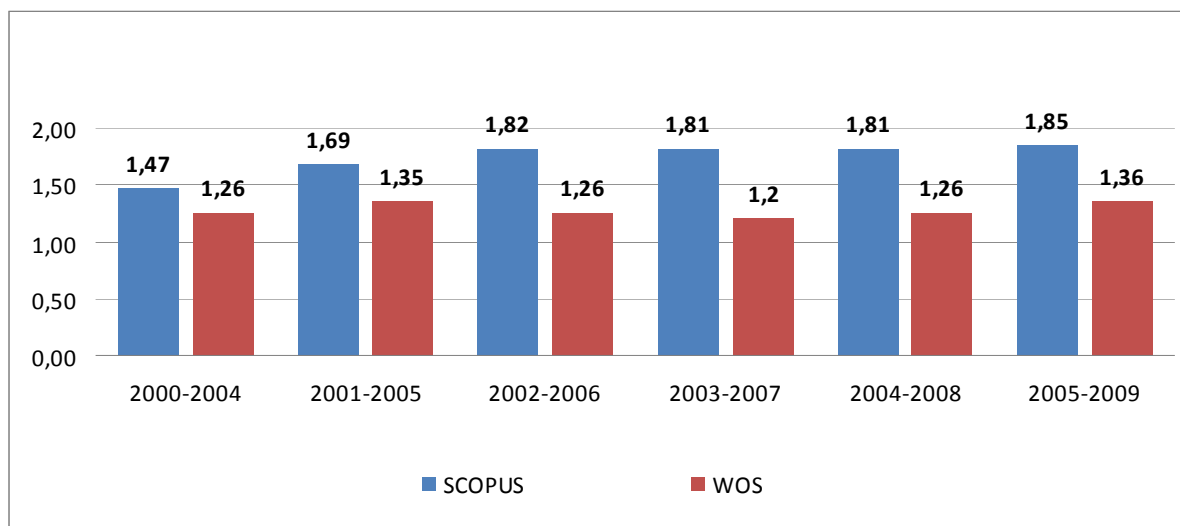
Figure 1. Average number of citations per article

About two-thirds of the publications in both indexes are co-authored. The share of Turkey's internationally co-authored articles over the last ten years was not changed, it is about 20%. In some areas of the social sciences, the share of international collaboration is higher. The research groups of social sciences in Turkey are mostly isolated (Gossart, C., Özman, M.). Therefore the identification of international and national collaboration networks in very important for domestic dissemination and for the international impact of Turkish social sciences .

Although recently more national journals have been included in both databases, we have observed that only 18% of the articles in *Social Sciences Citation Index, Arts & Humanities Citation Index* of ISI are from journals published in Turkey. This share is about 6% in the case of the *Social Sciences & Humanities Index* of Scopus.

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Incompleteness Problem for Indicators System of Research Programme

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In February 2008 the First Russian Academic Programme was adopted by the Government of the Russian Federation as a tool of public intervention in the area of science. The Programme consists of six parts including the Programme of *the Russian Academy of Sciences (*RAS). The RAS has decided to develop a verifiable evaluation system for providing assessment of the RAS Programme as a whole and of its projects.

The incompleteness of indicators system for the RAS Programme has emerged as a result of an application of the Objectives-Resources-Results approach describing relationships between the objectives, resources, and results. According to the approach current, new, and future indicators were divided into 6 categories for 1) objectives, 2) results, 3) resources, 4) efficiency (relationship between resources and results), 5) effectiveness (relationship between objectives and results), and 6) consistency (relationship between objectives and resources) [1]. According to the report [2] the results were divided into three classes: outputs, outcomes, and impacts; hence, result indicators were subdivided into three corresponding subcategories as well.

Besides of this, a need of corresponding between 6 indicator categories and stages of the RAS Programme assessment has emerged. Developers of the RAS Evaluation system used the stages and substages definitions according to the report [2]. These stages are ex-ante, mid-term, and ex-post. The latter, in its order, is divided into three substages: short (1-2 years after the RAS Programme termination), medium (4-7 years), and long terms (> 10 years) [2].

At present time, for the RAS Programme assessment decision-makers are using two indicator categories only, namely resources and results indicators, and among the results indicators they are using output and outcome indicators. As for the stages, indicators on only two stages (mid-term and short term ex-post) are analyzed by decision-makers. All this demonstrates the existence of problem of incompleteness (see Table 1 below).

Table 1. Indicator categories and stages of assessment

Categories / Stages (substages)	Objectives	Resources	Results			Consistency	Effectiveness	Efficiency
			Outputs	Outcomes	Impacts			
Ex-ante								
Mid-term		+	+	+				
Short term ex-post		+	+	+				
Medium term ex-post								
Long term ex-post								

To solve the problem, we are designing a projective dictionary for new indicators and a semantic dictionary for current indicators (see Figure 1). As for current indicators, each entry of the semantic dictionary contains a parametrized definition, diagrams for indicators, and links to other entries. Besides, entries may contain references to the desciption of information resources, variants of algorithms computing indicator values, and parameters for calculating the values [1]. The users of the projective dictionary are only the experts, responsible for development of new indicators. The projective dictionary design is based on a time-dependent semiotic model of an indicator emergence [3].

Indicator Entries in Evaluation System Dictionaries

RAS Evaluation system for the R&D Programme

Linguistic resources

Projective dictionary (new indicator entries)
- **U** indicator entry (T_1)
...
- **U** indicator entry (T_n)
...
- **V** indicator entry (T_1)
...
- **V** indicator entry (T_n)
...

Semantic dictionary:
- **X** indicator entry
...
- **Y** indicator entry
...

Authority resources

Links of indicator entries

Indicator definitions

Indicator diagrams

Evaluation legislation

Information resources

Program resources

Semantic and projective dictionaries' architecture including linkages to legislation, information, and program components of the RAS evaluation system

Figure 1

The semantic dictionary is based on the stationary semiotic model [3] which follows the idea of Frege's triangle where the three vertices are an indicator meaning, an indicator form, and a denotatum of the indicator, i.e. indicator program and information resources . The stationary semiotic model supposes that all composing entities do not change in time. The projective dictionary is based on the *time-dependent* semiotic model [3] which is a development of the stationary semiotic model, but takes into account the variability of new indicator concepts and forms of their presentation in the time domain.

While the semantic dictionary describes the current indicators, the projective dictionary deals with just new indicator concepts, where each of them can potentially turn into a real indicator when confirmed by decision-makers and then incorporated into the semantic dictionary. These concepts may be personal or collective, and always belong to an expert or a group of experts. The entries of the projective

dictionary are never deleted or modified. That is why for any time moment it is possible to see the state of any concept existed at the time. The change of the concept A does not imply editing of its entry. Rather, it implies the creation of a new concept B, which becomes the inheritor of the concept A, and the insertion of an entry for the concept B to the projective dictionary. So the structure of an entry of the projective dictionary is an expansion of that of the semantic dictionary as it must contain the extra data, fixing the time period of a concept actuality, the inheritance relations, and authors of any concept.

Acknowledgments

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Behind citing-side normalization of citations: the determinants of the Journal Impact Factor across fields

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Introduction

Interest is rising for alterative impact measures derived from Garfield's Journal Impact Factor (JIF). Those new measures cope with the diversity of scientific practices across areas and/or with chains of knowledge circulation. In additional to classical ex-post normalization based on statistical standardization field by field, mostly on the basis of predefined fields such as Thomson Reuter's "subject categories", two alternative families of measures have appeared. The first family builds on the classical "journal influence weight" of Pinski &Narin (1976), one of the forerunners of Google algorithms which in turn triggered new approaches of influence chains. The principle is to weight iteratively emitted citations by the impact of the source. Bergström's Journal Eigenfactor (2007) based on Thomson data, challenged by Scimago (de Moya-Anegon) based on Scopus are the best known examples. Depending on the settings, those measures can address two issues simultaneously, the variability of citing practices across areas and the chains of prestige. The second family, citing-side normalization, appeared recently with the Audience factor (Zitt & Small, 2008; Zitt, 2010) and then the SNIP (Moed, 2009-2010). They only aim only at correcting the measures of impact for the variability of citing practices, typically with a choice of classification-free measure.

Method - Result

Beyond the general idea, widely accepted, that impact and propensity to cite are correlated across fields, further empirical and especially analytical accounts of this relation are needed. Gene Garfield already paid attention to some aspects of the issue in 1976, with a special attention on non-cited literature. In the wake of influence measures, Althouse et al. (2009) studied the time drift of impact factors and stressed the various determinations of JIF. Basing ourselves on an analysis of the decomposition of Garfield's Journal Impact Factor, we propose a simple model to shed light on the across-fields determinants of JIF: propensity to cite and to cite rapidly, growth of the areas, generic character of research, structure of the database. The size of the field as such does not play a key-role in shaping the average values of JIF in a field, but only the upper bounds. The model gives a systematic ground to compare the various ways of normalization listed above, depending on the determinant factors that one wishes to control.

Conclusion

More generally, the choices of normalization for impacts and citations raise the issue of how a citation is valued. In parallel to the bibliometric publication counting options, the citation counting options and especially the normalization choices convey explicit or implicit models of the value of citations. Economists are sometimes adding a layer of meta-values to this bibliometric counting/weighting. We conclude by evoking some of aspects of this general problem, and recalling that citing-side normalization is a quite general principle. Beyond applications at the journal level, it can be extended to other citation measures.

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Evaluating Research Departments using Individual Level Bibliometrics

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Introduction

Research at the individual level of the scientist is a valuable approach to bibliometric evaluations; providing useful information both for and beyond assessment purposes. This approach, sometimes called the 'bibliometric portrait', can effectively characterize the progress a scientist has made in his/her career (see Costas & Bordons, 2005; Prakasan et al., 2009). In this study, we highlight the process of conducting individual level assessments in mathematics. Initially we compare the micro level approach to evaluations with the traditional meso level (departmental) approach, then examine the benefits/pitfalls of observing statistical relationships between an individual's publications, citations, and additional variables (i.e., age, mobility, student mentoring) obtained from their curriculum vitas.

Method

Six university departments in mathematics (Netherlands) provided a list of researchers (N=168 mathematicians) who have held a permanent position from 1999 to 2008. Bibliometric analyses were based on the same time period using scientific articles published in journals and serials processed for the Web of Science (WoS).[15] In addition to the bibliometric data, all researchers were asked to provide us with the following personal information: 1) birth date, 2) date of PhD graduation, 3) previous research affiliations (by address) prior to obtaining permanent position, and 4) PhD students mentored.

Results

Initial results demonstrate how individual-level analyses allow for 'perspective building' in departmental evaluations. Note from Table 1 (departmental level) that the U. of Amsterdam presents a stronger research output (P) and normalized impact (CPP/FCSm) as a whole, compared to other mathematics departments in the Netherlands. However, at the individual level (Mean ± SD; Median), there is a change in perspective: researchers at Groningen present a stronger publication output; while researchers from Utrecht outperform those from other departments (incl. Amsterdam), with a higher normalized impact. Although further comments may be made concerning Table 1, focus now on Figure 1: here we see that researchers at Utrecht present the highest CPP/FCSm scores; the only case with a median CPP/FCSm higher than 1 (above international level). The case of U. Amsterdam in this box-plot figure shows how a few outliers play a role in elevating the mean impact of the whole department. When looking at the median performance, the score is actually below 1.

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[15] P=Publications; C-sc=total citations, without self-citations; CPP=citations per paper; CPP/FCSm=normalized impact; JCSm/FCSm=normalized journal impact.

Further results pertaining to the age and academic age of the individual scientists, their mobility and mentoring programmes will be presented at the conference. The aim is to inform policy-makers with detailed insights into the composition of research departments, so that they might understand better how to resolve weaknesses and capitalize on strengths.

Table 1. Departmental level compared to Individual level indicators.

DEPARTMENT LEVEL	P	C-sc	CPP	CPP/FCSm	JCSm/FCSm
Leiden University	409	1664	4.07	1.27	3.21
Radboud University	136	377	2.77	0.74	3.73
University of Amsterdam	508	3477	6.84	2.01	3.41
Univerity of Groningen	338	1024	3.03	0.96	3.15
Utrecht University	334	1373	4.11	1.30	3.16
Vrije Unit. Amsterdam	412	1333	3.24	1.00	3.23

INDIVIDUAL LEVEL	P	C-sc	CPP	CPP/FCSm	JCSm/FCSm
Leiden University (N=33)	12.7 ± 8.98	50.85 ± 62.35	3.24 ± 3.07	1.14 ± 0.97	1.28 ± 0.69
	12.00	34.00	2.44	0.80	1.11
Radbound University (N=14)	8.86 ± 7.4	25.93 ± 29.42	2.48 ± 2.09	0.77 ± 0.44	1.06 ± 0.57
	6.00	15.00	1.73	0.80	0.95
Univ. of Amsterdam (N=42)	12.62 ± 11.62	83.81 ± 255.85	4.21 ± 7.92	1.19 ± 1.41	1.12 ± 0.53
	11.00	22.00	1.90	0.73	0.93
University of Groningen (N=18)	19.94 ± 9.26	61.33 ± 77.61	2.67 ± 1.84	0.90 ± 0.55	1.14 ± 0.26
	18.00	48.00	2.30	0.72	1.13
Utrecht University (N=30)	11.57 ± 8.78	47.8 ± 59.57	3.40 ± 2.72	1.31 ± 1.17	1.25 ± 0.74
	8.50	20.50	3.08	1.14	0.98
Vrije Univ. Amsterdam (N=31)	15.19 ± 9.74	46.48 ± 68.24	2.89 ± 2.43	0.78 ± 0.52	1.09 ± 0.37
	14.00	30.00	2.56	0.71	1.00
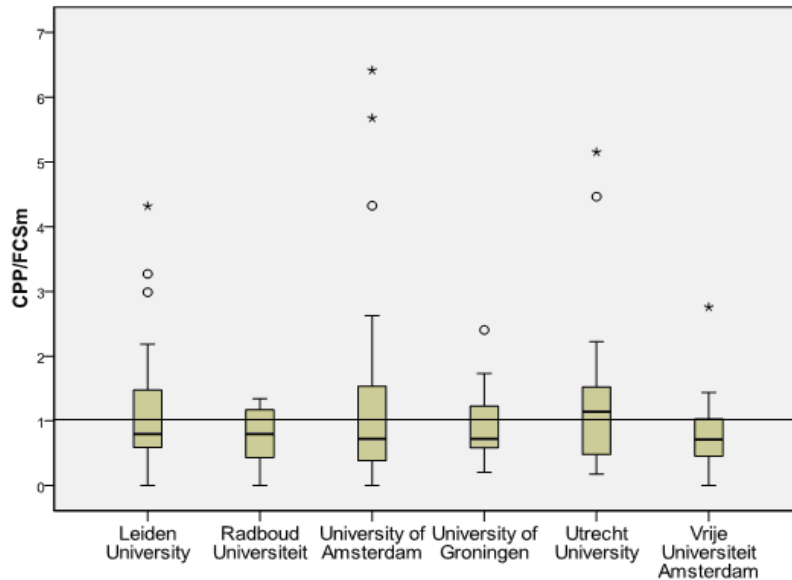
Figure 1. Box plot distribution of CPP/FCSm by researchers and university of affiliation.

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