Research Trends

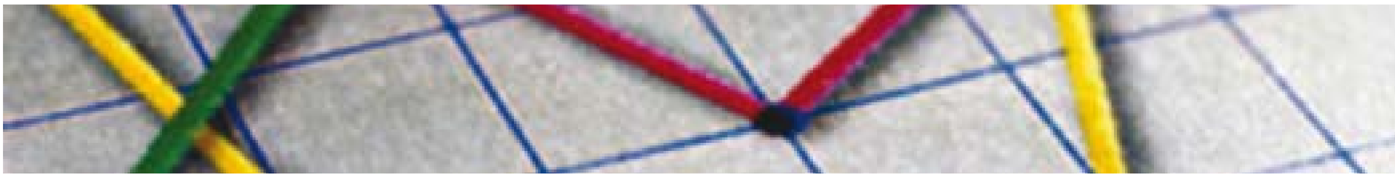
Volume 1 | Issue 14 Article 3

12-1-2009

Analyzing a multidisciplinary research field

Aschwin Wijnsma
Elsevier

Research trends



Analyzing a multidisciplinary research field

ASCHWIN WIJNSMA

A researcher who consults a bibliographic database and looks for articles using the keywords "CO_2" and "greenhouse" could be a climatologist working on atmospheric models or a botanist interested in boosting crop yields.

This simple example demonstrates the importance of reviewing the context of keywords and finding ways to delineate the field of research. Extending the combination of keywords usually delivers more precise results, but it will inevitably lead to reduced completeness, or recall. To increase recall without losing precision, data sets can be expanded using the information in the references from, and citations to, the initial data set. This approach was employed by Eric Archambault et al *(1)* to chart leading countries in the energy research field, using Scopus data for his analysis.

Setting a context

As "energy" is such a generic term in many scientific areas with numerous definitions, Archambault describes the context in his article as "research related to human society". Archambault also uses the following definition for "energy R&D", formulated by the Global Climate Change Group (GCCG) at Pacific Northwest National Laboratory, USA:

> "['Energy R+D' is] the linked process by which an energy supply, energy end-use or carbon-management technology moves from its conception in theory to its feasibility testing and small-scale deployment. [...It] encompasses activities such as basic and applied research as well as technology development and demonstration in all aspects of production, power generation, transmission, distribution and energy storage and energy-efficiency technologies."

Archambault's approach shares common ground with the **SciVal** method developed by Dick Klavans and Kevin Boyack. The latter employs keyword and co-citation analysis to define dynamic research paradigms or clusters *(2)*. According to this method, a paper is not simply allocated a research cluster based on its subject-area classification, making this mapping of science more realistic and sensitive to trends, notably in the multidisciplinary sciences. (See Research Trends, Issue 12, **'Analyzing the multidisciplinary landscape'**.

Scopus classifies journals in major subject areas, one of which is "Energy". Journals can be allocated to multiple subject areas as appropriate to their scope. The classification of journals in the "Energy" subject area is based on criteria that bear resemblance to the GCCG "energy R&D" definition. Interestingly, the average number of subject areas that journals in the "Energy" papers belong to (2.09) is higher than the average value of all science (1.37), indicating that they exhibit a strong degree of interdisciplinarity.

Measuring specialization against impact

Within the Scopus "Energy" subject area data set, a country analysis yields a bubble chart of the 20 most prolific countries (see Figure 1). On the horizontal axis is the Specialization Index, which is a country's share of the "Energy" subject area compared to all subject areas in which that country has published, relative to the world's share (1.37%). On the vertical axis, Relative Impact is plotted, which is defined as all citations in 1996–2007 to all articles in the "Energy" subject area produced by one country, relative to the world's impact in the "Energy" subject area (3.952). The bubble size is proportional to the total article output in 1996–2007.

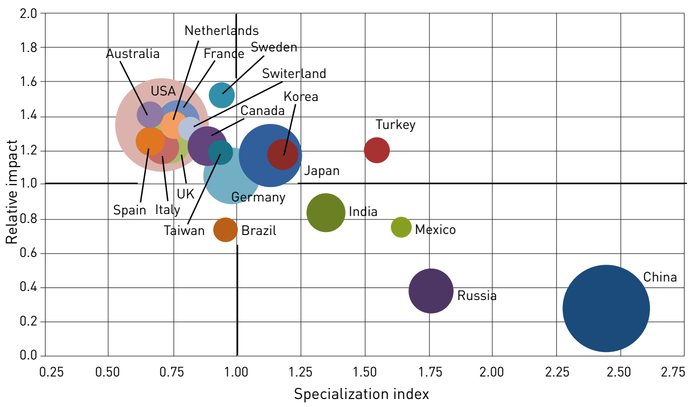


Figure 1 – Specialization versus Impact for the 20 most-prolific countries in the subject area "Energy", 1996–2007. Source: Scopus

Archambault presented a similar bubble chart, but he used another definition of the impact. He weighted the citations by their subject fields, took multiple, smaller citation time windows and averaged the results over 1996–2007 afterwards.

It is clear that there is a negative relationship between specialization and impact, which is strongly influenced by the posi-

Continued on page 7

Continued from page 6

tions of Russia and China on the chart. China pairs the highest level of specialization with the lowest impact of the top 20 countries. However, cultural influences, such as a tendency to publish in the Chinese language, may still hide many citations from view.

There are three countries that score higher than average on both indices: Japan, South Korea and Turkey – the latter being most notable outlier.

Specialization and international collaboration are vital

In the next chart (see Figure 2), we have replaced the Specialization index with another Scopus indicator: Country collaboration, which measures the international character of research. The average world collaboration rate in this context is 22.5%.

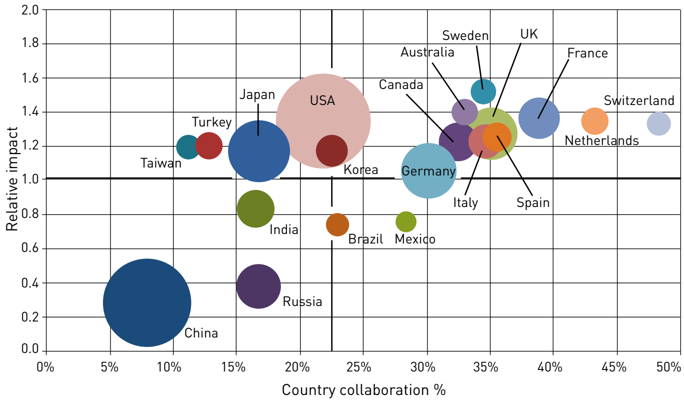


Figure 2 – Country collaboration versus Impact for the 20 most-prolific countries in the subject area "Energy", 1996–2007. Source: Scopus

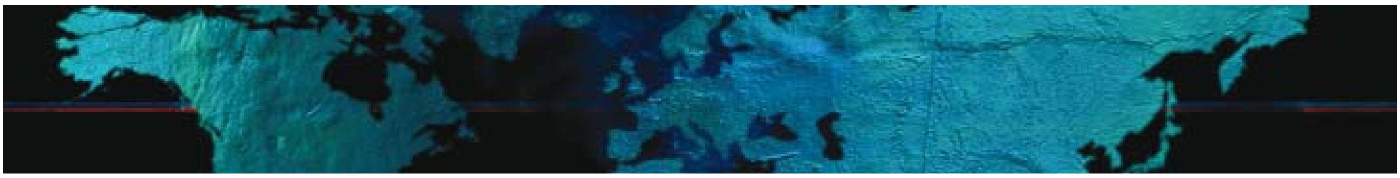
We observe a weak positive relationship, where international collaboration is associated with higher citation impact. A closer examination reveals that the horizontal positions of the bubbles on this chart are practically mirrored in Figure 1: countries with a high specialization index generally have a low collaboration rate. Exceptions are the USA, Japan, Turkey and Taiwan, whose impacts are high, even with a relatively low collaboration rate. It must be emphasized that removing China and Russia from this analysis destroys the positive correlation.

To analyze multidisciplinary research fields, advanced bibliographic analysis methods can be advantageous. A simple keyword search to delineate a multidisciplinary field may be insufficient, with unsatisfactory rates of recall and precision. However, this analysis, based on a dataset of papers that are classified under the generic subject area of "Energy", largely reproduces the same relationships that Archambault found.

The importance of energy research needs no further explanation, but the choice of strategy and approach partially depends on the effectiveness of specialization and international collaboration. In a recent speech at MIT, US President Barack Obama advocated US leadership in the development of clean-energy technologies, which alludes to specialization *(3)*, while he also reached out for international collaboration to mitigate global warming – another energy-related issue *(4)*. Future bibliometric analyses may reveal the effectiveness of his plans in terms of scientific quality.

References
(1) **Archambault, E. et al (2009) Bibliometric analysis of leading countries in energy research. Science-Metrix**.
(2) **Scival Spotlight – Information Website.**
(3) **McKenna, P. (2009) 'Obama says US in global race to develop clean energy', New Scientist**.
(4) **Goldenberg, S. and Watts, J. (2009) 'US aims for bilateral climate change deals with China and India', The Guardian**.

Country trends



Small countries lead international collaboration

JUDITH KAMALSKI

Recent research has shown that international research collaboration is growing rapidly *(1)*. This is unsurprising given the fact that many of the most pressing challenges in science are global in nature *(2)*. Think about climate change or the H1N1 flu virus: these clearly cross borders and demand a global response. Analyzing data on international collaborative article output by country reveals that smaller countries proportionally carry out more international research than those in larger countries (see Table 1).

Professor Jean-Claude Thill from the Department of Geography and Earth Sciences at UNC Charlotte explains: "There seems to be an inverse relationship between the degree of

Continued on page 8