

**Scientific Cooperation to Meet Grand Challenges:  
Valuating Russian Scientific Strengths  
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**Findings**

- Russia is exceptionally strong in physics, geosciences, space sciences, chemistry, and mathematics, garnering 4% to 8% of publications in these fields;
- Despite the relative size of the scientific community in Russia, its relative engagement with others in the scientific community is low;
- This disparity feeds a sense of non-transparency and yields national security concerns related to the activities of some Russian scientists, particularly those resident within state owned and operated institutes.
- Programs engaging Russian scientists may not have an effect on the total amount of published work, but may alter the perceived impact of it simply by changing the types of journals in which the work is published. They also help respond to transparency and other national security concerns.

Thomson Scientific is a leading source of published scientific articles and information on the subsequent citation of them. They maintain a large searchable database indexing approximately 9000 journals. Essential Science Indicators, a compilation of statistical information based on Thomson Scientific data, categorizes journals into 22 broad fields or disciplines. Multidisciplinary journals such as *Nature*, *Science*, and *Proceedings of the National Academy of Sciences of the USA* (PNAS) have their articles scanned and assigned to the appropriate disciplines. Publications are generally considered to be the currency of science--the more publications a scientist has, the more valuable he or she can be considered to science. Thomson's use of citation tracking goes one step beyond the quantity of publications, providing an easy way to determine the relevance or "impact" an article, a scientist, a journal, or a country has in a particular field, or in science as a whole. The more an article is cited in subsequent papers, the more important it is--therefore having a higher "impact." Based on the data compiled by Thomson Scientific, journals have been given "Impact Factors," a statistical determination based on the number of papers a journal publishes and how often they are cited. The three journals with the highest impact factors are the multidisciplinary journals listed previously: *Nature*, *Science*, and *PNAS*.

<b>Percentage of Publications in Leading Journals, 2001-2005</b>			
	<b>Nature*</b>	<b>Science</b>	<b>PNAS</b>
USA	40.9	46.45	73.88
England	10.64	7.77	6.65
Germany	5.70	5.35	7.58
France	3.88	3.91	5.42
Japan	3.59	2.76	6.54
Canada	3.14	2.96	3.89
Switzerland	2.17	2.42	2.63
Netherlands	1.91	1.80	1.90
Italy	1.81	1.55	2.83
Australia	1.63	1.97	1.91
Scotland	1.49	1.19	0.98
Sweden	1.22	1.05	2.33
Israel	1.00	0.87	1.99
Spain	0.94	0.59	1.54
Belgium	0.73	0.51	0.84
China	0.69	1.30	1.01
Denmark	0.68	0.70	0.86
Austria	0.62	0.65	0.60
Russia	0.37	0.48	0.56
S. Korea	0.35	0.25	0.67
* Includes all of the Nature journals			

In order to determine the areas of science in which Russia is the most competitive, we used Essential Science Indicators Sci-bytes and Web of Science, products offered by Thomson Scientific.

In a 1996-2006 10-year survey of scientific publications, the US, Japan, the United Kingdom, France, and Germany produced the largest total number of articles and also received the largest total number of citations. Russia was placed 9<sup>th</sup> in article publication but only 18<sup>th</sup> in citations. Two more focused Sci-bytes studies looked specifically at Russia's world share of science and social-science publications over five year periods. In the years 1999-2003, 3.35% of all scientific publications had at least one author from Russia. This dropped to 3.04% in the years 2001-2005.

A breakdown into scientific disciplines shows that Russia is exceptionally strong in physics, geosciences, space science, chemistry, and mathematics, garnering between 4 and 8% of the publications in each of these fields. Of note is the relative impact of Russia in each category

Percentages of Publications in <i>Physical Review Letters</i> , 2001-2005		Percentages of Publications in <i>Applied Physics Letters</i> , 2001-2005	
USA	45.73	USA	38.43
Germany	20.22	Japan	10.44
France	13.57	Germany	5.61
Japan	10.72	China	16.01
England	8.93	South Korea	6.65
Italy	7.82	France	5.61
Russia	6.89	England	5.33
Canada	5.25	Italy	3.65
Netherlands	4.66	Taiwan	3.29
Switzerland	4.63	Spain	2.15
China	4.60	Canada	2.09
Spain	4.47	Singapore	2.06
Israel	3.47	Russia	1.97
South Korea	2.79	Sweden	1.89
Poland	2.68	Switzerland	1.86

compared to the rest of the world, using the number of citations that the published papers have received as metrics. The average number of citations for a physics paper throughout the world in this time frame is 3.79, but Russian papers only received 3.01 citations per paper, a 21% difference. Thus Essential Science Indicators records this disparity in impact as -21. Therefore, even though Russia produces 8% of all the publications in physics, they are not cited frequently and, by extension, are considered to be less important.

Measuring impact based on citations is controversial. In the case of Russia, the science produced there may be getting under-cited, generating a lower apparent impact. The journals with the highest impact

factors are *Nature*, *Science* and *PNAS*. Despite producing 3% of scientific publications worldwide, Russian articles accounted for only 0.37%, 0.48%, and 0.56% of the publications in *Nature*, *Science* and *PNAS* respectively.

Publication in high impact journals leads to more citations not necessarily because the work is better, but because there is greater exposure. It is certainly possible that Russians (as well as those from other countries) have fewer opportunities to publish in these prestigious journals. It is also likely that Russian scientists are inclined to publish in local journals or in very discipline-specific journals which tend to be of lower overall impact. Looking at a broad scientific discipline gives similar results. Even though Russia produced 8% of all the physics publications, an analysis of *Applied Physics Letters* and *Physical Review Letters*, two of the leading physics

journals, showed that only 1.97% and 6.89% of their respective publications were from Russian scientists.

For the purpose of this survey it is not useful to address the issues associated with measuring impact; although this is a generally accepted measure, there is an element of bias. It is clear that within Russia, the bulk of the scientific output is in the areas of physics, geosciences, space science, chemistry, mathematics, and materials science. It is also true that in these fields Russia is responsible for a significant portion of the total published work.

### **More Information**

Thomson Scientific statistics on Russian scientific publishing from 2001 to 2005:  
[http://in-cites.com/research/2007/january\\_8\\_2007-1.html](http://in-cites.com/research/2007/january_8_2007-1.html)

Thomson Scientific statistics on Russian scientific publishing from 1999 to 2003:  
[http://in-cites.com/research/2004/november\\_1\\_2004-2.html](http://in-cites.com/research/2004/november_1_2004-2.html)

Thomson Scientific statistics on Russian publications and citations from 1994 to 2004:  
<http://in-cites.com/countries/russia.html>