

## EXECUTIVE SUMMARY

In 2010 India produced a total of 65,487 publications, which represents 3.4% of the world's output for that year – which is an increase from 2.5% in 2006.

India's publication output is growing rapidly. Between 2006 and 2010, the number of papers published by India yearly, has grown 12.3% (compound annual growth rate) per year, while the total stock of world publications has grown 4% in the same period. The only comparator countries' whose output is growing faster than India's are China (13.7%) and Iran (25%).

Energy was the fastest growing subject area in India between 2006 – 2010 (13.3% CAGR) but does not yet represent a large share of India's total research output (3.1%). Interestingly, of the 16 subject areas investigated in this report, Energy is the subject area showing the highest world normalized citation impact, indicating that the overall quality of India's energy research is above world average.

Materials Science, Physics and Astronomy, and Medicine are significant subject areas for India because they each represent over 13% of Indian total output and have also each grown more than 7% per year in the 2006 -

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<sup>1</sup> The All Science Journal Classification used in Scopus classifies publications into 27 main fields. This report focuses on 16 of those 27 fields.

2010 period. Of these, Materials Science has a citation impact just about equal to the world average (1.01), while the others show below world average citation impact.

The United States and United Kingdom share the top spot in terms of producing the highest impact publications. Both countries have an overall world normalized relative citation impact of 1.7 for the period (2006-2010) indicating their papers were on average, cited 1.7 times as often as the world average for the same period. In contrast, India has an overall relative citation impact of 0.68 for the same period (2006-2010) – which is below the world average (1.0). India has shown an increase in overall world normalized citation impact from 0.58 in the period 2002-2006 to 0.68 in the period 2006-2010.

We also see that South Africa and Singapore have gone from below world average citation impact to above world average levels by the 2006-2010 period indicating significant improvements in quality of research. The quality of Indian research, as represented by world normalized citation impact, is above that of the Russian Federation, China, and Iran, while marginally below that of Brazil; and significantly below the other comparator countries.

Of the 16 subject areas examined in this report, India shows 4 subject areas which demonstrate above world average citation impact, namely: Energy (1.26), Chemical Engineering (1.18), Engineering (1.04) and Materials science (1.01). Energy stands out as the subject area in which India has the highest world normalized citation impact (1.26), while also being the fastest growing subject area in India (13.3% CAGR).

Engineering and Materials Science stand out in that each represent a significant share of India's output (over 13% each) while Engineering demonstrates above world average citation impact (1.04) and Materials science just about equal to world average citation impact (1.01).

Looking at levels of international collaboration during the period 2006-2010 as a whole we see that 17.6% of all India's scientific publications have at least one author affiliated to an institution in another country, which is a similar level to Iran (17.7%) and higher than China (13.1%). The remaining comparator countries show higher levels of international collaboration than India. Most notably, we see that South Africa and Singapore show rapid increases in world normalized citation impact paired with high and rising levels of international collaboration (both countries show international collaboration levels of over 43% 2006-2010). In contrast, India, Iran, Brazil and the Russian Federation show relatively low levels of international collaboration (below 32% 2006-2010) and do not show significant increases (even some declines) as well as all demonstrating below world average citation impact.

Offsetting levels of international collaboration per country against world normalized citation impact for the period 2006-2010 reveals a correlation of .67 (indicating a positive relationship between citation impact and level of international collaboration). This supports findings reported in other studies, where international collaboration has been suggested to be a significant factor in achieving high citation impact.

Now that India has established itself as a significant player in terms of scientific output, future activities may focus on raising the overall quality of research. It may be of interest to understand how South Africa and Singapore have achieved the significant gains in overall quality of research, from below world average level, and how this may be related to their collaboration networks. In this context, India may need to identify which specific strategic partnerships and collaborations will help yield higher quality research and citation impact in the years to come.

Overview India 16 Subject Areas 2006-2010				
	Share of India's total output 2006-2010	World Normalized Citation Impact 2006-2010	Compound Annual Growth Rate 2006-2010	Percentage International Collaboration 2006-2010
*All subjects combined	100%	0.68	12.3%	17.6%
Agricultural and Biological Sciences	10.8%	0.58	5.8%	14.5%
Biochemistry, Genetics and Molecular Biology	13.2%	0.53	8.6%	20.2%
Chemical Engineering	6.6%	<b>1.18</b>	8.3%	15.7%
Chemistry	17.0%	0.71	5.3%	17.2%
Computer Science	9.9%	0.63	9.3%	17.3%
Earth and Planetary Sciences	4.1%	0.65	2.7%	26.1%
Energy	3.1%	<b>1.26</b>	13.3%	14.5%
Engineering	17.5%	<b>1.04</b>	5.9%	17.0%
Environmental Science	6.6%	0.63	5.4%	13.7%
Immunology and Microbiology	3.7%	0.52	6.7%	19.4%
Materials Science	13.9%	<b>1.01</b>	7.8%	22.0%
Mathematics	5.3%	0.87	10.5%	26.4%
Medicine	18.2%	0.52	8.0%	14.6%
Pharmacology, Toxicology and Pharmaceutics	8.7%	0.60	8.9%	8.9%
Physics and Astronomy	15.6%	0.83	9.0%	28.5%
veterinary	1.9%	0.33	8.9%	5.2%

**Figure 1.0** - Overview of India for 16 subjects 2006-2010: the percentage share of total Indian output for each subject area, the world normalized citation impact, compound annual growth rate and percentage international collaboration for the years 2006-2010. Publications are often classified with more than one subject area and as such, subject areas overlap in terms of the publications which represent them. For this reason, the cumulative percentage of the subject areas exceeds 100%.