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## **Contribution and Impact of Faculty and Scholars of IISER Mohali : (A Scientometric Study, 2008-12)**

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### **Abstract**

This paper analyses the broad characteristics of 186 research papers published and indexed in Scopus international multidisciplinary bibliographical database by the researchers and faculty of Institute of Science Education and Research (IISER), Mohali during 2008–12 by focusing on its publication growth characteristics, format and media of communication, research impact and quality, patterns of research collaboration, broad and narrow areas of research and contribution and citation impact of its more productive authors

**Keywords:** IISER, Mohali, higher education, institution, India, publication productivity, citation impact, research collaboration, scientometrics

### **Introduction**

Scientific performance of any research organization can be evaluated in the form of quality and quantity of “Research Publications” produced by the organization. If only quantitative measures are required, it is a simple matter to add the number of publications by the number of contributors. However, when the quality angle is to be factored in, the number of citations each publication has earned was taken as a proxy. It is a known fact that the research performance in higher education is gaining prominence for the last two decades in global landscape. Usually research performance of any organization is a multi-disciplinary and multi-dimensional concept, which cannot be encapsulated in a single universal indicator. The performance of an organization is generally evaluated on the basis of placement of its graduates, its contribution to

society, quality of education, quality of its research output, etc. The evaluation of research can also be measured on the basis of international collaborations, number of publications and citations received by such publications in the works published by the researchers all over the world. The evaluation of research output of a organization helps to frame a research policy and develop strategies for future course of research. It also helps to obtain funding for its research programs, fix priorities in research and recognize and reward the eminent researchers.

### **Indian Institutes of Science Education and Research (IISERs)**

The present scenario of higher education in India is changing drastically and it is more inclined towards computer related subjects by pushing the science education and research a back seat. Moreover, majority of the students are tempting/opting for computer-oriented career than science and its allied subjects. As a result, the Government of India had to pay attention and feel its significance when it comes to know the ranking of the country in global scientific landscape and also when it find difficulty in getting the faculty to teach the researchers in science across India. This made the Scientific Advisory Council to the Prime Minister of India (SAC-PM) to constitute a committee under Chairmanship of renowned scientist and Scientific Advisor to the Prime Minister of India, Prof. C.N.R. Rao, to address the issue at national level and submit a recommendation to the Government of India. After thorough debates, reviews and discussions, the Committee recommended for creation of five new institutions devoted only to science education and research to be named “Indian Institute of Science Education and Research” broadly on the lines of the “Indian Institute of Science (IISc), Bangalore”. As a result, five Indian Institutes of Science Education and Research (IISERs) were established across India under the Ministry of Human Resource Development (MHRD), Government of India as autonomous body with the aim to create world class institutes in frontier areas of science education and research.<sup>2</sup> They have been designed to reach the prestigious position in the global setting that IISc, IIMs and IITs presently enjoy.

The foundation stone of IISER Mohali, was laid by the Hon’ble Prime Minister of India Dr. Manmohan Singh on September 27, 2006. The Founder Director Prof. N. Sathyamurthy took charge on June 18, 2007<sup>1</sup>. As an autonomous Institution, the IISER Mohali awards B.S-M.S dual degree, M.S-PhD integrated and PhD degree in basic Sciences, i.e. mathematics, physics,

chemistry and biology. It also offers courses in interdisciplinary areas like earth & environmental sciences, astronomy & astrophysics, computational sciences, humanities & social sciences, etc.

The selection of students for admission is on merit basis through qualifying any of the following examinations: (i) Kishore Vaigyanik Protsahan Yojana (KVPY) – a scholarship program funded by the Department of Science and Technology ( DST) , Government of India; (ii) IITJEE Merit List – Those who feature in the regular merit list and (iii) IISERs Common Aptitude / Screening Test – a common entrance exam conducted by all IISERs together for the students passed class XII in central or state boards and have got marks above the cut-off percentile available at DST website or INSPIRE fellowship certificate obtained from the boards. For the PhD Programme, candidates who have passed one of the national level tests are admitted after conducting interview. Students of all courses including B.S–M.S dual degree, M.S–PhD integrated and PhD and Post Doctoral fellows get fellowship through out their course period. The first batch of BS–MS dual degree students were admitted in July 2007 and the first batch of PhD students were admitted in July 2008. The classes for the first batch of BS–MS students were started on August 16, 2007 in a transit campus<sup>2</sup>.

The high profile teaching faculty (involved in both teaching and research) at IISER Mohali were selected on highly competitive basis from India and abroad. They were given adequate time and support for setting up of laboratories to gear up their research in their area of specialization. Many extra–mural research projects were awarded to the faculty members of IISER Mohali from different scientific agencies/departments of the Government of India and the research projects of the institute also involve international collaboration<sup>1</sup>.

## **Review of Literature**

Few evaluation studies of different types of organizations, based on their publication output are undertaken in the past, both in India (including that of Indian Institute of Technology, Kharagpur<sup>3-4</sup>, Indian Institute of Technology, Roorkee<sup>5</sup>, University of Mysore<sup>6</sup>, Karnataka University<sup>7</sup>, University of Jammu<sup>8</sup>, BARC<sup>9</sup>, CSIR–NPL<sup>10</sup>, CSIR–IMTECH<sup>11</sup> and Rajiv Gandhi Centre for Biotechnology<sup>12</sup>) and abroad<sup>13</sup>. These studies concentrate mostly on publication growth characteristics, citation impact, national and international collaboration, contribution

and impact of leading authors and high cited papers, etc. Studies had also been conducted at the broader level, which includes evaluation of research at the group of institutes' level<sup>14</sup>. Still broader studies are available which deals with evaluation of scientific activity, including institutional activities<sup>15</sup>

## **Objective of the Study**

The main objectives of the present study are to analyze the broad characteristic features of the publication output of IISER Mohali during 2008–12, using quantitative and qualitative indicators.

In particular the study focuses on the following aspects:

- To study the growth and citation impact of its research output;
- To study the research output and citation impact under broad and narrow broad subject areas;
- To analyse its national and international collaboration;
- To analyse the contribution and impact of its leading authors; and
- To study the media of communication

## **Methods and Methodology**

The study is based on publication data, derived from international multidisciplinary Scopus database (<http://www.scopus.com>) for 5 years from 2008 to 2012. The Scopus is one the world's largest abstract and citation database of peer-reviewed literature. An advanced search with the following search strategy was used, which resulted in downloading of 186 records of the institute during 2008–12.<sup>1</sup>

(AF-ID("Indian Institute of Science Education and Research Mohali" 60103627)) AND (LIMIT-TO (PUBYEAR, 2012) OR LIMIT-TO(PUBYEAR, 2011) OR LIMIT-TO(PUBYEAR, 2010) OR LIMIT-TO(PUBYEAR, 2009) OR LIMIT-TO(PUBYEAR, 2008))

For collecting data on national and international collaboration, subject-wise distribution, individual authors and media of communication, separate search strategies were developed. The author, however, considered the data from 2008 onwards, as the institute was established in mid-2007. For analyzing the average citation per paper, the citation data for three years, two years, one year and zero year citation windows have been used for all articles published during

2008–09, 2010, 2011 and 2012.

In order to find out the Impact factor (IF) of the Journal in which IISER Mohali faculty published its research papers, the author visited website of the each journal and noted the impact factor (IF) of journal/source. As per the Journal’s website, the IF of the Journal was collected by the publisher from the Journal Citation Report database (JCR) in 2012.

## Analysis

### Growth of Research Papers and Authors

The total output of IISER, Mohali consists of 186 papers during 2008–12, of which 171 are published as articles, 4 as conference papers, 4 as reviews, 3 as letters, 2 as erratum, 1 as article in press and 1 as short survey. The number of papers of the institute has increased from 18 papers in 2008 to 65 papers in 2012, showing an annual average growth rate of 44.98%. The number of authors has grown from 19 authors in 2008 to 124 authors in 2012, showing an annual average growth rate of 65.43%. As far as contribution of the students is concerned, out of total 284 authors, five authors (1.76 %) are undergraduates and 80 authors (28.16%) are postgraduates. The Institute was started with one faculty (Founder Director) in 2007 and after 5 years of its journey it reached to 60 faculty excluding honorary, visiting and adjunct (Table 1).

3,4,5,6,7

**Table 1 : Year–Wise Growth of Research Papers & Authors at IISER Mohali, 2007–12**

Year	No. of Faculty*	No. of Authors		No. of Authors	TP	TC	ACPP
		UG	PG				
2008	24	--	1	19	18	100	5.56
2009	30		3	20	16	103	6.44
2010	44		4	39	34	146	4.29
2011	51	1	25	82	53	201	3.79
2012	60	4	47	124	65	83	1.28
Total		5	80	284	186	633	3.40

\*Strength of faculty was drawn from Annual reports of IISER Mohali for different financial years. However for the convenience of the study, the

same data was reconsidered as calendar year<sup>3,4,5,6,7</sup>

The citation impact (as measured by the average citation per paper on a three-year citation window) registered by all publications of the institute was 3.40, which decreased from 5.56 in 2008 to 1.28 in 2012 (Table 2). In terms of distribution of citations received by all papers since their publication till 1 September 2013, it was observed that the 91 papers (48.92%) had received 1–5 citations in contrast to only 6 papers (3.22% papers) receiving 26–45 citations. If we consider the author’s whose more number of articles received the highest number of citations, there are three articles of Prof. N. Sathyamurthy from chemistry positioned in the top 10 highly cited articles (Table 3). The overall h-index registered for all publications of the institute was 18 during 2008–12.

**Table.2: Distribution of IISER Mohali Papers Based  
On the Number of Citations\*, 2008–12**

Range of citations	No. of Articles	% Share of Citations	Range of Citations	No. of Articles	% Share of Citations
41–45	1	0.54	16–20	7	3.76
36–40	2	1.08	11–15	7	3.76
31–35	2	1.08	6–10	20	10.75
26–30	1	0.54	1–5	91	48.92
21–25	8	4.30	0	47	25.27

\*The number of citations were counted from the date of publication till 1 September 2012

On analysing the distribution of papers of the institute by impact factor (IF) range, it was observed that there were 26 papers (13.98%) of the IISER Mohali which were published in journals having impact factor range of 0.142 – 0.974, 128 papers (68.82%) in journals having IF range of 1.038 – 4.986 and 27 papers (14.52%) of the papers in journals having IF above 5. Another interesting finding here is that 1.08% of IISER Mohali papers were published in very high impact factor journal like “Science”, and “Cell” which are having an IF of 31.20 and 32.40 (Table 3).

**Table 3: Distribution of the Papers of IISER, Mohali by IF Range, 2008–12**

IF Range	No of Papers	Share of Papers	IF Range	No.of Paper	Share of Papers
0.142 – 0.974	26	13.98	7.115 – 7.781	09	4.7
1.038 – 1.927	36	19.35	9.681	02	1.05
2.057 – 2.986	48	25.81	10.26	02	1.05
3.022 – 3.898	31	16.67	31.201--- 32.403	02	1.05
4.069 – 4.986	13	6.99	Not eligible for IF	02	1.05
5.146 – 5.520	10	5.38	IF not available	03	1.57
6.024 – 6.213	02	1.08	Total Number of	186	100

**National  
and  
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### International Collaboration

The average share of international collaborative papers of IISER, Mohali during 2008–12 was 42.47%, which has increased from 5.56% in 2008 to 41.54% in 2012 (Table 4)

**Table 4. Share of International Collaboration in Institutional Output, 2008–12**

Period	TP	ICP	%ICP
2008	18	1	5.56
2009	16	5	31.25
2010	34	15	44.12
2011	53	31	58.49
2012	65	27	41.54
Total	186	79	42.47
TP=Total Papers; ICP=International Collaborative Papers			

The faculty and scholars of IISER, Mohali had international collaboration papers with scientists of 27 countries during 2008–12. The largest collaboration of IISER, Mohali was with United States (38 papers, 20.43% share), followed by Germany (23 papers, 37% share), Spain (10 papers, 5.38% share), Canada, Finland, Italy, Japan and Singapore (4 papers, 2.15% share each), France, Netherlands and U.K. (3 papers, 1.61% each), Algeria, China, Costa Rica, Demark, Mexico, Russia Federation, South Korea and Switzerland (2 papers, 1.08% each), and 1 paper each with 8 other countries (Table 5).



In terms of collaboration with individual foreign organizations with the institute scholars and faculty during 2008–12, the largest number of collaborative papers was with Max Planck Institute of Chemistry, Mainz, Germany (with 8 papers), followed by University of California, Los Angeles, USA (7 papers), University of Gottingen, Sweden (5 papers), University of Helsinki, Finland (4 papers), Arizona State University, USA (4 papers), Massachusetts Institute of Technology, USA (4 papers), Universitat de Barcelona, Spain (3 papers), Wageningen University & Research Centre (3 papers), Johannes Gutenberg Universitat, Mainz (3 papers), Germany, Institute for Theoretical Solid State Physics, Dresden, Germany (2 papers), etc.

**Table 5. Major International Collaborating Partner Countries of IISER, Mohali, 2008–12**

Collaborating Country	No. of Collaborating Papers	% Share of Collaborating Papers	Collaborating Country	No. of Collaborating Papers	% Share of Collaborating Papers
United States	38	20.43	U,K	3	1.61
Germany	23	12.37	Algeria	2	1.08
Spain	10	5.38	China	2	1.08
Canada	4	2.15	Costa Rica	2	1.08
Finland	4	2.15	Denmark	2	1.08
Italy	4	2.15	Mexico	2	1.08
Japan	4	2.15	Russia	2	1.08
Singapore	4	2.15	South Korea	2	1.08
France	3	1.61	Switzerland	2	1.08
Netherlands	3	1.61	Total	79	

### National Collaboration

The average share of national collaborative papers of IISER, Mohali in its total output during 2008–12 was 53.76%, which has decreased from 94.44% in 2008 to 40.00% in 2012 (Table 6).

**Table 6. Share of National Collaboration in Institutional Output, 2008–12**

Period	TP	NCP	%NCP
2008	18	17	94.44

2009	16	13	81.25
2010	34	22	64.71
2011	53	22	41.51
2012	65	26	40.00
Total	186	100	53.76
TP=Total Papers; NCP=National Collaborative Papers			

The IISER, Mohali papers had 172 collaboration linkages with different national organizations during 2008–12, of which 68 collaboration linkages were with 21 university & colleges, 47 collaboration linkages with 12 research institutes, 45 collaborative linkages with 8 institutes of national importance and 12 collaborative linkages with 6 industrial enterprises.

The largest number of collaboration linkages (21) of IISER, Mohali was with Panjab University, Chandigarh during 2008–12, followed by Indian Institute of Technology, Kanpur (19 linkages), Guru Nanak Dev University, Amritsar (12 linkages), Institute of Microbial Technology, Chandigarh (12 linkages), Jawaharlal Nehru Advanced Centre for Scientific Research, Bangalore (9 linkages), Anna University, Chennai (7 linkages), Institute of Mathematical Sciences, Chennai (7 linkages), National Institute of Pharmaceutical Research and Education, Mohali (6 linkages), Indian Institute of Technology, Chennai (5 linkages), Indian Institute of Science, Bangalore (4 linkages), Central Leather Research Institute, Chennai (4 linkages), Indian Institute of Science Education and Research, Kolkata (4 linkages), SUSCET, Mohali (3 linkages), Indian Institute of Technology, Kharagpur (3 linkages), B.S.Abdur Rahman University, Chennai (3 linkages), etc.

### **Subject–Wise Break–Up of Papers**

In terms of subject–wise break–up of IISER, Mohali research output, it was observed that the largest number and share of its research output was in physics & astronomy (67 papers, 36.02% share), followed by chemistry (61 papers, 32.80% share), biochemistry, genetics & molecular biology (47 papers, 25.27% share), mathematics (32 papers, 17.20% share), materials science (25 papers, 13.44% share), medicine (7 papers, 3.76% share), agricultural & biological sciences, chemical engineering, chemical engineering, earth & planetary sciences and engineering (6 papers, 3.23% share each) and pharmacology, toxicology and pharmaceuticals (5 papers, 2.69%

share).

Looking at the h-index, the highest (11) was achieved by physics & astronomy, followed by chemistry (9), biochemistry, genetics & molecular biology and materials science (7 each), mathematics (5), earth & planetary sciences (4), medicine and engineering (3 each), agricultural & biological sciences and pharmacology, toxicology & pharmaceuticals (2 each) and chemical engineering (1).

In terms of share of international collaborative papers, the largest share was recorded by earth & planetary sciences (100.0%), followed by physics & astronomy (47.76% share), mathematics (40.63% share), materials science (36.00%), chemistry (31.15% share), biochemistry, genetics & molecular biology (27.66% share) and agricultural & biological sciences and engineering (16.67% share each).

**Table 7. Subject-Wise Break-Up of Papers of IISER, Mohali, 2008-12**

Subfield	TP	TC	ACPP	H-Index	ICP	%ICP	%TP
Physics & Astronomy	67	312	4.66	11	32	47.76	36.02
Chemistry	61	207	3.39	9	19	31.15	32.80
Biochemistry, Genetics & Molecular Biology	47	119	2.53	7	13	27.66	25.27
Mathematics	32	52	1.63	5	13	40.63	17.20
Materials Science	25	121	4.84	7	9	36.00	13.44
Medicine	7	24	3.43	3	1	14.29	3.76
Agricultural & Biological Sciences	6	6	1.00	2	1	16.67	3.23
Chemical Engineering	6	4	0.67	1	0	0.00	3.23
Earth & Planetary Sciences	6	26	4.33	4	6	100.00	3.23
Engineering	6	42	7.00	3	1	16.67	3.23
Pharmacology, Toxicology & Pharmaceuticals	5	9	1.80	2	0	0.00	2.69
TP=Total Papers TC=Total Citations; ACPP=Average Citations per Paper; ICP=International Collaborative Papers							

### Contribution and Citation Impact of Leading Authors

The top most productive Indian authors involved in research at IISER, Mohali have published 6 to 18 papers each during 2008–12. The publication profile of these 11 authors along with their research output, citations received, h-index values and share of international collaborative papers are presented in Table 8. These 11 authors together have contributed 49.46% share (92 papers) in the cumulative publications output of the institute during 2008–12. Two authors have registered higher publications share than the group average of 8.36. They are N. Sathymurthy with research output of 18 papers, followed by S. Sinha (14 papers). The average citation impact per paper of 11 authors was 4.13 and it varied from 0.33 to 13.5. Four authors have registered citation impact more than the average citation per paper (4.13) of the 11 authors. They are Y. Singh with average citation per paper of 13.50, followed by V. Sinha (6.43), N. Sathyamurthy (5.28) and S. Sinha (4.14) during 2008–12. The average h-index of the 11 authors was 3.73 and it varied from 1 to 7. Five authors have registered h-index more than the average h-index (3.73) of the 11 authors during 2008–12. They are N. Sathyamurthy with h-index of 7, followed by Y. Singh (5), V. Sinha (5) and S. Sinha (5). The average share of international collaborative papers of the 11 authors was 30.43% and it varies from 0.0% to 100.0%. Four authors have achieved collaboration share more than average international collaboration share of 11 authors (30.43%). They are Y. Singh and V. Sinha with 100% international collaboration share, followed R. Kapoor (62.50%) and I.B.S. Passi (33.33%).

**Table 8. Productivity and Citation Impact of Top 11 Authors of IISER, Mohali, 2008–12**

Name	Department	TP	TC	ACP P	H- Inde x	ICP	%ICP
N. Sathyamurthy	Chemistry	18	95	5.28	7	5	27.78
S. Sinha	Physics	14	58	4.14	5	1	7.14
R. Kapoor	Chemistry	8	15	1.88	3	5	62.5
R.S. Johal	Physics	7	16	2.29	3	1	14.29
V. Sinha	Environmen tal Sciences	7	45	6.43	5	7	100
S. Mukhopadhyay	Biology	7	21	3	4	1	14.29
P. Gaupthasarma	Biology	7	8	1.14	2	0	0
Y. Singh	Physics	6	81	13.5	5	6	100
I.B.S. Passi	Mathematic	6	2	0.33	1	2	33.33

	s						
Dorai.K	Physics	6	19	3.2	3	0	0
M. Bhattacharya	Biology	6	20	3.33	3	0	0
Total		92	380	4.13	3.73	28	30.43
Total of the Institute		186					
Share of 11 authors in total papers of the institute		49.46					

### Media of Communication

Out of 186 papers published by IISER, Mohali, 171 were published in journals. These 171 papers were published in 91 journals: 9 papers each in 2 journals, 7 papers in 1 journal, 5 papers in 1 journal, 4 papers each in 4 journals, 3 papers each in 10 journals, 2 papers each in 22 journals and 1 paper each in 51 journals. The top 18 journals publishing 3 and more papers are listed in Table. The cumulative output of these 18 journals consists of 76 papers, constituting 44.44% share of total journal papers of the institute during 2008–12 (Table 9).

**Table 9. Media of Communication (Most Productive Journals) of IISER, Mohali, 2008–12**

S.No	Name of the Journal	No. of Papers
1.	Journal of Physical Chemistry A	9
2	Physical Review E Statistical Nonlinear and Soft Matter Physics	9
3	Physical Review Letters	7
4	Atmospheric Chemistry & Physics	5
5	Crystal Growth & Design	4
6	Chemical Physics Letters	4
7	Physical Review B Condensed Matter and Materials Physics	4
8	Polyhedron	4
9	Chemical Physics	3
10	Communications in Algebra	3
11	Journal of Chemical Physics	3

12	Biochimica Et Biophysica Acta Proteins and Practoteomics	3
13	Journal of Biological Chemistry	3
14	Current Science	3
15	Dalton Transactions	3
16	Journal of Coordination Chemistry	3
17	Journal of Molecular Structure	3
18	Molecular Physics	3
	Total	76

### Summary and Conclusion :

During the last five years, the faculty and scholars of IISER, Mohali have together published 186 papers, of which 171 were published as articles. The institute has published 18 papers during 2008 which increased to 65 papers by 2012, witnessing an annual average publication growth rate of 44.98%. The average citation impact per paper recorded for all its publications by the institute on a three year citation window was 3.40 during 2008–12. When scientific impact was considered for all publications of the institute since their publications till 1 September 2013, it was observed that only 3.22% (6 papers) of its papers had received 36 to 45 citations in contrast to a very large percentage 48.92% (91 papers) of papers receiving citations from 1 to 5. When the institute research impact was considered in terms of impact factor, 27 papers (14.52%) of the institute were found to have published in journals having IF above 5 in contrast to 26 papers (13.98%) papers in journals having impact factor range from 0.142 to 0.974. However, 1.08% of IISER Mohali papers were published in very high impact factor journal like “Science”, and “Cell” which are having an IF of 31.20 and 32.40. Around 42.47% of the papers of the institute are published in international collaboration with scientists of 27 countries during 2008–12, the largest number of papers were with USA (20.43%), followed by Germany (37%), Spain (5.38%), etc. Among the foreign organizations collaborating with the institute during 2008–12, the largest collaboration was with Max Planck Institute of Chemistry, Mainz, Germany (with 8 papers), followed by University of California, Los Angeles, USA (7 papers), University of Gottingen, Sweden (5 papers), etc. Compared to international collaboration, the average share of national collaboration was as high as 53.76% during 2008–12, which has decreased from 94.44% in 2008 to 40.00% in 2012. The institute had 172 collaboration linkages with different national

organizations, of which 68 collaboration linkages were with 21 university & colleges, 47 collaboration linkages with 12 research institutes, 45 collaborative linkages with 8 institutes of national importance and 12 collaborative linkages with 6 industrial enterprises during 2008–12. The largest number of collaboration linkages (21) of IISER, Mohali was with Panjab University, Chandigarh, followed by Indian Institute of Technology, Kanpur (19 linkages), Guru Nanak Dev University, Amritsar (12 linkages), Institute of Microbial Technology, Chandigarh (12 linkages), etc. The largest share of the research output of the institute was in physics & astronomy (36.02% share), followed by chemistry (32.80% share), biochemistry, genetics & molecular biology (25.27% share), mathematics (17.20% share), materials science (13.44% share), etc

The leading 11 authors of the institute have published 6 to 18 papers each during 2008–12, contributing together 49.46% share (92 papers) in the cumulative publications output of the institute during 2008–12. Only two authors have registered higher publications share than the group average of 8.36. Four authors each have registered more than the average citation per paper (4.13) and the average h-index (3.73) of the 11 authors during 2008–12. The 171 papers published by the institute were published in 91 journals. The top 18 journals contributed 76 papers, constituting 44.44% share of institute output during 2008–12.

**Research productivity of IISER Mohali is more interdisciplinary and need to explore new opportunities for collaborative research with industrial enterprises.** The institute may also explore new models of collaborative research, such as going in for Institute–private partnership in research. Such measures have the potential to catalyze publications activity, improve publication productivity of authors as well as help in improving the quality of research output

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