CSIR

RESEARCH PAPERS 2008

Synopsis

Council of Scientific and Industrial Research-National Institute of Science Communication And Information Resources

Informetrics Research Division

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1. INTRODUCTION TO METHODOLOGY

The Council of Scientific & Industrial Research (CSIR) is the premier industrial R&D organization in India. Its 39 constituent units (laboratories, centres, institutes, etc.) address various scientific and technological needs of an emerging economy, such as providing industrial competitiveness, social welfare and inclusiveness, building up a strong S&T base for strategic sectors and advancement of fundamental knowledge. Today CSIR is recognised as one of the world's largest publicly funded R&D organisations having linkages to academia, R&D organisations and industry. CSIR's R&D portfolio embraces areas as diverse as Aerospace, Biotechnology, Chemicals, etc.

Over more than two decades now, CSIR has been annually benchmarking its research output using scientometric techniques and comparing itself with other leading Research Institutions in the country. However, this has been done by aggregating the impact of all its papers using the impact factor of the journals in which the papers appear. This feature is continued this year but will gradually be withdrawn. A new approach is now introduced – that is of actually counting the citations obtained by the published papers in the recent past. For this we implement the following procedure: We take a target window of five years (2003-2007) and count all the papers (P) published by the CSIR and the other institutions during that period. Then the total citations (C) obtained by these papers during the census year (chosen as the single year 2008) is found. In effect, this will imply an impact $i = C/P$ for the output of each unit for 2008. The performance of each institution is then obtained as $E = iC = i^2P = C^2/P$. The performance is tracked over a rolling window of five years (target years 1999-2003 to 2003-2007, implying census years 2004 to 2008). Thomson-Reuters Web of Science (SCI- Expanded) database was used as the bibliometric database.

This report analyses only research papers; specifically, document types such as Research articles, Review articles and conference proceedings published in SCI Journals. All other publications such as editorials, meeting abstracts, conference proceedings, etc. indexed in Web of Science are not considered for analysis. Sections 2 and 5 give a descriptive analysis of CSIR publications during 2004 to 2008 and also benchmark with S& T publication output of other leading research institutions in the country. Sections 6 to 8 give the analysis of research publications of year 2008 in CSIR laboratories.

2. CSIR RESEARCH PAPERS: 2004-2008

A: Total Papers

Over the latest five year target window from 2004 to 2008, it is seen that the total number of SCI papers including all documents published by CSIR increased from 2921 to 4017. The percentage increase in number of papers from 2004 to 2008 was 37.52% (Figure 1).

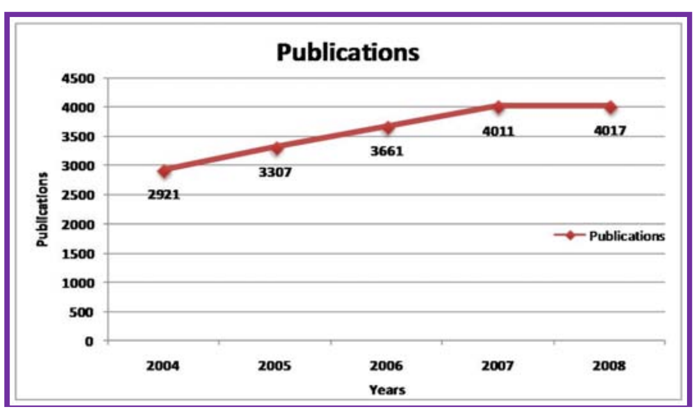


Figure 1: Number of papers (includes all document types) has been steadily increasing

B: Impact Factor/ Paper

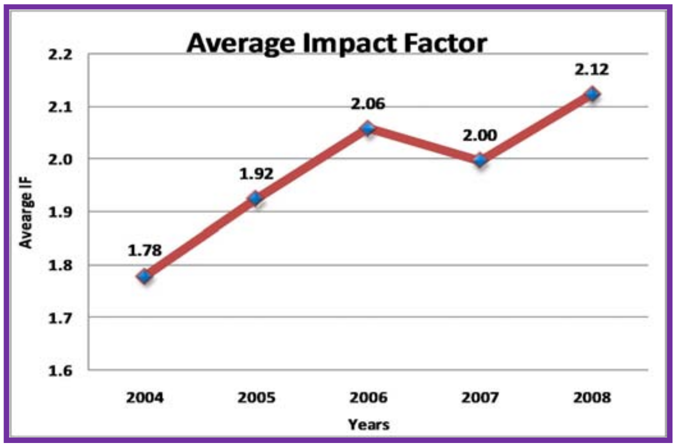


Figure 2: Impact Factor /paper has also increased

The earlier approach used was to estimate the impact of CSIR's output by assigning to each paper that appears in an SCI journal, a value equal to the impact factor of that journal as given by the Journal Citations Report for the previous year. This is an estimated or projected performance rather than a received or realized performance. The average Impact Factor/paper has increased from 1.78 to 2.12 during 2004 to 2008 when the same year Impact Factor is applied to the unique papers (considering the collaborating papers among laboratories only once) from CSIR. The percentage increase in Impact factor/paper from 2004 to 2008 is 19.29% (Figure 2).

3. THE ENERGY OF SCHOLARSHIP RECEIVED (C^2/P) BY CSIR RESEARCH PAPERS: 2004 - 2008

To assess the received or realized performance of CSIR, the actual citations received within the recent past has to be computed. To do this, we first chose a target window of five previous years (2003-2007) and counted all the papers (P) published by all the CSIR units during that period; then the total citations (C) obtained by these papers during a census window (chosen as the single year 2008) is found. In effect, this will imply a received impact $i = C/P$ for CSIR. The received performance of CSIR is then obtained as $E = iC = i^2P = C^2/P$ where P = Papers of five previous years; and C = Citations received in the census year.

The "energy of scholarship" received in 2004 was 18776; and that of year 2008 is 71988. The percentage increase in energy received from 2004 to 2008 is 283% (Figure 3). This reflects an increase in impact/paper as well as an increase in total number of papers. This becomes very clear when we display this on a two dimensional contour map later. The E-index for the CSIR as a whole has been computed on the unique papers (Papers resulting from collaboration among laboratories are counted only once).

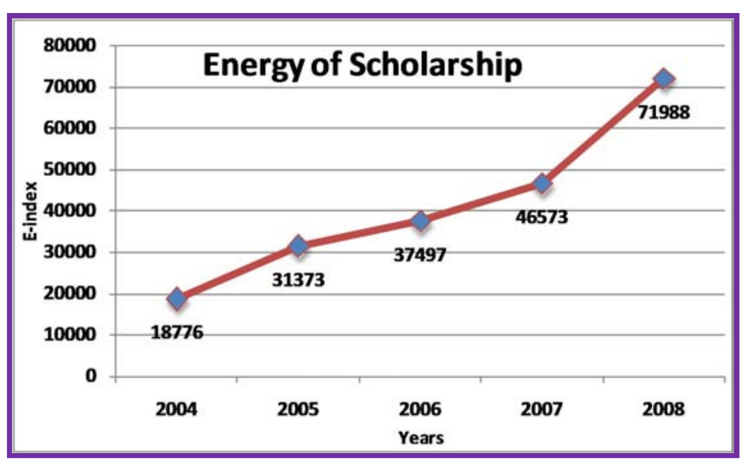


Figure 3: The energy of scholarship has also been steadily increasing – this reflects the increase in impact/paper as well as the increase in total number of papers

4. CSIR SHARE OF CONTRIBUTION TO NATIONAL S&T PUBLICATIONS

In Table 1, we review the CSIR publication output as a percentage of India's total scientific publications output. In 2008, 10.47% of Indian articles published in SCI covered journals came from CSIR. In the year 2004 the contribution of CSIR was 12.37%. Here it is important to notice that the SCI databases themselves have been growing rapidly in coverage and now covers more than 8000 journals. The Indian output has increased from 22508 articles in 2004 to 36637 in 2008. Data is fully based on Web of Science database. Again, papers resulting from collaboration within CSIR laboratories are counted only once.

Table 1: CSIR share in National S&T Publications

YEAR	INDIA	CSIR	% SHARE
2001	17812	2144	12.04
2002	19055	2306	12.10
2003	20948	2477	11.82
2004	22508	2784	12.37
2005	24604	3144	12.78
2006	27772	3482	12.54
2007	32408	3833	11.83
2008	36637	3837	10.47

5. CSIR RESEARCH PAPERS COMPARED TO OTHER LEADING RESEARCH INSTITUTIONS: 2004-2008

Table 2: Comparison of CSIR research papers with other research institutions

Institutions	2004	2005	2006	2007	2008	% increase 2004 – 2008
Papers						
AIIMS	392	471	470	562	684	74
BARC	701	645	810	709	931	33
CSIR	2784	3144	3482	3833	3837	38
DU	442	516	533	662	669	51
IISc	1004	1142	1170	1213	1246	24
IITs	2800	3181	3802	4234	4568	63
TIFR	496	534	494	531	584	18
E-Index						
AIIMS	2249	4021	4341	5600	8470	277
BARC	4254	7515	7588	8501	11450	169
CSIR	18776	31373	37497	46573	71988	283
DU	1952	3561	4465	6962	10249	425
IISc	11076	15731	13213	15599	21734	96
IITs	10118	17284	22609	32314	51113	405
TIFR	13415	25636	23496	23683	33483	150

Table 2 and Figures 4 and 5 benchmark the CSIR performance against six leading institutions in academic scientific research in India, the Indian Institute of Science (IISc), the All India Institute of Medical Sciences (AIIMS), Delhi University (DU), Bhabha Atomic Research Centre (BARC), the Tata Institute of Fundamental Research (TIFR) and the seven Indian Institute of Technologies (IITs). For the last five years, CSIR published the most number of papers and also has the highest energy performance indicator. During the period DU increased their published papers from 442 to 669 (51%) and the increase in energy performance is 425%.

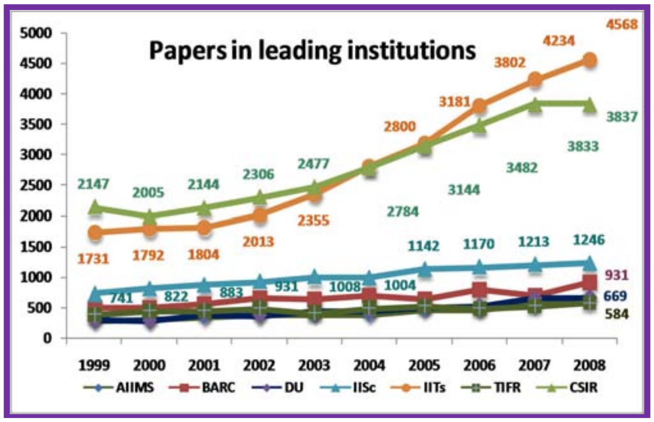


Figure 4: CSIR's output of papers compared to that of other research institutions

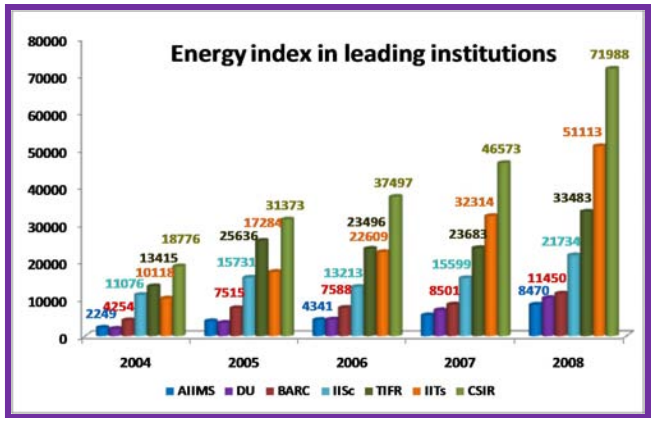


Figure 5: CSIR's energy of performance compared to that of other research institutions.

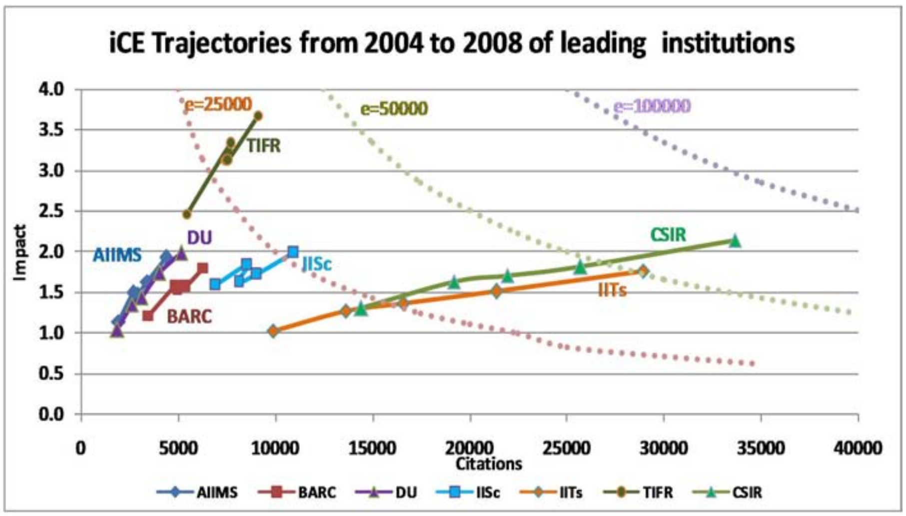


Figure 6: The energy of scholarship of CSIR benchmarked with other leading institutes

Figure 6 captures the relationship between quality and size in an iCE (impact-Citations-Energy) Map. The papers published by the leading research institutions in the country over the five year target window and the citations gathered by these papers in the census window of a single year immediately following the target window are used to compute the impact i and the energy E of scholarship. Next, i, C and E can be combined graphically into an iCE map which can then be displayed as a two dimensional contour map. The progress over the five year rolling windows from 1999-2003 to 2003-2007 gives rise to very interesting trajectory patterns. We can think of this as an impact-Citations-Energy (iCE) landscape. On the x-axis, we represent the quantity of output and on the y-axis, we represent quality of output. Also, since $E = iC$, contour lines can easily be plotted on the map and these are shown by dotted lines for E = 100000, 50000 and 25000. As performance is tracked over a five year rolling window from 2004 to 2008, an interesting dynamic picture appears. All institutions move up, metaphorically climbing a peak. Higher levels of performance are equated to having scaled higher heights of the quantity-quality landscape. Here, we emphasise the distinction we make between quality ($i = C/P$) and performance ($E = C/P \cdot C = iC$). CSIR's performance over the recent five-year period is seen to be excellent but moving from a low impact low volume to a high impact high volume path. Interestingly IITs are also following the same path. In direct contrast, TIFR is moving steadily up a high impact and low volume trajectory. Three of the remaining four institutions (DU, AIIMS and BARC) perform in nearly identical manner (low impact low volume path), with IISc belonging to this class of performance.

6. RESEARCH PAPERS 2008: SALIENT FEATURES

Table 3 disaggregates the CSIR research papers for 2008 in labwise manner. Here IICT records the highest number of Papers (517) and also has the highest Impact Energy (3849) and Energy Index (16423). IGIB has the highest Impact Factor per paper (3.38) while NIIST has the highest productivity (3.12) in terms of papers per Scientist.

Table 3: CSIR Research Papers 2008 – Salient Features

S.No	Laboratory	Papers	IF per paper	Impact Energy	Energy index	Papers/Scientist
1	AMPRI	24	1.14	48.28	202.12	0.50
2	CBRI	15	0.99	22.71	352.30	0.21
3	CCMB	116	3.29	3186.36	4513.32	1.17
4	CDRI	250	2.29	1808.98	3712.36	1.66
5	CECRI	160	1.78	714.42	1486.14	1.22
6	CEERI	17	0.93	34.66	127.52	0.18
7	CFTRI	171	1.86	849.23	2415.25	1.06
8	CGCRI	93	1.47	306.05	1042.63	0.82
9	CIMAP	47	1.68	225.66	291.95	0.47
10	CIMFR	32	0.81	37.74	47.74	0.17
11	CLRI	158	1.84	745.07	2985.38	1.33
12	CMERI	15	2.55	192.09	174.72	0.15
13	CMMACS	15	1.47	54.91	228.07	0.63
14	CRRI	8	0.72	9.61	14.69	0.07
15	CSIO	18	1.16	49.10	34.68	0.19
16	CSIR-HQ	2	2.41	13.08	28.13	0.02
17	CSMCRI	129	2.23	923.95	3516.84	1.40
18	IGIB	97	3.38	1474.06	2329.74	1.98
19	IHBT	62	1.65	256.32	275.37	1.35
20	IICB	144	3.13	1856.36	3019.21	1.87
21	IICT	517	2.29	3849.26	16423.68	2.47
22	IIIM	56	1.93	267.12	437.25	0.86
23	IIP	30	2.44	239.83	332.33	0.38
24	IITR	98	2.41	701.34	3194.30	1.27
25	IMMT	67	1.46	227.87	606.12	0.66
26	IMTECH	55	2.72	516.51	2094.81	1.10
27	NAL	53	1.59	206.65	466.01	0.14
28	NBRI	91	1.58	336.83	1581.80	0.93
29	NCL	397	2.52	3728.10	13923.02	1.70
30	NEERI	89	2.25	653.71	829.46	0.79
31	NEIST	55	1.56	200.95	728.29	0.60
32	NGRI	122	1.61	467.18	658.01	0.73
33	NIIST	234	2.71	2877.48	9380.80	3.12
34	NIO	138	1.84	659.02	920.05	0.81
35	NISCAIR	3	0.28	0.23	3.20	0.05
36	NISTADS	4	1.55	12.04	3.67	0.09
37	NML	105	1.61	348.63	777.85	0.73
38	NPL	279	1.77	1273.05	2062.09	1.39
39	SERC	22	0.92	25.64	13.76	0.25
	Grand Total	3988	2.14	29400.09	81234.68	

- **Impact Energy is computed as $\sum IF^2P = \sum IF^2$**
- **Energy Index is calculated on citations received in 2008 for papers from 2003 to 2007**
- **Data for Number of Scientists from PPD, CSIR**

7. RESEARCH PAPERS 2008: SUBJECT WISE DISTRIBUTION

Table 4: Research Papers 2008- Subject wise

Broad Subject		Papers	IF /paper	Total IE
1.	Chemistry	1339	2.47	12335
2.	Biology	464	2.59	4974
3.	Materials Science	410	1.64	1562
4.	Physics	217	1.70	947
5.	Engineering	208	1.09	405
6.	Biotechnology	187	1.78	907
7.	Environment/Ecology	178	1.89	916
8.	Medicine	174	2.77	1850
9.	Food Science & Technology	144	1.69	539
10.	Geology	136	1.77	622
11.	Agriculture	87	3.34	1187
12.	Plant Science	83	1.58	282
13.	Pharmacology & Toxicology	71	2.57	584
14.	Energy/Fuels	61	2.61	483
15.	Nano Science & Nano Technology	33	2.43	279
16.	Oceanography	32	1.52	100
17.	Mining, Metallurgy & Mineral Proc.	29	0.78	31
18.	Instruments and Instrumentation	22	2.70	176
19.	Fisheries	8	1.68	29
20.	Nuclear Science & Technology	7	1.04	8
21.	Information Science & Technology	7	1.77	27
22.	Veterinary Sciences	6	1.49	15
23.	Zoology	6	1.07	10
24.	Mathematics	5	1.33	11
25.	*Multidisciplinary Sciences*	74	1.27	1123

The research papers published in year 2008 are classified broadly into 24 main subjects based on the subject classification of the journals in which the papers are published. The subject wise grouping of research papers published in year 2008 by CSIR laboratories are shown in Table 4 and Figure 7. The highest number of papers are published in chemistry based journals (1339) which constitute to 34% of the total output of CSIR, followed by biology (464) and material science papers (410) which is 12% and 10% of total output respectivly. The average impact factor per paper is maximum for Agriculture based journals (3.34) followed by medicinal journals (2.77). Instrumentation group has average IF of 2.70, Energy and fuels group has average Impact Factor of 2.61 followed by biology with 2.59 and pharmacology with the average Impact Factor of 2.57. The Impact Energy is maximum in for Chemistry group i.e. 12335, followed by Biology group and medicine with 4974 and 1850 respectively. Agriculture group has only 87 papers but the Impact energy is 1187.

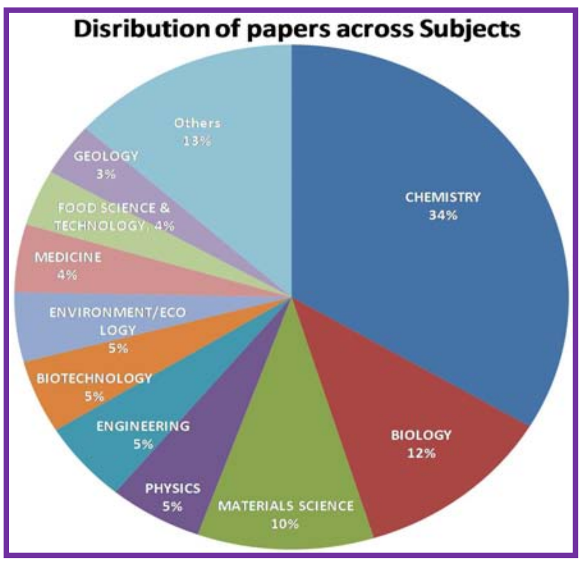


Figure 7: Distribution of research papers across subjects

8. RESEARCH PAPERS 2008: IN DIFFERENT DISCIPLINES

The CSIR Laboratories are mainly grouped into five disciplines according to their research areas, namely Biological Sciences, Chemical Sciences, Physical Sciences, Engineering Sciences and Information Sciences. Figures 8, 9, 10,11 give the features of research papers published in 2008 by laboratories in each discipline. There are four graphs in each group; plotting number of papers against four different parameters viz. (a) the average Impact Factor per paper; (b) Impact Energy which is sum of square of Impact Factors of the journals where the papers are published (c) Energy Index calculated for the papers in the target window of last five years ie. 2004-2007 and citations received in 2008 census window and (d) the papers published per scientist in each laboratory.

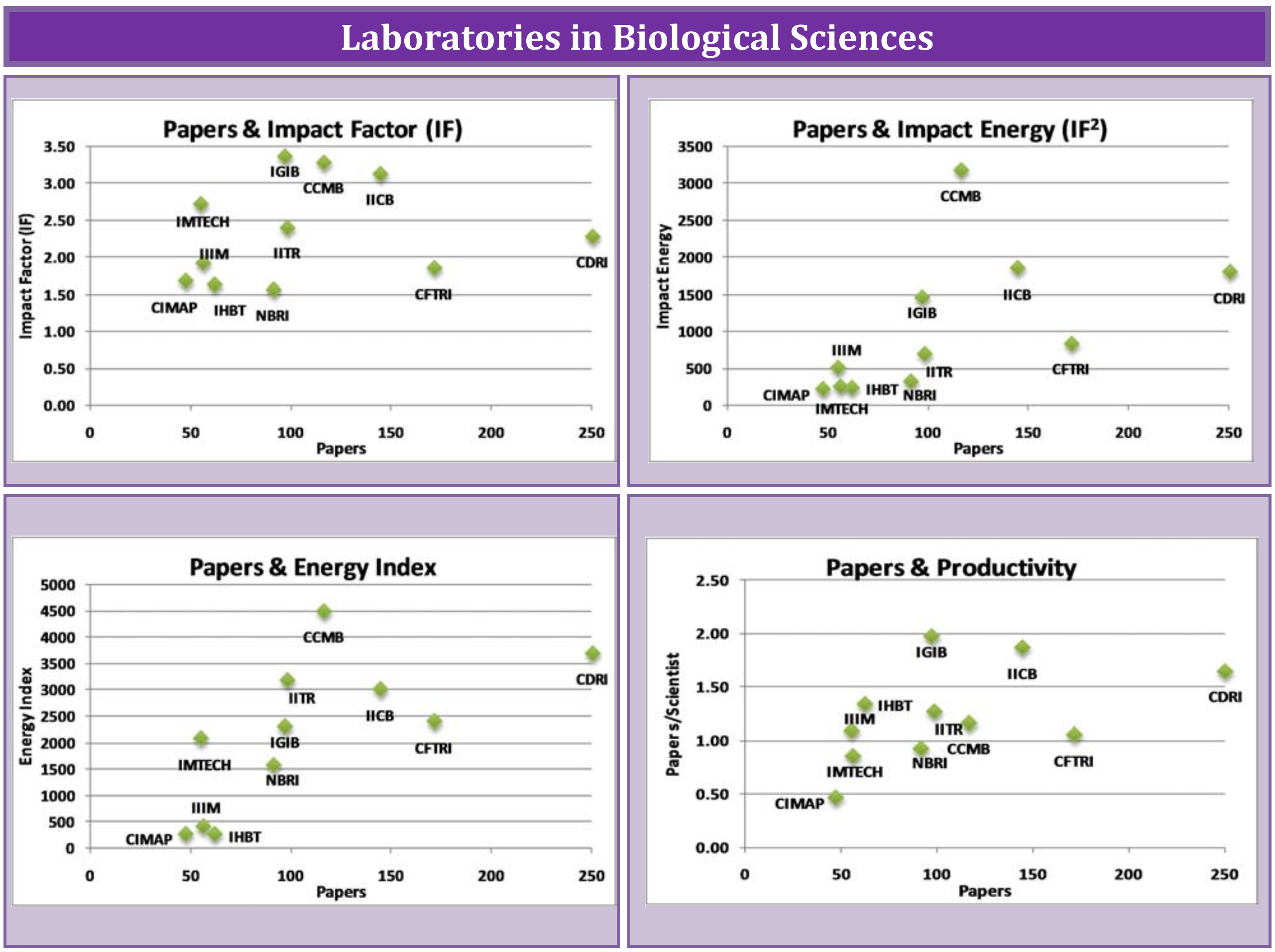


Figure 8: Salient features of Research publications for Biological discipline laboratories

In Biological Sciences group of laboratories CDRI has got maximum number of publications (250). The average impact factor (IF) per paper is highest for IGIB (3.38) followed by CCMB (3.29) and IICB (3.13). CCMB has the highest impact energy (3186) and energy index (4513). The number of papers per scientist is highest in IGIB (1.98) followed by IICB (1.87) and CDRI (1.66).

In Chemical Sciences group of laboratories, IICT published maximum number of papers in 2008 (517). The average impact factor (IF) per paper is highest for NIIST (2.71) followed by NCL (2.52) and IIP (2.44). IICT has impact energy of 3849 and energy index of 16423 followed by NCL with impact energy of 3728 and energy index of 13923. The number of papers published per scientist is highest in NIIST (3.12) followed by IICT (2.47) and NCL (1.70).

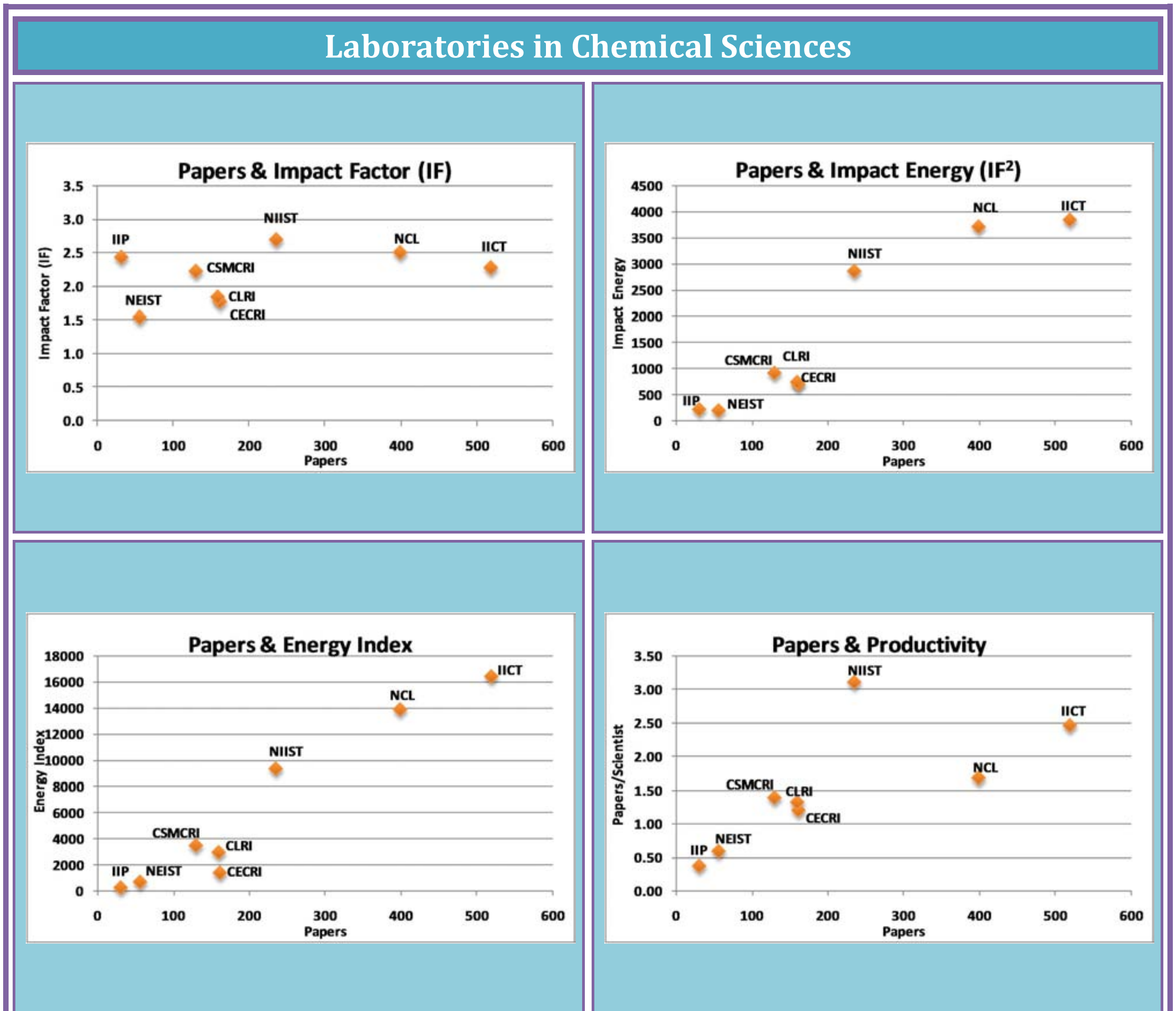


Figure 8: Salient features of Research publications for Chemical discipline laboratories

Laboratories in Engineering Sciences

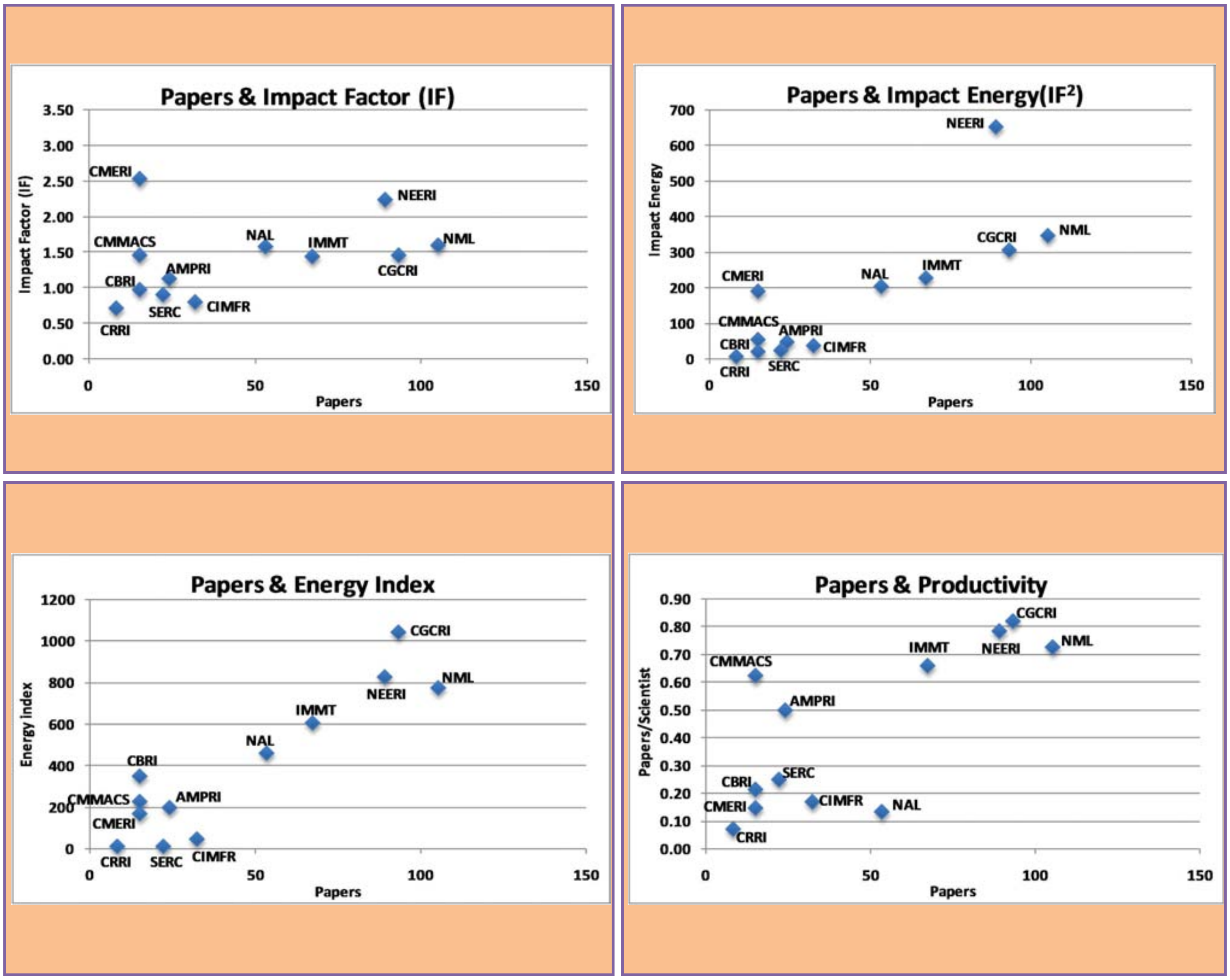


Figure 9: Salient features of Research publications for Engineering discipline laboratories

In Engineering Sciences group of laboratories NML has got maximum number of publications (105). The average impact factor (IF) per paper is highest for CMERI (2.55) followed by NEERI (2.25). NEERI has got the highest impact energy (653) and CGCRI has the highest energy index (1042). The number of papers published per scientist is highest in CGCRI (0.82) followed by NEERI (0.79) and NML (0.73).

In Physical Sciences group of laboratories, NPL published maximum number of papers (279). The average impact factor (IF) per paper is highest for NIO (1.84) followed by NPL (1.77) and NGRI (1.61). NPL has got the highest Impact energy (1273), highest Energy index (2062) and highest productivity in terms of paper per scientists (1.39).

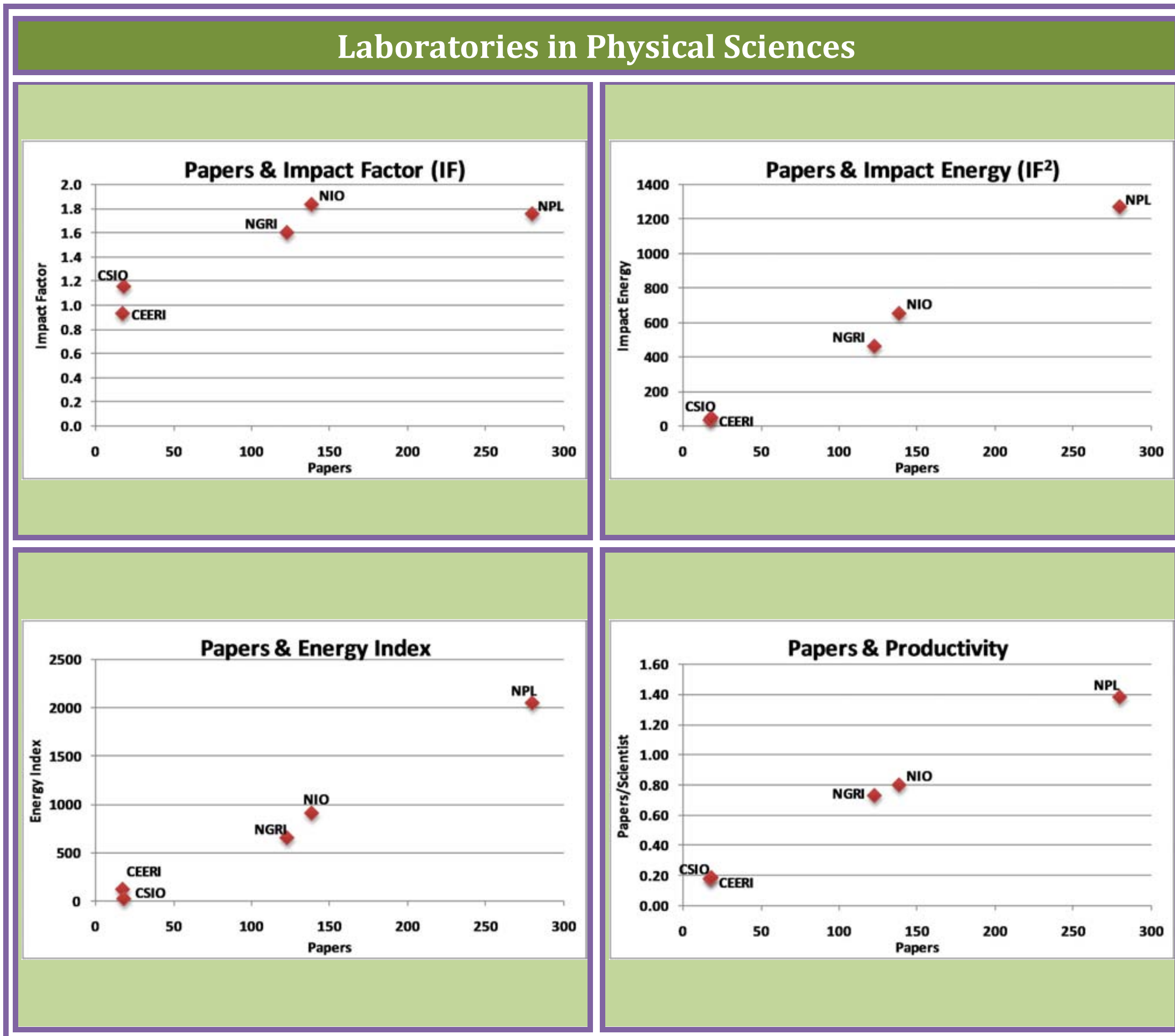
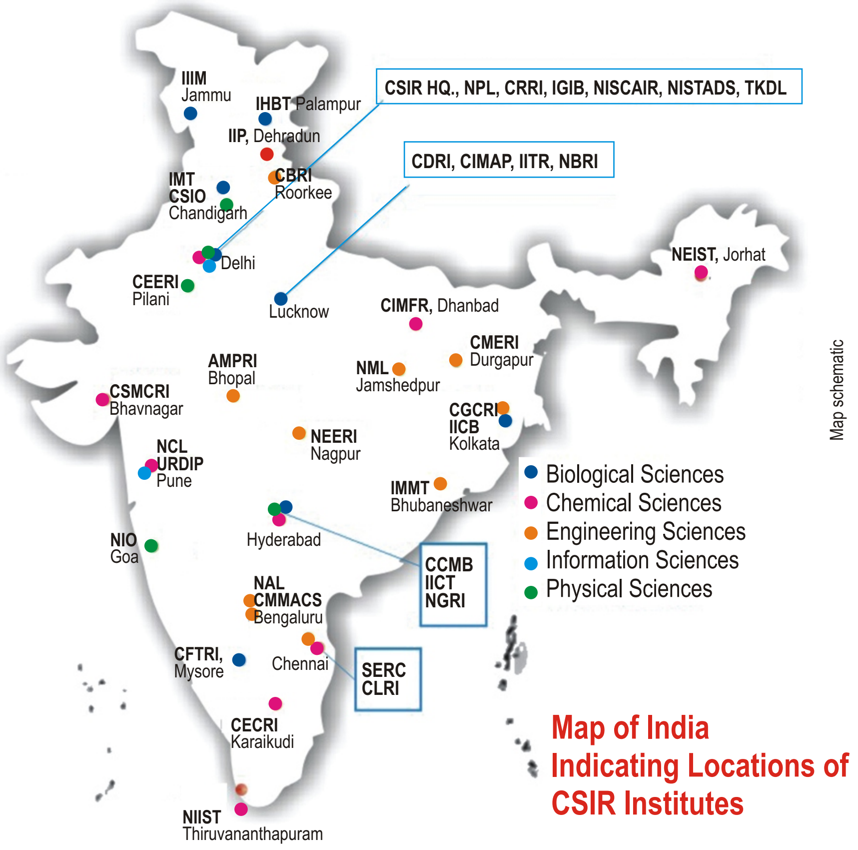


Figure 10: Salient features of Research publications for Physical discipline laboratories

9. ABBREVIATIONS USED

IF	**Impact Factor**
P	**Papers**
C	**Citations**
IE	**Impact Energy (IF^2xP) for a year**
E-index	**Energy Index (C^2/P)** **Last five year target window for papers for the next census year for citation**
CSIR	**Council for Scientific and Industrial Research, Delhi**
DU	**Delhi University, Delhi**
TIFR	**Tata Institute of Fundamental Research, Mumbai**
BARC	**Bhabha Atomic Research Centre, Mumbai**
IISc	**Indian Institute of Science, Bangalore**
AIIMS	**All India Institute of Medical Sciences, Delhi**
IITs	**Indian Institute of Technology (Chennai, Delhi, Guwahati, Kanpur, Kharagpur, Mumbai, & Roorkee)**
SCI	**Science Citation Index database from Thomson Reuters**

CSIR Institutes



ENGINEERING SCIENCES

AMPRI: Advanced Material and Processes Research Institute, Bhopal
CBRI: Central Building Research Institute, Roorkee
CGCRI: Central Glass and Ceramic Research Institute, Kolkata
CMERI: Central Mechanical Engineering Research Institute, Durgapur
CRRI: Central Road Research Institute, New Delhi
IMMT: Institute of Minerals and Materials Technology, Bhubaneswar
NAL: National Aerospace Laboratories, Bengaluru
NEERI: National Environmental Engineering Research Institute, Nagpur
NIIST: National Institute for Inter-disciplinary Science and Technology, Thiruvananthapuram
NML: National Metallurgical Laboratory, Jamshedpur
SERC: Structural Engineering Research Centre, Chennai

BIOLOGICAL SCIENCES

CCMB: Centre for Cellular and Molecular Biology, Hyderabad
CDRI: Central Drug Research Institute, Lucknow
CFTRI: Central Food Technological Research Institute, Mysore
CIMAP: Central Institute of Medicinal & Aromatic Plants, Lucknow
IGIB: Institute of Genomics & Integrative Biology, Delhi
IHBT: Institute of Himalayan Bioresource Technology, Palampur
IICB: Indian Institute of Chemical Biology, Kolkata
IIIM: Indian Institute of Integrative Medicine, Jammu
IMT: Institute of Microbial Technology, Chandigarh
IITR: Indian Institute of Toxicology Research, Lucknow
NBRI: National Botanical Research Institute, Lucknow

PHYSICAL SCIENCES

CEERI: Central Electronics Engineering Research Institute, Pilani
CSIO: Central Scientific Instruments Organisation, Chandigarh
NGRI: National Geophysical Research Institute, Hyderabad
NIO: National Institute of Oceanography, Goa
NPL: National Physical Laboratory, New Delhi

CHEMICAL SCIENCES

CLRI: Central Leather Research Institute, Chennai
CECRI: Central Electrochemical Research Institute, Karaikudi
CSMCRI: Central Salt & Marine Chemicals Research Institute, Bhavnagar
CIMFR: Central Institute of Mining and Fuel Research, Dhanbad
IICT: Indian Institute of Chemical Technology, Hyderabad
IIP: Indian Institute of Petroleum, Dehradun
NCL: National Chemical Laboratory, Pune
NEIST: North-East Institute of Science & Technology, Jorhat

INFORMATION SCIENCES

NISCAIR: National Institute of Science Communication And Information Resources, New Delhi
NISTADS: National Institute of Science Technology And Development Studies, New Delhi

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