Ranking of Indian engineering and technological institutes for their research performance during 1999–2008

Gangan Prathap and B. M. Gupta

Among the major countries, India has one of the largest infrastructures of engineering and technological institutes (over 2000). It also produces the largest number of engineering and technology graduates (over 300,000) every year. Some of these institutes are very prestigious and even make it to the list of top universities in the world[1–3]. Only a handful of institutes (IISc and some IITs) among the major Indian engineering and technological institutes, however, account for most of the research output of the country. Majority of the others, however have very meagre research output, which is also reflected in the poor out-turn of Ph Ds (less than a thousand each year) from these institutions. So far, no ranking of all the Indian engineering and technology institutes for their research performance has been undertaken. In this regard, it is to be noted that most of the international ranking schemes are complex exercises and assess for both quantity and quality of scientific research, but use such elitist levels of achievement (number of Nobel Laureates; papers in *Nature*, *Science*, etc.) that they cannot be meaningfully applied to the list under scrutiny here. In the present exercise therefore, a proposal is presented for a ranking of research performance of Indian engineering and technological institutes using data from SCOPUS[4] international bibliographical database, using a recently introduced *p*-index, which can serve as a composite indicator that combines quality with quantity[5–7].

A total of 67 Indian engineering and technological institutes with comparatively higher output of publications during a ten-year period from 1999 to 2008 were identified. These institutes together have published 75,166 papers during this period, according to publication data downloaded from the SCOPUS International multidisciplinary bibliographical database. Put together, this is more than the output of the university sector (59,685 papers) and constitutes nearly 23% of the total cumulative research output from India during 1999–2008.

The citations received by papers of these Indian engineering and technological institutes are considered for first three years (three-year citation window) from the date of their publications (C). This allows the average number of citations per paper (C/P) to be computed for each of these institutes for the three-year citation window. h-indices for these institutes for the same period (i.e. 1999–2008) were also determined from the SCOPUS database.

Table 1 shows the complete raw data for 30 of the 67 Indian engineering and technological institutes, i.e. the number of papers published (P), the citations obtained during the citation window (C), the average number of citations per paper (C/P), the number of papers resulting from international collaboration (ICP) and the percentage thereof (%ICP). Also shown in Table 1 are the Hirsch h-index and the newly proposed composite performance index (p). The ranking of the institutions in Table 1 has been done using the p-index, which needs some elaboration here. Papers can be assessed for quality only when we take into account the impact in terms of the citations obtained over the period of citation window. This problem is complex, as there are several ways of ranking performance, e.g. the simplest and crudest being by quantity of output (see Table 2), impact (citations – not shown here), or by quality (mean citation rate = C/P; also not shown here), or by a performance index combining quantity and quality, e.g. the h-index. The insight emerging from some recent studies which have re-visited the problem of ranking research performance of any entity (from individuals to countries) as one belonging to the domain of random multiplicative processes, considers the best single indicator to be used for ranking using quality and quantity together, to be a geometric mean of C and C/P. However, by dimensional analysis[5], one can show that this has the dimensions of $h^{3/2}$. Indeed, a substitute or mock h-index defined as $h_m = (C^2P)^{(1/3)}$ is the best indicator for performance[5–7], having the correct dimensionality, that of h. We may henceforth call it the p-index. The ranking using this is shown in Table 1, and the ranking in terms of papers alone is shown in Table 2 for comparison.

Some old insights are reinforced and some new insights emerge from Tables 1 and 2. It is not surprising that by number (quantity) or by performance (quality and quantity combined), IISc and the IITs lead the tables among all engineering and technological institutes in the country. Lower down the list, from Tables 1 and 2, many institutes change position. Although the NITs have been around for a long time (earlier known as RECs), and have been upgraded to deemed university and institutes of national importance status, their research performance is still dismal. In fact, many Indian engineering and technological universities and private institutes are doing comparatively better in terms of performance.

Table 3 reveals the performance of the Indian engineering and technological institutions (measured in terms of p values) when they are grouped into various categories. It is seen that the IITs and IISc are group leads in terms of research performance among these six groups. The research performance of other four groups was still far behind the performance of both IISc and IITs. In addition, the research performance of the IIITs and NITs is disappointing when compared to that of the technological universities and some select engineering colleges.

The ranking of the various institutions within each group defined above according to the p-index also give an indication of how each category performs within its peer group. For example, among the IITs, the best performance in terms of p-index values (39.27) is shown by IIT Kanpur, followed by IIT Bombay (36.73), IIT Kharagpur (35.37), IIT Delhi (32.51), IIT Madras (29.09), IIT Roorkee (25.93) and IIT Guwahati (19.36).

Similarly, among the universities, the best performance in terms of p-index values (30.30) is shown by Jadavpur University, Kolkata, followed by Anna University, Chennai (24.54); Cochin University of Science and Technology, Cochin (18.67); Birla Institute of Technology and Science, Pilani (18.33); Bengal Engineering and Science University,

Table 1. Top 30 Indian engineering and technological institutes ranked using the performance index *p* using publication data from *SCOPUS* database during 1999–2008

Sl. no.	Institution	*P*	*C*	*C/P*	ICP	%Share of ICP	*h*	*p*
1	IISc, Bangalore	12951	40438	3.12	2742	21.17	79	50.17
2	IIT Kanpur	6234	19432	3.12	1383	22.18	58	39.27
3	IIT Bombay	7228	18926	2.62	1519	21.02	50	36.73
4	IIT Kharagpur	7370	18057	2.45	1239	16.81	49	35.37
5	IIT Delhi	6520	14967	2.30	1071	16.43	50	32.51
6	Jadavpur University	4807	11565	2.40	872	18.10	43	30.30
7	IIT Madras	5715	11864	2.08	1017	17.80	46	29.09
8	IIT Roorkee	3471	7780	2.24	543	15.64	43	25.93
9	Anna University	3687	7381	2.00	691	18.70	35	24.54
10	IIT Guwahati	1596	3402	2.13	220	13.78	26	19.36
11	Cochin University of Science and Technology	1625	3252	2.00	218	13.40	26	18.67
12	BITS, Pilani	867	2310	2.66	192	22.10	25	18.33
13	Institute of Chemical Technology, Mumbai	652	1970	3.02	88	13.50	27	18.12
14	IT BHU, Varanasi	878	1434	1.63	99	11.28	23	13.28
15	Bengal Engineering and Science University, Howrah	891	1309	1.47	169	18.97	17	12.44
16	College of Engineering, Anna University, Chennai	1000	1370	1.37	115	11.50	20	12.34
17	Harcourt Butler Institute of Technology, Kanpur	425	712	1.68	1	0.23	16	10.61
18.	Jawaharlal Nehru Technological University, Hyderabad	738	885	1.2	37	4.18	16	10.20
19	Maulana Azad NIT, Bhopal	155	385	2.48	16	10.32	11	9.85
20	NIT/REC, Rourkela	557	687	1.23	44	7.90	18	9.46
21	NIT/REC, Warangal	388	560	1.44	24	6.19	13	9.31
22	NIT/REC, Trichy	745	775	1.04	103	13.83	17	9.31
23	Sant Longowal Institute of Engineering and Technology, Sangrur	324	496	1.53	38	11.73	13	9.12
24	PSG College of Technology, Coimbatore	803	777	0.97	39	4.86	16	9.09
25	NIT, Jamshedpur	817	774	0.95	73	8.94	12	9.02
26	Thapar Institute of Engineering and Technology, Patiala	422	546	1.29	24	5.69	14	8.91
27	Netaji Subhas Institute of Technology, New Delhi	326	454	1.39	48	14.72	13	8.58
28	Delhi College of Engineering, New Delhi	279	414	1.48	28	10.04	12	8.50
29	BITS, Mesra	472	525	1.11	77	16.30	12	8.36
30	S.J. College of Engineering, Mysore	241	375	1.56	37	15.40	12	8.36

Howrah (12.44); Jawaharlal Nehru Technological University, Hyderabad (10.20); Sant Longowal Institute of Engineering and Technology, Sangrur (9.12); Birla Institute of Technology and Science, Mesra (8.36); Indian School of Mines, Dhanbad (8.33); Vellore Institute of Technology, Vellore (6.36); Thapar Institute of Engineering and Technology, Patiala (6.36); Nirma Institute of Science and Technology, Ahmedabad (5.45), and Punjab Engineering College, Chandigarh (4.14).

Among the National Institutes of Technology, the best performance in terms of *p*-index values (9.85) is shown by Maulana Azad NIT, Bhopal, followed by NIT/REC, Rourkela (9.46); NIT/REC, Warangal (9.31); NIT/REC, Trichy (9.31); NIT/REC, Jamshedpur (9.02); NIT/REC, Surathkal (7.33); NIT/REC, Calicut (7.04); NIT/REC, Durgapur (6.57); NIT/REC, Kurukshetra (6.56); NIT/REC, Jaipur (6.34); NIT/REC, Hamirpur (6.25); NIT/REC, Nagpur (6.24); NIT/REC, Allahabad (5.52); NIT/REC, Silchar (5.45); Dr B.R. Ambedkar NIT, Jalandhar (4.37); NIT/REC, Srinagar (3.30); NIT/REC, Surat (3.15); NIT/REC, Raipur (1.91); NIT/REC, Agartala (0.58), and NIT/REC, Patna (0.58).

Similarly, among the Indian Institutes of Information Technology, the best performance in terms of *p*-index values (6.55) is shown by IIIT, Bangalore, followed by IIIT, Hyderabad (6.21); IIIT, Pune (2.74); IIIT, Allahabad (2.70); Atal Bihari Vajpayee IIIT and Management, Gwalior (1.30), and Pandit Dwarka Prasad Mishra IIIT, Design and Manufacturing, Jabalpur (0.97).

Among the select engineering colleges, the best performance in terms of *p*-index values (18.21) is shown by Institute of Chemical Technology, Mumbai followed by Institute of Technology, BHU (13.28); College of Engineering, Anna University, Chennai (12.34); Harcourt Butler Institute of Technology, Kanpur (10.61); PSG College of Technology, Coimbatore (9.09); Netaji Subhas Institute of Technology, Delhi (8.58); Delhi College of Engineering, Delhi (8.50); S.J. College of Engineering, Mysore (8.36); Shri Govind Seksaria Institute of Science and Technology, Indore (6.58); R.V. College of Engineering, Bangalore (6.28); Manipal Institute of Technology, Manipal (5.43); Sri Sivasubramaniya Nadar College of Engineering, Chennai (4.56); Madhav Institute of Technology and Science, Gwalior (4.30); M.S. Ramaiah Institute of Technology, Bangalore (3.52); College of Engineering, Thiruvanathapuram (3.39); JNTU College of Engineering, Hyderabad (3.18); Government College of Engineering, Pune (3.07); Dhirubhai Ambani Institute of Information and Communication Technology, Gandhinagar (2.76); Madras Institute of Technology, Chennai (2.06), and V. J. Technological Institute, Mumbai (1.18).

We have used a more rational procedure for ranking the research performance of Indian engineering and technological institutes, in the country. The overall ranking of top 67 Indian engineering and technological institutions, and ranking of individual institutions among the six groups of institutions give an indicative,

Table 2. Top 67 Indian engineering and technological institutes ranked using the total number of papers published during 1999–2008 according to the *SCOPUS* database

Rank	Institution	*P*	Rank	Institution	*P*
1	IISc, Bangalore	12951	35	NIT/REC, Hamirpur	305
2	IIT Kharagpur	7370	36	NIT/REC, Nagpur	295
3	IIT Bombay	7228	37	NIT/REC, Calicut	286
4	IIT Delhi	6520	38	Delhi College of Engineering, New Delhi	279
5	IIT Kanpur	6234	39	IIIT, Bangalore	279
6	IIT Madras	5715	40	S.J. College of Engineering, Mysore	241
7	Jadavpur University	4807	41	NIT/REC, Durgapur	238
8	Anna University	3687	42	NIT/REC, Allahabad	238
9	IIT Roorkee	3471	43	Dr B.R. Ambedkar NIT, Jalandhar	219
10	Cochin University of Science and Technology	1625	44	Punjab Engineering College, Chandigarh	217
11	IIT Guwahati	1596	45	Manipal Institute of Technology, Manipal	214
12	College of Engineering, Anna University, Chennai	1000	46	NIT/REC, Jaipur	193
13.	Bengal Engineering and Science University, Howrah	891	47	Nirma University of Science and Technology, Ahmedabad	158
14	IT BHU, Varanasi	878			
15	BITS, Pilani	867	48	Maulana Azad NIT, Bhopal	155
16	NIT, Jamshedpur	817	49	JNTU College of Engineering, Hyderabad	153
17	PSG College of Technology, Coimbatore	803	50	Government College of Engineering, Pune	146
18	NIT/REC, Trichy	745	51	Sri Sivasubramaniya Nadar College of Engineering, Chennai	116
19	Jawaharlal Nehru Technological University, Hyderabad	738			
20.	Institute of Chemical Technology, Mumbai	652	52	Dhirubhai Ambani Institute of Information and Communication Technology, Gandhingar	105
21	NIT/REC, Rourkela	557			
22	BITS, Mesra	472	53	NIT/REC, Surat	104
23	ISM, Dhanbad	463	54	IIIT, Allahabad	90
24	Vellore Institute of Technology, Vellore	429	55	Madhav Institute of Technology and Science, Gwalior	89
25	Harcourt Butler Institute of Technology, Kanpur	425	56	College of Engineering, Thiruvananthapuram	89
26	Thapar Institute of Engineering and Technology, Patiala	422	57	M.S. Ramaiah Institute of Technology, Bangalore	67
			58	Atal Bihari Vajpayee IIIT and Management, Gwalior	66
27	NIT/REC, Warangal	388	59	Veermata Jijabai Technological Institute, Mumbai	61
28	Shri Govindram Seksaria Institute of Technology and Science, Indore	369	60	NIT/REC, Srinagar	59
			61	NIT/REC, Silchar	57
29	NIT/REC, Surathkal	357	62	Madras Institute of Technology, Chennai	55
30	R.V. College of Engineering, Bangalore	345	63	IIIT, Pune	33
31	Netaji Subhas Institute of Technology, New Delhi	326	64	Pandit Dwarka Prasad Mishra IIIT, Design and Manufacturing, Jabalpur	10
32	Sant Longowal Institute of Engineering and Technology, Sangrur	324			
			65	NIT/REC, Raipur	7
33	IIIT, Hyderabad	313	66	NIT/REC, Agartala	5
34	NIT/REC, Kurukshetra	306	67	NIT/REC, Patna	5

Table 3. Ranking of Indian engineering and technological institute groups using the performance index *p* during 1999–2008 according to the *SCOPUS* database

Rank	Institution	*P*	*C*	*p*
1	IITs (7)	38134	94428	61.61
2	IISc (1)	12951	40438	50.17
3	University and Deemed University (13)	15100	29402	38.54
4	Select Engineering Colleges (20)	6413	8823	22.98
5	NITs/RECs (20)	5336	5732	18.33
6	IIITs (6)	791	637	8.01

Numbers in brackets indicate number of institutions in the group.

if not nearly comprehensive, assessment of how the engineering and technological sector of higher education is performing as generators of new knowledge.

1. Balaram, P., *Curr. Sci.*, 2004, **86**, 1347–1348.
2. http://www.arwu.org/
3. Virk, H. S., *Curr. Sci.*, 2004, **87**, 416.
4. http://www.scopus.com
5. Prathap, G., *Scientometrics* (to appear), 2009; DOI: 10.1007/s11192-009-0066-2
6. Prathap, G., *Scientometrics* (to appear), 2009; DOI: 10.1007/s11192-009-0067-1
7. Prathap, G., *Scientometrics* (to appear), 2009; DOI: 10.1007/s11192-009-0068-0

Gangan Prathap is in the National Institute of Science Communication and Information Resources, New Delhi 110 012, India; B. M. Gupta is in the National Institute of Science, Technology and Development Studies, New Delhi 110 012, India.*
**e-mail: gp@niscair.res.in*