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Returns on Library Investment: A Study of the Leading Engineering and Technology Institutes in India

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Abstract :- The study is based on the secondary data compiled by the Ministry of Human Resource & Development, Govt., of India for the period 2012-13, 2013-14 & 2014-15 and was released as the ranking list of Institutes of Engineering and Technology in India for the year 2016. The study aims to assess the Returns on Investment (ROI) of the twenty leading libraries of the Institutes of Engineering and Technology in India in the form of institutional research output. An attempted has also been made to rank the each individual library on the basis of seven different parameters chosen for the study and worked out the difference between their ascribed rank as per the MHRD list and the achieved ranks worked out on the basis of chosen. The rankings have been calculated on the basis of scores earned by each individual library against each individual parameter. The results showed that the Institutes of Engineering and Technology in India concentrate more on procurement of electronic resources in their libraries, spending nearly three-fourth of their budget on the procurement of electronic documents mostly in the form of online journals and eBooks. While evaluating the ascribed and achieved ranking, 95% libraries under study faced shuffle, as 55% libraries slipped in their rank, while as 45 % improved and 5% showed no change. The study gives a clear idea about the importance of libraries and the part these sub-institutions' play in the overall ranking of their institution.

Key Words: - Library Budget, Print Resources, E-Resources, IIT's, Research Output, Return on Investment, India, Technical Education, Institutes of Technology, Return on Library Investment

INTRODUCTION: - Given the scope for employment and other entrepreneurship opportunities offered, the technical education India has gained huge momentum over a period of time, and so has Govt., of India shown keenness towards the opening up more and more Institutes of Engineering and Technology across the length and breadth of the country. The expansion of technical education and the widespread growth of these technical institutions have raised questions over the quality and standard these institutions maintain and so has government of India come up its own institutional ranking mechanism, whereby Engineering and Technological Institutions in India are each year ranked by the Ministry of MHRD under NIRF (National Institutional Ranking Framework). As is known that ranking of an academic or a technical institution is undertaken by evaluating various parameters of an institution and more the institutions shows, health and promise in its different sub-institutions, the better is expected it to obtain its rank.

Institutional library is one of the important sub-institutions of any academic or technical institution, which contributes in its own way towards the overall growth and development of an institution. But, many a times, the contribution of some smaller sub-institutions go unrecognized, with the result, people at the helm don't owe importance to such sub-institutions and an institutional library

is one such sub-institution, the importance of which is mostly undermined. Accordingly, the present study is an attempt to assess the role and contribution of libraries as sub-institutions in the overall growth and development of an institution and in the overall ranking of an institution.

To undertake the present study, data were retrieved from the official website of the Ministry of Human Resource and Development (MHRD), Govt., of India. The data were released by the ministry of MHRD in the form of ranking list of 100 leading Engineering and Technical Institutions across India. Accordingly, it was conceived to assess the overall contribution of a library in the overall ranking of its institution, by undertaking perceived ranking on seven different parameters. The study also explores the Return of Investment (ROI) in libraries in the form of research output of the institution and in helping obtain better rank for the institution.

RELATED STUDIES: - A good number of studies have been undertaken by the researchers all across the world related to the ranking of educational institutions. Most of the researchers have discussed about how the ranking influence in shaping a rebuilding an institution and some common parameters which are commonly used by different agencies in the ranking of institutions. In a study conducted to evaluate the institutes of technology in India on the basis of their research output as reported by SCOPUS, during the period 1999-2008, compiled a ranking list of 30 leading institutes of technology (Prathap & Gupta, 2009). The researchers analysed the aspects like, research papers published during the period of study, citations obtained, average citations per paper, international research collaboration etc., and so has evolved a trend among the students, scholars and the faculty members towards the use of electronic resources all across the world (Pandita, 2012), whereby major portion of the library budgets are being spent on the procurement of electronic resources.

Researchers have shown concerns over the growing costs of the library subscriptions and the weaning library budgets, while studying evidence based librarianship approach at the Yale University (Gallagher, Bauer, & Dollar, 2005). As a cost cutting measure, the authors advocated that libraries should discontinue subscribing those print journals which have very less or almost negligible readership. The study somewhere points towards the shift in the readership from print to electronic and if the document is available in the both the forms, it is electronic form, which is being preferred by the readers over print. The authors suggest that libraries should not lose relevance to its reader in the internet era, and subscription and procurement of e-resources in the libraries will surely ensure the relevance of libraries in the internet era.

Public institutions should be made more accountable and drawing statistical comparison is one of the important parameters in this regard (Goldstein & Spiegelhalter, 1996). The researchers opined of having a model to establish institutional measures and their performance, as these techniques help to point out actual existing differences among the institutions under study. A study on the Massachusetts Institutes of Technology, discussed about the changing role of the institutions in the commercialization of research through the spinoff of new companies (O'Shea, Allen, Morse, O'Gorman, & Roche, 2007). The authors owe the quality of research faculty, supporting organizational mechanism, science and engineering resource base and other institutional policies

as the reason for MIT's success. The researchers are also of the view that local and regional environment can help in developing a better understanding about the success of the institute and so should other institutes follow the suit by taking MIT as a case.

In the changing nature of collection management, librarians are facing challenges given the transition in collection development, which has moved from print to electronic resources (Branin, Groen, & Thorin, 2011). In a study of Drexel University, the researchers found that electronic resources are more cost effective than the print resources from the usage point of view (Montgomery & King, 2002). Apart from increased usage of e-resources, there is equally minimal requirement of infrastructure, labour and space than the paper library (Connaway & Lawrence, 2003).

The institutional ranking as a significant impact on its decision making, formulating strategies or taking the operational decisions, as every care is taken to uphold the reputation and the prestige which an institution enjoys (Hazelkorn, 2007). Different agencies employ different parameters to evaluate the performance of any institute and the library forms one of the most integral & significant components of the institutional performance evaluation. The libraries play their part both in structuring the instructional material and make sure to render all such documents services which enhance the organizational goals (Lindauer, 1998). Researchers are also advocating to evaluate the performance of the libraries in the light of Ranganathan's Five Laws of library science (Kyrillidou & Cook, 2008).

There is a growing use of electronic sources of information by the students, faculty and scholars across the management institutes in India (S. Singh & Pandita, 2017). The researchers also observed that on average, each management institute in India spends two-third of their library budget towards the procurement of electronic resources, mostly in the form of journal databases. The researchers also observed that on average, each management spending INR 1.166 million rupees on the resource procurement against each faculty member. Similarly, more than 50% library budget in the university libraries is being spent on the procurement of e-resources (Pandita & Singh, 2018). Each individual institution prioritizes its resource procurement and so do some institutions spend more money on the procurement of print resources while others spend more on the procurement of electronic resources (H. Singh & Mahajan, 2017). Even the individual institutions do not follow a uniform pattern in the collection development on a regular basis, as their priorities keep shifting on year to year basis and so do fluctuate their fund allocations.

The Returns on Investment model for libraries was developed at the University of Illinois at Urbana-Champaign (UIUC) with the main purpose to assess the benefits we reap from the investments made in libraries and in mobilizing investment in the library in the shape of research grants etc. (Luther, 2008). The researchers studies different university library systems for 10 years across different regions of the world and found that local factors play a considerable part in fund mobilization for libraries (Tenopir et al., 2010). Accordingly, in the undergoing study, the libraries of the twenty leading Institutes of Engineering and Technology have been chosen for the study,

the ranking list compiled and released by the MHRD, Govt., of India (National Institutional Ranking Framework (NIRF). MHRD (India), 2016). Given the fact, it was conceived to analyse returns of library investment related facts and figures of these leading technical institutions during the years 2012-13, 2013-14 & 2014-15.

OBJECTIVES OF THE STUDY: - To assess the library resource procurement trend among the Engineering and Technological Institutes in India.

To present an overview of the research output of twenty leading Engineering and Technology Institutes in India.

To correlate the research output of twenty leading Engineering and Technology Institutes in India as a return on investment in the library.

To work out ascribed and achieved rank of the libraries of the institutions under study on the basis of seven different identified parameters, as per the information provided by the respective Engineering and Technology Institutes to MHRD, while compiling data.

RESEARCH METHODOLOGY: - The present study has been undertaken on the twenty leading Institutes of Engineering and Technology in India, chosen from the list of leading hundred Institute of Technology released by the Ministry of Human Resource and Development, Govt. of India on April 04, 2016, which can be accessed at https://www.nirfindia.org/engg. The data pertaining to the total number of faculty member, the library budget & the research output of the institutes were retrieved against each individual institute, understudy for the year 2012-13, 2013-14 & 2014-15. The analysis in all the below mentioned tables has been undertaken by correlating the data with the library services and activities and accordingly, the libraries of the twenty leading Institutes of Technology have been ranked on the basis of their performance against each parameter. A twenty point scale has been adopted to assign the score to each individual institutional library on the basis of performance, measuring from 1 to 20. Accordingly, on the basis of scores earned by each individual library, a revised rank has been assigned (achieved rank). The aggregate perceived score earned against seven different parameters has been clubbed in Table-9 to assign the overall revised perceived rank to each individual library.

Table-1 Twenty leading Institutes of Technology in India

S.No.	Year of Est.	State	Institute	Regular Faculty Members	Score	All Indian Rank (ASR)
1	1959	Tamil Nadu	Indian Institute of Technology, Madras (IIT Madras)	540	89.41	**1**
2	1958	Maharashtra	Indian Institute of Technology, Bombay (IIT Bombay)	565	87.66	**2**
3	1951	West Bengal	Indian Institute of Technology, Kharagpur (IIT Kharagpur)	686	83.91	**3**
4	1961	Delhi	Indian Institute of Technology, Delhi (IIT Delhi)	497	82.02	**4**
5	1959	Uttar Pradesh	Indian Institute of Technology, Kanpur (IIT Kanpur)	389	81.07	**5**
6	1847	Uttarakhand	Indian Institute of Technology, Roorkee (IIT Roorkee)	416	78.68	**6**
7	2008	Telangana	Indian Institute of Technology, Hyderabad (IIT Hyderabad)	139	77.22	**7**
8	2008	Gujarat	Indian Institute of Technology, Gandhinagar (IIT Gandhinagar)	81	75.20	**8**

S.No.	Year of Est.	State	Institute	Regular Faculty Members	Score	All Indian Rank (ASR)
9	2008	Punjab	Indian Institute of Technology, Ropar-Rupnagar (IIT Ropar)	63	74.88	**9**
10	2008	Bihar	Indian Institute of Technology, Patna (IIT Patna)	74	74.68	**10**
11	1994	Assam	Indian Institute of Technology, North Guwahati (IIT Guwahati)	361	74.62	**11**
12	1964	Tamil Nadu	National Institute of Technology, Tiruchirappalli (IIT Tiruchirappalli)	220	74.45	**12**
13	1984	Tamil Nadu	Vellore Institute of Technology, Vellore (VIT Vellore)	1293	74.40	**13**
14	1919	Uttar Pradesh	Indian Institute of Technology (BHU), Varanasi (IIT BHU)	228	74.39	**14**
15	1961	Gujarat	Sardar Vallabhbhai National Institute of Technology, Surat (SVNIT Surat)	187	73.13	**15**
16	2009	Madhya Pradesh	Indian Institute of Technology, Indore (IIT Indore)	77	72.00	**16**
17	1955	Jharkhand	Birla Institute of Technology, Ranchi (BIIT Ranchi)	216	71.80	**17**
18	1960	Maharashtra	V. National Institute of Technology, Nagpur (DU) (VNIT Nagpur)	181	71.29	**18**
19	1961	Odisha	National Institute of Technology, Rourkela-Rourkela (NIT Rourkela)	279	70.80	**19**
20	2009	Himachal Pradesh	Indian Institute of Technology, Mandi (IIT Mandi)	62	70.32	**20**

Source: - Ministry of HR& D GOI https://www.nirfindia.org/engg
DU-Deemed University, BHU-Banaras Hindu University
ASR; - Ascribed Rank

RESULTS: - The data retrieved has been tabulated as per the identified objectives of the study and the mathematical computations in most of the tables have been performed by using simple mathematical expressions. Percentage at most of the places has been drawn up to two decimal places, but has not been rounded off for 100% figure.

Table-2 Investment - Procurement of books & Journals (Print)
Amount is in INR in Lakhs

Year of Est.	University library	2012-13	2013-14	2014-15	Total Spending in Lakhs	Avg spending each year in lakhs	ASR	ACR	PS1
2008	IIT Patna	630.72	995.06	1648.81	3274.59	1091.53	**10**	**1**	**20**
1847	IIT Roorkee	716.37	770.86	187.82	1675.05	558.35	**6**	**2**	**19**
1961	NIT Rourkela	219.83	312.00	208.21	740.04	246.68	**19**	**3**	**18**
1959	IIT Kanpur	202.37	163.23	111.70	477.3	159.10	**5**	**4**	**17**
1994	IIT Guwahati	118.41	143.86	191.30	453.57	151.19	**11**	**5**	**16**
1960	VNIT Nagpur	200.00	184.00	63.84	447.84	149.28	**18**	**6**	**15**
1959	IIT Madras	123.07	143.56	145.85	412.48	137.49	**1**	**7**	**14**
1984	VIT Vellore	112.96	195.44	62.41	370.81	123.60	**13**	**8**	**13**
1951	IIT Kharagpur	110.00	120.00	136.17	366.17	122.05	**3**	**9**	**12**
1961	SVNIT Surat	39.43	271.42	48.33	359.18	119.72	**15**	**10**	**11**
1919	IIT Varanasi	113.59	46.64	192.16	352.39	117.46	**14**	**11**	**10**
1961	IIT Delhi	135.64	108.58	79.89	324.11	108.03	**4**	**12**	**9**
2009	IIT Indore	150.72	147.69	19.27	317.68	105.89	**16**	**13**	**8**
1958	IIT Bombay	69.00	95.70	54.06	218.76	72.92	**2**	**14**	**7**
2008	IIT Gandhinagar	60.77	44.11	67.23	172.11	57.37	**8**	**15**	**6**
1964	NIT Tiruchirappalli	38.67	51.11	74.74	164.52	54.84	**12**	**16**	**5**
2008	IIT Hyderabad	43.10	53.19	51.17	147.46	49.15	**7**	**17**	**4**
2009	IIT Mandi	25.95	21.26	38.55	85.76	28.58	**20**	**18**	**3**

Year of Est.	University library	2012-13	2013-14	2014-15	Total Spending in Lakhs	Avg spending each year in lakhs	ASR	ACR	PS1
2008	IIT Ropar	9.31	8.03	26.10	43.44	14.48	**9**	**19**	**2**
1955	BIT Ranchi	5.80	5.12	1.77	12.69	4.23	**17**	**20**	**1**
	Total (Average)*	3125.71 (156.28)*	3880.86 (194.04)*	3409.38 (170.46)*	10415.95 (520.79)*	3471.95 (173.59)*			

*ASR-Ascribed Rank, ACR-Achieved Rank PS-Perceived Score * Average*

It is a well known fact that libraries make their investments in the form of procurement of books and other reading material. Accordingly, Table-2 reflects the investment of libraries in the procurement of books and journals by the libraries under study. Since all the 20 listed institutes have procured print documents during each year, reflects the fact that print is still a preferred source of information in the institutes of technology. IIT Patna, IIT Roorkee & IIT Rourkela are the three leading Institutes to spend the maximum amount on the procured print documents, while as, Birla Institute of Technology, IIT Ropar and IIT Mandi have spent the minimum amount on the procurement of print documents. Although there is a huge difference between the amount spent by the top spending and least spending institute, and the reason cannot be simply the choice. The difference can be due to the availability of funds, availability of print resources in respective libraries and the demand for print resources. Although, the institutes listed in their standing order of their library spending from highest to lowest, do not show any direct correlation with their age or year of establishment, but apparently most of the newly established institutes, especially those established post 2000 have made very lesser spending on the procurement of their library resources. With the result, most of the newly established institutes have been ranked between 14 and 20 along with few institutes established pre 2000.

Table-3 Investment - Procurement of books & Journals (Electronic)
Amount is in INR in Lakhs

Year of Est.	University library	2012-13	2013-14	2014-15	Total Spending	Avg spending each year	ASR	ACR	PS2
1958	IIT Bombay	1015.32	1431.80	2335.38	4782.50	1594.16	**2**	**1**	**20**
1951	IIT Kharagpur	1330.00	1450.00	1634.07	4414.07	1471.35	**3**	**2**	**19**
1959	IIT Madras	1040.51	1288.96	1488.41	3817.88	1272.62	**1**	**3**	**18**
1959	IIT Kanpur	995.18	1306.87	1368.21	3670.26	1223.42	**5**	**4**	**17**
2008	IIT Gandhinagar	1469.56	995.86	543.27	3008.69	1002.89	**8**	**5**	**16**
1961	IIT Delhi	731.79	909.82	1067.69	2709.30	903.10	**4**	**6**	**15**
1847	IIT Roorkee	427.39	299.46	1044.71	1771.56	590.52	**6**	**7**	**14**
2009	IIT Mandi	399.00	422.00	569.00	1390.00	463.33	**20**	**8**	**13**
1994	IIT Guwahati	369.96	567.62	253.07	1190.65	396.88	**11**	**9**	**12**
1984	VIT Vellore	276.64	288.26	418.52	983.42	327.80	**13**	**10**	**11**
2008	IIT Patna	349.58	299.60	311.34	960.52	320.17	**10**	**11**	**10**
2008	IIT Ropar	311.44	196.96	259.70	768.10	256.03	**9**	**12**	**9**
2009	IIT Indore	244.45	258.13	264.87	767.45	255.81	**16**	**13**	**8**
1961	SVNIT Surat	74.77	234.11	338.52	647.40	215.80	**15**	**14**	**7**
2008	IIT Hyderabad	76.76	211.73	295.47	583.96	194.65	**7**	**15**	**6**
1961	NIT Rourkela	94.97	112.63	304.42	512.02	170.67	**19**	**16**	**5**

Year of Est.	University library	2012-13	2013-14	2014-15	Total Spending	Avg spending each year	ASR	ACR	PS2
1964	NIT Tiruchirappalli	99.16	99.16	231.98	430.30	143.43	**12**	**17**	**4**
1960	VNIT Nagpur	57.95	76.69	92.39	227.03	75.67	**18**	**18**	**3**
1955	BIT Ranchi	52.62	68.42	34.43	155.47	51.82	**17**	**19**	**2**
1919	IIT Varanasi	34.60	44.41	37.40	116.41	38.80	**14**	**20**	**1**
	Total (Average)*	9451.65 (472.58)*	10562.49 (528.12)*	12892.85 (644.64)*	32906.99 (1645.34)*	10968.99 (548.44)*			

*ASR-Ascribed Rank, ACR-Achieved Rank PS-Perceived Score * Average*

Table-3 reflects the investment of libraries in the procurement of e-books and e-journals by the libraries under study. A considerable difference can be seen between the amount spent by IIT Bombay and the IIT Varanasi, the two leading and lest spending institutes to procurement of electronic resources. This fund spending difference among the listed institutes is not limited to a particular year, but goes parallel almost in each individual year. The apparent difference in the fund spending can again be owed to the reasons pointed out under Table-2. However, contrary to print resources, IIT Bombay, IIT Kharagpur and IIT Madras libraries have procured the higher number of e-documents, despite the availability of funds. The reason can be owed to the greater demand for e-documents among the students of these institutes. The year of establishment of the institutions here again do not show any direct correlation with the procurement of electronic sources of information in their libraries. As the institutes established much earlier than those established post 2000 have spent far less amount on the procurement of e-resources in their libraries. Hence the procurement of e-resources can be directly correlated with the demand for e-resources.

Table-4 Investment - Percentage share on the procurement of electronic and print documents

Year of Est.	Library, Institute of Technology	Total Fund spending during 2012-13, 2013-14 & 2014-15					Avg spending each year in lakhs	ASR	ACR	PS3
		Print		E-documents		Total Amount in lakhs				
		Amount in lakhs	%Share	Amount in lakhs	%Share					
1958	IIT Bombay	218.76	4.37	4782.5	95.63	5001.26	1667.08	**2**	**1**	**20**
1951	IIT Kharagpur	366.17	7.66	4414.07	92.34	4780.24	1593.41	**3**	**2**	**19**
2008	IIT Patna	3274.59	77.32	960.52	22.68	4235.11	1411.70	**10**	**3**	**18**
1959	IIT Madras	412.48	9.75	3817.88	90.75	4230.36	1410.12	**1**	**4**	**17**
1959	IIT Kanpur	477.3	11.50	3670.26	88.50	4147.56	1382.52	**5**	**5**	**16**
1847	IIT Roorkee	1675.05	48.59	1771.56	51.41	3446.61	1148.87	**6**	**6**	**15**
2008	IIT Gandhinagar	172.11	5.41	3008.69	94.59	3180.80	1060.26	**8**	**7**	**14**
1961	IIT Delhi	324.11	10.68	2709.3	89.32	3033.41	1011.13	**4**	**8**	**13**
1994	IIT Guwahati	453.57	27.58	1190.65	72.42	1644.22	548.07	**11**	**9**	**12**
2009	IIT Mandi	85.76	5.81	1390	94.19	1475.76	491.92	**20**	**10**	**11**
1984	VIT Vellore	370.81	27.38	983.42	72.62	1354.23	451.41	**13**	**11**	**10**
1961	NIT Rourkela	740.04	59.10	512.02	40.90	1252.06	417.35	**19**	**12**	**9**
2009	IIT Indore	317.68	29.27	767.45	70.73	1085.13	361.71	**16**	**13**	**8**
1961	SVNIT Surat	359.18	35.68	647.4	64.32	1006.58	335.52	**15**	**14**	**7**
2008	IIT Ropar	43.44	5.35	768.1	94.65	811.54	270.51	**9**	**15**	**6**
2008	IIT Hyderabad	147.46	20.16	583.96	79.84	731.42	243.80	**7**	**16**	**5**
1960	VNIT Nagpur	447.84	66.35	227.03	33.65	674.87	224.95	**18**	**17**	**4**

Year of Est.	Library, Institute of Technology	Total Fund spending during 2012-13, 2013-14 & 2014-15					Avg spending each year in lakhs	ASR	ACR	PS3
		Print		E-documents		Total Amount in lakhs				
		Amount in lakhs	%Share	Amount in lakhs	%Share					
1964	NIT Tiruchirappalli	164.52	27.65	430.3	72.35	594.82	198.27	**12**	**18**	**3**
1919	IIT Varanasi	352.39	75.16	116.41	24.84	468.80	156.26	**14**	**19**	**2**
1955	BIT Ranchi	12.69	7.54	155.47	92.46	168.16	56.05	**17**	**20**	**1**
	Total (Average)*	10415.95 (520.79)*	24.04	32906.99 (1645.34)*	75.96	43322.94 (2166.14)*	14440.98 (722.04)*			

*ASR-Ascribed Rank, ACR-Achieved Rank PS-Perceived Score * Average*

Table-3 reflects the overall investments made by the libraries under study in the procurement of both electronic and printed documents for their clientele. There is a huge difference in the overall library budget spent by Indian Institute of Technology, Bombay and Birla Institute of Technology towards the procurement of both print and electronic resources. This difference in budget allocation mainly depends upon the age of the institution. The older the institution, the higher it is supposed to receive grants from the government, and younger the institution, lesser will be grants allocated to it. On average the listed institutes have spent 24.04% of their library budget on the procurement of print documents and 75.96% on the procurement of e-resources. IIT, Bombay, IIT Gandhinagar, IIT Ropar, IIT Mandi, Birla Institute of Technology, IIT Kharagpur, IIT Madras have spent more than 90% of their library budget on the procurement of electronic resources. This resource procurement pattern also reflects the fact that compared to print; e-documents are in greater demand in institutes of Technology, almost in the ration of 1:9, given the spending made on both the type of resources. Funds is not an issue with the newly established IIT's across India, as most of the IIT's established post 2000 have spent more money on the procurement of library resources than those institutes established much earlier. Spending money on the procurement of library resources appears simply a case of need and demand irrespective of the form of resource. However, a growing trend can be observed towards the procurement of e-resources by the Institutes of Technology across India

Table-5 Returns - research output of Institutes of Technology across India, as reported in SCOPUS

Year of Est.	Library, Institute of Technology	2012	2013	2014	Total	Avg publications each year	ASR	ACR	PS4
1951	IIT Kharagpur	1650	1687	1843	5180	1726	**3**	**1**	**20**
1961	IIT Delhi	1548	1643	1800	4991	1663	**4**	**2**	**19**
1958	IIT Bombay	1334	1581	1741	4656	1552	**2**	**3**	**18**
1984	VIT Vellore	893	1675	1969	4537	1512	**13**	**4**	**17**
1959	IIT Madras	1353	1385	1564	4302	1434	**1**	**5**	**16**
1847	IIT Roorkee	1194	1132	1277	3603	1201	**6**	**6**	**15**
1959	IIT Kanpur	1080	1146	1204	3430	1143	**5**	**7**	**14**
1994	IIT Guwahati	751	857	915	2523	841	**11**	**8**	**13**
1964	NIT Tiruchirappalli	553	500	579	1632	544	**12**	**9**	**12**
1961	NIT Rourkela	450	524	622	1596	532	**19**	**10**	**11**
1955	BIT Ranchi	318	336	427	1081	360	**17**	**11**	**10**
1960	SVNIT Surat	257	280	301	838	279	**15**	**12**	**9**
2008	IIT Hyderabad	151	216	319	686	228	**7**	**13**	**8**
1919	IIT Varanasi	322	156	117	595	198	**14**	**14**	**7**

Year of Est.	Library, Institute of Technology	2012	2013	2014	Total	Avg publications each year	ASR	ACR	PS4
2009	IIT Indore	99	184	255	538	179	**16**	**15**	**6**
2009	IIT Mandi	35	63	434	532	177	**20**	**16**	**5**
2008	IITPatna	94	154	195	443	147	**10**	**17**	**4**
2008	IIT Ropar	102	121	161	384	128	**9**	**18**	**3**
1960	VNIT Nagpur	109	110	148	367	122	**18**	**19**	**2**
2008	IIT Gandhinagar	36	85	138	259	86	**8**	**20**	**1**
	Total (Average)*	12329 (616.45)*	13835 (691.75)*	16009 (800.45)*	42173 (2108.65)*	14057 (702.85)*			

*ASR-Ascribed Rank, ACR-Achieved Rank PS-Perceived Score * Average*

Returns of Investment (ROI) in libraries can be assessed on different fronts, and research output of an institution in form of research articles published by the students, scholars and faculty members of an institution is one of returns on the investments made by the library. Making available resources to researchers is one of the pre-requisites to undertake the quality research, but the availability of resources does not necessarily mean that resource availability will result into a greater research output. The graphical presentation of resource procurement rank and research output rank clearly reflects the difference. The institutes, which have spent a considerable amount on the resource procurement, have recorded far less research output than those institutes, which have spent significantly lower amounts on resource procurement. The research output of the IIT's established post 2000 is far lesser than those IIT's established prior 2000. There can different reasons for the considerable difference in the research output of the old and newly established IIT's and the foremost being the availability of senior and junior faculty members in the each individual institution. Most of the newly established IIT's lack senior faculty members, which is one of the foremost reasons for their less research output. Besides, most of the young faculty members find it difficult to publish their research results with the good and reputed journals, hence prefer to publish with any other non-indexed journals. Also, the greater the number of research facilities and the faculty an institution owns better are the chances that an institute will have the better research output. In terms of research output IIT Kharagpur, Delhi and Mumbai are the three leading research institutes in their standing order to publish the maximum number of research articles in the well-established SCOPUS indexed journals. IIT, Gandhinagar has published the minimum number of research articles during the period of study, hence stand at the bottom of the table.

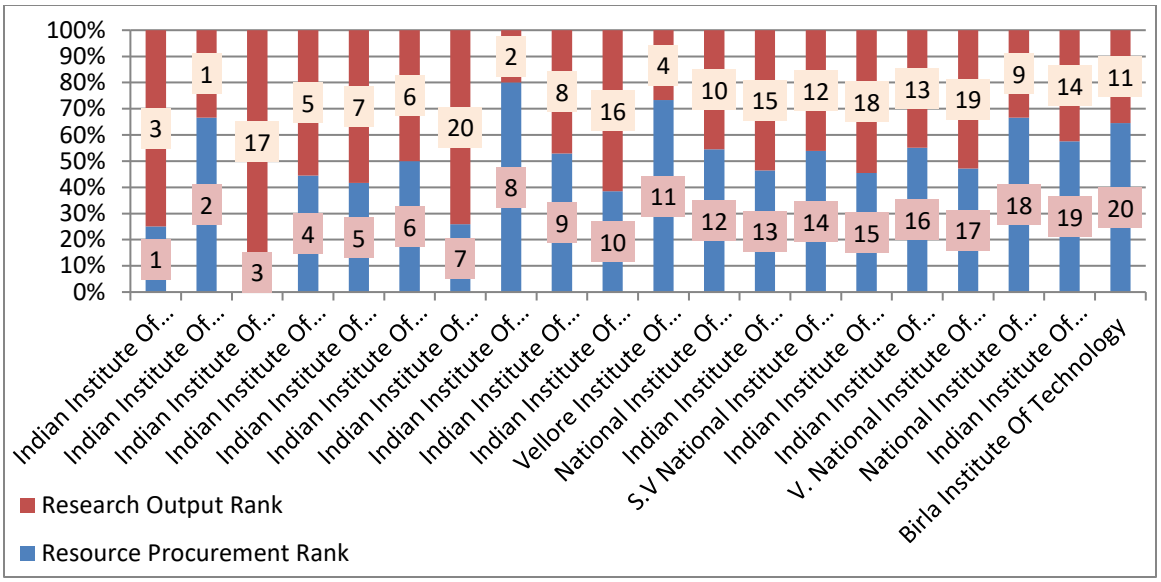

Figure 1 Representation of resource procurement rank Vs research output rank

Table-6 Investment - Expenditure incurred on publication of each research article

Year of Est.	Library, Institute of Technology	Total Library Spending	Total Research output	Average expenditure on each article in Lakhs	ASR	ACR	PS5
1955	BIT Ranchi	168.16	1081	0.15	**17**	**1**	**20**
1984	VIT Vellore	1354.23	4537	0.29	**13**	**2**	**19**
1964	NIT Tiruchirappalli	594.82	1632	0.36	**12**	**3**	**18**
2008	IIT Hyderabad	731.42	686	0.54	**7**	**4**	**17**
1961	IIT Delhi	3033.41	4991	0.60	**4**	**5**	**16**
1994	IIT Guwahati	1644.22	2523	0.65	**11**	**6**	**15**
1919	IIT Varanasi	468.80	595	0.78	**14**	**7**	**14**
1961	NIT Rourkela	1252.06	1596	0.78	**19**	**8**	**14**
1951	IIT Kharagpur	4780.24	5180	0.92	**3**	**9**	**12**
1847	IIT Roorkee	3446.61	3603	0.95	**6**	**10**	**11**
1959	IIT Madras	4230.36	4302	0.98	**1**	**11**	**10**
1958	IIT Bombay	5001.26	4656	1.07	**2**	**12**	**9**
1960	SVNIT Surat	1006.58	838	1.20	**15**	**13**	**8**
1959	IIT Kanpur	4147.56	3430	1.20	**5**	**14**	**8**
1960	VNIT Nagpur	674.87	367	1.83	**18**	**15**	**6**
2009	IIT Indore	1085.13	538	1.96	**16**	**16**	**5**
2008	IIT Ropar	811.54	384	2.11	**9**	**17**	**4**
2009	IIT Mandi	1475.76	532	2.77	**20**	**18**	**3**
2008	IIT Patna	4235.11	443	9.56	**10**	**19**	**2**
2008	IIT Gandhinagar	3180.80	259	12.28	**8**	**20**	**1**
	Total (Average)*	43322.94 (2166.14)*	42173 (2108.65)*	1.02			

*ASR-Ascribed Rank, ACR-Achieved Rank PS-Perceived Score * Average*

Every penny spent by the library on the procurement of resources during a particular period should be seen an investments made by the library against each faculty member and each student on proportionate basis. Accordingly, on average, Rupees 1.02 lakh has been spent by the library of

each individual institution under study on the procurement of resources towards the publication of each individual research article. Birla Institute of Technology has on average spent Rs. 0.15 lakh on the resource procurement against each published research article, the lowest among the listed institutes. Vellore Institute of Technology and NIT Tiruchirappallli are the other two institutes which have spent judiciously on the procurement of resources against each published research article. While as, IIT Gandhi Nagar has on average spent Rs.12.28 lakh on the resource procurement against each published research article, highest among the listed institutes. IIT Patna, IIT Mandi & IIT Roper are the other leading Institutes of Technology which have spent a higher amount on the resource procurement against each published research article. Given the total amount spent by each individual institute on the procurement of resources in their libraries and their subsequent research output during the period of study, reflects the judicious use of resources by each individual institution. Given the fact, by and large the newly established institutions have spent a far greater amount on the procurement of library resources against each published research article.

Table-7 Returns - Average articles published by each Faculty Member

Year of Est.	Library, Institute of Technology	Total research output	Total faculty members	Avg articles published by each faculty member during last three years	ASR	ACR	PS6
1961	IIT Delhi	4991	497	10.04	**4**	**01**	**20**
1959	IIT Kanpur	3430	389	8.81	**5**	**02**	**19**
1847	IIT Roorkee	3603	416	8.66	**6**	**03**	**18**
2009	IIT Mandi	532	62	8.58	**20**	**04**	**17**
1958	IIT Bombay	4656	565	8.24	**2**	**05**	**16**
1959	IIT Madras	4302	540	7.96	**1**	**06**	**15**
1951	IIT Kharagpur	5180	686	7.55	**3**	**07**	**14**
1964	NIT Tiruchirappalli	1632	220	7.41	**12**	**08**	**13**
1994	IIT Guwahati	2523	361	6.98	**11**	**09**	**12**
2009	IIT Indore	538	77	6.98	**16**	**09**	**12**
2008	IIT Ropar	384	63	6.09	**9**	**11**	**10**
2008	IIT Patna	443	74	5.98	**10**	**12**	**9**
1961	NIT Rourkela	1596	279	5.72	**19**	**13**	**8**
1955	BIT Ranchi	1081	216	5.00	**17**	**14**	**7**
2008	IIT Hyderabad	686	139	4.93	**7**	**15**	**6**
1961	SVNIT Surat	838	187	4.48	**15**	**16**	**5**
1984	VIT Vellore	4537	1293	3.50	**13**	**17**	**4**
2008	IIT Gandhinagar	259	81	3.19	**8**	**18**	**3**
1919	IIT Varanasi	595	228	2.60	**14**	**19**	**2**
1960	VNIT Nagpur	367	181	2.02	**18**	**20**	**1**
		42173	6554	6.43			

*ASR-Ascribed Rank, ACR-Achieved Rank PS-Perceived Score * Average*

Faculty members are the strength of any academic institution and so holds true about Institutes of Technology and the individual capabilities of each faculty member to undertake research activities. Some faculty members are more pro-active in the research area, while as many others can be reactive. So the individual attitudes of each faculty member are going to come into play to decide about the research output against each faculty member. Given the fact, Vallore Institute of Technology has 1293 faculty members, the maximum among the listed institute, but on average

each faculty member has published less than 4.00 research articles, hence stands almost at the bottom of the table. On average, each faculty member from the listed institutes of technology has published 6.43 research articles during the period of study. IIT Delhi is the leading institute from where each faculty member on average published 10.04 research articles, the highest. Individual research abilities and the working capacity of researchers play a very profound role on their research output. Given the fact, the individual research output of each individual faculty member from the newly established institutes is even quite higher than the faculty members working in some of the well-established institutions. So facilities and reputation alone may not work alone for the better research output, but the individual research zeal and ability of researchers is equally important.

Table-8 Investment - Average spending made against each Faculty Member

Year of Est.	Library, Institute of Technology	Total Spending	Total faculty members	Avg articles published by each faculty member during last three years	Expenditure incurred on each faculty member in lakhs	ASR	ACR	PS7
2008	IIT Patna	4235.11	74	5.98	57.23	**10**	**1**	**20**
2008	IIT Gandhinagar	3180.80	81	3.19	39.26	**8**	**2**	**19**
2009	IIIT Mandi	1475.76	62	8.58	23.80	**20**	**3**	**18**
2009	IIT Indore	1085.13	77	6.98	14.09	**16**	**4**	**17**
2008	IIT Ropar	811.54	63	6.09	12.88	**9**	**5**	**16**
1959	IIT Kanpur	4147.56	389	8.81	10.66	**5**	**6**	**15**
1958	IIT Bombay	5001.26	565	8.24	8.85	**2**	**7**	**14**
1847	IIT Roorkee	3446.61	416	8.66	8.28	**6**	**8**	**13**
1959	IIT Madras	4230.36	540	7.96	7.83	**1**	**9**	**12**
1951	IIT Kharagpur	4780.24	686	7.55	6.96	**3**	**10**	**11**
1961	IT Delhi	3033.41	497	10.04	6.10	**4**	**11**	**10**
1961	SVNIT Surat	1006.58	187	4.48	5.38	**15**	**12**	**9**
2008	IIT Hyderabad	731.42	139	4.93	5.26	**7**	**13**	**8**
1994	IIT Guwahati	1644.22	361	6.98	4.55	**11**	**14**	**7**
1961	NIT Rourkela	1252.06	279	5.72	4.48	**19**	**15**	**6**
1960	VNIT Nagpur	674.87	181	2.02	3.72	**18**	**16**	**5**
1964	NIT Tiruchirappalli	594.82	220	7.41	2.70	**12**	**17**	**4**
1919	IIT Varanasi	468.8	228	2.60	2.05	**14**	**18**	**3**
1984	VIT Vellore	1354.23	1293	3.50	1.04	**13**	**19**	**2**
1955	BIT Ranchi	168.16	216	5.00	0.77	**17**	**20**	**1**
		43322.94	6554	6.43	6.61			

*ASR-Ascribed Rank, ACR-Achieved Rank PS-Perceived Score * Average*

The investments made by a library in the procurement of resources during a particular period of time and the research output of the institution in form of research articles give a fair idea about the amount invested in producing each research article. Keeping in view the standard student, scholar and faculty ratio, then on an average Rs. 6.61 lakh has been spent by the each listed technological institute on the resource procurement against each faculty member during the period of study. IIT Patan has on average spent Rs. 57.23 lakh on the procurement of resources against each faculty member, the highest among the listed institutes. IIT Patna is followed by IIT Gandhi Nagar and IIT Mandi with an average spending of Rs. 39.26 Lakh and Rs. 23.80 lakh, respectively. Birla

Institute of Technology has on average spent the lowest Rs 0.77 Lakh on the resource procurement against each faculty member.

It is evident from the tabulated figures that grants allocated to each individual institution is not made on the basis of the existing infrastructure of the institute or the faculty members etc. The four leading institutes in the table have fewer faculties, but have received sufficient funds for resource procurement. This in turn has helped the institution to spend lavishly on resource procurement against each faculty member.

The newly established Institutes of Technology in India viz., those established post 2000 have spent much higher amount on the procurement of resources against each faculty member than those institutes established prior the year 2000. The reason here can be simply owed to the fact that newly established IIT's in India have lesser number of faculty members than those in the well-established institutes. With the results, the overall amount spent on the procurement of library resources by each newly established institute is on the higher side to that of older institutes.

Table-9 Return-Perceived ranking of Institutes of Technology libraries on the basis of parameters discussed above

Year of Est.	Library, Institute of Technology	PS1	PS2	PS3	PS4	PS5	PS6	PS7	Total	ASR	ACR
1951	IIT Kharagpur	12	19	19	20	13	14	11	108	**3**	**1**
1959	IIT Kanpur	17	17	16	14	8	19	15	106	**5**	**2**
1847	IIT Roorkee	19	14	15	15	12	18	13	106	**6**	**2**
1958	IIT Bombay	7	20	20	18	9	16	14	104	**2**	**4**
1959	IIT Madras	14	18	17	16	11	15	12	103	**1**	**5**
1961	IIT Delhi	9	15	13	19	17	20	10	103	**4**	**5**
1994	IIT Guwahati	16	12	12	13	16	12	7	88	**11**	**7**
2008	IIT Patna	20	10	18	4	2	9	20	83	**10**	**8**
1984	VIT Vellore	13	11	10	17	19	4	2	76	**13**	**9**
1961	NIT Rourkela	18	5	9	11	15	8	6	72	**19**	**10**
2009	IIT Mandi	3	13	11	5	3	17	18	70	**20**	**11**
2009	IIT Indore	8	8	8	6	5	12	17	64	**16**	**12**
2008	IIT Gandhinagar	6	16	14	1	1	3	19	60	**8**	**13**
1964	NIT Tiruchirappalli	5	4	3	12	18	13	4	59	**12**	**14**
1961	SVNIT Surat	11	7	7	9	8	5	9	56	**15**	**15**
2008	IIT Ropar	2	9	6	3	4	10	16	50	**9**	**16**
2008	IIT Hyderabad	4	6	5	8	10	6	8	47	**7**	**17**
1955	BIT Ranchi	1	2	1	10	20	7	1	42	**17**	**18**
1919	IIT Varanasi	10	1	2	7	15	2	3	40	**14**	**19**
1960	VNIT Nagpur	15	3	4	2	6	1	5	36	**18**	**20**

*ASR-Ascribed Rank, ACR-Achieved Rank PS-Perceived Score * Average*

On the basis of perceived rank and the subsequent score earned by each individual library under study, the libraries of IIT Kharagpur, IIT Kanpur and IIT Roorkee have emerged as the leading academic libraries of the country among the Institutes of Technology. NIT Nagpur library on aggregate has earned the minimum score during the period as such stands placed at the bottom of the table. While drawing the overall comparison of each individual institute on different parameters, it emerges that the older and well established IIT's have scored better over the IIT's established post 2000. As all the IITs established post 2000 found their place among the last ten

institutes and all the top ten places went to the older institutes. Still more, there are some well-established institutes which scored far lesser and stood at the bottom of the table.

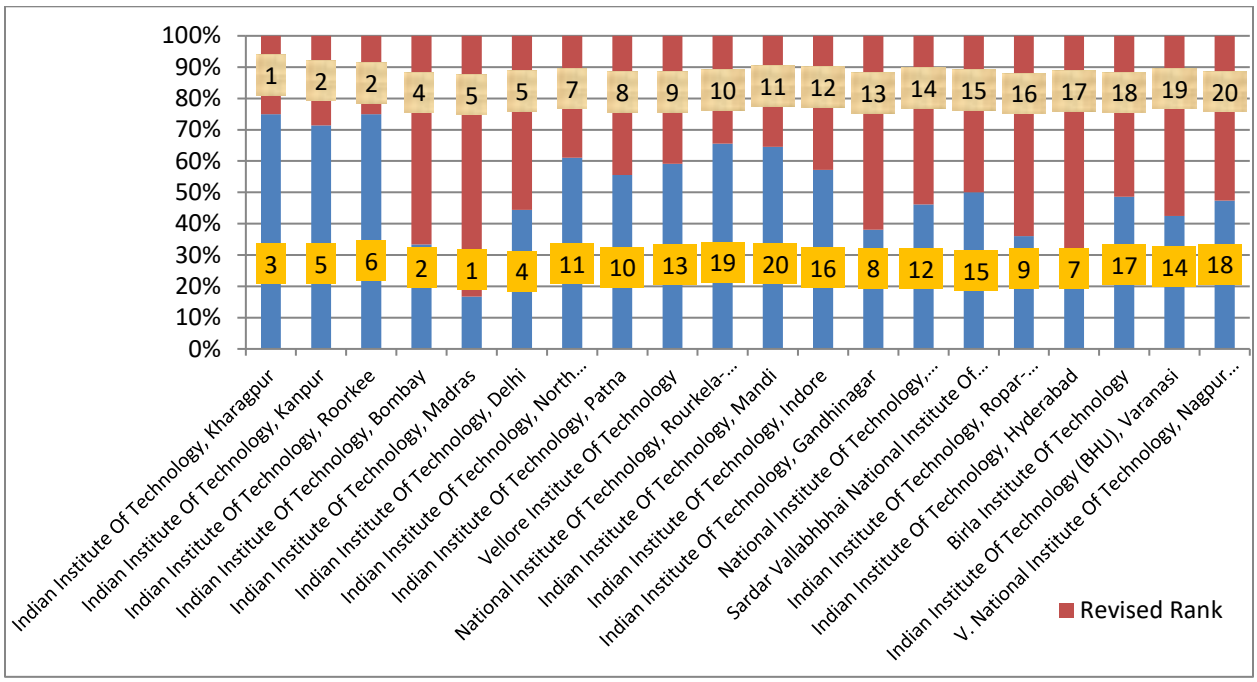

Figure 2 Perceived ranking of libraries of IIT in relation to their all India institutional rank

From the revised ranking table, it is evident that 95% institutional libraries faced change in their rankings with 40% institutions improved their ranking, while as 55% institutions slipped down to the lower ranks with 5% institutions facing no change in their rankings. Indian Institute of Technology, Hyderabad faced the maximum 10 points change in its rankings, IIT Rourkela and IIT Mandi each faced the second highest 09 point change in their rankings. IIT Kharagpur improved from rank 3 to rank 1, IIT Kanpur and IIT Roorkee improved from their respective rank of 5 & 6 shared the 2nd rank jointly.

CONCLUSION: - It is quite evident from the analysis that there is a considerable difference in the investments made by the each individual Institute of Engineering and Technology in India in the procurement of library resources and so can be found difference in the returns on these investments mostly in the shape of research output of each individual institution. Better the investments made by the in the libraries, higher is the overall research output of an institution. More the institute has spent money on the procurement of library resources more is the research output of that particular institute. It is equally important to note that judicious use of resources can result into greater research output with minimum investment.

Although, both electronic and print documents are being procured in the libraries of the leading Engineering and Technology Institutions in India, but still the major portion of the library budgets is being spent by these libraries on the procurement of e-documents, constituting nearly three fourth of the total library budget. 80% institutes under study have invested more than 60% of their

library budget on the procurement of e-documents, while as only 20% institutes have invested around 40% of their library budgets on the procurement of print documents. It is evident from the figures that there is a considerable difference in the amount allocated to each individual institution for procurement of library resources and so is the difference in the number of research articles published by each individual institution, which more or less signifies the returns on library investment. Except for few institutes, the research output against each faculty member in each individual institute is not that encouraging. The disproportionate allocation of funds made to each individual institution for resource procurement is slightly an area of concern.

Year of establishment of each individual institute plays a profound role on the various aspects studied. Money does not appear to be an issue with the age of the institution, as most of the newly established IIT's have spent more money on the procurement of library resources than those established much earlier. This is an indicative of the fact that money is not the constraint with the Institutes of Engineering and Technology in India, as Govt., of India is spending huge money on the education sector of the country in general and the higher & technical education in particular.

Most of the newly established Engineering and Technological Institutes in India have lesser faculty members, which has resulted in their having lesser research output than the older Institutes. Again, the resource procurement of newly established institutes against each faculty member is quite higher. However, year of establishment has no direct correlation with the overall performance of the institutional library. Newer and younger institutes have shaped up their libraries very well by making healthy investments on resource procurement. Based on the overall performance of each individual library, the libraries associated with the older Engineering and Technology Institutes have achieved the top ten ranks hence by and large justify their ranking with the overall ranking of their institution.

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