Measuring Richness of the Research Output: A Scientometric Method

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Abstract

Citation considered as yardstick for richness of the scientific publications. In this paper attempt has been made to derive measures of richness of scientific output using Richness factor index for paper, organization, year and author. In order to identify the richness of the publications, the publications pertaining to Indian Institute of Management, Internationally renowned management institutions, were taken up for the study with the opinion that these publications were reached globally. Therefore 13 IIMs faculty research publications were considered for the study. The data were collected from Scopus data base. 5755 publications were identified during the period of 1965 to 2018. Out of 5755 papers, 3625 (63.0%) papers were cited where as 2130 (37.0%) were not cited. It can be inferred that 63% of the IIM's research publications were reached the users. The richness of the reached paper was calculated based on the derived formula and the same has been discussed. The results were encouraging and can be compared with different types of indexes and impact factor.

Keywords

Indian Institute of Management; Richness Factor Index; Richness Factor; India

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INTRODUCTION

Simple indicators as the total number of citations to all papers or the average citation frequency have obvious disadvantages like the difficulty to determine all the citation counts with reasonable accuracy or giving undue weight to highly cited review articles, or taking a possibly large number of irrelevant (not or lowly cited) papers into account. This can be avoided by considering only a small number of relevant or significant papers, but this solution raises the question how to determine this core set of significant papers from a given set of publications. Taking a fixed number or a certain percentage of all publications into consideration would mean a somewhat arbitrary and biased choice.

Several different citation-based indices are used to measure research performance. Authors consider that these indices correlate well with qualitative perception of quality. The analyzing of an individual department provides an overall picture of its quality. Scientometric studies are performed by scientific managers, scientometricians, renowned scientists and science journalists. An important number of scientometric studies have been carried out on scientist groups, disciplines, journals as well as Universities and research institutes Jipa, (2011).

Hirsch (2005) introduced a single index to quantify a scientist's published research impact which created an unprecedented response from the scientometrics community. As an improvement of the h-index, Egghe (2006) proposed the g-index. Alonso et al. (2010)[134] presented a new index called hg-index in order to reduce the disadvantages of using h-index and g-index, without affecting the advantages of both the measures. Non-parametric statistics enables us to honour both productivity and quality, whereas the impact may be lower in the case of averaging for the sole reason of higher productivity. These statistics share the appreciation of both productivity and citation rates with the h-index, but they differ from the h-index in that a range of tests for the significance of the impact (above or below expectation) becomes available. Less-cited papers can thus be appreciated proportionately, while the h-index uses the h-value as a threshold for the cut-off of the tails of the distributions. (Glanzel, 2007, Vinkler 2010, 2011).

REVIEW OF RELATED LITERATURE

A variety of data analysis methods are employed during Scientometric analysis including co-authorship analysis, and citation analysis (i.e., papers or authors often cited in cycle) Callon (1986); Callon, Courtiaol & Laville (1991); He (1999); Leydesdorff (1997); Peters & Van Raan (1993). Conventional Scientometric methods is generally, evaluate the research trend by investigating the publication outputs of different countries (Rahman, Haque, & Fukui, 2005), research institutes (Rajendram, Lewison, & Preedy, 2006), journals (Javed M (2008), subjects (Rajendran, Ramesh Babu, & Gopalakrishnan, 2005) and research fields (Davis & Gonzalez, 2003 , Krishnamoorthy, Ramakrishnan & Devi, 2009).

h index (Hirsch,2005); h2 index (Kosmulkski, 2006); g index(Leo Egghe, 2006); a index (Jin, 2006); Normalized h index (hnom) (Sidiropoulos, Katsaros, and Manolopoulos 2007); r Index (Jin et al, 2007); ar index, (Jin, 2007); e index (Zhang, 2009); hg index, (Alonso 2010) and p index (GanganPrathap, 2010) Karpagam et al (2011) studied the Mapping of nanoscience and nanotechnology research in India and Karpagam (2014) studied the various measures of collaboration in nanobiotechnology and the indices like h-index, g-index, hg-index and p-index have been used to find the productivity and impact of the published work of a scientist or scholar of the priority countries.

OBJECTIVES

The objectives of the study were

1. To identify the richness of the research output of a publications
2. To derive a methodology for identifying the richness of the research output of a paper, author and organizations.

MEASURE OF RICHNESS

There exist three factors for Richness.

- The first factor of richness will be based on number of citations.
- The citations are based number of author of a paper is to be considered as second factor.
- The age of the paper also has an impact which has been considered as third factor

Therefore Richness factor can be calculated using the formula

Richness factor (RF) = No. of citations/no. of authors*age of the paper

The Richness factor can be

- for a paper
- for a organization
- for a year
- for an author

1. Richness Factor for a paper

$$RF_{Paper} = \frac{Cit_{paper}}{Tot_{author} * AoP}$$

where RF_{Paper} = Richness Factor of paper

Cit_{Paper} = No. of Citations of a paper
Tot_{author} = Total No. of authors of a paper
AoP = Age of a paper

Age of a paper can be calculated as follows

AoP = (Base year of the study – Paper published year) + 1

Eg. Let Base year may be 2018
Paper publication year may be 2017
Therefore AoP = (2018-2017)+1 = 1+1 = 2

2 Richness Factor for a Organization

$$RF_{Org} = \frac{Cit_{Org}}{Tot_{author} * NoP}$$

where RF_{Paper} = Richness Factor of paper
Cit_{Paper} = No. of Citations of a paper
Tot_{author} = Total No. of authors of a paper
NoP = Number of papers

3. Richness Factor for a year

$$RF_{Year} = \frac{Cit_{Year}}{Tot_{author} * AoP}$$

where RF_{Year} = Richness Factor of year
Cit_{Year} = No. of Citations of a Year
Tot_{author} = Total No. of authors of a year
AoP = Age of a year

4. Richness Factor of an author

$$RF_{author} = \frac{Cit_{author}}{Tot_{paper} * PoP}$$

where RF_{author} = Richness Factor of author
Cit_{author} = Total Citations of a author
Tot_{author} = Total No. of collaborated authors
PoP = Period of Publish
Period of Publish can be calculated as follows

PoP = (Last paper published year – First published Paper year) + 1

Eg. Let First published paper year 2002
Last published Paper year may be 2018
Therefore AoP = (2018-2002)+1 = 16+1 = 17

Method of Calculation

1. RF index for paper

The sample paper data for the calculation were shown in Table 1

Table 1: Sample data of papers

S.No	NoA	Authors	Year	Source title	Volume	Issue	Pages	Cited by	Document Type	IIMs	aop	RF Index
1	1	Varma P.	2018	Journal of Development Studies	54	10	20	1	Article	AHM	1	1.00
2	3	Singla C., George R., Veliyath R.	2017	Journal of Business Research	81		14	2	Article	AHM	2	0.33
3	10	Koblinsky M., Matthews Z., Hussein J., Mavalankar D., Mridha M.K., Anwar I., Achadi E., Adjei S., Padmanabhan P., van Lerberghe W.	2006	Lancet	368	9544	10	286	Review	AHM	13	2.20
4	3	Gupta R., Batra J.L., Lal G.K.	1995	International Journal of Production Research	33	9	11	79	Article	LUC	24	1.10

RF Index for Paper 1

Cit_{Paper} = No. of Citations of a paper = 1
Tot_{author} = Total No. of authors of a paper = 1
AoP = Age of a paper = 1

$$RF\ Index = RF_{Paper} = \frac{Cit_{paper}}{Tot_{author} * AoP} = 1/1*1 = 2$$

RF Index for Paper 2 = 2/(2*3) = 0.33
RF Index for Paper 3 = 286/(10*13) =2.20
RF Index for Paper 4. = 79/(3*24) = 1.10

Table 2: Sample RF Index calculated

Paper	Cit_{Paper}	Tot_{author}	AoP	Calculation	RF Index	Richness of paper
1	1	1	1	1/(1*1)	1	Third
2	2	3	2	2/(3*2)	0.33	Fourth
3	286	10	13	286/(10*13)	2.20	First
4	79	3	24	79/(3*24)	1.10	Second

Inference – Third paper has first high richness paper. It is followed by fourth paper; first paper and second paper.

2. RF index for Organisation

The sample organisation data for the calculation were shown in Table 3

Table 3: Sample data for organization

S.No.	*IIMs*	Papers	Number of authors	Citations	RF Index	Rank
1	IIM-A	999	2916	13852	0.005	3
2	IIM-B	725	2127	9847	0.006	1
3	IIM-C	836	2136	10698	0.006	2

RF Index for Organisation 1

Richness Factor for a Organization

$$RF_{Org} = \frac{Cit_{Org}}{Tot_{author} * NoP}$$

where RF_{Paper} = Richness Factor of paper
Cit_{Paper} = No. of Citations of a paper
Tot_{author} = Total No. of authors of a paper
NoP = Number of papers

Cit_{Paper} = No. of Citations of a paper = 13852
Tot_{author} = Total No. of Citations of of a paper = 999
NoP = Number ofa paper = 2916

$$RF\ Index = RF_{Paper} = \frac{Cit_{paper}}{Tot_{author} * AoP}$$

$$= 13852/999*2916 = 0.005$$

RF Index for Organisation 2 = 9847/(725*2127) = 0.006
RF Index for Organisation 3 = 10698/(836*2136) = 0.006

RICHNESS OF IIM PUBLICATIONS

In order to identify the richness of the publications, the publications pertaining to Indian Institute of Management, Internationally renowned management institution, were taken up for the study with the opinion that these publications were reached globally. There exist 20 IIMs of which 6 of them were established in 2015 (Table 4). Therefore 13 IIMs faculty research publications were taken up for the study. The data were collected from Scopus data base. 5755 publications were identified during the period of 1965 to 2018.

Table 4 List of IIMs in India with short name, year of establishment, location and URL

S. No	Name	Short Name	Year of Establishment	Location	Website
1	Indian Institute of Management Calcutta	IIM-C	1961	Kolkata, West Bengal	iimcal.ac.in
2	Indian Institute of Management Ahmedabad	IIM-A	1961	Ahmedabad, Gujarat	iimahd.ernet.in
3	Indian Institute of Management Bangalore	IIM-B	1973	Bangalore,Karnataka	iimb.ernet.in
4	Indian Institute of Management Lucknow	IIM-L	1984	Lucknow, Uttar Pradesh	iiml.ac.in
5	Indian Institute of Management Kozhikode	IIM-K	1996	Kozhikode,Kerala	iimk.ac.in
6	Indian Institute of Management Indore	IIM-I	1996	Indore, Madhya Pradesh	iimidr.ac.in
7	Indian Institute of Management Shillong	IIM-S	2007	Shillong,Meghalaya	iimshillong.in
8	Indian Institute of Management Rohtak	IIM-Rohtak	2010	Rohtak,Haryana	iimrohtak.ac.in
9	Indian Institute of Management Ranchi	IIM-R	2010	Ranchi,Jharkhand	iimranchi.ac.in

10	Indian Institute of Management Raipur	IIM-Raipur	2010	Raipur,Chhattisgarh	iimraipur.ac.in
11	Indian Institute of Management Trichy	IIM-T	2011	Trichy,Tamil Nadu	iimtrichy.ac.in
12	Indian Institute of Management Udaipur	IIM-U	2011	Udaipur,Rajasthan	iimu.ac.in
13	Indian Institute of Management Kashipur	IIM-Kashipur	2011	Kashipur,Uttarakhand	iimkashipur.ac.in
14	Indian Institute of Management Nagpur	IIM-N	2015	Nagpur,Maharashtra	iimnagpur.ac.in
15	Indian Institute of Management Bodh Gaya	IIM-BG	2015	Bodh Gaya, Bihar	www.iimbg.ac.in
16	Indian Institute of Management Visakhapatnam	IIM-V	2015	Visakhapatnam,Andhra Pradesh	iimv.ac.in
17	Indian Institute of Management Amritsar	IIM Amritsar	2015	Amritsar, Punjab	iimamritsar.ac.in
18	Indian Institute of Management, Sambalpur	IIM Sambalpur	2015	Sambalpur, Odisha	iimsambalpur.ac.in
19	Indian Institute of Management, Sirmaur	IIM Sirmaur	2015	Sirmaur district, Himachal Pradesh	http://www.iimsirmaur.ac.in/
20	Indian Institute of Management, Jammu	IIMJ	2016	Jammu	http://www.iimj.ac.in/

Reach of the publications identified based on the citation. Therefore citation analysis of 5755 papers thus taken up for study has been carried out and the same has been shown in table 3.

Table 5 Cited/uncited

S.No.	Cited/Uncited	Papers	Percent	Cumulative Percent
1	Cited	3625	63.0	63.0
2	Uncited	2130	37.0	100.0
	Total	**5755**	**100.0**	

Out of 5755 papers, 3625 (63.0%) papers were cited where as 2130 (37.0%) were not cited. It can be inferred that 63% of the IIM's research publications were reached the users.

RICHNESS FACTOR

As discussed above "Richness Factor" (RF) for a paper, organization, year and author were calculated using the formula stated above. The formula used for calculating the Richness of a paper were shown in (1) above. Similarly Richness for organisation, year and author were calculated using the formula in (2), (3) and (4) above. The range of Richness factor thus calculated for a paper were grouped in nine different ranges. The range and number of papers under each category were shown in Table 6.

Table 6 RF Index for IIMs

S.No.	Range of RF Index	Papers	Percent	Cumulative Percent
1	.00 to .49	2353	64.9	64.9
2	.50 to .99	642	17.7	82.6
3	1.00 to 1.49	270	7.4	90.1
4	1.50 to 1.99	132	3.6	93.7
5	2.00 to 2.49	77	2.1	95.8
6	2.50 to 2.99	38	1.0	96.9
7	3.00 to 3.49	29	.8	97.7
8	3.50 to 3.99	15	.4	98.1
9	4.00 and above	69	1.9	100.0
	Total	**3625**	**100.0**	

Out of 3625 papers, 630 (17.4%) of publications has Richness factor more than one. Nearly 69 (1.9%) publications whose Richness factor were more than four. The richness factor index of 2353 (64.9%) publications was ranges between 0.00 and 0.49. Similarly 642 (17.7%) papers RF index ranges between 0.50 and 0.99. It can be inferred that 630 publications have high relevance among 3625 cited publications of IIM.

The authorship pattern with grouped RF index of these papers were analysed and the same has been shown in Table 7

Table 7: Authorship pattern Vs Grouped RF Index

S.No.	Grouped RF Index	Single author	Two authors	Three authors	Four authors	Five authors	Six and above	Total
1	.00 to .49	467	889	563	241	96	97	2353
2	.50 to .99	167	268	145	42	9	11	642
3	1.00 to 1.49	109	88	52	17	0	4	270
4	1.50 to 1.99	44	46	23	10	3	6	132
5	2.00 to 2.49	33	25	14	3	1	1	77
6	2.50 to 2.99	13	17	5	3	0	0	38
7	3.00 to 3.49	10	13	4	1	0	1	29
8	3.50 to 3.99	9	4	2	0	0	0	15
9	4.00 and above	30	27	7	4	1	0	69
Total		882	1377	815	321	110	120	3625

Out of 69 papers that has richness factor more than four, 30 were single author publications and the remaining were collaborative research. Out of 630 publications that has richness factor one and above, 248 papers were single author paper and the remaining 382 were collaborative research. Normally other scientometric indexes shows that collaborative research can categorized as high order paper. The index factor thus derived unbiased and be used for identifying the outreach paper.

The IIMs with grouped RF index of these papers were analysed and rank were provided based on RF index of a paper. The IIM centre, RF index range and the rank were shown in Table 8.

Table 8 IIMs Vs RF Index

S.No	IIMs	.00 to .49	.50 to .99	1.00 to 1.49	1.50 to 1.99	2.00 to 2.49	2.50 to 2.99	3.00 to 3.49	3.50 to 3.99	4.00 and above	Total	Rank based on RF Index
1	IIM-A	703	144	59	36	24	12	6	5	10	999	3
2	IIM-B	442	148	53	35	18	10	5	3	11	725	2
3	IIM-C	601	115	52	25	9	5	6	2	21	836	1
4	IIM-I	98	41	19	1	7	1	4	1	6	178	6
5	IIM-KASHIPUR	16	9	5	3	2	0	0	0	0	35	10
6	IIM-K	146	50	19	7	1	5	3	0	5	236	7
7	IIM-L	180	70	26	13	9	3	2	3	8	314	4
8	IIM-RAIPUR	47	15	9	2	0	0	0	0	1	74	12
9	IIM-R	16	7	3	0	0	0	0	0	0	26	13
10	IIM-	48	26	17	8	7	2	2	1	6	117	5

	ROHTAK											
11	IIM-S	30	6	3	0	0	0	1	0	0	40	9
12	IIM-T	12	2	3	0	0	0	0	0	1	18	8
13	IIM-U	14	9	2	2	0	0	0	0	0	27	11
Total		**2353**	**642**	**270**	**132**	**77**	**38**	**29**	**15**	**69**	**3625**	

Nine IIMs were having Rich publication index more than four. Out of 69 papers that has richness factor more than four, 21 papers from IIM-C. It is followed by 11 papers from IIM-B; 10 papers from IIM-A (10) and 8 papers from IIM-L. Out of 630 publications that has richness factor more than one, 152 papers were from IIM-A, 135 papers from IIM-B and 120 papers were from IIM-C. The remaining 223 papers were other IIMs.

RICHNESS FACTOR INDEX FOR ORGANISATIONS

Richness factor index for organizations were calculated based on the formula derived and stated in (2) above. The same has been shown in Table 9.

Table 9: IIMs Vs RF Index

S.No.	IIMs	Papers	Number of authors	Citations	RF Index	Rank
1	IIM-A	999	2916	13852	0.005	**13**
2	IIM-B	725	2127	9847	0.006	**11**
3	IIM-C	836	2136	10698	0.006	**12**
4	IIM-I	178	370	1654	0.025	**8**
5	IIM-KASHIPUR	35	73	165	0.065	**2**
6	IIM-K	236	523	1873	0.015	**10**
7	IIM-L	314	647	3265	0.016	**9**
8	IIM-RAIPUR	74	238	449	0.025	**7**
9	IIM-R	26	58	95	0.063	**4**
10	IIM-ROHTAK	117	228	811	0.030	**6**
11	IIM-S	40	108	268	0.062	**5**
12	IIM-T	18	40	136	0.189	**1**
13	IIM-U	27	70	121	0.064	**3**
	Total	**3625**	**9534**	**43234**		

This method will enable to identify the high rich paper or outreached paper of the institution. The Richness factor index ranges between 0.005 and 0.189. Highest RF index were papers published by IIM-T. It is followed by IIM–Kashipur and IIM-U.

RICHNESS FACTOR INDEX FOR YEAR

Richness factor index for yearwise cited paper were calculated based on the formula derived and stated in (3) above. The same has been shown in Table 10.

Table 10: Year Vs RF Index

S.No.	Year	Papers	NoA	Cited by	RFI
1	1965	1	1	1	1.00
2	1966	3	4	6	0.50
3	1967	1	1	5	5.00
4	1968	3	4	17	1.42
5	1969	2	3	10	1.67
6	1970	3	6	5	0.28
7	1971	5	6	37	1.23
8	1972	3	4	6	0.50
9	1973	4	8	14	0.44
10	1974	6	7	31	0.74
11	1975	4	7	53	1.89

12	1976	10	13	52	0.40
13	1977	7	10	14	0.20
14	1978	7	12	184	2.19
15	1979	7	15	69	0.66
16	1980	9	11	74	0.75
17	1981	11	17	25	0.13
18	1982	6	10	59	0.98
19	1983	13	23	981	3.28
20	1984	5	12	23	0.38
21	1985	14	26	754	2.07
22	1986	12	24	127	0.44
23	1987	9	16	317	2.20
24	1988	10	19	108	0.57
25	1989	10	19	60	0.32
26	1990	12	17	596	2.92
27	1991	11	18	233	1.18
28	1992	20	38	139	0.18
29	1993	23	38	525	0.60
30	1994	21	45	181	0.19
31	1995	23	42	346	0.36
32	1996	38	78	629	0.21
33	1997	39	78	471	0.15
34	1998	40	90	1379	0.38
35	1999	48	235	1181	0.10
36	2000	50	90	911	0.20
37	2001	57	128	1405	0.19
38	2002	59	130	974	0.13
39	2003	94	239	1982	0.09
40	2004	94	313	2399	0.08
41	2005	98	229	1183	0.05
42	2006	115	281	2193	0.07
43	2007	119	292	2068	0.06
44	2008	146	402	2678	0.05
45	2009	169	417	2611	0.04
46	2010	176	440	2433	0.03
47	2011	225	723	2999	0.02
48	2012	260	673	2537	0.01
49	2013	265	660	1990	0.01
50	2014	288	692	2159	0.01
51	2015	325	930	1943	0.01
52	2016	320	943	1279	0.00
53	2017	245	734	621	0.00
54	2018	80	261	157	0.01
	Total	**3625**	**9534**	**43234**	

(NoA-Number of Authors; RFI-Richness Factor Index)

This method will enable to identify the years in which high rich paper or outreached paper were published. The Richness factor index ranges between 0.00 and 5.00. Highest RF index were papers published during 1967. It is followed by year 1983 (3.28); 1990 (2.92); 1987 (2.20); 1978 (2.19) and 1985 (14).

RICHNESS FACTOR INDEX FOR AUTHOR

Richness factor index for authorwise cited paper were calculated based on the formula derived and stated in (4) above. The same has been shown in Table 11.

High RF Index publications

High Richness factor index for publications paper were identified and the same has been shown in Table 12.

Nearly 40 papers have RF index more than five. Out of 40 papers, five papers from IIM-A; four papers from IIM-B; 13 from IIM-C; five from IIM-I; three from IIM-K; six from IIM-L and four from IIM-ROHTAK.

Out of forty, 20 were solo research paper and 20 were collaborated paper. Out of 20 solo research papers four from IIM-A; one from IIM-B, five from IIM-C; one each from IIM-I and IIM-K; four from IIM-L and four from IIM-ROHTAK.

Highly cited paper

The paper that has more than 200 citations were taken up and RF index calculated and the same has been shown in Table 13.

It can be seen from the table 13 that 18 papers were more than 200 citations. Out of 18, there were 17 collaborated paper and one solo research paper. The RF index of these 18 papers was ranges between 0.18 and 27.27. Out of 18 papers, eight from IIM-A, four from IIM-B, four from IIM-C; One each from IIM-I and IIM-L.

Table 11: Author Vs RF Index

S.No.	Inst. Name	Author name	Total no. of papers	Total no. Authors	Total Citations	First Published Year	Last Published Year	RF Index	Rank
1	IIM-A	Shukla, P.R.	69	254	1472	1992	2018	0.003	12
2	IIM-B	Gosh, P	39	126	369	2010	2018	0.008	7
3	IIM-C	Mukerjee R.	124	270	995	1990	2018	0.001	13
4	IIM-I	Dey S.	18	41	81	2010	2018	0.012	3
5	IIM-KASHIPUR	Batra S.	12	28	26	2015	2018	0.019	2
6	IIM-K	Balooni K.	20	54	168	2000	2018	0.008	8
7	IIM-L	Ali J.	31	52	179	2007	2016	0.011	5
8	IIM-RAIPUR	Gupta S.	30	105	218	2013	2018	0.012	4
9	IIM-R	Bala P.K.	9	20	6	2013	2017	0.007	11
10	IIM-ROHTAK	Khare A.	45	96	290	2011	2017	0.010	6
11	IIM-S	Roychoudhury B.	8	23	34	2010	2018	0.021	1
12	IIM-T	Godwin T.	7	15	4	2013	2017	0.008	10
13	IIM-U	Roy S.	12	27	13	2014	2018	0.008	9

Table 12: High Richness Factors Publications

S. No.	No A	Title/Authors	Year	Source title	Volume	Issue	Page count	Cited by	IIMs	AOP	RF Index
1	1	Network design for reverse logistics / Srivastava S.K.	2008	Omega	36	4	14	300	IIM-L	11	27.27
2	2	Women as policy makers: Evidence from a randomized policy experiment in India / Chattopadhyay R., Duflo E.	2004	Econometrica	72	5	35	497	IIM-C	15	16.57
3	2	Pervasive computing: A paradigm for the 21st century / Saha D., Mukherjee A.	2003	Computer	36	3	8	407	IIM-C	16	12.72
4	2	A network algorithm for performing fisherâ€™s exact test in r Ã— c contingency tables / Mehta C.R., Patel N.R.	1983	Journal of the American Statistical Association	78	382	8	806	IIM-A	36	11.19
5	1	Pruning strategies for mining high utility itemsets / Krishnamoorthy S.	2015	Expert Systems with Applications	42	5	11	44	IIM-A	4	11.00
6	1	Performance evaluation and a flow allocation decision model for a sustainable supply chain of an apparel industry / Jakhar S.K.	2015	Journal of Cleaner Production	87	1	23	40	IIM-ROHTAK	4	10.00
7	1	Revisiting the supplier selection problem: An integrated approach for	2014	Expert Systems with	41	6	10	50	IIM-ROH	5	10.00

		group decision support / Kar A.K.		Applications					TAK		
8	1	Revenue management for remanufactured products / Mitra S.	2007	Omega	35	5	10	118	IIM-C	12	9.83
9	1	Supply chain coordination using revenue-dependent revenue sharing contracts / Palsule-Desai O.D.	2013	Omega (United Kingdom)	41	4	17	59	IIM-I	6	9.83
10	2	Supply chain analysis under green sensitive consumer demand and cost sharing contract / Ghosh D., Shah J.	2015	International Journal of Production Economics	164		11	76	IIM-C	4	9.50
11	2	Harnessing the influence of social proof in online shopping: The effect of electronic word of mouth on sales of digital microproducts / Amblee N., Bui T.	2011	International Journal of Electronic Commerce	16	2	23	133	IIM-K	8	8.31
12	1	The effect of country-of-origin on foreign brand names in the Indian market / Kinra N.	2006	Marketing Intelligence and Planning	24	1	16	107	IIM-L	13	8.23
13	2	A comparative analysis of greening policies across supply chain structures / Ghosh D., Shah J.	2012	International Journal of Production Economics	135	2	16	110	IIM-B	7	7.86
14	2	Managing a big data project: The case of Ramco cements limited / Dutta D., Bose I.	2015	International Journal of Production Economics	165		14	61	IIM-C	4	7.63
15	2	Unemployment and the real wage: The economic basis for contesting political ideologies / Bhaduri A., Marglin S.	1990	Cambridge Journal of Economics	14	4	19	432	IIM-C	29	7.45
16	3	Managing cross-cultural issues in global software outsourcing / Krishna S., Sahay S., Walsham G.	2004	Communications of the ACM	47	4	5	330	IIM-B	15	7.33
17	2	Agri-fresh produce supply chain management: A state-of-the-art literature review / Shukla M., Jharkharia S.	2013	International Journal of Operations and Production Management	33	2	45	88	IIM-K	6	7.33
18	2	Adoption of green supply chain management practices and their impact on performance: An exploratory study of Indian manufacturing firms / Mitra S., Datta P.P.	2014	International Journal of Production Research	52	7	23	73	IIM-C	5	7.30
19	1	Linguistic features for review helpfulness prediction / Krishnamoorthy S.	2015	Expert Systems with Applications	42	7	9	27	IIM-A	4	6.75
20	2	Green supply chains: A perspective from an emerging economy / Jayaram J., Avittathur B.	2015	International Journal of Production Economics	164		11	54	IIM-C	4	6.75
21	1	Inventory management in a two-echelon closed-loop supply chain with correlated demands and returns / Mitra S.	2012	Computers and Industrial Engineering	62	4	10	46	IIM-C	7	6.57
22	4	The role of gender stereotypes in	2009	Entrepreneursh	33	2	21	262	IIM-I	10	6.55

		perceptions of entrepreneurs and intentions to become an entrepreneur / Gupta V.K., Turban D.B., Wasti S.A., Sikdar A.		ip: Theory and Practice							
23	2	Sustainable supply chain management: Review and research opportunities / Gupta S., Palsule-Desai O.D.	2011	IIMB Management Review	23	4	12	101	IIM-I	8	6.31
24	1	Knowledge management and intellectual capital - The new virtuous reality of competitiveness / Rastogi P.N.	2000	Human Systems Management	19	1	10	118	IIM-L	19	6.21
25	1	Trade in health services / Chanda R.	2002	Bulletin of the World Health Organization	80	2	6	103	IIM-B	17	6.06
26	1	Individual spirituality, workplace spirituality and work attitudes: An empirical test of direct and interaction effects / Pawar B.S.	2009	Leadership and Organization Development Journal	30	8	19	60	IIM-K	10	6.00
27	1	Analysis of a two-echelon inventory system with returns / Mitra S.	2009	Omega	37	1	10	58	IIM-C	10	5.80
28	1	Consumers' susceptibility to interpersonal influence as a determining factor of ecologically conscious behaviour / Khare A.	2014	Marketing Intelligence and Planning	32	1	19	29	IIM-ROHTAK	5	5.80
29	1	Neighborhood search heuristics for the uncapacitated facility location problem / Ghosh D.	2003	European Journal of Operational Research	150	1	13	92	IIM-A	16	5.75
30	1	Models to explore remanufacturing as a competitive strategy under duopoly / Mitra S.	2016	Omega (United Kingdom)	59		13	17	IIM-C	3	5.67
31	1	Innovations for the poor by the poor / Gupta A.K.	2012	International Journal of Technological Learning, Innovation and Development	5	1-Feb	12	39	IIM-A	7	5.57
32	2	The antecedents and consequents of user perceptions in information technology adoption / Agarwal R., Prasad J.	1998	Decision Support Systems	22	1	15	233	IIM-C	21	5.55
33	1	Service quality and customers' purchase intentions: An empirical study of the Indian banking sector / Choudhury K.	2013	International Journal of Bank Marketing	31	7	15	33	IIM-C	6	5.50
34	2	A systematic approach to conducting review studies: An assessment of content analysis in 25 years of IB research / Gaur A., Kumar M.	2018	Journal of World Business	53	2	10	11	IIM-I	1	5.50
35	2	Consumer decision-making across modern and traditional channels: E-commerce, m-commerce, in-store / Maity M., Dass M.	2014	Decision Support Systems	61	1	13	55	IIM-L	5	5.50
36	1	Antecedents to green buying behaviour: A study on consumers in	2015	Marketing Intelligence	33	3	21	22	IIM-ROH	4	5.50

		an emerging economy / Khare A.		and Planning					TAK		
37	2	Defining 'success' for software projects: An exploratory revelation / Agarwal N., Rathod U.	2006	International Journal of Project Management	24	4	13	142	IIM-I	13	5.46
38	1	The diffusion of mobile phones in India / Singh S.K.	2008	Telecommunications Policy	32	9-Oct	10	59	IIM-L	11	5.36
39	2	Managing product returns for reverse logistics / Srivastava S.K., Srivastava R.K.	2006	International Journal of Physical Distribution and Logistics Management	36	7	23	136	IIM-L	13	5.23
40	3	Foreign and domestic ownership, business groups, and firm performance: Evidence from a large emerging market / Douma S., George R., Kabir R.	2006	Strategic Management Journal	27	7	21	203	IIM-B	13	5.21

Table 13: RF Index for Highly Cited papers and RF Index

NoA	Authors	Year	Source title	Volume	Issue	Pages	Cited by	IIMs	Age of paper	RF Index
2	A network algorithm for performing fisherâ€™s exact test in r Ã— c contingency tables / Mehta C.R., Patel N.R.	1983	Journal of the American Statistical Association	78	382	8	806	IIM-A	36	11.19
144	Culture specific and cross culturally generalizable implicit leadership theories: Are attributes of charismatic/transformational leadership universally endorsed? /Den Hartog D.N. (et al)	1999	Leadership Quarterly	10	2	34	528	IIM-A	20	0.18
45	Differences between tight and loose cultures: A 33-nation study / Gelfand M.J.(et al.)	2011	Science	332	6033	5	503	IIM-A	8	1.40
2	Women as policy makers: Evidence from a randomized policy experiment in India / Chattopadhyay R., Duflo E.	2004	Econometrica	72	5	35	497	IIM-C	15	16.57
2	Unemployment and the real wage: The economic basis for contesting political ideologies /Bhaduri A., Marglin S.	1990	Cambridge Journal of Economics	14	4	19	432	IIM-C	29	7.45
2	Pervasive computing: A paradigm for the 21st century / Saha D., Mukherjee A.	2003	Computer	36	3	8	407	IIM-C	16	12.72
3	Computing an exact confidence interval for the common odds ratio in several 2Ã—2 contingency tables / Mehta	1985	Journal of the American Statistical Association	80	392	5	363	IIM-A	34	3.56

	C.R., Patel N.R., Gray R.									
3	Managing cross-cultural issues in global software outsourcing / Krishna S., Sahay S., Walsham G.	2004	Communications of the ACM	47	4	5	330	IIM-B	15	7.33
1	Network design for reverse logistics / Srivastava S.K.	2008	Omega	36	4	14	300	IIM-L	11	27.27
10	Going to scale with professional skilled care / Koblinsky M. (et al.)	2006	Lancet	368	9544	10	286	IIM-A	13	2.20
4	The role of gender stereotypes in perceptions of entrepreneurs and intentions to become an entrepreneur / Gupta V.K., Turban D.B., Wasti S.A., Sikdar A.	2009	Entrepreneurship: Theory and Practice	33	2	21	262	IIM-I	10	6.55
2	Branch and Bound Experiments in Convex Nonlinear Integer Programming / Gupta Omprakash K., Ravindran A.	1985	Management Science	31	12	14	237	IIM-A	34	3.49
6	Radical change accidentally: The emergence and amplification of small change / Plowman D.A., Baker L.T., Beck T.E., Kulkarni M., Solansky S.T., Travis D.V.	2007	Academy of Management Journal	50	3	29	236	IIM-B	12	3.28
2	The antecedents and consequents of user perceptions in information technology adoption /Agarwal R., Prasad J.	1998	Decision Support Systems	22	1	15	233	IIM-C	21	5.55
10	Conflict management style: Accounting for cross-national differences / Morris M.W., Williams K.Y., Leung K., Larrick R., Mendoza M.T., Bhatnagar D., Li J., Kondo M., Luo J.-L., Hu J.-C.	1998	Journal of International Business Studies	29	4	19	222	IIM-A	21	1.06
3	Trading activity and expected stock returns / Chordia T., Subrahmanyam A., Anshuman V.R.	2001	Journal of Financial Economics	59	1	30	216	IIM-B	18	4.00
69	Culture-level dimensions of social axioms and their correlates across 41 cultures / Bond M.H. (et al.)	2004	Journal of Cross-Cultural Psychology	35	5	23	215	IIM-A	15	0.21
3	Foreign and domestic ownership, business groups, and firm performance: Evidence from a large emerging market / Douma S., George R., Kabir R.	2006	Strategic Management Journal	27	7	21	203	IIM-B	13	5.21

CONCLUSION

The present study on measure of Richness Index factor of scientific publications of Indian Institute of Management institutions scientific output has implications a large proportion of their publications were outreached the users This study will pave way to enhance the quality of the papers they publish.

Further method has been designed to identify the richness of the publications. Here the author introduced an indicator called as Richness Factor Index for individual paper, for organization, for the year, for individual authors which is calculated in a way similar indexes such as h index, h2 index; g index; a index; Normalized h index (hnom); r Index; ar index; e index; hg index, p index, Relative Uncitedness Index (RUI) and Relative Citation Impact (RCI).

Simple indicators as the total number of citations to all papers or the average citation frequency have obvious disadvantages like the difficulty to determine all the citation counts with reasonable accuracy or giving undue weight to highly cited review articles, or taking a possibly large number of irrelevant (not or lowly cited) papers into account. This can be avoided by considering only a small number of relevant or significant papers, but this solution raises the question how to determine this core set of significant papers from a given set of publications.

The present study enables to derive a methodology to measure the richness of the publications among the users using Richness Factor Index for paper, organization, year and author. The comparative study with previous studies such as various indices and other method will prove the worthiness of this measure for rich and reaching of the scientific publication. Similar studies may be undertaken for other R & D organization, subject areas in order to identify the worthiness of measurement technique suggest in this study.

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