A Schema for Optimizing Research Publications Metrics for National Ranking of Engineering Institutions in India

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Abstract-   The institutions of higher education in India are in need of infusion of quality and clarity on the move towards building world-class educational institutions. Research assessment and national ranking of Indian educational institutions can play an important role in improving performance and quality of academic institutions. The National Institutional Ranking Framework (NIRF) has been developed by Ministry of Human Resource and Development (MHRD), Govt. of India to provide an Indian context to educational aspiration and needs of the institutions. The NIRF provides for ranking of institutions under five broad Outcome Based Education (OBE) generic parameters namely: i) Teaching, Learning and Resources (TLR); ii) Research, Professional Practice and Collaborative Performance (RPC); iii) Graduation Outcomes (GO); iv) Outreach and Inclusively (OI); and v) Perception. The National Ranking metrics is a quantitative indication of the degree to which an institution has practiced the OBE generic five parameters. This paper focuses on Research publications which is one of the important components of Research, Professional practice and Collaborative Performance (RPC) parameter. In this paper, two case studies have been developed and tabulated to highlight the importance of quality publications. Further, the scores in the RPC parameter obtained by the top 100 Engineering institutions in India Rankings 2016 have been analyzed. Based on the analysis, we are proposing a schema for optimizing Research Publications Metrics for National Ranking of Engineering Institutions in India.

Keywords – India Rankings 2016, NIRF, OBE, Research Publications Metrics.

I. Introduction

The NIRF is a moderated version of QS and is self-reporting [1]. The NIRF was launched in September 2015 and institutions were asked to submit online applications by December 2015 for the First National Ranking [2]. A total of 1438 Engineering Institutions submitted the online applications for Ranking. The Ranking list called India Ranking 2016 was published in April 2016 showing the top 100 Engineering Institutions in India [3].

NIRF provides the ranking of institutions under five broad generic parameters viz. 1) TLR, 2) RPC, 3) GO, 4) OI and 5) Perception [1]. TLR parameter is related to faculty student ratio, faculty qualification and experience, library and laboratory facilities etc. RPC parameter forms the ultimate test of the effectiveness of research activities which is

assessed by publications, citation, and IPR metrics. GO parameter is about student outcomes, assessed based on Results, Placements, higher education and salary packages of placed students. OI lays special emphasis on representation of Women and Socially Challenged Persons in student and/or faculty populations, and also on outreach activities of the institution. Perception gives a significant importance to the awareness of the institution by its Stakeholders which is accomplished through stakeholder survey.

Research Publications form an important component of Research, Professional practice and Collaborative Performance (RPC) parameter. Research Publications Metrics contribute 30 marks to the RPC parameter. The NIRF will be referring the data bases of Elsevier (Scopus), Thomson Reuters (Web of Science), Google Scholar and Indian Citation Index for the calculation of Research Publications metrics [1].

The authors have analyzed the scores in the RPC parameter obtained by top 100 Engineering institutions in India Rankings 2016. Based on the analysis and other parameters, this paper has proposed a schema for optimizing Research Publications metrics for National Ranking of Engineering Institutions in India.

II. NATIONAL INSTITUTIONAL RANKING

The National Institutional Ranking was based on the information and data provided by the institutions. The scores obtained by the institutions in the five parameters viz TLR, RPC, GO, OI and Perception each carrying 100 marks, were averaged taking into account their respective weightage and assigned Ranking for the top hundred institutions. A sample of ten institutions taken from the list of hundred institutions [3] is shown in Table 1.

Table -1 Experiment Result

S. No	Name of the Institutions	Overall Rank
1	IIT Madras	1
2	VIT Vellore	13
3	PSG College of Technology, Coimbatore	24
4	RV College, Bangalore	35
5	KoneruLakhmaiah Education Foundation, Guntur	59
6	Nirma Institute of technology, Ahmedabad	48
7	CBIT, Hyderabad	71
8	BVRIT, Bhimavaram	73
9	Vignan Foundation, Guntur	88
10	University Institute of Chemical Technology, Chandigarh	100

III. METHOD AND IMPLEMENTATION

The method explained in the National Institutional Ranking Framework has been followed to compute the value of Research Publication Metrics [1]. Two case studies have been devised to illustrate the calculation of Research Publication Metrics. The optimized Research Publication Metrics has been computed using the mean (μ) of the RPC scores.

A. Research Publications Metrics–

The Research Publications (PU) metrics carries 30 marks. The PU metrics is calculated as shown below:

$$PU = 30 \times P/F$$
$$P = 0.6\ PS + 0.3\ WS + 0.1\ GS \qquad (1)$$

PS = No. of papers indexed in Scopus
WS = No. of Papers Indexed in Web of Sciences
GS = No. of Papers Indexed in Google Scholar
F = No. of faculty in the institution

B. Calculation of Research publications (PU) metrics –

The calculation of research publication metrics is explained below with the help of an example:

- Number of faculty in the institution   = F

- Number of Professors = F1

- Number of Assoc. Professors=F2

- Number of Asst. Professors=F3

Let n11,n12 and n13 be the number of publications by each Professor, Assoc.Professor and Asst.Professor respectively indexed in Scopus. Total number of publications indexed in Scopus (PS) can be computed as follows:

$$PS = F1 \times n11 + F2 \times n12 + F3 \times n13 \qquad (2)$$

Let n21, n22 and n23 be the number of publications by each Professor, Assoc.Professor and Asst.Professor respectively indexed in Web of Sciences. Total number of publications indexed in Web of Sciences (WS) can be computed as follows:

$$WS = F1 \times n21 + F2 \times n22 + F3 \times n23 \qquad (3)$$

Let n31,n32 and n33 be the number of publications by each Professor,Assoc.Professor and Asst.Professor respectively indexed in Google Scholar. Total number of publications indexed in Google Scholar (GS) can be computed as follows:

$$GS = F1 \times n31 + F2 \times n32 + F3 \times n33 \qquad (4)$$

Once PS, WS, and GS have been computed, the next step is to calculate the values of P.

$$P = PS \times 0.6 + WS \times 0.3 + GS \times 0.1 \qquad (5)$$

Finally, we can compute the Research Publication Metrics as shown in equation 6.

$$\text{Research Publications Metrics} = P \times 30/F \qquad (6)$$

To explain the calculation of Research Publications Metrics, two case studies have been developed and tabulated based on no. of research publications indexed in Scopus, Web of Science and Google Scholar by each category of faculty viz Professors, Assoc. Professors and Asst. Professors. Further, we have taken an example of an institution which has 279 number of faculty to elaborate the two case studies. Assuming the cadre ratio of 1:2:6, number of Professors, Associate Professors and Assistant Professors are 31, 62 and 182 respectively.

C. Case Study 1- one publication per faculty per year –

Table 2 shows one publication by each category of faculty and demonstrates the method to calculate the research publication metrics. It is observed from Table 2 that if each category of faculty has one publication per year as per details shown above, then the score in Research Publications metrics will be 5.95 marks out of a maximum of 30.

Table - 2 One publication per faculty per year

Categories	No. of Faculty members	No. of paper published per year indexed in		
		Scopus	Web of Sciences	Google Scholar
Professor	**31**	**1**	**-**	**-**

Assoc Professor	62	-	1	-
Asst Professor	186	-	-	1
Total	279	31×1=31	62×1=62	182×1=182
Calculation of Research Publication Metrics	(31×0.6 + 62×0.3 + 182×0.1) x 30/ 279 = 5.95			

D. Case Study 2- Two publications per faculty per year –

Table 3 shows two publications by each category of faculty and demonstrates the method to calculate the Research Publication metrics. It is observed from Table 3 that if each category of faculty has two publications per year as per details shown below, then the score in Research Publications metrics will be 12 marks out of a maximum of 30.

Table - 3 Two publications per faculty per year

Categories	No. of Faculty members	No. of paper published per year indexed in		
		Scopus	Web of Science	Google Scholar
Professor	31	2	-	-
Assoc Professor	62	-	2	-
Asst Professor	186	-	-	2
Total	279	31x2=62	62x2=124	186x2=372
Calculation of Research Publication Metrics	(62x0.6 + 124x0.3 + 186x0.1) x 30/ 279 = 12			

IV. RESULTS AND DISCUSSION

The results are based on the analysis of the RPC scores obtained by the top 100 institutions in India Rankings 2016. The analysis includes selection of data, collation in the form of tables, calculation of mean and then computing the optimized Research Publication Metrics.

A. Analysis of RPC Parameter –

The RPC scores out of 100 marks achieved by each institution has been tabulated in descending order i.e. the institution which topped in the RPC Parameter is placed at Rank 1and so on. The collation of RPC data is shown from Tables 4 to 13.

Table - 4 RPC scores for Rank 1 to 10

Rank	1	2	3	4	5	6	7	8	9	10
RPC Score	94.14	94.02	93.52	92.68	91.20	85.24	83.50	83.07	82.22	81.06

Table - 5 RPC scores for Rank 11 to 20

Rank	11	12	13	14	15	16	17	18	19	20
RPC Score	80.37	80.03	79.62	78.70	78.66	76.83	76.03	75.86	75.78	75.73

Table - 6 RPC scores for Rank 21 to 30

Rank	21	22	23	24	25	26	27	28	29	30

RPC Score	75.69	74.72	74.56	73.91	73.64	73.56	73.08	72.99	72.19	72.09

Table - 7 RPC scores for Rank 31 to 40

Rank	31	32	33	34	35	36	37	38	39	40
RPC Score	72.07	71.82	71.63	71.57	70.35	68.79	68.29	67.97	67.86	67.76

Table - 8 RPC scores for Rank 41 to 50

Rank	41	42	43	44	45	46	47	48	49	50
RPC Score	67.06	66.41	66.40	66.33	65.55	65.31	64.82	64.68	64.67	64.47

Table - 9 RPC scores for Rank 51 to 60

Rank	51	52	53	54	55	56	57	58	59	60
RPC Score	63.73	62.91	62.54	62.13	61.90	61.80	61.37	59.86	59.18	58.47

Table - 10 RPC scores for Rank 61 to 70

Rank	61	62	63	64	65	66	67	68	69	70
RPC Score	58.23	58.12	58.11	58.03	57.85	57.67	56.85	56.73	56.55	56.15

Table - 11 RPC scores for Rank 71 to 80

Rank	71	72	73	74	75	76	77	78	79	80
RPC Score	55.58	55.27	54.52	53.42	53.41	53.01	52.66	52.37	51.98	51.91

Table - 12 RPC scores for Rank 81 to 90

Rank	81	82	83	84	85	86	87	88	89	90
RPC Score	50.65	50.29	50.09	50.00	49.66	49.06	48.27	48.05	47.74	47.61

Table - 13 RPC scores for Rank 91 to 100

Rank	91	92	93	94	95	96	97	98	99	100
RPC Score	47.19	46.65	45.97	41.67	41.32	41.22	39.29	38.61	38.54	34.04

We have analyzed the RPC scores of top hundred institutions as collated from Table 4 to Table 13 and have computed the mean of the hundred values as shown in equation 7.

$$\mu = \frac{1}{N} \sum_{i=1}^{N} x_i$$

(7)

Where, xi is the RPC scores of the ith institution and N = 100

Mean of RPC scores = sum of 100 RPC Scores / 100

= 6376.32 / 100

= 63.76

The standard deviation (σ) from the set of 100 RPC scores can be calculated using equation 8,

$$\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \mu)^2}$$

(8)

Where, μ is the mean and x_i is the RPC score for the ith rank institution

σ =13.61

Figure 1 shows the graph constituting the RPC scores, mean and the standard deviation. It is observed that the mean is 63.76 and one standard deviation plus is 77.37 and one standard deviation minus is 50.14. The obtained value of the mean will be used to calculate the optimized Research Publication metrics and one standard deviation minus will be used to calculate Research Publication metrics (minimum).
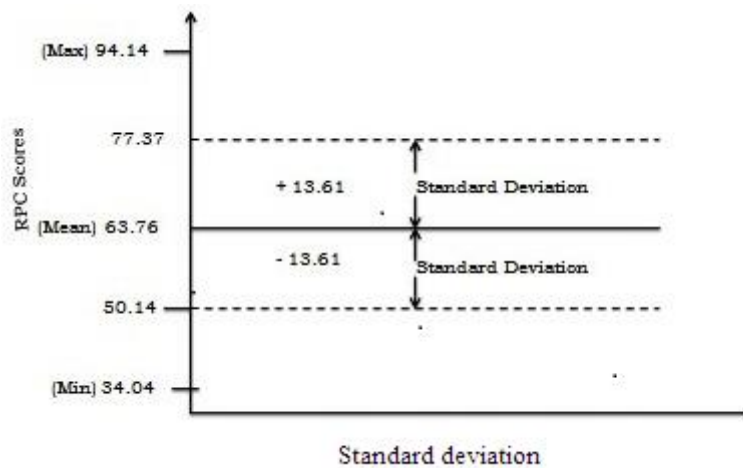

Figure 1.   Standard Deviation of RPC Parameter

B. *Optimized Research Publications Metrics –*

The weightage of Research Publication Metrics towards RPC Parameter is 0.3 [1]. Based on the weightage of 0.3, the optimized Research Publications metrics can be computed as below:

Optimized Research Publication Metrics = Mean value of RPC × 0.3

$$= 63.76 \times 3$$

$$= 19.128$$

$$= 19.0$$

Thus the optimized research publication metrics value is 19.00.

We have also computed the minimum value of Research Publications Metrics.

Minimum Research Publications Metrics = (Mean of RPC value-one standard deviation) × 0.3

$$= (67.76\text{-}13.61) \times 0.3$$

$$= 50.15 \times 0.3$$

$$= 15.45 \sim 15.0$$

V. TARGET FOR RESEARCH PUBLICATIONS

Every faculty member in the institution is required to contribute towards quality Research Publications. The order of priority for Research Publications should be 1) Indexed in Scopus, 2) Indexed in Web of Science and 3) Indexed in Google Scholar. The institutions need to fix the number of publications in priority 1, priority 2 and priority 3 for each category of faculty in the beginning of the academic year. The marks likely to be scored in Research Publications metrics can be estimated based on the number of faculty in each category and the number of publications by each one of them in priority 1, priority 2 and priority 3.

The ideal score of Research Publications Metrics is 30.0 [1]. It is difficult to achieve the maximum score since it requires a large numbers of publications indexed in Scopus and Web of Sciences.

We are proposing that the optimized Research Publication Metrics can be adopted by the institutions for fixing the target for publications. There are many solutions to achieve the optimized score of 19.0. The solution depends on the number of faculty in the institution and the number of publications by each of them. One solution has been worked out for an institution which has 279 nos. of faculty. Assuming the cadre ratio of 1:2:6, 279 nos. of faculty constitute 31 Professors, 62 Assoc. Professors and 186 Asst. Professors. The solution is illustrated in Table 14.

Table - 14 Target for Research Publications (Optimized)

Categories	No. of Faculty members	No. of paper published per year indexed in		
		Scopus	Web of Sciences	Google Scholar
Professor	31	2	1	1
Assoc Professor	62	0	2	2
Asst Professor	186	0	0	4
Total	279	31×2=62	31×1 + 62×2 = 279	31×1 + 62×2 + 186×4 = 713
Calculation of Research Publications Metrics	(62×0.6 + 279×0.3 + 713×0.1) × 30 /279 = 18.67 ~ 19.0			

It is observed from Table 14 that the target for publications by each faculty member to achieve the optimized Research Publications Metrics is given below.

a) Every faculty is required to publish four papers per year.
b) Professors need to publish two papers indexed in Scopus and one paper each indexed in Web of Sciences and Google Scholar.
c) Assoc. Professors need to publish two papers each indexed in Web of Sciences and Google Scholar/
d) Asst. Professors need to publish all the four papers indexed in Google Scholar
e) Faculty can publish a paper in a priority higher than the specified. The order of priority from the lowest to the highest is Google Scholar, Web of Science and Scopus.

In case, it is difficult to achieve the optimized value of Research Publications Metrics, it is proposed that the minimum value of Research Publication Metrics can be adopted. One solution to achieve the minimum value of 15.0 is illustrated in Table 15. The target for publications for each category of faculty can be extracted from the Table 15 as explained in Table 14.

Table - 15 Target for Research Publications (Minimum)

Categories	No. of Faculty	No. of paper published per year indexed in :

	members	Scopus	Web of Science	Google Scholar
Professor	31	2	-	1
Assoc Professor	62	-	2	1
Asst Professor	186	-	-	3
Total	279	31×2=62	62×2 = 124	31×1 + 62×1 + 186×3 = 651
Calculation of Research Publications Metrics	(62×0.6 + 124×0.3 + 651×0.1) × 30 /279 = 15.0			

VI.CONCLUSION

Academic freedom and institutional autonomy are important challenge to build world class universities. The importance of quality Research Publication component is highlighted in this paper. The publications indexed in Scopus are to be given top priority, next priority be assigned to papers indexed in Web of Sciences and the last priority be allotted to papers indexed in Google Scholar. Every faculty member in the institution is required to contribute towards quality research publications. The institutions need to motivate the faculty to publish quality papers every year and fix the target for each category of faculty. The ideal score of Research Publications Metrics is 30.0. However, it is difficult to achieve the maximum score since it requires a large numbers of publications indexed in Scopus and Web of Sciences. It is proposed that the institutions may adopt the optimized value of 19.0 for Research Publications Metrics for fixing the target for publications for each category of faculty as per Table 14. In case, it is found difficult to achieve the optimized value, they may adopt the minimum value of 15.0 and fix the target for publications as per Table 15. The optimized value of Research Publications Metrics has been computed based on 'India Ranking 2016'. The Value will be reviewed and revised once 'India Ranking 2017 ' is published, which is expected in Apr. 2017 as per MHRD Govt. of India notification.

REFERENCE

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