A Comprehensive Bibliometric Analysis Of The International Journal Of Production Economics

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Abstract- *The present study provide a comprehensive bibliometric analysis of the International Journal of Production Economics (IJPE) covering a ten-year period from 2010 to 2019. As journals serve as primary communication channels for disseminating scientific knowledge, the study evaluates the productivity trends, authorship patterns, geographical distribution of contributions, channels of communication, and applicability of Lotka's Law to author productivity within IJPE. Bibliometric a key evaluative tool within Library and Information Science, enables quantitative assessment of publication patterns, growth of literature, and collaborative trends in scholarly communication. Using data extracted from all issues of IJPE published during the decade, this study systematically tabulates, categorizes, and analyses 3218 research articles through MS-Excel to meet the defined objectives. The year-wise analysis reveals fluctuating yet progressively collaborative research activity, with 2013 showing the highest productivity. The study records an overall collaboration rate of 0.90, signifying a strong culture of co-authorship in the field of production economics. The contribution received in this journal are more from China than from other countries.*

Keywords- Lotka's Law; Economic; Bibliometric Analysis; Research Productivity; Scientometric Study; Production Economic.

I. INTRODUCTION

Journals are the primary source of information and an important media for communication. They play a major role for communicating the latest research findings and publishing the articles containing the current development in any field of knowledge. Information is one of the most important resources for a nation and forms the integral base for the economic. Information has been growing out in an exponential rate which is often referred to as information explosion. Similarly the journals publication has also been increasing day by day, since the first scientific the journal started publication in 1665. The journals are the indicators of literature growth in any field of knowledge. "The record of proceedings or transactions of a learned society of the daily record of a public body such as legislature."(Parmer, P.P & Bhuta, B., 1989).

Economics

Economics is the social science that studies economic activity to gain an understanding of the processes that govern the production, distribution and consumption of goods and services in an economy. The term *economics* comes from the Ancient Greek, hence "rules of the house (hold for good management)". 'Political economy' was the earlier name for the subject, but economists in the late 19th century suggested "Economics" as a shorter term for "economic science" to establish itself as a separate discipline outside of political science and other social sciences.

According to John Mayndra Keynes, "the theory of economics does not furnish a body of settled conclusion immediately applicable to policy. It is a method rather than a doctrine, an apparatus of the mind, a technique of thinking, which helps its possessor to draw correct conclusions." (Paul Samuelson, 1980).

Bibliometric

Bibliometric is the most active field of "Library and Information Science". Bibliometric is first known to have been applied by 'E.J. Cole' and 'N. B. Eales' in 1917. They analyzed comparative anatomy paper by counting the number of publication by country. A subsequent study was conducted by "Hulme" in 1923. Both of these studies designate it as the statistical bibliography and defined it as the application of quantitative techniques to library, and bibliographical work. "Alan Pritchard" in 1969 has coined the term bibliometric. For this term Dr. S. R. Ranganathan used another term Librametry in 1948 (Kabir, 1997).

According to Mr. Hawking "Quantitative analysis of the Bibliographic features of a body of Literature"; Allen Pritchard, (1969) "Bibliometric as the application of mathematical & statistical methods to books & other media of communication"; White & McCain, (1989) "bibliometric is the quantitative study of literatures as they are reflected in bibliographies".

Review of Literature

1. Bibliometric studies that evaluate research progresses of publication based on publication records (Pritchard 1969). It used to analysis of research publication and growth rate of research progress in a variety of fields (Nederhof et al. 2005). It is planned for getting informed about a specific field to evolution and productivity of journal publication and it also help identify, analyze, and organize by elements for evolution of trends in the subject (Francisco, and et.al. 2022). Bibliographic analysis was used to show collaboration with countries, institutions and authors and assist to examination of fundamental research paradigms of subject field (Tu, Brennan, Lewis and Seyedamir, 2022). It is used to evaluate influential articles in a subject field and objectively analyze their study impact on publication output (Miao, and eat al., 2022).

2. Authorship pattern are important facets in bibliometric study. The study was conducted to examine the patterns of authorship in CSIR-IMTECH scientists/researchers in the 1991 to 2010. It found that the 902 articles were published in 20 year, pattern of authorship and the collaborative degree and strength of authors. And majority of the scientists preferred to publish research papers in joint authorship i.e.753 (83.48%) and only 149 (16.51%) were single-author. the overall publication mean of single-author and joint authored articles were 7.45 and 37.65, respectively (Sengar. 2014). the study reveal that the distribution of productivity of authors in the field of HCL research in the year 2006 to 2011. Author productivity data is disaggregated standardized means of measuring author publication productivity (Kumar, 2014).

3. Geographical area is a particular part of a town or city, a country, a region, or the world, but these areas publication contribution is knowledge assets of particular scientist or researchers. The study was conducted to analysis the publication of DESIDOC Bulletin of Information Technology and the journal to assess the trends research output, pattern of authorship and geographic distribution of output, Most of the contributions (88 %) are from India and 12 % are foreign contributions (Bansal, 2013). The paper analyses of Indian research in Materials Science during the year 2001to 2010 on several parameters including publication growth and rank, country-wise contribution and international collaborative linkages and leading collaborating countries, most productive Indian institutions and authors (Gupta, Bala, and Kshitig, 2013). The Canadian Journal of Information and library science (CJILS) research study analysis 337 articles, book reviews; editorial and conference papers were published during 1993 to 2021. Authorship patterns, geographical locations of authors, keywords and contributions of various institutions from different continents were brought into consideration for this study (Hussain, 2022).

4. The Bradford's law examined the Indian LIS literature based on Bibliometric indicators based in Library and Information Science Abstracts (LISA) in the period of 1967-2004. The used law to identify core journals preferred to publish their research work in journals it found that the core journals originated from India (Patra and Chand, 2006). Similarly, Egghe's (1990). Venable, G.T., Shepherd, B. A., Roberts, M. L., Taylor, D. R., Khan, N. R., & Klimo, P. (2014), Hiremath M. R., Gourikeremath, M. G. N., Hadagali, G. S., & Kumbar, B. D. (2016). Also examined the Bradford's law in various subject fields and found that the data do not fit with sample data Ram and Plaiwa, (2014), and theoretical and practical aspects of Bradford's law in subject filed. It revealed that the law does not fit the theoretical distribution (Tunga, 2013).

5. Form-wise distribution is a fundamental aspect of scientometric analysis, revealing the types of documents contributing to knowledge dissemination in any field (Gupta & Sharma, 2019). Studies commonly categorize research outputs into articles, reviews, conference papers, book chapters, and reports to assess their relative contribution to scientific progress (Kumar & Singh, 2020). Research has shown that original research articles typically dominate publication records, reflecting the primary mode of knowledge creation, while review articles serve to consolidate and synthesize existing knowledge, often attracting higher citations (Patel & Desai, 2021). The proportion of conference papers varies significantly across disciplines, with fields like computer science and engineering showing a higher tendency to disseminate findings at conferences compared to social sciences, where journal articles prevail (Ahmed & Rehman, 2022). Bibliometric analyses frequently use form-wise distribution data to identify publication trends, for example, increases in open-access articles or shifts from print to digital formats (Lee, 2021).

Scope & Limitations

The International Journal of Production Economics was established in 1971. It is a peer-reviewed academic journal in the field of economic. The journal articles are published on both theoretical and empirical aspects of international economics. The IJPE circulates 12 issues per year and currently published by Elsevier. Scope and limitation of the present study is limited the content of these journal is collected from years 2010 to 2019. The data was then subjected to analysis as per the objectives of the study. All the analyzed data is arranged and tabulated systematically for

making observations. At the end data accessed has analyzed by helping of MS-Excel was used for data entry and analyzed data has represented in the form of tables and figuers.

Objectives of the Study

- To find out geographical distribution in the journal
- To identify authorship pattern of articles published in the journal
- To test the appropriateness of Lotka's law of scattering
- To find out the types of document in the journal

Methodology

Bibliometric studies include quantitative and qualitative techniques. For this purpose, several science indicators have been developed and used. The most commonly used indicator is the number of publications. To measure quality of journal present research focuses on author productivity and productivity patterns of authors writing in journal.

Data Analysis

In the IJPE analysis of total no. of 3218 articles published during 2010 to 2019 was done. The collected data is arranged and tabulated systematically for making observations. At the end data accessed has analyzed by helping of MS-Excel was used for data entry and analyzed data has represented in the form of tables and figures.

Year-Wise Publication Productivity and Collaboration Rate

The year-wise distribution of publications in the International Journal of Production Economics has presented in table no.1 and figure no. 1
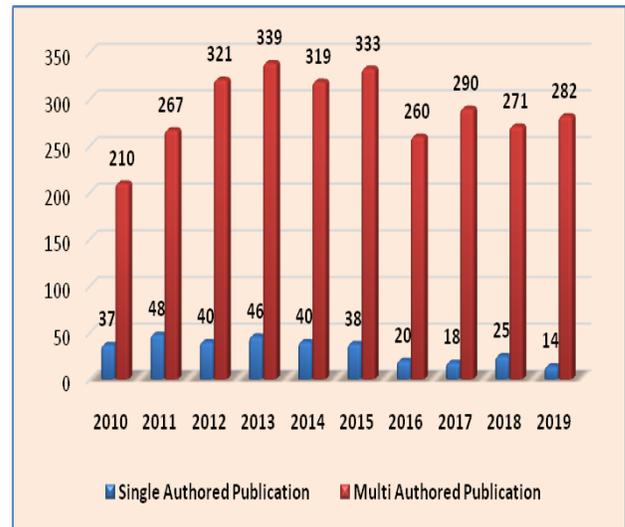
TableNo. 1:Year-WisePublicationProductivityandCollaborationRate

Year	Single Authored Publication	Multi Authored Publication	Total No. of Publication	Collaboration Rate
2010	37	210	247	0.85
2011	48	267	315	0.85
2012	40	321	361	0.89
2013	46	339	385	0.88
2014	40	319	359	0.89
2015	38	333	371	0.90
2016	20	260	280	0.93
2017	18	290	308	0.94
2018	25	271	296	0.92
2019	14	282	296	0.95
Total	**326**	**2892**	**3218**	**0.90**

Figure no.1: Year-Wise Publication Productivity and Collaboration Rate

It can be seen from table no.1 and figure no. 1 that during 2010 to 2019 a total no. 3218 articles were published in the IJPE by researchers in various countries. It is observed that the highest number of the contributions were contributed in year 2013 with 385 contributions, Minimum contributions were contributed in years 2010 with 247 contributions. In Total, over the entire period, there were 326 single authored publications, 2892 multi authored publications, and a total of 3218 publications. The overall collaboration rate for this period was 0.90, indicating that, on average, 90% of publications were the result of collaboration between multiple author.

Geographical Distribution of Research Output

Geographical distribution of research output means the article published from different countries.

Table No. 2: Country-Wise Distribution of Articles

Sr. No.	Country	Frequency	Percentage	Rank
1	China	1803	19.62	1
2	United States	1667	18.14	2
3	United Kingdom	763	8.30	3
4	Canada	452	4.92	4
5	Taiwan	420	4.57	5
6	Italy	417	4.54	6
7	France	350	3.81	7
8	Germany	339	3.69	8
9	Netherlands	266	2.89	9
10	Brazil	245	2.67	10
11	Spain	216	2.35	11

12	India	189	2.06	12
13	Australia	166	1.81	13
14	Iran	150	1.63	14
15	Turkey	137	1.49	15
16	Sweden	122	1.33	16
17	Korea	101	1.10	17
18	Japan	88	0.96	18
19	Singapore	88	0.96	18
20	Finland	86	0.94	19
21	Switzerland	84	0.91	20
22	Israel	79	0.86	21
23	Belgium	77	0.84	22
24	Denmark	76	0.83	23
25	México.	64	0.70	24
26	Portugal	62	0.67	25
27	Austria	61	0.66	26
28	Greece	59	0.64	27
29	Hungary	51	0.56	28
30	Chile	49	0.53	29
31	Malaysia	42	0.46	30
32	South Korea	39	0.42	31
33	Slovenia	38	0.41	32
34	United Arab Emirates	26	0.28	33
35	New Zealand	25	0.27	34
36	Thailand	24	0.26	35
37	Colombia	21	0.23	36
38	Indonesia	19	0.21	37
39	Poland	19	0.21	37
40	Tunisia	19	0.21	37
41	Philippines	18	0.20	38
42	Ireland	16	0.17	39
43	Norway	16	0.17	39
44	Saudi Arabia	15	0.16	40
45	Lebanon	11	0.12	41
46	Qatar	10	0.11	42
47	Argentina	8	0.09	43
48	Pakistan	8	0.09	43
49	Romania	7	0.08	44
50	Russia	7	0.08	44
51	Croatia	6	0.07	45
52	Nigeria	5	0.05	46
53	Brunei	4	0.04	47
54	Egypt	4	0.04	47
55	Uruguay	4	0.04	47
56	Vietnam	4	0.04	47
57	Bangladesh	3	0.03	48
58	Belarus	3	0.03	48
59	Honduras	3	0.03	48
60	Morocco	3	0.03	48

| 61	Serbia	3	0.03	48
62	Azerbaijan	2	0.02	49
63	Bahrain	2	0.02	49
64	Costa Rica	2	0.02	49
65	Ghana	2	0.02	49
66	Kenya	2	0.02	49
67	Oman	2	0.02	49
68	Peru	2	0.02	49
69	South Africa	2	0.02	49
70	Venezuela	2	0.02	49
71	Algeria	1	0.01	50
72	Bulgaria	1	0.01	50
73	Cuba	1	0.01	50
74	Czech Republic	1	0.01	50
75	Ecuador	1	0.01	50
76	Georgia	1	0.01	50
77	Iceland	1	0.01	50
78	Jamaica	1	0.01	50
79	Jordan	1	0.01	50
80	Kazakhstan	1	0.01	50
81	Kuwait	1	0.01	50
82	Lithuania	1	0.01	50
83	Montenegro	1	0.01	50
84	Puerto Rico	1	0.01	50
	Total	**9189**	**100**	
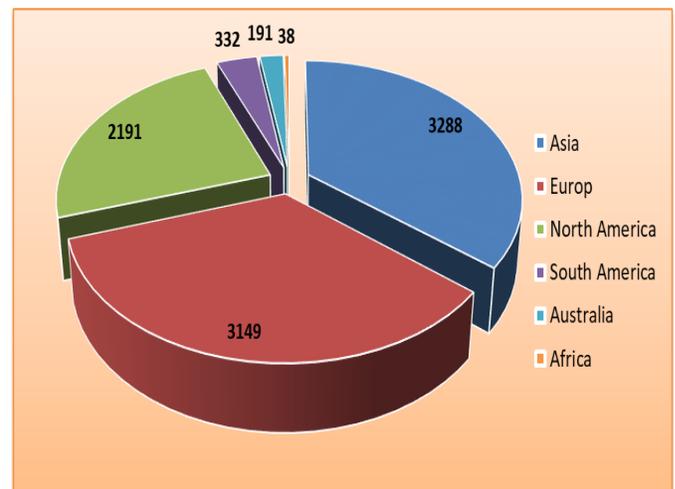
Figure2:Continent-WiseDistributionofArticles

This table showing the country-wise distribution of articles along with their frequency, percentage and rank. This table represents the number of articles from different countries. It can be observed from Table No. 2 and Figure No. 2 show that, there were as many as 84 countries carrying out research and produced 3218 articles. Table no. 2 provides ranked List of countries contributing to this field, the number of publications of each country and their share in percentages

is the top producing China 1,803 articles (19.62% - Rank 1st), publications of the total output.

Authorship and Collaboration Trend

Collaborative writing engages two or more persons in the process of producing a written work as a group, where everyone involved is contributing content or decisions on the work being produced. Collaboration in research is said to have taken place when 2 or more person work together on a scientific problem of project and effort, both intellectual.

Table No. 3: Authorship and Collaboration Trend

| Year	Number of paper with various Authorship						Total No. of Publications
	One	Two	Three	Four	Five	More than Five	
2010	37	98	80	25	7	0	247
2011	47	113	109	38	6	2	315
2012	40	128	132	43	15	3	361
2013	46	112	129	71	23	4	385
2014	40	96	142	56	17	8	359
2015	38	97	124	82	21	9	371
2016	19	82	88	68	18	5	280
2017	18	60	128	81	17	4	308
2018	24	63	101	77	24	7	296
2019	14	70	123	64	19	6	296
Total	**323**	**919**	**1156**	**605**	**167**	**48**	**3218**
%	**10.04**	**28.56**	**35.92**	**18.71**	**5.28**	**1.49**	**100**
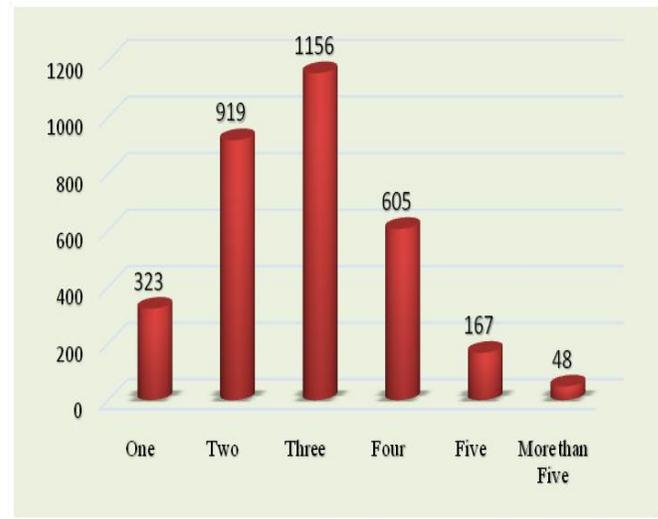
Figure No. 3: Authorship and Collaboration Trend

Analysis in the table No. 3. & Figure No. 3 shows that Single Authors contributions form 323 (10.04%), Two Authors contributions form 919 (28.56%), three authors contributions form 1156 (35.92%), four authors contributions form 605 (18.71%), five authors contributions form 167 (5.28%) and more than five authors Contribution from 48 (1.49%). Regarding authorship pattern, it may be inferred that two authors and three authors form the majority among the authorship clusters

Distribution of Literature in Various Channels of Communication

Researchers communicated their publication through variety of communication channels.

Table No. 4:Channels of Communication

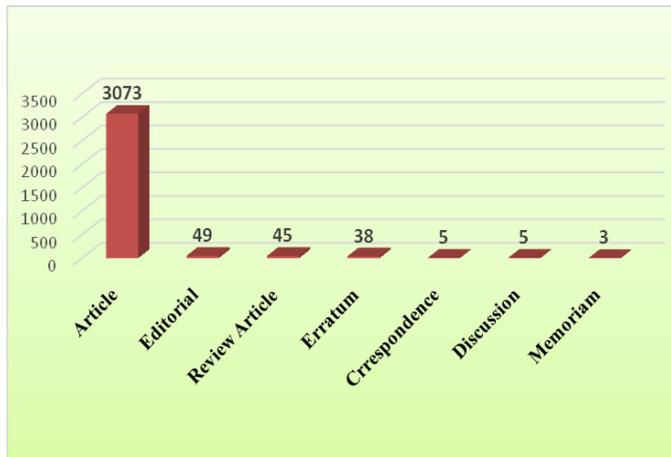| Sr. No.	Channels of Communication	No. of Publication	Percentage
1	Article	3073	95.49
2	Editorial	49	1.52
3	Review Article	45	1.40
4	Erratum	38	1.18
5	Correspondence	5	0.16
6	Discussion	5	0.16
7	Memoriam	3	0.09
	Total	**3218**	**100**

Figure No. 4: Channels of Communication

From the Table No. 4 and Figure No. 4 shows that, 3073 (95.49%) of the Articles was published, followed by Editorial with 49 (1.52%) contributions, Review Articles 45 (1.40%), Erratum with 38 (1.18), Correspondence and Discussion each 5 (0.16%) contributions and Memoriam with 3 (0.09) contributions. All above the channels of communications and total content of Research analyzed.

Lotka's Law (Number of Authors) Contribution of Article

In 1926, Alfred J. Lotka who was then working for an insurance company, published the paper entitled The Frequency Distribution of Scientific Productivity, Journal of the Washington Academy of Sciences. His law provided basic Theoretical Base for Bibliometric studies involving authorships.

In the case look at it is found that the number of persons making two contributions is about one fourth of those making one contributions, the numbers making in contributions is about $1/n^2$ of those making one. In other words for every 100 authors contributing one articles, 25 authors will contribute two articles, about 11 authors will contribute 3 articles and 6 authors will contribute 4 articles and so on. Those laws is based on the study of chemistry and physics literature later it has generated much interest and attracted the attention of researchers and it has been applied and tested in many other fields (Sangam, 2008).

The number of articles wise expected authors calculated on the basis of Lotka's Equation is shown in table.

Table No. 5: Number of Articles wise Expected Authors Calculated on the basis of Lotka's Equation

No. of papers, X	No. of Authors (Observed)	Observed %	No. of Authors (Expected)	Expected %
1	322	10.01	322	51.36
2	917	28.50	113	18.02
3	1157	35.95	61	9.73
4	607	18.86	40	6.38
5	167	5.19	28	4.47
6	38	1.18	22	3.51
7	8	0.25	17	2.71
8	1	0.03	14	2.23
10	1	0.03	10	1.59

Determination of Exponent Value (n)

Since the contribution of articles data does not fit Lotka's inverse square law applied to it; hence different procedure was adopted.

Lotka's Inverse square law is expressed as:

$$X^n Y = C$$

Putting the value of $X=1$ and $Y=322$' the calculation obtained was

$$1^n 322 = C$$
$$C = 322$$

Putting the value of $x=2$, and $y=917$, and $C=322$,
The calculation obtained was;
$$2^n \times 917 = 322$$
$$2^n = 917/322$$
$$2^n = 2.84$$
$$n \log 2 = \log 2.84$$
$$n(0.3010) = 0.4533$$
$$n = 0.4533/0.3010$$
$$n = 1.51$$

Using the value of n = 1.51, the number of authors contributed two, three or more articles each were computed and the number of expected authors compared with number observed authors. It discloses from table no. 5 that total of observed number of author is 3216 and that of expected number of author is 627.

The first condition of Lotka's inverse square law is the proportion of all contributors who make a single contribution should be about 51.36%. However in our study it

10.01 %. Therefore here is scope to say that this condition is not satisfied in our data set.

Application of statistical tests:

Nonetheless, the second condition is 'the number of authors making 'n' contribution is about $1/n^2$ of those making one contribution'. For endeavoring to satisfy this condition and test the formulated hypothesis of the study i.e. 'Lotka's Inverse Square Law of Scientific Productivity is fit for the selected dataset of the Applied Economics', as identified earlier the K-S statistical test is to be applied.

Productivity of Authors based on Lotka's Law

In order to verify whether the observed distribution of author productivity fits the estimated distribution, Pao (1985) suggests applying the non-parametric Kolmolgorov-Smirnov (K-S) goodness-of-fit test. To validate Lotka's law, a calculation was done using the equations (1–2) to identify the values of n and C to test whether the concept of Lotka's law fits into the data of the present study or not. To this end the maximum difference between the real and estimated accumulated frequencies is calculated, this value then being compared with the critical value (c.v.) obtained as: Thus, based on the data presented in Table no. 6, the calculated values of n and C are 1.51 respectively.

TableNo.4.5.10:DistributionofAuthorProductivityBasedon Lotka'sLaw

No. of articles	Frequency of authors		Cumulative Frequency		D=[Fo(x)-Sn(x)]
	Observed	Expected	Sn(x)	Fo(x)	
1	0.10006	0.51356	0.10006	0.51356	**0.41350**
2	0.28496	0.18022	0.38502	0.69378	0.30876
3	0.35954	0.09729	0.74456	0.79107	0.04651
4	0.18863	0.06379	0.93319	0.85486	-0.07833
5	0.05190	0.04466	0.98509	0.89952	-0.08557
6	0.01180	0.03509	0.99689	0.93461	-0.06228
7	0.00249	0.02711	0.99938	0.96172	-0.0376 6
8	0.00031	0.02233	0.99969	0.98405	-0.01564
10	0.00031	0.01595	1.00000	1.00000	0.00000

The maximum deviation between the cumulative frequencies of the observed and expected value is determined by the following formula

$$D = Max [Fo (X) - Sn(X)]$$

Where Fo(X) is the cumulative frequency of expected value Sn(X) is the cumulative frequency of observed value

If we check the statistical table it will be observed that at 0.01 level of significance,

$$\text{K-S Statistics} = \frac{1.63}{\sqrt{n}}$$

Here n is number of authors observed during the study which is 3216 (Refer Table 5)

$$\text{K-S Statistics} = \frac{1.63}{\sqrt{3216}}$$

$$\text{K-S Statistics} = \frac{1.63}{\sqrt{56.71}} = 2.87427$$

Further, from the analysis it seems that the proportion of all contributors who make a single contribution is about 10.01 percent (please refer table no. 5). It means in the study both the conditions of Lotka's law are not being satisfied.

So, the Dmax value 0.41350 (Table 4.5.10) is less than the critical value 2. 87427, which resulted in conclusive application of Lotka's law to the data of literature produced by International Journal of Production Economics Dmax=**0.41350<2.87427** Hence data does not fits into generalized form of Lotka's law with exponent value of n = 1.51.

II. CONCLUSION

1. It is observed that the highest number of the contributions were contributed in year 2013 with 385 contributions, Minimum contributions were contributed in years 2010 with 247 contributions. In total, over the entire period,

there were 326 single authored publications, 2892 multi authored publications, and a total of 3218 publications. The overall collaboration rate for this period was 0.90, indicating that, on average, 90% of publications were the result of collaboration between multiple author.

2. It can be observed from Table No. 2 and Figure No. 2 show that, there were as many as 84 countries carrying out research and produced 3218 articles. Table no. 2 provides ranked List of countries contributing to this field, the number of publications of each country and their share in percentages is the top producing China 1,803 articles (19.62% - Rank 1st), publications of the total output.

3. Analysis in the table No. 3. & Figure No. 3 shows that Single Authors contributions form 323 (10.04%), Two Authors contributions form 919 (28.56%), three authors contributions form 1156 (35.92%), four authors contributions form 605 (18.71%), five authors contributions form 167 (5.28%) and more than five authors Contribution from 48 (1.49%).

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5. The first condition of Lotka's inverse square law is the proportion of all contributors who make a single contribution should be about 51.36%. However in our study it 10.01 %. Therefore here is scope to say that this condition is not satisfied in our data set.

6. So, the Dmax value 0.41350 (Table 4.5.10) is less than the critical value 2. 87427, which resulted in conclusive application of Lotka's law to the data of literature produced by International Journal of Production Economics Dmax=**0.41350<2.87427** Hence data does not fits into generalized form of Lotka's law with exponent value of n = 1.51.

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