Patterns Of Published Scientific Literature On Nuclear Engineering Based On Web Of Science: A Study

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Abstract

The study presents a patterns of 216423 papers published on the topic of 'Nuclear Engineering' during the period of 2009-2018. Web of Science database used to collect data and further refine with limit and exclude provisions. Maximum 32507 papers recognized in the year of 2018 that is 15.020% of the total papers published during the considered year of study i.e. 2009-2018. 'Industrial and Engineering Chemistry' got the top position in the list with 3982 papers publication that is 1.840% of the total publication. Wang Y is the top in the list of authors who contribute 1003 papers that is 0.463% of the total papers. United States of America (USA) contributed maximum among all other counties i.e. 27.122% of the total papers. 'Chinese Academy of Sciences' got the top position in the list with 6820 papers publication that is 3.151% of the total publications. The maximum 52 papers were contributed by Prausnitz, J.M., 'National Natural Science Foundation of China' got the top position in the list with 25376 papers publication that is 11.725%. 'Engineering' recognized as one of the top research area with maximum 77116 publications i.e. 35.632% of the total papers. Maximum 212236 papers published in the English language that is 98.065% of the total published papers during 2009-2018.

Keywords: Nuclear Engineering, Patterns, Literature, USA, Publications.

1. INTRODUCTION

Study of estimating the "quality" of science is called as Scientometrics. It is regularly done utilizing bibliometrics which is an estimation of the effect of technical publications. It incorporates all quantitative parts of the study of science, correspondences and policies of science.Nuclear Engineering is the primary field of engineering concerned with the development of Nuclear reactions and atomic energy efficiency. Nuclear engineering which deals with the fundamental principles of basic science such as physics and mathematics that delimit nuclear reactions and the neutrons-gamma rays transmission [6]. The present research paper aims to explore the characteristics of research publications reflected in various communication channels. Required data has been taken from WoS Collection 10 years (2009-2018) by using the key word "Nuclear Engineering". Very few studies have been conducted on engineering and allied subjects but there is no study has been conducted on Nuclear Engineering. Hence, the present study has been conducted to explore the variables of the research literature. and deduce statistics concerning the yearly growth in the number of publications.

2. **Literature Review**

A literature review is an acute and meticulous evaluation of earlier research. There are many studies were made at global level allied to the present study Naqvi. (2017) quantitative investigation, as a tool for effective evaluation of research performance at various levels, has been adopted for the analysis of the research output in Genetic Engineering with special focus on the research trends in this field. The examination covers a time of ten years starting from 2006 and ending in 2015 with records drawn from the Scopus information base.The study put on the various parameters for capturing the trend- growth pattern of the literature. A total 30417 number of records have been retrieved from the database. The growth trend of the literature was not constant throughout the study period. It has highest output in 2006 and lowest in 2010. Kondu, A. found to have performed high productive author. Journal of Biological Chemistry with 1140 (3.75%) publications The study also identifies the 'Journal of Biological Chemistry' is a highly productive journal with 1140 (3.75%) publications from USA, Massachusetts Institute of Technology (USA) ranked first place with 325 publications. Among Analysis of sub subject category 'Genetic Engineering' is a multi-disciplinary subject. during the period under study [7].Pattanashetti (2017) The study presents an analysis of the research output from India, Japan, and South during 2000-2014 using SCI Web of Science. For the purpose of the study different parameters are to be used i.e., growth, collaboration indices, and activity index. Findings reveal that the "Number of paper to citationsratio for Korea, India and Japan are 30,578: 2,66,902 , 20,836: 1,97,679 and 24,494: 2,04,393 respectively. Publication trend is increasing trend in India and South Korea and there is a decline trend in Japanese publications. Coordinated effort between writers in Japan and South Korea is marginally better than India with respect to collaboration of authors, as maximum number of articles in South Korea and Japan contributed are composed by three writers. When compared to South Korea and Japan, there is more number of publications in India. The International Journal of Heat and Mass Transfer and Journal of Materials Processing Technology head the list from all nations [8].Kumar and Pandit (2018) described the productivity of Science and engineering literature during the selected period 1985–2016 based on Web of Science. The study shows a detailed comparison of research organizations or to rank them. For the purpose of the study they used scientometric measures i.e., numbers of publications, citations, and the h-index, subject wise comparison, country-wise comparison, organization wise distribution in India, identification of most preferred areas and decadal comparison of publications in Science and Engineering [4]. Hosamani &Bagalkoti (2014) conducted a scientometric analysis of Indian research on Engineering indexed by web of science from 1999 to 2013. The study revealed that India has produced 48,570 publications with 4,44,223 citations, India's average growth rate is 0.218 and the doubling time is 3.600 correspondingly. Indian Institute of Technology (IIT), Delhi ranked the first place among top 20 Indian Research Institutions. most prolific author is Kumar, A. with 747 Publications. There is an increasing trend regarding international collaboration. Finally the study also found that Highly Cited Papers, Activity Index, subject wise distribution, journal wise distribution of publication [3].

3. **Objectives**

1. To know the distribution year wise
2. To analyseDoubling Time and Relative Growth Rate
3. To prepare the distribution of ranking journals
4. To identify top twenty productive authors
5. To study country wise distribution
6. Profile of top 20 most productive organizations
7. To assess top twenty editors
8. To know the prolific funding agencies
9. To know the major research areas
10. To know the top twenty languages of literature.

4. Methodology

Required Data has been retrieved from the WoS Collection by using specific keyword "Nuclear Engineering" for a period of ten years. A total of 216423 publications have been found. Downloaded data have been entered into an excel sheet for analysis and tabulation as per the objectives of the study and for publications pattern characterization.

5. Analysis and Interpretation of Data

Year wise publication:

Table 1 shows that the year-wise distributions of publication in Nuclear Engineering during the period (2009-2018). The maximum (32507) publications were published in the year 2018, followed by 28498 publications in the year 2017 and the minimum (13673) publications published in the initial year of the study i.e. 2009. The increasing trend of the publication during the period of study has been represented in the table.

Relative Growth Rate and Doubling Time of Publications:

Table 2 shows doubling timerelative growth rate of Nuclear Engineering research publications from the noticeable period 2009-2018. The study used model (Relative Growth Rate and Doubling time) given by Mahapatra in 1985. On time increase of publications were calculated through RGR and the doubling time (dt) is directly proportional to RGR. The increasing trends of Relative Growth Rate (RGR) has been shown i.e. 0.64 in the beginning year and the end year RGR was 1.90 found. The doubling time was decline during the study period2009-2018.

The mathematical representation for the mean relative growth rate and Doubling Time of the journal articles have been calculated by using following formula:

$$RGR = \frac{W2-W1}{T2-T1}$$

Where

T2 = the element of final time
W1 = Loge, natural log of the preliminary number of contributions
RGR = Growth Rate over the specific period of the intermission
W2 = Loge, natural log of the last number of contributions
T1 = the element of initial time

Growth Models:

Exponential and linear growth trend has been fitted to number of articles for the year 2009 to 2018. The figures1, 2 and 3 shows that the R^2 value for exponential trend (0.986) is less than linear trend (1). Tthis shows that comparatively linear trend is appropriately fitted than exponential trend.

Most Productive Title of Source:

Table 3 shows the channels of communication used by the scientists for the publication of their research work. Highest (3982) number of articles were published in the Journal of Industrial and Engineering Chemistry (1.840%) followed by Biomaterials (0.794%). More number of articles (1687) were published in third place in Scientific Reports (0.779%).

Most Productive Authors:

Table 4 reveals the most productive authors. Highest proliferated productivity by Wang Y (0.463%) i.e. 1003.Second highest productivity by Liu Y (0.429%) i.e. 928. Followed by Zhang Y (0.423%) and Li Y (0.403) are the third and fourth rank with the productivity of 916 and 872

Most Productive Countries:
Table 5 shows countries that mark a place in the top ten in the year range of 2009-2018. The USA gets the top rank with 58699 publication contribution that is 27.122% of the total publication. Interestingly India get the sixth position with 8881 (4.104) publications.

Scientometric Profile of Global Organizations:
Table 6 shows that contribution of top 10 organizations in the research. Total of 50019 papers that are 9.07% of the total papers contributed by the top twenty organizations as listed in the table. 'Chinese Academy of Sciences' get the top position in the list with 6820 papers publication that is 3.151% of the total publication.

Most Productive Editors:
Table 7 shows the top ten most productive editors name who contributed their paper in the field of Nuclear Engineering from the marked period (2009-2018). The maximum 52papers contributed by Prausnitz J M followed by Yarmush, M I with 43 publications, Chun, H.J., Kasper, C., and Khang. G. contributed same number of papers i.e. 33(0.015%) respectively.

Profile of Funding Agencies:
Table 8 shows that contribution of top 20 funding agencies in the research. Total of 63037 papers that are 11.725% of the total papers contributed by the top twenty Funding Agencies as listed in the table. 'National Natural Science Foundation of China' get the top position in the list with 25376 papers publications that are 11.725% of the total publications.

Research Areas:
Table 9 indicates the top ten research areas in the field of 'Nuclear Engineering' paper publication. Engineering recognized as one of the top research area with maximum 77116 publications that are 35.632% of the total papers.Materials Science occupied 2nd rank with 41974 publications (19.394%) and Chemistry is the third ranked research area with 30461(14.075%) publications.

Language of Papers:
Table 10 presents the maximum 212236 papers published in the English Language that is 98.065% of the total published paper among 2009-2018. German get the 2nd position in the top 20 languages with 1349 (0.623%) publications and Chinese language get the third rank with 866 publications (0.400%).
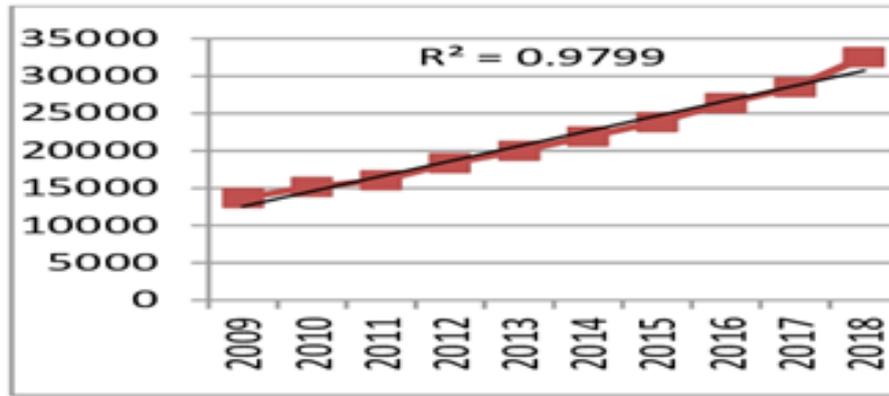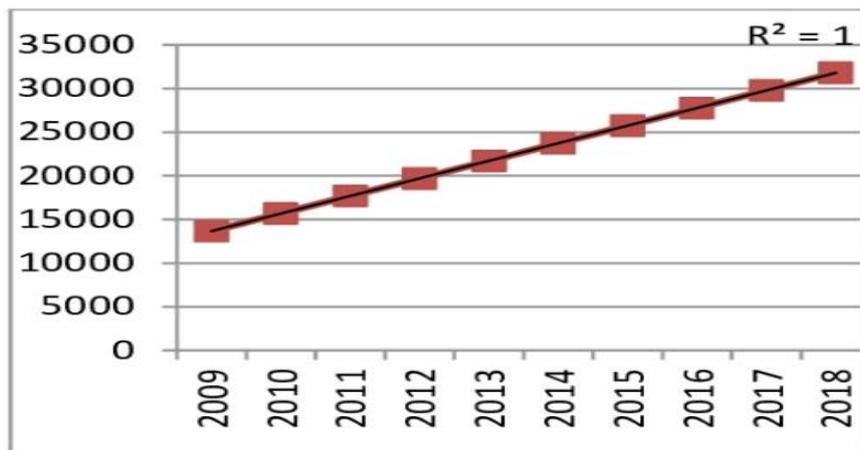
Figure 1: Linear trend for No. of articles
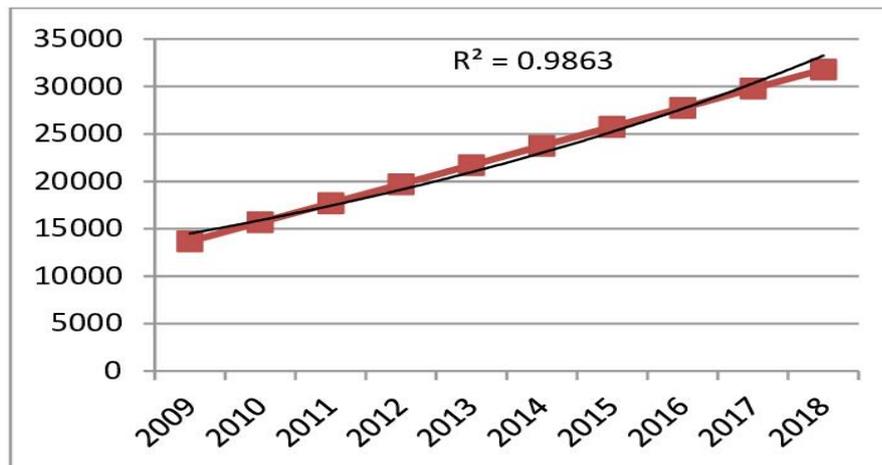

Figure 2: Linear trend for cumulative No. of articles

Figure 3: Exponential trend for cumulative No. of articles

Table 1 Year wise publication

Year	Publications	Average (%)
2009	13673	6.318
2010	15181	7.015
2011	16042	7.412
2012	18358	8.482
2013	19993	9.238
2014	21921	10.129
2015	23865	11.027
2016	26385	12.191
2017	28498	13.168
2018	32507	15.020
Total	**216423**	**100**

Table 2 Relative Growth Rate and Doubling Time

Year	Publications	Cumulative No. of articles	Log(p)1	Log(P)2	RGR(P)	Mean RGR	Dt(p)	Mean Dt
2009	13673	13673	9.52	9.52	0			
2010	15181	28854	9.63	10.27	0.64		1.08	
2011	16042	44896	9.68	10.71	1.03		0.67	
2012	18358	63254	9.82	11.05	1.24		0.56	
2013	19993	83247	9.90	11.33	1.43		0.49	
2014	21921	105168	10.00	11.56	1.57	1.31	0.44	0.53
2015	23865	129033	10.08	11.77	1.69		0.41	
2016	26385	155418	10.18	11.95	1.77		0.39	
2017	28498	183916	10.26	12.12	1.86		0.37	
2018	32507	216423	10.39	12.28	1.90		0.37	
Total	216423	432846						

Table 3 Most Productive Title of Source

Rank	Title of Sources	No. of Publications	% of 216423
1	Journal of Industrial and Engineering Chemistry	3982	1.840
2	Biomaterials	1719	0.794
3	Scientific Reports	1687	0.779
4	Plos One	1596	0.737
5	Tissue Engineering Part A	1487	0.687
6	Abstracts of Papers of The American Chemical Society	1472	0.680
7	Acta Biomaterialia	1415	0.654
8	Acs Applied Materials Interfaces	1351	0.624
9	International Journal Of Engineering Education	1346	0.622
10	Journal of Biomedical Materials Research Part A	1233	0.570

Table 4 Most Productive Authors

Sl. No	Author	Publications	% of 216423
1	Wang Y	1003	0.463
2	Liu Y	928	0.429
3	Zhang Y	916	0.423
4	Li Y	872	0.403
5	Wang J	781	0.361
6	Li J	733	0.339
7	Wang L	722	0.334
8	Zhang L	679	0.314
9	Zhang J	659	0.304
10	Liu J	600	0.277

Table 5 Most Productive Countries

Country	Rank	No. of Publications	% of 216423
USA	1	58699	27.122
Peoples R China	2	46614	21.538
Germany	3	14728	6.805
England	4	13969	6.454
South Korea	5	10056	4.646
India	6	8881	4.104
Italy	7	8572	3.961
Japan	8	8455	3.907
France	9	8169	3.775
Canada	10	7902	3.651

Table 6 Scientometric Profile of Top 10 Most Productive Global Organizations

Organization	Rank	No. of Publications	% of 216423
Chinese Academy of Sciences	1	6820	3.151
University of California System	2	5547	2.563
Centre National De La Recherche Scientifique Cnrs	3	3913	1.808
United States Department of Energy Doe	4	3340	1.543
Massachusetts Institute of Technology Mit	5	2356	1.089
Harvard University	6	2330	1.077
Tsinghua University	7	2256	1.042
Indian Institute of Technology System Iit System	8	2165	1
University of London	9	1986	0.918
University of Texas System	10	1982	0.916

Table 7 Most productive editors

Sl. No	Editors	Publications	% of 216423
1	Prausnitz J M	52	0.024
2	Yarmush M l	43	0.020
3	Chun H J	33	0.015
4	Kasper C	33	0.015
5	Khang G	33	0.015
6	Portner R	26	0.012
7	Hopwood Da	23	0.011
8	Clarke D R	20	0.009
9	Doherty M F	20	0.009
10	Segalman R A	20	0.009

Table 8 Profile of Top 10 Funding Agencies

Sl No	Funding Agencies	Frequency of Publication	% of 216423
1	National Natural Science Foundation of China	25376	11.725
8	National Science Foundation of China	10525	4.863
3	National Institutes of Health	6166	2.849
2	Fundamental Research Funds for the Central Universities	3523	1.628
5	National Basic Research Program of China	2837	1.311
4	Engineering and Physical Sciences Research Council	2222	1.027
6	China Postdoctoral Science Foundation	1541	0.712
7	European Union	1277	0.590
9	EPSRC	1122	0.518
10	Australian Research Council	1069	0.494

Table 9 Top 10 Research Areas

Sl No	Research Areas	Frequency of Publication	% of 216423
1	Engineering	77116	35.632
2	Materials Science	41974	19.394
3	Chemistry	30461	14.075
4	Science Technology	20973	9.691
5	Physics	19307	8.921
6	Computer Science	15845	7.321
7	Biotechnology Applied Microbiology	14737	6.809
8	Biochemistry Molecular Biology	12646	5.843
9	Cell Biology	8815	4.073
10	Mechanics	6871	3.175

Table 10 Languages of Papers

Languages	Publication	% of 216423
English	212236	98.065
German	1349	0.623
Chinese	866	0.400
Spanish	554	0.256
Portuguese	304	0.140
French	233	0.108
Polish	204	0.094
Japanese	151	0.070
Korean	110	0.051
Croatian	85	0.039

6. Findings and Conclusion

As per results, maximum of 32507 publications recognized in the year of 2018 that is 15.020% of the total publications in the range of 2009-2018. The mean RGR and Dt are of 1.31 and 0.53. Based on the study, linear trend is more suitable and tailored. 'Journal of Industrial and Engineering Chemistry' ranked first place in the list with 3982 publications that are 1.840% of the total publications. Wang Y. is the top in the list of authors who contribute 1003 papers that are 0.463 total publications. The USA recognized as one of the top country in the list that contains a maximum of 58699 papers that are 27.122% of the total publications. 'Chinese

Academy of Sciences' got the top position in the list with 6820 publication that is 3.151% of the total publication. Prausnitz J M is recognized most productive editor with 52 (0.024) papers. 'National Natural Science Foundation of China' is ranked first positions that are of 25376 (11.725%) publications. Engineering recognized as one of the top research area with maximum 77116 publications that are 35.632% of the total papers. Maximum 2864 papers published in the English Language that is 98.065% of the total publications among 2009-2018.

This study provided only a bird's eye view of nuclear engineering research publications indexed in the Web of Science. It can further be expanded to comparing the publications in Scopus, Google Scholar, and other prominent databases. Further, it doesn't analyze the author-level and institutional level collaboration which may be a direction for future research. Moreover, these outcomes may be useful for scholars, scientists, students, and policymakers in the field of nuclear engineering.

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