

SCIENTOMETRICS STUDY OF ASME JOURNAL OF APPLIED MECHANICS FROM 2007-2018

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The study deals with analysing scholarly communication published in the ASME Journal of Mechanics from 2007 to 2018. Various Scientometric indicators like Collaboration Indices, Relative Growth Rate, Doubling Time, Relative Citation Rate, Publication Efficiency Index, Immediacy Index, Co-authorship pattern index are used. The study deals with Keyword analysis also. The author's Keywords, Keyword plus, and Title words are used for analysis. Country-wise, institution wise, author wise ranking lists are created during the study. h-index, g-index and m-index are applied to analyse the impact of authors in Applied Mechanics. Data was analysed by R-programming, Bibexcel, Microsoft Excel software. The study shows that the multi-author pattern of publication increases, and the relative growth rate is only 0.10. 'England' obtained the highest score in PEI. In 2007 the highest score was recorded in Immediacy Index. 'Huang Y' contributed 35 articles with rank first. 'Hutchinson JW' received the highest citations (336) and ACP score (24). The highest frequency word 'elasticity' (51) in the author's keywords, 'behaviour' (132) in Keywords plus and 'analysis' (160) in Title word occurred. USA (49.66%) and 'Tsinshua University' (4.48%) have the highest contribution in Applied Mechanics.

Keywords: Publication Efficiency Index, Relative Growth Rate, Doubling Time, Collaboration Indices, h-index, g-index, m-index, Co-authorship pattern, Keyword Analysis, Immediacy Index

INTRODUCTION

Research in the Modern Era is an integral part of academic activities. So that every field of knowledge is tremendously producing research. The research activities are becoming more complex due to the application and interrelation of different disciplines. Engineering is the application of science and Mathematics. So, publications in Engineering and Technology are much broader than any other field. So, tracking and evaluating the effect of Scholarly communication is much complex in nature. Scientometrics indicators and bibliometric analysis help us understand the nature of growth and ranking of Scholar communication generated in the field of Engineering and Technology. We can understand recent trends of research, nature of

research output and growth of scholarly communication with the help of Scientometrics analysis of devoted journals in a particular field.

In the present study, the American Society of Mechanical Engineer's Journal of Applied Mechanics has taken. American Society of Mechanical Engineers is an association founded in 1880 by a small group of leading industrialists. It is a not-for-profit membership organization. This organization deals with collaboration, skill development and knowledge sharing in the field of Mechanical Engineering. In the present scenario, organizations have more than 100000 members from more than 140 countries, and thirty-two thousand members are students.

ASME (American Society of Mechanical Engineers) runs different qualitative programmes to enhance the knowledge of Mechanical Engineering. This organization provided continuing education programmes, developing codes and standards, research and conference publications. ASME digital journal database is one of the qualitative research databases in Mechanical Engineering, which publishes 35 Journals in the field of Mechanical Engineering and its interdisciplinary fields. For the present study, the Journal of Applied Mechanics is taken for Scientometrics analysis and scholarly communication published during 2007-2018. Journal of Applied Mechanics deals with all areas of theoretical and applied mechanics. The areas related to aerodynamics, Aeroelasticity, Biomechanics, Boundary layers, composite materials, computational mechanics, etc. are excluded from this journal. The frequency of its publication is monthly. The journal started from

1933 to the present, and its impact factor as per Journal Citation Reports (JCR) 2018 is 2.772. It is a well-known journal in the field of Mechanical Engineering.

In the present study, the Scientometric indicators and bibliometric analysis tools were used to understand the nature and growth of scholarly communication in Applied Mechanics. Through this study, we tried to understand the collaboration, co-authorship pattern, production growth of research articles, required doubling time for research growth and analysis of quality of research output. It also provides different ranking in this field.

REVIEW OF LITERATURE

There are large studies have been carried out in the field of bibliometrics and scientometrics. Some of the resent studies are reviewed and presented. In Associate with present study, pattern analysis related to authorship, bibliographic forms, citations, contributing institutions in the field of cotton research published in Journal of Indian Society for cotton improvement. The study indicates the growth in the cotton field. It is found a multi-authorship pattern. 'Crop Science' is the highest cited foreign journal (164 citations), and the 'Journal of Indian Society of Cotton Improvement' is the highest cited Indian Journal (280 citations). (Dixit, Swati, and karate, 2007). Bibliometrics analysis of 779 articles published in Journal of Food Science and Technology were studied and authorship pattern, citation analysis was carried out. In the study, it was found that a joint author makes the maximum number of contributions. The contribution of Indian authors

(82.72%) is more. Only 17.28% of developed nations contributed to this journal. Karnataka (1241 articles) is the highest contributed state. (Vijay and Raghavan, 2007).

In the Scientometric study on publication productivity of the Bio-organic division at Bhabha atomic Research centre, 475 articles were published by Bio-organic division during 1972-2002. 'Synthesis' (202 articles) and 'Bio-organic Chemistry' (100 articles) are the highest contributed subjects. The highest collaboration co-efficient 1.0 was found in 1972, 1976-1977, 1980-1985, 1987, 1989-90, and 1993. (Kadmani, B. S. and et al., 2005). Baskaran published an article entitled "Publication pattern and authors collaboration of cardiology research" The data is retrieved from the MEDLINE database on cardiology during 1991-2010. A total of 829 articles were analysed. The study measures countries' annual growth rate and collaboration index. The mean degree of collaboration is 0.70, and the highest score recorded is 0.88 in 1991. (Baskaran, and Batcha, Sadik, 2012). The scientometric study published in the field of Phonology had used collaborative indices

The study published in phonology subject used collaborative indices and relative growth rate along with doubling time reveals that the degree of collaboration is 0.5 and collaboration co-efficient and modified collaboration coefficient is 0.5. Goswami, U. was the first rank author in phonology. 'Lingua' is the first rank journal; the USA was the highest contributed country. (Batcha and Chaturbhuji, 2019). Buriak, in the Editorial entitled "Hot Topics in Materials Chemistry and the Immediacy Index long-term versus short-term

impact", using Web of Science data, the immediacy index Chemistry of Material has gone up substantially, to a highly competitive 1.93 for 2014, from 1.27 for 2013. (Buriak, Jillian, 2015). Aithal published an article entitled "Comparative study of various research indices used to measure the quality of research publication". This paper explained the various indicators to access the impact authors based on citations such as h-index, g-index, and i10-index. The paper suggested some of the new indicators like ARP-Index, RC-Index, Cost Index. (Aithal, P. S., 2017).

While analysing research productivity of particular journal the above mention review papers are useful but there are many scientometric indicators like Relative citation index, Immediacy Index, publication Efficiency index which analyses the impact of research productivity on global scale. These indicators are used in the present study.

OBJECTIVES OF THE STUDY

1. To study the co-authorship pattern and collaboration in the field of Applied Mechanics
2. To measure the year-wise distribution and growth of literature.
3. To find out core keywords in the field of Applied Mechanics
4. To measure the influence and visibility of research output from a global perspective by using RCI, PEI, Immediacy Index
5. To measure the country-wise impact of publication

6. To identify the ranking of authors, countries, and institutions involved in research activity.

METHODOLOGY

For the present study, data were collected from the Web of Science. The search term “ASME transaction in Journal of Mechanics” is used, and the duration selected from 2007 to 2018. Total 1786 documents were generated. For segregating the data into the required table format, Bibexcel and HistCite software were used. The data analysis was done with the help of Scientometric indicators in Excel. Keyword data retrieved from R-programming software. The following are the indicators used for data analysis.

Collaboration Index (CI)

Collaboration Index is nothing but the mean number of authors per joint paper. For the analysis of the collaboration index, a single-authored paper that is equal to one is always omitted. So the formula for CI is $CI = (\text{Total author}) / (\text{Total joint paper})$.

Degree of Collaboration (DC)

Subramanyam suggested this indicator. It is defined as the ratio of the number of collaborative research papers to the total number of research papers in the discipline during a specific period. DC is easy to calculate and easily interpretable as a degree gives zero weight to single-authored papers and consistently ranks higher a discipline with a higher percentage of multiple-authored papers. (Subramanyam, 1983).

Collaborative Coefficient (CC)

The indicator is a measure of collaboration in research that reflects both the mean number of

authors per paper and the proportion of multi-authored papers. According to Ajiferuke, CC tends to zero as single-authored papers dominate and $1-1/j$ as J-authored papers dominate. It implies that the higher the value of CC, the higher the probability of multi-authored papers.

Modified Collaborative Coefficient (MCC)

As discussed by Savanur and Srikanth (2010), the derivation of the new measure is almost the same as that of CC, as given in Ajiferuke et al. Imagine that each paper carries a single “credit”, this credit being shared among the authors. Thus, if a paper has a single author, the author receives one credit, with two authors each receive $1/2$ credits, and in general, if we have X authors, each receives $1/X$ credits. (This is the same idea of fraction productivity defined by Solla price and Beaver as the score of an author when he is assigned $1/n$ of a unit for one item for which n author has been credited). Hence, the average credit awarded to each author of a random paper is $E[1/X]$, a value between 0 and 1. Since we wish 0 to correspond to single authorship, we define the modified collaborative coefficient (MCC).

Relative Growth Rate (RGR)

The growth rate is the main feature of any research activity, and the information explosion in the form of enormous publications represents the growth of scholarly communication. The relative Growth rate (RGR) increases the number of articles/pages per unit of time.

Doubling Time (DT)

There exists a direct equivalence between the relative growth rate and the doubling time.

Doubling time is the time required for articles to become double the existing amount. If the number of articles/pages of a subject double during a given period, the difference between the logarithms of numbers at the beginning and end of this period must be number 2. If a natural logarithm is used, this difference has a value of 0.693.

Relative Citation Index (RCI)

This Scientometric indicator was developed by the Institute of Scientific Information (now Thomson Reuters, USA) to calculate science and engineering indicators. Relative citation Index measures both the influence and visibility of journal research from a global perspective. If $RCI = 1$ indicates that the journal's citation rate of a particular year is equal to the total number of publication citation rates. If $RCI > 1$ indicates that the journal citation rate of a particular year is higher than the citation rate of total journals publication and if $RCI < 1$ indicates that journal citation rate of a particular year is less than the total journal's publication citation rate.

Publication Efficiency Index

Hadagali (2019) used this indicator in Scientometric analysis of material Science research. Examining the impact of research papers produced by a given country is significantly related to the research effects. The publication Efficiency index. If $PEI > 1$, this indicates that the impact of publication in a given field by a particular country is more than the research efforts devoted to it during the period considered. If $PEI < 1$, the impact of publication in a given field by a particular country is less than the research efforts (Chen and Guan, 2011).

Immediacy Index

The Immediacy Index is a measure of how quickly the average article in a particular journal is cited. It is expressed by the "ratio of the citations received in a particular year, by the source items of journals of the same year divided by the number of foresaid source items."

Co-authorship Index (CAI)

It is obtained by calculating proportionately the publication by single, two and multi-authored papery by Ajiferuke and Tague. If $CAI = 100$ indicates that a country's Co-authorship efforts first a particular type of authorship correspondents to the world average $CAI > 100$ reflects higher than average co-authorship effort and $CAI < 100$ shows lower than average Co-authorship effort by that country for a given type of pattern.

RESULTS AND DISCUSSION

Year wise distribution of Co-authorship pattern and Collaborative Indices:

Table No. 1 represents the analysis of the Collaborative Index (CI), Degree of Collaboration (DC), Collaboration Co-efficient (CC), and Modified Collaborative Coefficient (MCC). The Collaborative Index (CI) found that in the year 2017, the collaborative index is highest, i.e., 3.15. It means that collaboration between two and more than two authors are highest in 2017. The average collaboration in this journal is 2.81. The statistical data shows that the two authors collaboration is highest in this journal. Out of 1786 articles, 671 authors have two authors collaboration. The Degree of Collaboration statistic shows that the

| Sr. No | Name of Indicator | Formula | Meaning of Symbol |
|--------|------------------------------------|--|--|
| 1 | Collaboration Index | $CI = \frac{\sum_{j=1}^A jf_j}{N}$ | f_i = the number of J authored papers published in a discipline during a certain period of time. N = the total number of research papers published in a discipline during a certain period of time. |
| 2 | Degree of collaboration | $DC = \frac{Nm}{Nm + Ns}$ | Nm = Number of multiple-authored papers Ns = Number of single-authored papers |
| 3 | Collaborative Coefficients | $CC = 1 - \frac{\sum_{j=1}^A \left(\frac{1}{j}\right) f_j}{N}$ | F_j = the number of authored papers N = Total number of research papers published K = the greatest number of authors per paper |
| 4 | Modified Collaborative Coefficient | $MCC = \frac{A}{A-1} \left\{ \frac{\sum_{j=1}^A \left(\frac{1}{j}\right) f_j}{N} \right\}$ | A is a normalization constant to be determined. Setting A=1 yields the measure CC. The requirement that j=0 for single authorship does not restrict. The above equation is not defined for the trivial case when A=1, which is not a problem since collaboration is meaningless unless at least two authors are available. CC approaches MCC only when A ∞, but is otherwise strictly less than MCC by the factor 1-1/A. |
| 5 | Relative Growth Rate | $\bar{R}_{(1-2)} = \frac{w_2 - w_1}{T_2 - T_1}$ | R (1-2) = mean relative growth rate over the specific period of interval. W₁ = Natural log of an initial number of articles/pages. W₂ = natural log of the final number of articles/pages after a specific period of interval. T₂ – T₁ = the unit difference between the initial time and the final time. |
| 6 | Doubling Time | $DT = \frac{0.693}{\bar{R}}$ | 0.693 = Natural logarithm R = Relative Growth Rate |
| 7 | Relative Citation Index | $RCI = \frac{TNCy/TNCp}{TNP_y/TNP_p}$ | TNC_y = Total number of citations received to the total number of articles in y year. TNC_p = Total number of citations received to the total number of articles in period p. TNP_y = Total number of publications in y year. TNP_p = Total number of publications in period p. |
| 8 | Publication Efficiency Index | $PEI = \frac{TNC_i/TNC_t}{TNP_i/TNP_t}$ | TNC_i = Total number of citations received by Journal i. TNC_t = Total number of citations received by all countries. TNP_i = Total number of items published by country i. TNP_t = Total number of items published by all countries. |
| 9 | Immediacy Index | $I_i(J_y) = \frac{C}{X}$ | I_i(J_y) = Immediacy Index of the journal J for the year Y. C = Number of citations received by x source items published in journal J in the year Y. X = Number of source items published in J in the year Y. |
| 10 | Co-authorship Index | $CAI = \frac{N_{ij}/N_{io}}{N_{oj}/N_{oo}} * 100$ | N_{ij} = Number of papers having j authors in block i. N_{io} = Total output of block i. N_{oj} = Number of papers having j authors for all blocks. N_{oo} = Total number of papers for all authors of all blocks. |

average degree of collaboration is 0.88, and the highest degree of collaboration was found in 2018 (0.94). The data represents that degree of collaboration is growing continuously. Only in the year 2011, it slightly glides, which is 0.92. It shows that the collaboration between two and more authors are increasing continuously. The Collaboration Co-efficient and Modified Collaboration Co-efficient are almost the same, and the average of these indices are 0.55 and 0.56, respectively. We found the highest collaboration

Coefficient of 0.62 in the years 2017 and 2018. It is because the single-author paper is less in these years, so the collaboration was increased. As the data shows, single author contributors to this journal are decreasing, which is why collaboration Co-efficient increases. It increases by 0.14 difference in 12 years. The Modified Collaboration Co-efficient remains almost the same, and it also indicates that multi-author impact is increasing.

Table 2 Year wise distribution of Co-authorship Pattern and Collaboration Indices

| Sr. No. | Year | Author wise distribution | | | | | | Total Authors | Total of Articles | CI | DC | CC | MCC |
|------------|------|--------------------------|-----|-----|-----|-----|---------------|------------------|----------------------|--------------|--------------|--------------|--------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 and more | | | | | | |
| 1 | 2007 | 28 | 69 | 42 | 8 | 6 | 1 | 361 | 154 | 2.34 | 0.82 | 0.48 | 0.48 |
| 2 | 2008 | 29 | 72 | 42 | 17 | 6 | 0 | 397 | 166 | 2.39 | 0.83 | 0.49 | 0.49 |
| 3 | 2009 | 17 | 55 | 25 | 11 | 4 | 3 | 285 | 115 | 2.48 | 0.85 | 0.51 | 0.51 |
| 4 | 2010 | 21 | 49 | 38 | 11 | 9 | 4 | 351 | 132 | 2.66 | 0.84 | 0.52 | 0.52 |
| 5 | 2011 | 11 | 59 | 46 | 14 | 6 | 3 | 374 | 139 | 2.69 | 0.92 | 0.56 | 0.57 |
| 6 | 2012 | 21 | 47 | 51 | 20 | 8 | 3 | 409 | 150 | 2.73 | 0.86 | 0.54 | 0.55 |
| 7 | 2013 | 24 | 68 | 65 | 32 | 13 | 10 | 619 | 212 | 2.92 | 0.89 | 0.57 | 0.57 |
| 8 | 2014 | 20 | 70 | 42 | 29 | 10 | 3 | 472 | 174 | 2.71 | 0.89 | 0.55 | 0.55 |
| 9 | 2015 | 14 | 50 | 28 | 17 | 12 | 12 | 402 | 133 | 3.02 | 0.90 | 0.57 | 0.58 |
| 10 | 2016 | 12 | 53 | 31 | 25 | 17 | 11 | 466 | 149 | 3.13 | 0.92 | 0.6 | 0.6 |
| 11 | 2017 | 10 | 32 | 32 | 21 | 16 | 11 | 409 | 122 | 3.35 | 0.92 | 0.62 | 0.62 |
| 12 | 2018 | 8 | 47 | 29 | 33 | 12 | 11 | 459 | 140 | 3.28 | 0.94 | 0.62 | 0.62 |
| Total | | 215 | 671 | 471 | 238 | 119 | 72 | 5004 | 1786 | 2.81 Mean | 0.88 Mean | 0.55 Mean | 0.56 Mean |

Relative growth rate and Doubling time

Table 2 conveys the chronological status of growth in the productivity of the journal of

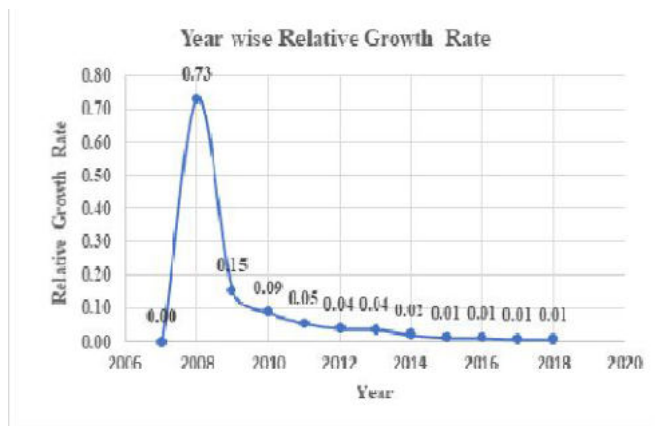
Mechanics. The table shows that the growth rate started from 0.731 in 2008 and it continuously decreasing.

Table 3: Year-wise Relative growth rate and Doubling Time of ASME Journal of Applied Mechanics

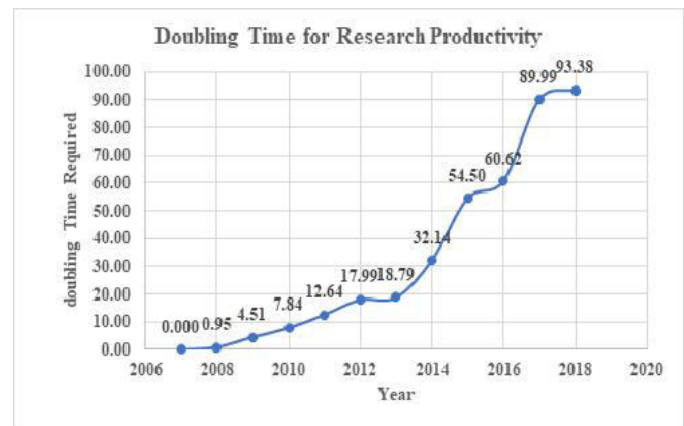
| Sr. No | Year | Number of Articles | Cumulative No. of Articles | W1 | W2 | RG | Mean of RG | DT | Mean of DT |
|--------|------|--------------------|----------------------------|-------|-------|-------|------------|-------|------------|
| 1 | 2007 | 154 | 154 | - | 5.037 | - | 0.1 | - | 32.8 |
| 2 | 2008 | 166 | 320 | 5.037 | 5.768 | 0.731 | | 0.95 | |
| 3 | 2009 | 115 | 435 | 5.768 | 6.075 | 0.154 | | 4.51 | |
| 4 | 2010 | 132 | 567 | 6.075 | 6.34 | 0.088 | | 7.84 | |
| 5 | 2011 | 139 | 706 | 6.34 | 6.56 | 0.055 | | 12.64 | |
| 6 | 2012 | 150 | 856 | 6.56 | 6.752 | 0.039 | | 17.99 | |
| 7 | 2013 | 212 | 1068 | 6.752 | 6.974 | 0.037 | | 18.79 | |
| 8 | 2014 | 174 | 1242 | 6.974 | 7.124 | 0.022 | | 32.14 | |
| 9 | 2015 | 133 | 1375 | 7.124 | 7.226 | 0.013 | | 54.5 | |
| 10 | 2016 | 149 | 1524 | 7.226 | 7.329 | 0.011 | | 60.62 | |
| 11 | 2017 | 122 | 1646 | 7.329 | 7.406 | 0.008 | | 89.99 | |
| 12 | 2018 | 140 | 1786 | 7.406 | 7.488 | 0.007 | | 93.38 | |

The lowest growth rate is 0.007, found in 2018, and the average relative growth rate is 0.10 as we find relative growth rate decreasing so that doubling time is increasing. In 2008 the doubling time was 0.95, which increase tremendously and in 2018, doubling time for the author’s productivity requires 93.38. The average time is 32.78.

Graph No. 1 shows how relative growth of journal productivity declines. After 2008 it declines tremendously, and it continuously declines in the forthcoming years. Graph No.2 also show Doubling Time increasing to make the research productivity doubled.



Graph 1 Year-wise Relative Growth Rate



Graph 2 Year-wise Doubling Time

Relative Citation Index

Table 3 shows the statistical data related to the Relative Citation Index. It shows that a total of 15611 citations were received. If we count articles per paper, the highest citations per paper were received in 2007 (2729 citations) for 154 articles. However, as time increases, citation count increases, so for understanding the actual impact of paper quality, the relative citation index is useful. It is highest in 2007, having a 2.03 RCI score. The lowest relative citation received in

2018 with 0.19. It found inconsistency in the relative citation index score. In the year 2007, 2008, 2011, 2012, and 2014 the relative citation rate was 2.03, 1.07, 1.02, 1.38, 1.28 respectively. It means the journal citation rate of these years was higher than the total number of publication citation rates. In 2009, 2010, 2013, 2015, 2016, 2017, 2018, the relative citation rate was less than 1. It means the journal citation rate in these years is less than the total journal's publication citation rate. The average Relative citation rate is 0.98 means less than 1.

Table No. 3 Relative Citation Index of ASME Journal of Mechanics

| Sr. No. | Year | TNP | TNC | ACP | RCI |
|--------------|------|-------------|--------------|--------------------------|------|
| 1 | 2007 | 154 | 2729 | 17.72 | 2.03 |
| 2 | 2008 | 166 | 1554 | 9.36 | 1.07 |
| 3 | 2009 | 115 | 986 | 8.57 | 0.98 |
| 4 | 2010 | 132 | 972 | 7.36 | 0.84 |
| 5 | 2011 | 139 | 1237 | 8.9 | 1.02 |
| 6 | 2012 | 150 | 1808 | 12.05 | 1.38 |
| 7 | 2013 | 212 | 1594 | 7.52 | 0.86 |
| 8 | 2014 | 174 | 1913 | 10.99 | 1.26 |
| 9 | 2015 | 133 | 1052 | 7.91 | 0.9 |
| 10 | 2016 | 149 | 918 | 6.16 | 0.7 |
| 11 | 2017 | 122 | 615 | 5.04 | 0.58 |
| 12 | 2018 | 140 | 233 | 1.66 | 0.19 |
| Total | | 1786 | 15611 | Mean of RCI= 0.98 | |

Country wise Publication Efficiency Index

Table 4 represents the country-wise citation and Scientometric indicator- Publication efficiency index (PEI) used on citation received by the country. It shows that a given country's

research paper is significantly related to the research efforts. Countries like the USA, England, Canada, Italy, Germany, Taiwan, Iran, Netherland, Singapore, Russia, Spain, and Brazil have received the Publication Efficiency Index

score of more than 1. It means the impact of publications in Applied Mechanics by these countries is more than research efforts. England

has the highest 1.38 PEI score, and Norway has received the lowest 0.43 PEI score in Applied Mechanics.

Table 4: Country-wise distribution of Publication Efficiency Index obtained by ASME journal of Applied Mechanics

| Sr. No. | Country | Item Published | Time Cited | PEI |
|--------------|--------------------|----------------|--------------|------|
| 1 | USA | 887 | 8393 | 1.02 |
| 2 | China | 456 | 3772 | 0.89 |
| 3 | England | 89 | 1125 | 1.36 |
| 4 | Canada | 83 | 786 | 1.02 |
| 5 | France | 75 | 628 | 0.9 |
| 6 | India | 63 | 566 | 0.97 |
| 7 | Italy | 51 | 656 | 1.38 |
| 8 | Germany | 41 | 499 | 1.31 |
| 9 | Israel | 39 | 350 | 0.97 |
| 10 | Japan | 39 | 329 | 0.91 |
| 11 | Taiwan | 32 | 308 | 1.04 |
| 12 | Iran | 30 | 287 | 1.03 |
| 13 | South Korea | 29 | 203 | 0.75 |
| 14 | Netherlands | 25 | 245 | 1.05 |
| 15 | Sweden | 23 | 149 | 0.7 |
| 16 | Singapore | 22 | 241 | 1.18 |
| 17 | Russia | 18 | 206 | 1.23 |
| 18 | Spain | 17 | 157 | 0.99 |
| 19 | Turkey | 17 | 119 | 0.75 |
| 20 | Scotland | 13 | 109 | 0.9 |
| 21 | Austria | 12 | 77 | 0.69 |
| 22 | Brazil | 10 | 119 | 1.28 |
| 23 | Norway | 10 | 39 | 0.42 |
| 24 | Other (42 Country) | 152 | 1062 | 0.75 |
| Total | | 2223 | 20306 | |

Immediacy Index of year-wise publication

The Table 5 represents the citation given to the research papers of a particular year within the same published year. It means 154 articles are published in 2007 and received 22 citations in 2007. On these data, the Immediacy Index is a well-known scientometric indicator to calculate

the impact of research articles within the publication year. The table shows the highest Immediacy Index score (0.76) received in 2014 and the lowest Immediacy Index score received in 2008. The impact of research productivity is much higher in 2014. In 2017 and 2012 impact of research productivity is nearest to 2014 (0.61,0.53 respectively).

Table 5: Year-wise distribution of Immediacy Index of the publication of ASME Journal of Applied Mechanics

| Sr. No. | Year | Published Articles | Citation given to articles in published Year | Immediacy |
|---------|------|--------------------|--|-----------|
| 1 | 2007 | 154 | 22 | 0.14 |
| 2 | 2008 | 166 | 16 | 0.1 |
| 3 | 2009 | 115 | 14 | 0.12 |
| 4 | 2010 | 132 | 28 | 0.21 |
| 5 | 2011 | 139 | 45 | 0.32 |
| 6 | 2012 | 150 | 79 | 0.53 |
| 7 | 2013 | 212 | 45 | 0.21 |
| 8 | 2014 | 174 | 133 | 0.76 |
| 9 | 2015 | 133 | 46 | 0.35 |
| 10 | 2016 | 149 | 67 | 0.45 |
| 11 | 2017 | 122 | 74 | 0.61 |
| 12 | 2018 | 140 | 73 | 0.52 |

Year-wise pattern of co-authorship

Table 7 shows year wise co-authorship pattern. In 2007, 2008, 2009, 2010, and 2012 the co-authorship index of a single author is more than 100. It means in these years, co-authorship

for the single-authored correspondent to the world's average. In the same way, in 2007, 2008, 2011, 2014, and 2015 the co-authorship index of two authored papers were more than 100, which means in these years, co-authorship for two authorship correspondence to the world's average.

In 2012, 2013, 2015, 2016, and 2018 co-authorship of multi-author co-authorship patterns show more than 100. The highest single-authored was observed in 2007. The highest two authorship

was observed in 2007, and the highest multi-authorship pattern was found in 2017—lowest co-authorship for single, two, and multi-authorship patterns found in 2018, 2017, 2007, respectively.

Table 6: Year-wise co-authorship Pattern found in ASME Journal of Applied Mechanic

| Sr. No. | Year | Single Authored Papers | Co-authorship index of single Author | Two Authored Papers | Co-authorship index of Two Authors | Multi-Authored Papers | Co-authorship index of Multi-Authors | Total |
|--------------|------|------------------------|--------------------------------------|---------------------|------------------------------------|-----------------------|--------------------------------------|-------------|
| 1 | 2007 | 28 | 151.04 | 69 | 119.26 | 57 | 73.45 | 154 |
| 2 | 2008 | 29 | 145.12 | 72 | 115.45 | 65 | 77.7 | 166 |
| 3 | 2009 | 17 | 122.8 | 55 | 127.3 | 43 | 74.2 | 115 |
| 4 | 2010 | 21 | 132.16 | 49 | 98.81 | 62 | 93.21 | 132 |
| 5 | 2011 | 11 | 65.74 | 59 | 112.98 | 69 | 98.51 | 139 |
| 6 | 2012 | 21 | 116.3 | 47 | 83.4 | 82 | 108.48 | 150 |
| 7 | 2013 | 24 | 94.04 | 68 | 85.38 | 120 | 112.33 | 212 |
| 8 | 2014 | 20 | 95.48 | 70 | 107.08 | 84 | 95.8 | 174 |
| 9 | 2015 | 14 | 87.44 | 50 | 100.06 | 69 | 102.95 | 133 |
| 10 | 2016 | 12 | 66.9 | 53 | 94.68 | 84 | 111.87 | 149 |
| 11 | 2017 | 10 | 68.09 | 32 | 69.82 | 80 | 130.13 | 122 |
| 12 | 2018 | 8 | 47.47 | 47 | 89.36 | 85 | 120.48 | 140 |
| Total | | 215 | | 671 | | 900 | | 1786 |

Country wise Co-authorship pattern

Table 7 shows the top 23 contributed countries with their Co-authorship pattern. The data shows that the USA, England, France, India, Italy, Israel, Japan, South Korea, Netherland, Russia, Turkey, and Austria found a single authorship index score of more than 100. It means in these countries’ Co-authorship for single authorship correspondent to the world’s average.

The USA, Canada, India, Israel, Taiwan, Iran, South Korea, Spain, Scotland have more than 100 scores in the two authors Co-authorship index. It means these countries have co-authorship for two authors, which is correspondent to the world’s average. Similarly, it was found in China, England, France, Italy, Germany, Japan, Netherland,

Sweden, Singapore, Russia, Spain, Brazil, and Norway for the multi-authorship index. The graphical representation showed the pattern of yearly Co-authorship.

Ranking of Authors contributed to the journal of Mechanics

Table 9 shows the ranking list of the first 50 authors. As data shows, the highest contribution is given by ‘Huang Y.’ having 35 articles in his record. ‘Wang X.’, ‘Feng X.’, ‘Zhang Y.’ contribute 23, 22, 20 respectively. As the record shows, the highest citation was received by Hutchinson J.W. with a citation score of 336. The second rank is received by ‘Huang Y’ with 314 citations. However, if we go through the average citation per paper, the highest ACP received by

Table 7: Country-wise Co-authorship Pattern found in ASME Journal of Applied Mechanics

| Sr. No. | Year | Single Authored Papers | Co-authorship index of single Author | Two Authored Papers | Co-authorship index of Two Authors | Multi-Authored Papers | Co-authorship index of Multi-Authors | Total |
|--------------|------|------------------------|--------------------------------------|---------------------|------------------------------------|-----------------------|--------------------------------------|-------------|
| 1 | 2007 | 28 | 151.04 | 69 | 119.26 | 57 | 73.45 | 154 |
| 2 | 2008 | 29 | 145.12 | 72 | 115.45 | 65 | 77.7 | 166 |
| 3 | 2009 | 17 | 122.8 | 55 | 127.3 | 43 | 74.2 | 115 |
| 4 | 2010 | 21 | 132.16 | 49 | 98.81 | 62 | 93.21 | 132 |
| 5 | 2011 | 11 | 65.74 | 59 | 112.98 | 69 | 98.51 | 139 |
| 6 | 2012 | 21 | 116.3 | 47 | 83.4 | 82 | 108.48 | 150 |
| 7 | 2013 | 24 | 94.04 | 68 | 85.38 | 120 | 112.33 | 212 |
| 8 | 2014 | 20 | 95.48 | 70 | 107.08 | 84 | 95.8 | 174 |
| 9 | 2015 | 14 | 87.44 | 50 | 100.06 | 69 | 102.95 | 133 |
| 10 | 2016 | 12 | 66.9 | 53 | 94.68 | 84 | 111.87 | 149 |
| 11 | 2017 | 10 | 68.09 | 32 | 69.82 | 80 | 130.13 | 122 |
| 12 | 2018 | 8 | 47.47 | 47 | 89.36 | 85 | 120.48 | 140 |
| Total | | 215 | | 671 | | 900 | | 1786 |

Table 8: Ranking of Most prolific authors contributed to ASME Journals of Applied Mechanic

| Sr. No. | Authors | Records | % of Total 1786 | Rank of Authors | Total Citations | ACP |
|---------|---------------|---------|-----------------|-----------------|-----------------|-------|
| 1 | Huang Y | 35 | 1.96 | 1 | 314 | 8.97 |
| 2 | Wang X | 23 | 1.29 | 2 | 108 | 4.70 |
| 3 | Feng X | 22 | 1.23 | 3 | 214 | 9.73 |
| 4 | Zhang Y | 20 | 1.12 | 4 | 183 | 9.15 |
| 5 | Liu Y | 19 | 1.06 | 5 | 64 | 3.37 |
| 6 | Chen Y | 19 | 1.06 | 5 | 100 | 5.26 |
| 7 | Elishakoff I | 18 | 1.01 | 6 | 60 | 3.33 |
| 8 | Wang Y | 17 | 0.95 | 7 | 70 | 4.12 |
| 9 | Bazant Z | 17 | 0.95 | 7 | 118 | 6.94 |
| 10 | Bazant ZP | 16 | 0.9 | 8 | 105 | 6.56 |
| 11 | Liu C | 16 | 0.9 | 8 | 80 | 5.00 |
| 12 | Chen J | 16 | 0.9 | 8 | 156 | 9.75 |
| 13 | Zhang W | 15 | 0.84 | 9 | 245 | 16.33 |
| 14 | Zhang X | 15 | 0.84 | 9 | 60 | 4.00 |
| 15 | Chen W | 15 | 0.84 | 9 | 141 | 9.40 |
| 16 | Hutchinson JW | 14 | 0.78 | 10 | 336 | 24.00 |
| 17 | Pindera MJ | 14 | 0.78 | 10 | 135 | 9.64 |
| 18 | Waas AM | 14 | 0.78 | 10 | 40 | 2.86 |
| 19 | Wu J | 14 | 0.78 | 10 | 163 | 11.64 |
| 20 | Zhang H | 14 | 0.78 | 10 | 78 | 5.57 |

‘Hutchinson’. The second ACP rank was received by ‘Tezduyar T.E.’ with a 20.825 ACP score. The third ACP rank received by ‘Kardomateas G.A.’ has got 20.08 ACP Score.

Author’s Ranking as per h-index, g-index and m-index

Three Scientometric indicators measure the author’s impact. h-index indicates the quantity and quality of research articles published by authors, and It is a well-known and universally accepted indicator to rank the authors based on published papers and citations. However, there are many limitations to the h-index. So, the g-index is an improved version of the h-index that was used. It

gives more weightage to highly cited papers. That is why the g-index is always high than the h-index. m-index is also the higher version of the h-index. It is the average of low and high citations received during the long period of the career. It includes a total of years of research as a third variable component. That is why it is a more specific index to measure the impact of scholarly communication by authors.

Table 10 shows that the first three authors with the highest h-index are ‘Huang Y’, ‘Zhang W’, and ‘Fleck NA’, who received 9, 9, and 8 h-index scores. The data also indicate that the first three authors with the highest g-index are ‘Huang Y’,

Table 9: Author’s Ranking as per h-index, g-index and m-index

| Sr. No. | Authors | Records | Rank of Authors | Total Citation | PY Start | h-index | g-index | m-index |
|---------|---------------|---------|-----------------|----------------|----------|---------|---------|---------|
| 1 | Huang Y | 35 | 1 | 314 | 2007 | 9 | 16 | 0.692 |
| 2 | Wang X | 23 | 2 | 108 | 2007 | 5 | 9 | 0.385 |
| 3 | Feng X | 22 | 3 | 214 | 2007 | 7 | 14 | 0.538 |
| 4 | Zhang Y | 20 | 4 | 183 | 2008 | 8 | 13 | 0.667 |
| 5 | Liu Y | 19 | 5 | 64 | 2008 | 5 | 7 | 0.417 |
| 6 | Chen Y | 19 | 5 | 100 | 2007 | 7 | 9 | 0.538 |
| 7 | Elishakoff I | 18 | 6 | 60 | 2008 | 5 | 7 | 0.417 |
| 8 | Wang Y | 17 | 7 | 70 | 2008 | 5 | 7 | 0.417 |
| 9 | Bazant Z | 17 | 7 | 118 | 2007 | 5 | 10 | 0.385 |
| 10 | Bazant Zp | 16 | 8 | 105 | 2008 | 5 | 9 | 0.417 |
| 11 | Liu C | 16 | 8 | 80 | 2007 | 6 | 8 | 0.462 |
| 12 | Chen J | 16 | 8 | 156 | 2007 | 7 | 12 | 0.538 |
| 13 | Zhang W | 15 | 9 | 245 | 2007 | 9 | 15 | 0.692 |
| 14 | Zhang X | 15 | 9 | 60 | 2009 | 5 | 6 | 0.455 |
| 15 | Chen W | 15 | 9 | 141 | 2008 | 6 | 11 | 0.500 |
| 16 | Hutchinson JW | 14 | 10 | 336 | 2007 | 7 | 14 | 0.538 |
| 17 | Pindera MJ | 14 | 10 | 135 | 2007 | 6 | 11 | 0.462 |
| 18 | Waas AM | 14 | 10 | 40 | 2010 | 4 | 6 | 0.400 |
| 19 | Wu J | 14 | 10 | 163 | 2007 | 8 | 12 | 0.615 |
| 20 | Zhang H | 14 | 10 | 78 | 2007 | 5 | 8 | 0.385 |

‘Zhang W’, ‘Hutchinson JW’, with 16, 15, and 14 g-index scores. First, three authors who received the highest m-index score are ‘Reis OM’, ‘Gao HJ’, ‘Bazileves Y’, who received 1, 0.75, 0.75, respectively. Eight authors received the third rank in m-index with a score of 0.75.

Author’s keyword, keyword plus and Title words Analysis

The author’s keyword, keyword plus, title, and abstract are essential aspects of the keyword analysis. With the help of the word’s analysis, we can easily make the core list of words in any branch of knowledge. In the present study author’s keywords, keyword plus, and title keywords are taken for study. According to Jones and Jackson,

“keywords are a list of words or phrases provided by the authors and signify the meaning or main ideas presented in the paper” (Jones and Jackson, 1970). These words give us a list of terms which is helpful for any researchers of a particular field. The author usually provides core concepts as keywords. Keyword plus is the unique feature of the Web of Science database. It is the field that provides expanded terms stemming from the record’s cited reference or bibliography. It helps the researchers to understand the current trends in the relevant field. According to Garfield¹³, keyword plus terms can capture an article’s content with greater depth and variety (Garfield, 1990).

Table 10: Frequency distribution of words from author’s keywords, keyword plus & Title words

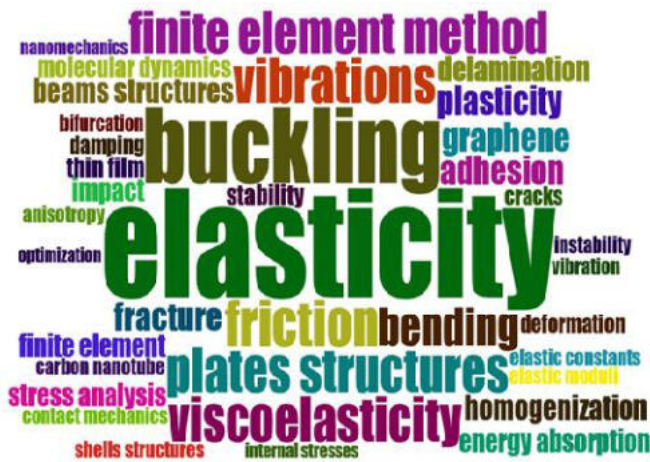
| Sr. No. | Author's Keyword | Frequency | Keyword Plus | Frequency | Title words | Frequency |
|---------|-------------------------|-----------|-----------------------|-----------|-------------|-----------|
| 1 | elasticity | 51 | behaviour | 132 | analysis | 160 |
| 2 | finite element analysis | 39 | model | 124 | elastic | 155 |
| 3 | buckling | 36 | deformation | 109 | model | 135 |
| 4 | friction | 22 | mechanics | 83 | modelling | 104 |
| 5 | plates structures | 21 | fracture | 76 | materials | 102 |
| 6 | vibrations | 21 | solids | 70 | dynamic | 88 |
| 7 | viscoelasticity | 21 | systems | 58 | nonlinear | 85 |
| 8 | finite element method | 20 | plates | 56 | response | 85 |
| 9 | bending | 18 | simulation | 54 | stress | 77 |
| 10 | adhesion | 14 | dynamics | 51 | surface | 75 |
| 11 | fracture | 14 | stability | 51 | method | 73 |
| 12 | graphene | 14 | mechanical properties | 49 | finite | 69 |
| 13 | plasticity | 14 | stress | 46 | theory | 67 |

Contribution of Countries with ranks

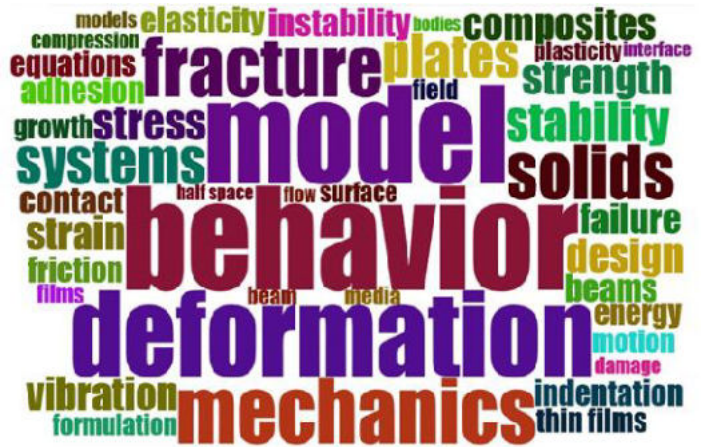
The data are given in table No. 12 represents the contribution of different countries in the Journal of Mechanics with the rank lists. It shows that the USA contributed 887 articles out of 1786.

It means the USA’s contribution is 49.66 % and got the first rank. China’s contribution was 456 (25.53%), England’s contribution was 89 (4.98%), and these two countries got second and third ranks. The table also shows the country-wise

Graph 3 Author's Keyword



Graph 4 Keyword



Graph 5 Title Words



citation data, and the USA has got the highest citations 8393 with the first rank and China got citations 3772 with the second rank. However, the ACPI indicator shows that Italy received the highest position with a 12.86 ACPI score, and it

means Italy had fewer papers contributed to this journal, but the citation received by each article is higher than any other country.

Table 11: Country-wise contribution of articles in ASME Journal of Applied Mechanics

| Sr. No. | Name of Country | Published Articles | % of Total 1786 | Rank of Country | Total Citations | Average citations per Paper (ACPI) | Average citations per year (ACPY) |
|---------|----------------------|--------------------|-----------------|-----------------|-----------------|------------------------------------|-----------------------------------|
| 1 | USA | 887 | 49.66 | 1 | 8393 | 9.46 | 699.42 |
| 2 | China | 456 | 25.53 | 2 | 3772 | 8.27 | 314.33 |
| 3 | England | 89 | 4.98 | 3 | 1125 | 12.64 | 93.75 |
| 4 | Canada | 83 | 4.65 | 4 | 786 | 9.47 | 65.5 |
| 5 | France | 75 | 4.2 | 5 | 628 | 8.37 | 52.33 |
| 6 | India | 63 | 3.53 | 6 | 566 | 8.98 | 47.17 |
| 7 | Italy | 51 | 2.86 | 7 | 656 | 12.86 | 54.67 |
| 8 | Germany | 41 | 2.3 | 8 | 499 | 12.17 | 41.58 |
| 9 | Israel | 39 | 2.18 | 9 | 350 | 8.97 | 29.17 |
| 10 | Japan | 39 | 2.18 | 9 | 329 | 8.44 | 27.42 |
| 11 | Taiwan | 32 | 1.79 | 10 | 308 | 9.63 | 25.67 |
| 12 | Iran | 30 | 1.68 | 11 | 287 | 9.57 | 23.92 |
| 13 | South Korea | 29 | 1.62 | 12 | 203 | 7.00 | 16.92 |
| 14 | Netherlands | 25 | 1.4 | 13 | 245 | 9.80 | 20.42 |
| 15 | Sweden | 23 | 1.29 | 14 | 149 | 6.48 | 12.42 |
| 16 | Singapore | 22 | 1.23 | 15 | 241 | 10.95 | 20.08 |
| 17 | Russia | 18 | 1.01 | 16 | 206 | 11.44 | 17.17 |
| 18 | Spain | 17 | 0.95 | 17 | 157 | 9.24 | 13.08 |
| 19 | Turkey | 17 | 0.95 | 17 | 119 | 7.00 | 9.92 |
| 20 | Scotland | 13 | 0.73 | 18 | 109 | 8.38 | 9.08 |
| 21 | Austria | 12 | 0.67 | 19 | 77 | 6.42 | 6.42 |
| 22 | Brazil | 10 | 0.56 | 20 | 119 | 11.90 | 9.92 |
| 23 | Norway | 10 | 0.56 | 20 | 39 | 3.90 | 3.25 |
| 24 | Other (42 Countries) | 152 | 8.51 | NIL | 1062 | 6.99 | 88.5 |

Intuitional Contribution to the Journal with Ranks:

Table 13 shows the ranking list of institutions based on their contribution to the Journal of Mechanics. As per data given in the table, Tsinghua University got the first rank with 80 papers.

‘University of California System’ got the second rank with 79 research articles, and ‘North-western University’ got the third rank with 71 research articles in its credit. This list provides the first 30 institutions who contributed to this journal, and they received a rank up to 23.

Table 12 : Intuitional Contribution to the Journal with Ranks

| Sr.No. | Organizations-Enhanced | Records | % of 1786 | Rank |
|--------|---|---------|-----------|------|
| 1 | Tsinghua University | 80 | 4.479 | 1 |
| 2 | University of California System | 79 | 4.423 | 2 |
| 3 | North-western University | 71 | 3.975 | 3 |
| 4 | University of Illinois System | 66 | 3.695 | 4 |
| 5 | University of Illinois Urbana Champaign | 62 | 3.471 | 5 |
| 6 | Zhejiang University | 59 | 3.303 | 6 |
| 7 | Xi An Jiao tong University | 51 | 2.856 | 7 |
| 8 | Massachusetts Institute of Technology MIT | 43 | 2.408 | 8 |
| 9 | Georgia Institute of Technology | 36 | 2.016 | 9 |
| 10 | University System of Georgia | 36 | 2.016 | 9 |

FINDINGS AND CONCLUSION

The study reveals that multi-author collaboration increases in the publication trends of the studied journal of Applied Mechanics. Due to multi-author collaboration increase every year, all collaboration indices found increasing year by year. It shows collaborative efforts taken by researchers from the field of Applied Mechanics. As the relative growth rate found decreasing, it means the research productivity needs to be improved in this field. Citations received by articles shows the global recognition of the research. According to relative growth rate during the year 2007, 2008, 2011, 2014 were more than 1. It means the research articles citation rate is higher than the total publication of this journal in the field of Applied Mechanics. Publication Efficiency index reveals that Italy is the country who received the highest PEI score means this country has a smaller number of research articles but has conducted research which were

globally accepted and have higher impact in the field of Applied Mechanics. Immediacy index found highest in 2014 with 0.76 score which means 174 articles published in 2014 got quick recognition and have greater impact in the research of applied Mechanics in 2014 itself.

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