

Growth and Impact of Artificial Intelligence Research Output in India: A Study

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Abstract

The citation analysis is an essential part of an institution's measure and evaluation of research quality. The present study is tracing the growth and impact of Computer Science Research Output in India. The study traces the growth of publication and pattern of citations. The journal observed progressive inclination in the number of publications and citations over the years. Total of 158 publications, have been published during the time span of 7 years (i.e., from year 2008–2014). Compound Annual Growth Rate (CAGR) of publication is 58.58%. The authors have a preference to work in alliance at various levels, which evidently signifies that they are well aware of the benefits working in collaboration that enable the exchange of knowledge and ideas among researchers leading to qualitative research.

Keywords: Research, artificial, India, citation analysis, collaboration

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INTRODUCTION

Citations are typically regarded as the formal appreciation of the previously published sources of information that relate to the citing author's research [1]. Thus, the number of times, a publication has been cited by other authors is an indication of overall scientific utility of that particular article [2]. Given that utility is one aspect of scientific quality, citation counts are commonly used by decision makers to gauge the academic performance of individual researchers, departments and research institutions when making decisions about funding, hiring, promotion and tenure and as well as to compare the development of different disciplines and national scientific outputs and the use of citation counts for academic evaluation has increased rapidly since the introduction of computerized citation indexes and citation scores have been advertised as objective quantitative indicators of scientific performance and a precious addition to conventional methods of research evaluation, such as peer review [3]. The use of citation counts for academic evaluation is based on the assumption that authors select references based on their relevance and contribution to the author's own work, and that all important sources are credited by citation. Citation analysis has conquered the world of science policy analysis. The main objectives of

citation analysis are to evaluate and to interpret citations received by the articles, authors, institutions and other aggregates of scientific activities. The primary function of citation is to provide a connection between two documents, one which cites and the other which is cited [4].

Citation analysis has been used for the evaluation of research performance. Among others, the main uses have been the study of rankings of journals, university departments, scientists, research institutions, and academic journals. The starting point of this approach is that citations, even the negative ones, are a measure of influence in science: the more often an article is cited the more it is known to the scientific community [5]. The whole academic community acts as a big set of peers to recognize, by means of citations, the value of a given contribution and the decisions of this jury can be studied using Citation Indices. Citation analysis can be used to identify the most frequently cited journals relevant to a given field. As noted by many studies, in a given area or discipline, a few core journals receive many citations and the rest of journals receive far less citations. This pattern has been also identified with authors and other units of analysis [6]. Dynamic mapping of science using Citation Indices has been pursued for

more than 30 years now [7]. The starting point is that citations from paper to paper or from journal to journal provide indicators of intellectual linkages between subject areas, organizations or individuals. Research approaches used in this field study are co-citations (one document is cited by two other documents) and bibliographic coupling (two documents are cited in another document). There are mainly three application areas in citation analysis first qualitative and quantitative evaluation of scientists, publications and scientific institutions, second is modeling of the historical development of science and technology and final is information search and retrieval [1].

PROBLEM

The contemporary epoch is facing a drastic change in the way people find and use information resources. Although the information gathering and use pattern in the traditional print environment have been studied for many years, the electronic media present a new and relatively unexplored area for such study. Research output and citation analysis is an essential tool to know the impact of research. Consequently, need was felt to determine the Growth and Impact of the India top publication on Artificial intelligence i.e. "International Journal of Artificial Intelligence".

REVIEW OF RELATED LITERATURE

Basu (1999) analyzed that the foreign collaboration has great impact on visibility of Indian science research [8]. Okubo (1999) compared the international paper proportion of five Chinese scientific journals in 1996 with that of well-known foreign journals in the same category, and argued that journals with a high impact factor always have internationalization [9]. Das and Sen (2001), Arunachalam *et al.* (1993) analyzed the authorship patterns of the citations and shows that more than 15 percent contributions are single-authored and about 85 percent are the result of teamwork [10, 11]. Single-authored articles amount to 15.52 percent of the total citations and about 28 percent resulted through the collaboration of five or more authors. Of the citations, 88.73 per cent pertain to journal articles. Out of the total citations, 9.48 percent

are author self-citations and 7.3 percent are journal self-citations. Ren and Rousseau (2002) analyzed journal citation report (JCR) data from 2000 and 2001 [12]. They found that Chinese English language journals are not internationally recognized and have very low international visibility.

Glanzel and Schubert (2005) found that the standards and, particularly, the visibility of scientific research, depend on the level of collaboration [13]. Lee (2005) found that IMCB (Institute of Molecular and Cell Biology) researchers have been very selective in where they publish – 95.6% of the articles were published in ISI journals [14]. The articles received an average of 25 to 35 citations per article, and the percentage of non-cited articles is 11.6%. Four articles received more than 200 citations, and 18 received between 100 to 200 citations. Moin *et al.* (2005) reviewed the scientific output of Iran over the period 1967-2003 and compared it with 15 countries in the year 2000 [15]. During these years Iran's relative share in global scientific output increased from 0.0003 percent to 0.29 percent in 2003. Comparing the ratio of science output to gross national product, Iran stood at the 13th place among 16 countries in the year 2000. Harirchi *et al.* (2007) investigated factors behind co-authorship between scientists in Iran and elsewhere and also compared the Iranian pattern of collaboration with other countries [16]. The results showed that not all co-authored articles were the result of a collaborative project. Sharing laboratory devices, accessing knowledge and increased efficiency of the study were the main collaborative motives behind the co-authorships. Wang *et al.* (2007) analyzed the internationalization of ten of China's English language scientific journals [17]. The data showed that though the total trend of Impact Factor and Total Citation keeps rising; their subject rank has shown a slight decrease.

Davarpana and Behrouzfar (2009) investigated the internationalization and visibility of Iranian scientific journals covered by the Institute for Scientific Information (ISI) between 2000 and 2006 [18]. The results showed that the visibility rate of Iranian journals is low compared to their international

counterparts. Garg and Kumar (2010) analyzed 5317 articles and reviews published in 46 Indian science journals indexed by Science Citation Index Expanded (SCIE) during 2006 indicated that these journals predominantly published domestic papers [19]. About 40 percent of the papers published in these journals were cited in the international literature during January 2006–June 2009. The proportion of cited papers and the rate of citation varied for domestic, foreign, and collaborative papers, as well as among disciplines and publishers. The analysis indicated that collaborative papers had the highest rate of citation per paper. Mingers and Xu (2010) investigated the number of citations received by papers published in six well-known management science journals [20]. It considers factors that relate to the author(s), the article itself, and the journal. The results show that the strongest factor is the journal itself; but other factors are also significant including the length of the paper, the number of references, the status of the first author's institution, and the type of paper, especially if it is a review.

Sotudeh (2011) found that Iran experienced a considerable citation loss, compared to its expectation level [21]. The results also confirmed a relatively poor publication strategy adopted by Iranian scientists and that a publication concentration does not necessarily enhance the chance of being widely cited. A bibliometric method was used to obtain a view of the scientific production about breast reconstruction by data extracted from the Institute for Scientific Information (ISI) [22]. Specific parameters were retrieved from the ISI. Articles about breast reconstruction were analyzed to obtain a view of the topic's structure, history, and document relationships using HistCite software. The study found that the number of articles was constantly increasing. Most highly cited articles described the methods of flap construction in the surgery. Other highly cited articles discussed the psychological or emotional aspects of breast reconstruction, skin sparing mastectomy, and breast reconstruction in the irradiated breast.

Correll *et al.* (2014) attempted Scientometric analysis of International Journal of Information Science and Technology [23]. It is based on the references appended to International Journal of “International Journal on Information Science and Technology” during 2009–2013. The study was based on 1390 references appended to 75 articles contributed by the authors in International Journal on Information Science and Technology. It was found that journals citations are more in number than the other citations. In authorship pattern, it was found that solo research was predominant then collaborative research. The degree of collaboration was calculated and it was found that the single authorship trend is Decrease gradually in International Journal of Information Science and Technology. It has been observed that researchers cite latest documents. The study shows the period of International Journal of Information Science and Technology is 5 years approximately.

Furthermore, Minguillo *et al.* (2014) investigate whether scientific publications can give plausible suggestions about whether R&D support infrastructures in the UK successfully foster scientific activity and cooperation [24]. For this, research publications associated with UK SPs were identified from Scopus for the years 1975–2010 and analyzed by region, infrastructure type and organization type. Industry-academia collaborations show that on-park firms tend to collaborate with partners beyond their local region rather than the local HEI. Support infrastructures may therefore not help to reduce the uneven development and geographic distribution of research-intensive industries in the UK. Pollack and Adler (2014) they uses quantitative techniques to reveal trends in project management related research published between 1962 and 2012 [25]. The data set for this research includes 94,472 unique records sourced from the Scopus and ISI Web of Science databases. The research has revealed evidence to indicate a change in emphasis in project management research from a technical engineering orientation to one which encompasses a broader organizational perspective.

OBJECTIVES

The main objectives of the study are:

- i. To trace the growth of Artificial Intelligence Research Output.
- ii. To determine the source type preferred for publishing research.
- iii. To explore the pattern and growth of citations.
- iv. To examine the impact authorship/collaborative pattern on the citations.

METHODOLOGY

The study is based on the data collected from the journal of *“International Journal of Artificial Intelligence”* and (ISSN-09740635) in the subject area of Computer Science and subject category of Artificial Intelligence. International Journal of Artificial Intelligence has been ranked number 1 journal in India in the field of Artificial Intelligence (*H-index=9*) according to SJR (SC Imago Journal and Country Ranking). Scopus database was used to retrieve publication and citation data. The retrieved results were then analyzed.

SCOPE

The Scope of the Study is limited to Journal articles published between (Years 2008–2014).

DATA- ANALYSIS AND INTERPRETATION

Distribution of Source Type

The research output in the field of computer science is published in diverse formats like research articles journals, Review articles, book reviews etc. based on the type of research performed by the researchers (Table 1). All the published scholarly content in the International Journal of Artificial Intelligence are in the form of journal articles 158(100%).

Table 1: Year- Wise Distribution of Publications.

Year	No. of Publications
2008	09
2009	16
2010	18
2011	42
2012	30
2013	24
2014	19
Total	158

Compound Annual Growth Rate of Publications

The Table 2 shows that the 7 years Compound Annual Growth Rate (CAGR) of 58.58%. It understand that it rush forward at a very high rate.

Table 2: Compound Annual Growth Rate of Publications.

Period	Output Cumulative		CAGR (Compound Annual Growth Rate)
	Initial	Final	
2008–2014	09	158	50.58%

International Collaboration of Published Documents

International Collaboration accounts for the articles that have been produced by researchers from several countries. The data shows that in year 2012 highest number (30.3%) foreign publications have been published followed by year 2013 (22.22%), 2010 (16.67%), 2011 (13.95%), 2009 (4.74%). The chart shows the ratio of a journal's documents signed by researchers from more than one country (Figure 1).

Authorship Pattern of Publications

It is evident from Table 3 that 139 (87.97%) publications are co-authored. The top partnership has taken place among more than three authors, which constitutes 32.9% of the entire.

Table 3: Authorship Pattern of Publications.

Authorship Pattern	No. of Publications
Single authored	19 (12.0%)
Two- authored	45 (28.5%)
Three-authored	42 (26.6%)
Multi-authored (> three authors)	52 (32.9%)
Total	158

Citation Pattern of Publications

The data reveals that there is a progressive inclination in the citations over the passing years. The publications of year 2013 receive maximum citations (172 citations) followed by year 2012 receive 92 citation. The study comprehends that the visibility and quality of research improved with the passing years. The vivid picture is offered in Figure 2.

Citation Pattern of Publications

The data reveals that with the passing years the number of self-citations rate decreases and

the number of cross citation increase (Figures 3 and 4).

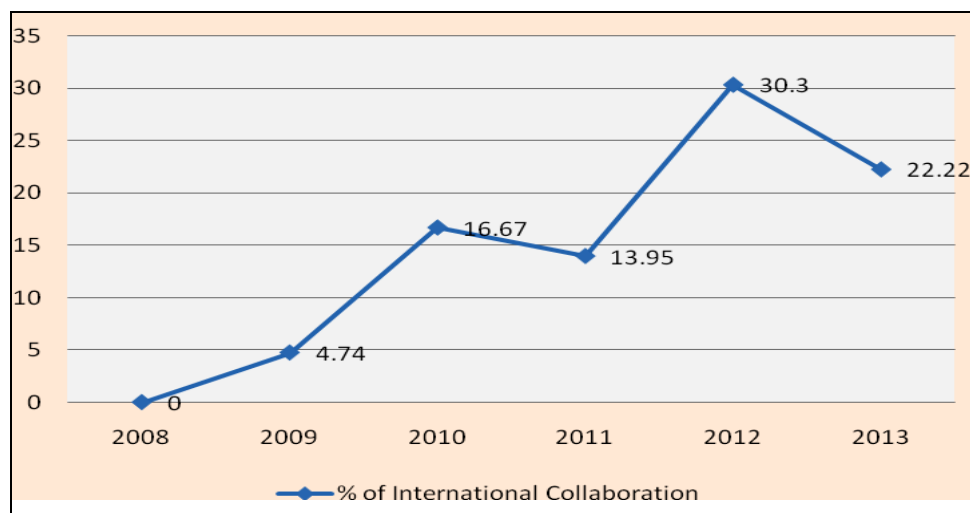


Fig. 1: Percentage of International Collaboration.

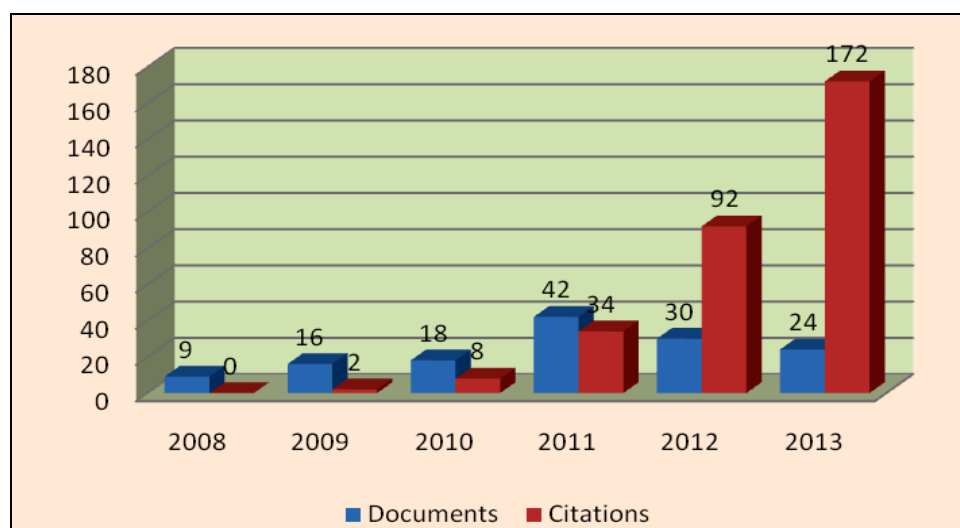


Fig. 2: Year Wise Number of Documents and Citations.

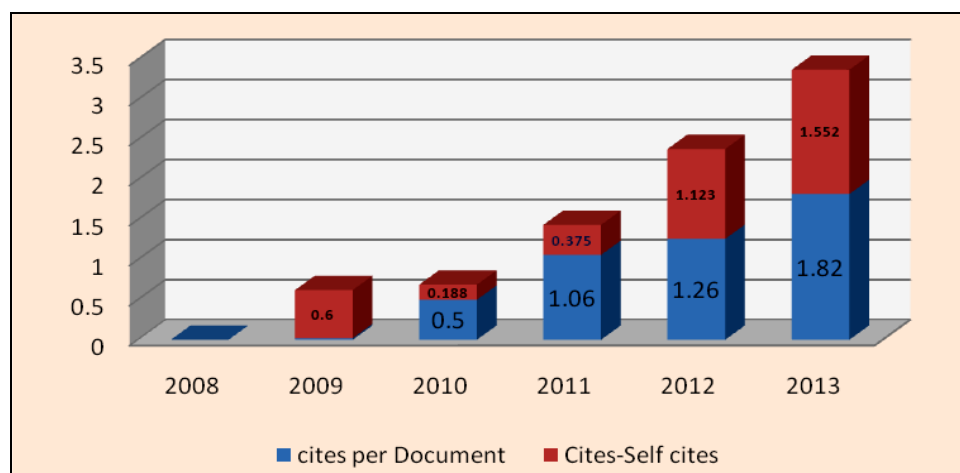


Fig. 3: Cites per Document vs. External Cites per Document.

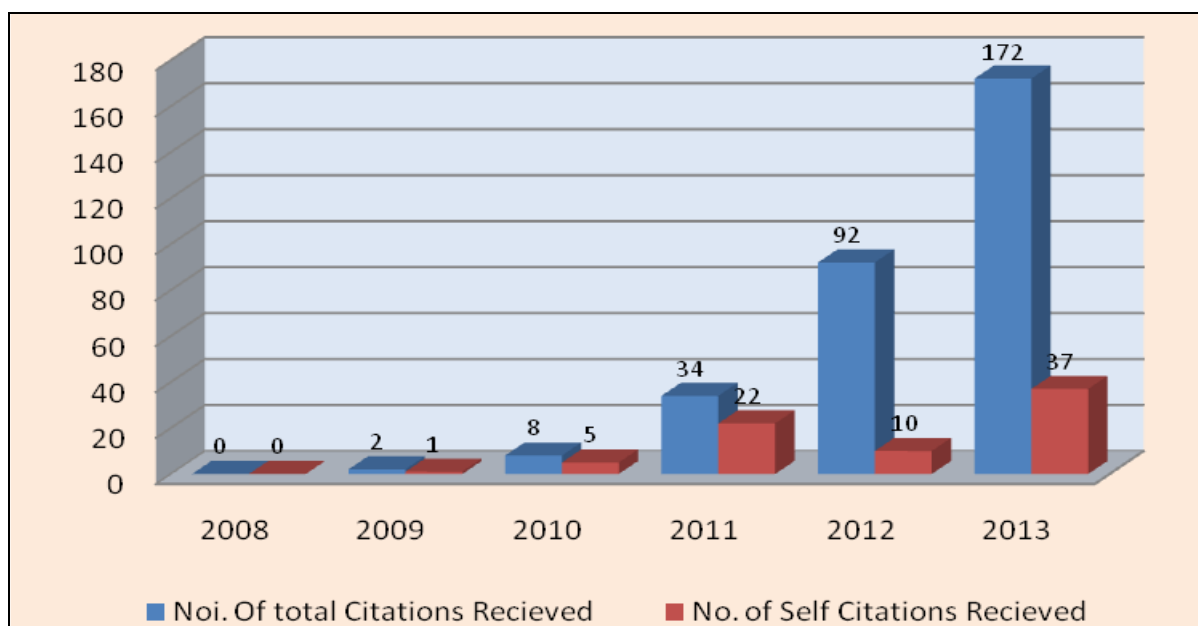
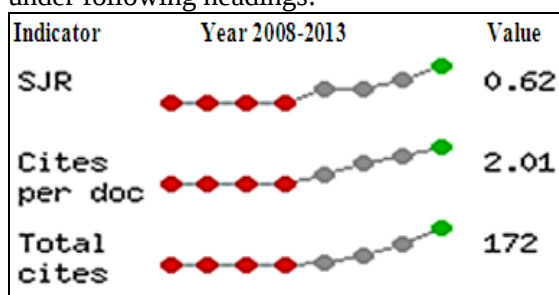


Fig. 4: Citation and Self Citation Pattern.

FINDINGS

The major findings of the study are discussed under following headings:



Growth in Publications: The initial years of the journal received modest amount publications, which eventually rose with fluctuating patterns over the years. However, artificial intelligence being the most vast and innovative field of research for every developed and developing nation. The growth of publications must escalate further with qualitative publications. The fluctuations in number of publications may be attributed to an array of factors, which include first in year (2008) only one issue is published; another one may be that although the journal received number of publications but not meeting quality factors and so on.

Quality of Publications: Publications during the inception year received zero citations. However, in preceding years quality of publications seems to enhance with rising number of citations, and average citation/

publication, which also featured fluctuating pattern over the years. The fluctuations in citations can be due to number of factors, which include less visibility of the journal, not so suitable topics of research according to current trends in Artificial Intelligence Research that may be of meaning in near future.

Collaborations: The authors have a preference to work in alliance at various levels, which evidently signifies that they are well aware of the benefits working in collaboration that enable the exchange of knowledge and ideas among researchers leading to qualitative research.

CONCLUSION

The study provides an overview of growth and development of research out in the field of Artificial Intelligence published in Indian journal (*International Journal of Artificial Intelligence*). Although the publications count in journal show increasing trend with qualitative publishing yet, keeping in view the immense importance of the Artificial Intelligence research particularly for developing nations like India there is much to do to improve the growth and development of scholarly output in the particular field to improve and advance stability of the nation. In above milieu it becomes imperative to deliberate upon the causes that are

contributing towards stumpy research output in the journal.

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