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Pandemic Effect on the Research Output of Netaji Subhas University of Technology: A Scientometric study

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The study is based on 2789 publications,authored by faculty of Netaji Subhas University of Technology from the year 2006 to 2020 and indexed in the Scopus database. The publications include the document types, articles, articles-in-press, reviews, and conference papers.The research output has been studied to explain the effect of the pandemic onit. The document types, articles, articles-in-press and reviews have been included in the category, articles and conference. The average of annual shares from the year 2006 to 2020 has been found 6.7% and the highest contribution of 13.5% in the year 2018 followed by 10.8% in the year 2019. It is 9.6% in the pandemic year 2020, which is greater than the average of annual share 6.7%.

Keywords:*COVID-19; Engineering Science and Technology; State University; Delhi; Research output; Scientometrics*

0 INTRODUCTION

From the early months of the year 2020, the global pandemic caused due to the spread of COVID-19, has put the mental, physical and economic situations of each individual on hold. The interactions and movement have beenreduced in every walk of life. The acceptability of online interaction has increased. (Graham-Clare, 2021)[1]has mentioned that Springer publisher has made a9% year-on-year increase in the publication of articles following the 24% increase in submission in the year 2020. Also,the growth in readership of Springer content was seen by Graham-Clare. The way of living and working of researchers have fundamentally changed. Publishers

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are supporting the researchers in different ways by providing remote access to content, by providing platforms for the research community to share their experiences and perspectives, researcher blog, source, publishing regular series, etc.

(Netaji Subhas University of Technology, 2021)[2] Netaji Subhas University of Technology (NSUT) a state University of Govt. of NCT of Delhi is known by this name since 26th September 2018. Earlier it was known as Netaji Subhas Institute of Technology (NSIT)from Feb. 1997 to Sept 2018 and as Delhi Institute of Technology (DIT) from July 1983 to Feb. 1997. The University has been placed at 76th rank in Indian Ranking 2020 from NIRF in the engineering category. In the academic years, 2017-18, 2018-19 & 2019-20 about 50 Ph.D. students have graduated and more than 200 are pursuing this degree in 2019-20 from the University. The admission in two year PG programs of University in the academic year 2018-19 has crossed one hundred.

1 REVIEW OF LITERATURE

Research outputs of the authors, affiliated to NSUT, have been studied by different researchers at different times to see their behaviours. (Choudhary, Singh, & Prasad, 2020)[3]Authors studied the 334 recent research publications of 42 NSUT professors from nine departments related to engineering & science that were indexed in the Scopus database.The dominance factor was found the maximum among the professors of the Mathematics department.(Choudhary & Singh, A scientometric study of NSIT publications in science and technology during 2006 to 2015, 2018)[4]covered1184 research publications of NSIT published from 2006 to 2015 and indexed in Scopus.Tb reported anaverage annual growth rate (10.9%), productivity per capita (12.3), and average productivity per author (0.34).(Choudhary & Choudhary, Publication output of Netaji Subhas Institute of Technology, Delhi (1996-2015): A scientometric study, 2016)[5] studied the share of research publications from NSIT in the subject areas of the Institute to that with other institutesfrom Delhi in two block years (2006 to 2010 and 2011 to 2015) as an effect of consortium-based subscription to journals. It was found that the share of the Institute in Delhi had gone up from 3.1 % to 3.3% from the block years 2006-2010 to 2011-2015. About 75% of publications of the Institute were found from the Departments namely ECE, COE, ICE, and Mathematics.

2 OBJECTIVES

- To find the annual share of publications in the pandemic year 2020 compared to the fifteen-year of publications
- To compare the priority index for leading document types over the study period from 2006 to 2020 at the University.
- To see the effect of the pandemic on the publication of research output using the growth rate during past years.
- To find out the effect on author productivity and the authorship pattern in the pandemic year.
- To find the citation shares in the year 2020 of the publications during 2006 to 2018.

3 METHODOLOGY

Publication data of NSUT have been collected from Scopus database using Netaji Subhas Institute of Technology and variant name as affiliation and the Netaji Subhas University of Technology as address.The address search withthe Universityhas been made because itdid not appear in the variant names in the affiliation search in Scopus.The data were exported in excel files for the two searches and were merged into one file. Duplicate records were removed. Data so obtained were scanned through the field, 'author with affiliation' and the unwanted records were removed from the study.

For citation-share, the citation count has been collected using the citation trackerservice of Scopus database for affiliation search. The data have been collected in January 2021.

4 SCOPE

(Thelwall, 2018)[6]has mentioned that in the old article, occasionally correction is made inthe Scopus database, so the error may vary over time. Hence the errors in built in retrieved publication data could not be corrected in the present study.In other words, publications data of NSUT are representative data of NSUT. The document types namely, book, book chapter, editorial, erratum, note, letter, and short survey have not been studied for analysis. Document types namely, article, conference paper, review,

article-in-press have only been analysed in this paper.The research publications on engineering, science, and technology have been identified from knowledge and awarenesswhere the name of the department has not been given along with the author.

5 DISCUSSION AND ANALYSIS

51 ANNUAL SHARE OF RESEARCH OUTPUT

A total of 2789 contributions have been found in the Scopus database, contributed by the authors of NSUT from the year 2006 to 2020. Out of these, the document types namely article, article-in-press, review, and conference paper have constituted 93.0% of publications.The other document-types are short-survey (0.1%), erratum (0.2%), letter (0.3%), editorial (0.3%), book (0.3%), note (0.4%), and book-chapter (5.3%). The annual share ofresearch outputs in major document types in engineering and science from the year 2006 to 2020 have been given in Table 1. The priority to contribute as an article in a year has been calculated using the formula –

Priority Index (PI) for article = $[\{N_{ai}/N_{ao}\} / \{N_{oi}/N_{oo}\}]$

Here - N_{ai}=Number of articles in the year i;N_{ao}=Number of articles in all years; N_{oi}=Number of all contributions in the year i; N_{oo}=Number of all contributions in all years.

Similarly,the priority to contribute asa conference paper hasalso been calculated and given in the table. The value of PI, greater than one in a year has indicated the priority over the other as a document type in that year.

Table 1: Annual Share of Research Output

Year	% share (Count)	Yearly % share (count)		PI = [{N_{ai}/N_{ao}} / {N_{oi}/N_{oo}}]		Auth count (Art)	Authcount (Conf)	No. of Auth per contribution (Art)	No. of Auth per contribution (Conf)
		Article	Conference paper	Article Priority Index	Conf Priority Index				
2006	3.2 (83)	57.8 (48)	42.2 (35)	1.09	0.90	129	103	2.69	2.94
2007	2.5 (66	59.1 (39)	40.9 (27)	1.11	0.87	98	75	2.51	2.78
2008	3.2 (84)	66.7 (56)	33.3 (28)	1.25	0.71	132	93	2.36	3.32
2009	4.7 (122)	54.9 (67)	45.1 (55)	1.03	0.96	175	198	2.61	3.60
2010	4.6 (119)	55.5 (66)	44.5 (53)	1.04	0.95	178	160	2.70	3.02
2011	5.2 (136)	47.1 (64)	52.9 (72)	0.89	1.13	184	250	2.88	3.47
2012	4.7 (122)	45.1 (55)	54.9 (67)	0.85	1.17	153	211	2.78	3.15
2013	4.8 (124)	54.8 (68)	45.2 (56)	1.03	0.96	209	171	3.07	3.05
2014	5.8 (150)	49.3 (74)	50.7 (76)	0.93	1.08	228	229	3.08	3.01
2015	7.3 (188)	55.9 (105)	44.1 (83)	1.05	0.94	341	274	3.25	3.30
2016	9.8 (253)	39.9 (101)	60.1 (152)	0.75	1.28	345	485	3.42	3.19
2017	10.3 (267)	52.8 (141)	47.2 (126)	0.99	1.01	477	404	3.38	3.21
2018	13.5 (350)	50.6 (177)	49.4 (173)	0.95	1.05	572	538	3.23	3.11
2019	10.8 (279)	50.9 (142)	49.1 (137)	0.96	1.05	525	474	3.70	3.46
2020	9.6 (250)	70.0 (175)	30.0 (75)	1.32	0.64	598	254	3.42	3.39
	100 (2593)							3.00	3.20

It has been found that the maximum share of 13.5% contribution has been made in the year 2018 followed by 10.8% in 2019. In the pandemic year, 2020 the share ofresearch output has been found 9.6%.

The priority index for contributing anarticle is the maximum whereas that for contributing a conference paper is the minimum during the pandemic year 2020. The average number of contributors per article and that for each conference paper hasbeen calculated tobe 3.0 and 3.2 respectivelyduring the period of study. The maximum number of contributors per article has been found in the year 2019 followed by the pandemic year 2020 and 2016 respectively. The maximum number of contributors per conference paper has been found in the year 2009 followed by 2011. In the pandemic year 2020, the number of contributors per conference paper has been foundgreater thanthe average and smaller than that in the year, 2019.

5.2 AVERAGE GROWTH RATE AND THE CONTRIBUTION IN THE PANDEMIC YEAR 2020

The average growth rate (AGR) over annual intervals from the period 2007 to 2019 has been calculated to be 9.77% using the followingformula -

AGR= [{(Contribution in the year 2019)/(Contribution in year 2006)}^(1/13) – 1]

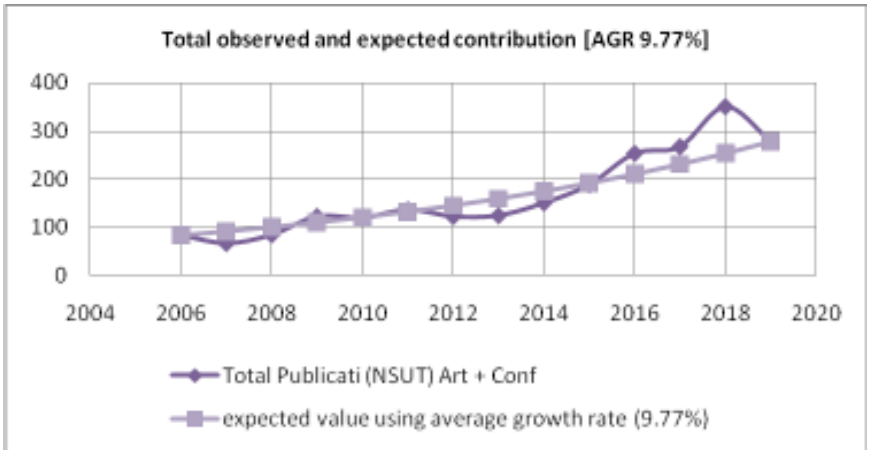

Figure 1: Average Growth Rate of Research Outcome

It is indicated in figure-1 that the observed research outputs are greater than the expected research outputs in the years 2016, 2017 & 2018. The average of the absolute difference between expected and observed research outputs from the year 2007 to 2018 has been found to be 26.7. The difference between the 'observed research outputs' and 'expected research outputs' in the pandemic year 2020 has been found about twice of the above calculated average difference with negative effect i.e. the observed output is less than expected. It has indicated the dip in total research outputs in the pandemic year, from the average growth rate.

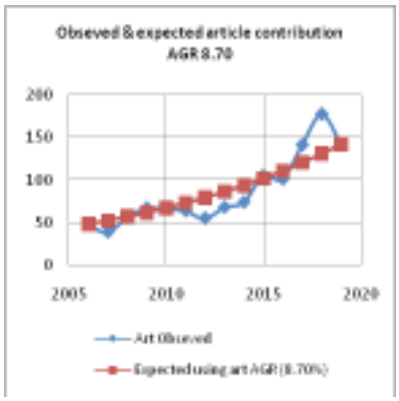

Figure 2: Observed and expected article contribution

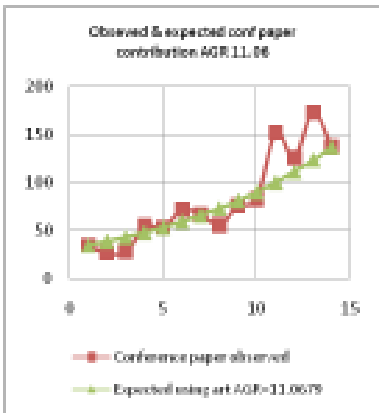

Figure 3: Observed and Expected Conference Paper Contribution

For contributions as an article, the value of AGR has been calculated to be 8.70. Also,the average of the absolute differences, between observed and expected values has been calculated to be 14.2. In the pandemic year 2020, the said difference has been found about twice of above-calculated average (14.2) with a positive effect, i.e. the observed value is more than the expected value.

For contribution as a conference paper, the value of AGR has been calculated to 11.06. Also, the average of the absolute differences, between the observed andthe expected values has been calculated to be16.1. In the pandemic year 2020 the difference between the 'observed research outputs' and 'expected research outputs' has been found more than four times of above calculated average 16.1 with a negative effect, i.e. the observed value is less than the expected value. In other words, the research outputs as a conference paper in the pandemic year have been less than the calculation using AGR.

5.3 DEPARTMENT-WISE CONTRIBUTION

The annual shares in the research-outputs in the departments in Science and Engineering of the University have been given in Table-2. The departments in Science and Engineering of the University are Electronics and Communications Engineering (ECE), Instrumentation and Control Engineering (ICE), Computer Science and Engineering (CSE), Mathematics (Math), Information Technology (IT), Mechanical Engineering (ME), Biological Sciences and Engineering (BSE), Physics (Phy), and Chemistry (Chem).

Table 2: Annual Shares in the Research-Outputs in the Departments

Year	ECE Yearly Share %	ICE Yearly Share %	CSE Yearly Share %	Math Yearly Share %	IT Yearly Share %	ME Yearly Share %	BSE Yearly Share %	Phy Yearly Share %	Chem Yearly Share %
2006	31.3	20.5	21.7	13.3	1.2	6.0	1.2	4.8	0.0
2007	21.2	18.2	16.7	22.7	3.0	13.6	0.0	4.5	0.0
2008	20.2	19.0	20.2	19.0	8.3	6.0	1.2	3.6	2.4
2009	31.1	8.2	23.0	9.8	18.0	3.3	1.6	3.3	1.6
2010	29.4	13.4	17.6	10.9	11.8	8.4	0.8	2.5	5.0
2011	29.4	23.5	19.9	13.2	7.4	2.9	1.5	2.2	0.0
2012	22.1	14.8	19.7	13.9	13.9	11.5	0.0	2.5	1.6
2013	32.3	15.3	21.8	13.7	6.5	1.6	2.4	4.0	2.4
2014	23.3	22.7	18.7	16.0	4.7	2.0	6.0	5.3	1.3
2015	19.7	27.1	17.0	13.8	4.8	5.9	9.0	2.1	0.5
2016	28.1	30.0	14.6	7.1	6.3	6.3	5.9	1.6	0.0
2017	22.1	33.0	17.6	4.5	7.1	6.4	6.4	2.6	0.4
2018	23.7	16.9	24.0	5.4	12.3	10.3	3.7	1.4	2.3
2019	24.4	20.4	20.8	5.0	10.4	10.4	2.9	2.2	3.6
2020	20.8	21.2	16.4	10.8	11.2	7.2	5.6	4.0	2.8
Overall	24.8	21.5	19.3	10.0	8.9	7.1	4.0	2.8	1.7

About 75% of total research outputs have been contributed by ECE, ICE, CSE,& Math. Each of these departments has individually contributed more than 10% during the study period. In the pandemic year 2020, out of the four, ECE, and CSE have less annual shares than their respective annual shares in 2019 and also than their overall shares in the study period.

5.4 AUTHORSHIP AND AUTHOR PRODUCTIVITY

In Table-3 the shares of 'Single Author Pub', 'Joint Author Pub', 'Multi-Author Pub', and 'Mega Author Pub' for articles as well as conference papers have been given. Here these terms have been used for the documents written by one author, two authors, three authors, and more than three authors. Accordingly, the authorship share Single, Joint, Multi, and Mega.

The average productivity per author (APPA) has been defined as the number of papers divided by the number of authors. These have also been mentioned in Table 2 for articles as well as conference papers.

The annualshare of single-authoredarticlesto the articles of that year has been found maximum (25.6%) in the year 2007 followed by 22.4% in the year 2009. The annualshare of single-authored articles to the articles of that yeardecreased to 1.4% in 2019 which again increased to 4.0% in the pandemic year 2020.

Table 3: Authorship Share in Article and Conference Papers

Year	Authorship Share (Article)					Authorship Share (Conference Paper)				
	Single Author Pub %	Joint Author Pub %	Multi Author Pub %	Mega Author Pub %	APPA (Art)	Single Author Pub %	Joint Author Pub %	Multi Author Pub %	Mega Author Pub %	APPA (Conf)
2006	12.5	37.5	25.0	25.0	0.37	2.9	28.6	45.7	22.9	0.34
2007	25.6	35.9	15.4	23.1	0.40	7.4	51.9	14.8	25.9	0.36
2008	21.4	46.4	17.9	14.3	0.42	3.6	25.0	28.6	42.9	0.30
2009	22.4	31.3	20.9	25.4	0.38	1.8	16.4	32.7	49.1	0.28
2010	15.2	42.4	18.2	24.2	0.37	1.9	37.7	30.2	30.2	0.33
2011	9.4	34.4	31.3	25.0	0.35	2.8	19.4	33.3	44.4	0.29
2012	10.9	29.1	40.0	20.0	0.36	1.5	29.9	37.3	31.3	0.32
2013	5.9	26.5	41.2	26.5	0.33	0.0	33.9	37.5	28.6	0.33
2014	6.8	32.4	29.7	31.1	0.32	1.3	30.3	43.4	25.0	0.33
2015	6.7	29.5	37.1	26.7	0.31	6.0	15.7	39.8	38.6	0.30
2016	5.9	26.7	35.6	31.7	0.29	3.3	27.0	38.2	31.6	0.31
2017	2.1	30.5	36.9	30.5	0.30	1.6	15.1	52.4	31.0	0.31
2018	1.1	27.1	41.2	30.5	0.31	3.5	27.7	34.7	34.1	0.32
2019	1.4	22.5	31.7	44.4	0.27	1.5	21.2	33.6	43.8	0.29
2020	4.0	25.1	28.6	42.3	0.29	2.7	17.3	37.3	42.7	0.30

The annual share of joint-authored articles to the articles in that year wasthe minimum (22.5%) in the year 2019 which increased to 25.1% in the pandemic year 2020. It has been foundto be maximum, 46.4% in 2008.

The annual share of joint-authored articles to the articles in that year has been found to be maximum for the years 2006 to 2011 in all types of authorship in article contributions. This place of maximum annualshare of joint-authored articles has been replaced by annual shares of multi-authored articlesin the years 2012 to 2020 except for 2014.

The annual share of single-authored conference papers to the conference papers in that year has been found to be maximum 7.4% in the year 2007 followed by 6% in 2015. This hasbeen found the minimum (1.5%) in the year 2019. This annual share of joint-authored conference papers has increased to 2.7% in the pandemic year 2020.

The maximum annual share in conference papers prior to 2019 has been many of the times, of multi-authored papers. In the years 2019 & 2020, the maximum annual share in conference papers has been that of mega-authored papers.

Author productivity in terms of average publications per author has increased for articles as well as for conference papers in the pandemic year 2020 in comparison to the pre-pandemic year 2019.

5.5 CITATION SHARES IN THE YEAR 2020 TO THE DOCUMENTS

In Table-1 the publication count has been mentioned for select document types. The publication count for other document types (book chapter, note, editorial, erratum, short survey & book) has been given in Table 4 along with the count as per the citation tracker. The percent of the documents cited, the citation per cited document and the percent deviation in two searches in the same source have also been calculated and given in the table.

Netaji Subhas Institute of Technology became the NetajiSubhas University of Technology in the year 2018 and in Scopus affiliation search this new name has not been found on the date of search conducted. Hence the abrupt data have been for the years 2019 & 2020 inTable 4.

Table 4: Publication Count for Other Document Types

Year	Publication count (Citation Tracker for NSIT)	Publication (other document types	Deviation	% deviation	Citation in 2020	Total Citation till 2020	Citation Share in 2020 (%)	No of doc cited	% doc cited	Citation /cited doc
2006	87	1	3	3.6	39	770	5.1	68	81.9	11.3
2007	68	2	0	0.0	48	609	7.9	59	89.4	10.3
2008	91	5	2	2.4	83	1442	5.8	73	86.9	19.8
2009	127	3	2	1.6	72	1352	5.3	99	81.1	13.7
2010	126	2	5	4.2	115	1478	7.8	100	84.0	14.8
2011	142	3	3	2.2	111	1364	8.1	115	84.6	11.9
2012	125	1	2	1.6	110	1136	9.7	100	82.0	11.4
2013	137	11	2	1.6	162	1292	12.5	119	96.0	10.9
2014	165	9	6	4.0	242	1637	14.8	136	90.7	12.0
2015	192	7	-3	-1.6	434	2206	19.7	176	93.6	12.5
2016	272	12	7	2.8	424	1717	24.7	217	85.8	7.9
2017	306	32	7	2.6	817	2385	34.3	240	89.9	9.9
2018	389	38	1	0.3	830	1697	48.9	265	75.7	6.4
2019	268	54	-65		605	799	75.7	170	60.9	4.7
2020	160	16	-106		10	155		63		
			Average	2.2						

The maximum percent of the documents (96%) cited has been seen in the year 2013 whereas the maximum number of citations per document (19.8) has been calculated for the year 2008. From the year 2006 to 2018 the deviation percent have been found in between -1.6 to 4.2. In the year 2020, the documents published in 2018 have been cited about 48.9% of their total citations. In the pandemic year, the 2017 published documents have been cited 34.3% of their total citations. This value has further decreased to 24.7%, 19.7%, 14.8%, 12.5%, and so on in the years 2016, 2015, 2014, 2013, and so on respectively. It has indicated that the effect on citation share in the pandemic is not significant.

6 CONCLUSION

Most of the research publications in engineering science & technology in the University are contributed by the faculty members, the two-year post-graduate students, the Ph.D. students, and the four-year undergraduate engineering students. Their numbers in the University are increasing regularly so there is a great potential for more research activities at the University. Research publications from the year 2013 to the year 2019 have regularly increased except for a great jump in the publicationsin the year 2018. In the pandemic year 2020, the drop in the total publication by about 10% from the publication in the year 2019 has been seen. This drop is mostly due to the lesser contribution as conference papers from the calculation using AGR. The departments which have shared about 75% of the research output in the study period have not been able to sustain their annual share of research output either in comparison to their last annual share or average share in the pandemic year 2020. The average growth rates over the period 2006 to 2019 for the total research publications, the journal articles, and the conference papers have been found to be 9.7%, 8.7% & 11% respectively. In the pandemic year, the research output as a journal article has been found more than the expected output of journal articles. The productivity per author (APPA) for articles as well as the conference papers in the pandemic year 2020 have been found more than that in the year 2019 although less than that in the years 2017 & 2018. The annual share of single-authored articles and joint-authored articles in the pandemic year has increased compared to the previous year. Also, annual shares of single-authored and multi-authored conference papers have increased in the pandemic year than in the previous year.

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