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# **A Scientometrics Study of Research Productivity of VSS University of Technology(VSSUT) as Reflected in Scopus Database during 2015-2020**

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## **ABSTRACT**

In this study we aims to measure and evaluate the quantitative growth of research productivity of VSS University of Technology, Odisha using scientometrics parameters such as annual growth rate, author productivity, institution-wide collaboration, and collaboration pattern. The research publications data of VSSUT were retrieved from Scopus from 2015 to 2020. The total publications of 1889 sample datasets are used for this study. The maximum annual growth rate of 85.91 is recorded in 2018, whereas negative value of AGR of -8.5 is recorded in the year 2016. Engineering is the top productive subject domain and S. Panda found to be the most prominent author in this given period with 121 publications. The researcher of VSSUT mostly preferred to published their research work in the form of articles (733 with 51.14%) and followed by conference paper (556 with 39.04%), Book chapter (59 with 4.14%) papers. It has been found that for VSSUT the domestic collaboration is high and there is lack of international collaboration observed. Cluster analysis of key terms indicates that VSSUT research are mainly concentrating in the core areas of control systems, particle swarm optimization, neural network, data mining and artificial intelligence. Significant amount of research were also carried out focusing on microwaves and signal processing & cloud computing. The National Institute of Technology, Rourkela found to be the top collaborating institution while USA found to be the top collaborating country of VSSUT.

**Keywords:** Scientometrics, Collaboration, VSS University of Technology, Research Productivity

## INTRODUCTION

Scientometrics studies are frequently used to evaluate and measure research publications and productivity of an institution/organisation, individual researchers (Sahoo & Pandey, 2020). The terms bibliometrics and scientometrics have been introduced simultaneously by Pritchard, Nalimov & Mulchenko in 1969. Many research fields use scientometrics methods to explore the impact of their field, the impact of a set of researchers, the impact of a particular paper, or to identify particularly impactful papers within a specific field of research. The present study analyzed the research output produce by the faculty, staff and researchers of the Veer Surendra Sai University of Technology (VSSUT).

The Veer Surendra Sai University of Technology (VSSUT) is one of the major universities of Odisha established in 1956. The university provides different programs like B.Tech, B.Arch, M.tech, M.Sc., M.Phill, MCA, and Ph.D programmes The University has sixteen departments like Chemistry, Physics, Mathematics, Chemical engineering, Information technology, and humanities are very prominent especially for their high-quality research. Many researchers of this university have been awards and recognition for their high-quality research. In today's context research plays an important role in the recognition and credibility of any institution. Measuring the research output of universities becomes pertinent and scientometrics is widely used tools for evaluating and analysing the research output of individuals, groups, organisations or institutions, and countries. Scientometrics study also facilitates the comparison of research productivity among individuals, groups, institutions or countries (Sahoo & Pandey, 2020).

In the present study we attempt to assess the research work carried out at VSSUT by evaluating the research publications by the institute which were retrieved and indexed in Scopus database during 2015-2020. A total of 1889 papers were published by the researchers of VSSUT. The primary objective of this study are- (i) To measure the annual growth rate and research productivity (ii) Research distribution and Collaborative pattern (iii) Identify the prominent journals for research communication (iv) Visualization of co-authorship, trend analysis and research impact

## REVIEW OF LITERATURES

Maharana and Sethi (2013) analyzed the bibliometric assessment of the scientific research output of Sambalpur University found that Chemistry is the most sought area of research and publication of faculty followed by Physics and Plant Science etc. The degree of collaboration of the university is 0.99. Mandhirasalam (2015) have studied the research output of Thiagarajar College of Engineering during 1972-2014. The study found that 1497 papers published during study period and highest number of 259 papers traced in 2014. The institute has notably contributed to the research in science, engineering, and technology and the publications have increased significantly during the last seven years. Majhi and Maharana (2012) evaluated the research productivity of the physical science discipline of Sambalpur University from 1971 to 2010 and stated that majority of research publications on physical science have been brought out in co-authorship collaborative approach. Baskaran (2013) analyzed the author productivity, discipline-wise and institution-wise collaboration and ranking of authors of Alagappa University during 1999-2011. Relative growth rate (RGR) was found to be fluctuating trend during the study period. The degree of collaboration and its' mean value is found to be 0.963. The top three institutions with Alagappa University are Central Electro Chemical Research Institute, National Cheng King University, and Anna University. The study also found that South Korea is the most preferred collaborative partner with 7.61% and material science highly productive subject area with 172 (22.26%) papers. Sevukan and Sharma (2008) study on research performance of biotechnology faculties in central universities of India from 1997-2006. The study found that two-authored publications predominate amongst the pattern of authorship; applicability of Lotka's law is validated from the values  $n = 2.12$ ,  $C = 0.669$ , and  $D = 0.027$  derived using least square method. Bhui and Sahu(2018) evaluates the citation count of article publications in journals of Indian Institute of Technology (IIT) Kharagpur from 2000-2016. The study concluded that the journal named Psychological Studies ranked first with 27 publications of faculties whereas Journal of Business Ethics received highest citations and grabbed the first position amongst the journals. Collaborative researches by three author received maximum citations. The study also finds that quantity in publications alone does not produce more citations.

Based on the literature reviewed, it is found that there are few studies conducted on analyzing the scientific output of an individual institution using scientometrics indicators. Therefore, we carried out the present study to bridge the knowledge gap by analyzing the VSSUT's scientific contributions and research. In this study, we have analyzed the scientific literature published from VSSUT during 2015-2020. The prominent authors and leading journal are identified and authorship & collaborative patterns were analyzed in detail for understanding research pattern.

## **MATERIALS AND METHODS**

In the present study, we adopted following search strategy to retrieve the data sample. Scopus bibliographic database has been extensively used to collect the research publications data. Further irrelevant records were removed and total sample of 1889 records covering period of 2015-2020 are finalized for the analysis.

**Search Query:** AF-ID ( "VSS University of Technology" 60071276 ) AND ( LIMIT-TO ( PUBYEAR , 2015-2020 ) )

The data sample has further refined and it has been found that the maximum 1032(54.63%) of total documents were published as "Article" followed by "Conference Paper" with 715(37.85%) and 35(1.85%) of the documents published as "Review" and a negligible portion of documents 11(0.58%) featured as book chapter. Further, it has been observed that significant share 18.32% (346) of the total research documents has been published on open-access platforms that signify major changes in the VSSUT researcher's behaviors and approaches towards open access. The acceptance for sharing their research findings in open domain has grown significantly during last few years. For this study we have also used VOSviewer data visualization tool to create network map and keyword clusters that helps in understanding of authorship and collaboration pattern & core research focus (Eck and Waltman, 2010).

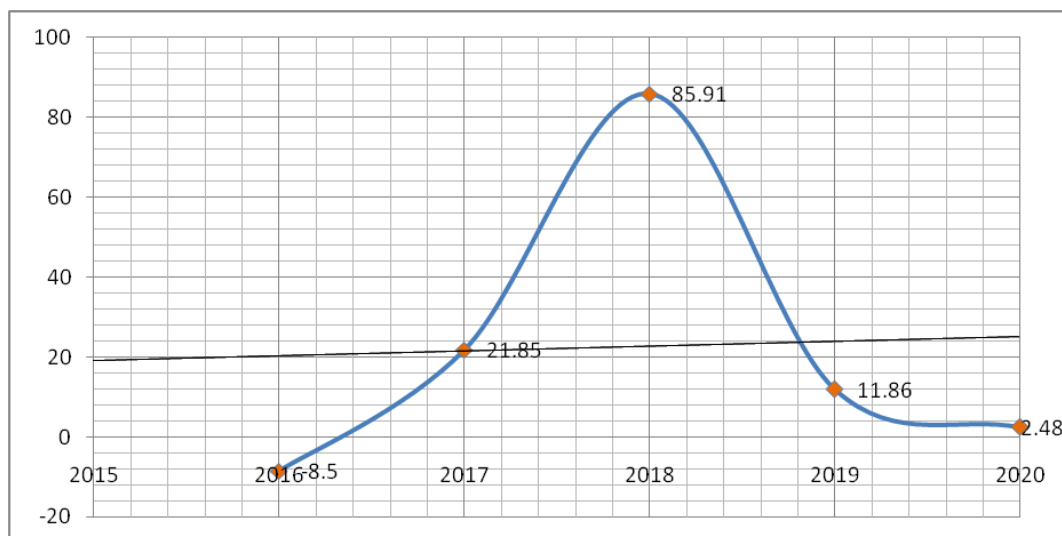
## DATA ANALYSIS AND RESULTS DISCUSSION

### Annual Growth Rate (AGR) of Publications

The stated formula is used to determine the value of Annual Growth Rate (AGR) of publications.

$$\text{AGR} = \frac{\text{End Value} - \text{First Value}}{\text{First Value}} \times 100$$

From the analysis it is observed that there is no uniform AGR for the research publications. It can be concluded that the institutional research publications has continuously increased and in the year 2018 the highest number of research papers were published by the scientific community of VSSUT. The maximum annual growth rate of 85.91 was recorded in 2018, whereas negative value of AGR of -8.5 recorded in the year 2016. The data value of annual growth rate is represented in **Figure-1**.



**Figure 1:** Annual growth rate of Research Productivity

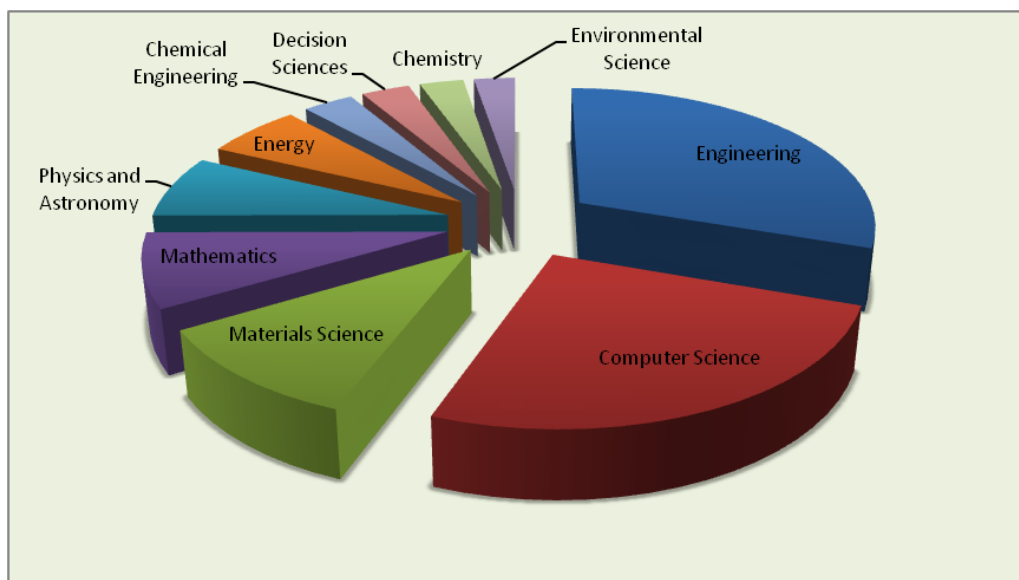
The detail values of year wise publications productivity with citations counts are depicted in Table-1.

**Table 1:** Cumulative publications, Annual growth rate and Citations trend

Year	No of Document	%TP	Cumulative	AGR	TC	%TC
2015	200	10.59	10.59		84	0.83
2016	183	9.69	20.28	-8.5	434	4.30
2017	213	11.28	31.56	21.85	887	8.78
2018	396	20.96	52.52	85.91	1644	16.28
2019	443	23.45	75.97	11.86	3062	30.31
2020	454	24.03	100.00	2.48	3990	39.50

### Discipline-wise Productivity of Research

The Discipline-wise distribution of research productivity are primary dominated in the subject domain of Engineering research 1079(57.12%) followed by Computer science 904(47.86%) and Material Science 382(20.22%). It is found that there is no uniform distribution of research in various disciplines. It is also observed that significant portion of the research belongs to Mathematics 301(15.93%), Physics and Astronomy 255(13.50%), Energy 219(11.59%) and Chemical engineering-115(6.09%). A domain wise distribution of research is represented in **Figure-2**.



**Figure 2:** Domain-wise distributions of Research Productivity

## Scattering of Research in Scientific Journals

The **Table-2** shows the Top-15 sources on which the research papers were published by the researcher of VSSUT during 2015-2020.

**Table-2:** Distribution of Research in Scientific Journals

Source Title	No of publication	% of TP	TC	TC/P
Advances in Intelligent Systems and Computing	123	6.51	247	2.01
Materials Today Proceedings	78	4.13	188	2.41
Smart Innovation Systems and Technologies	43	2.28	140	3.26
International Journal of Innovative Technology and Exploring Engineering	30	1.59	231	7.70
Lecture Notes in Electrical Engineering	28	1.48	21	0.75
IOP Conference Series Materials Science and Engineering	27	1.43	29	1.07
Lecture Notes in Mechanical Engineering	24	1.27	10	0.42
International Journal of Engineering and Advanced Technology	20	1.06	142	7.10
International Journal of Applied Engineering Research	19	1.01	86	4.53
International Journal of Recent Technology and Engineering	19	1.01	10	0.53
Journal of King Saud University Computer and Information Sciences	18	0.95	105	5.83
Arabian Journal for Science and Engineering	17	0.90	585	34.41
Engineering Science and Technology An International Journal	17	0.90	85	5.00
Journal of Materials Science Materials In Electronics	16	0.85	189	11.81
Procedia Computer Science	16	0.85	68	4.25

It is observed that, the researchers of VSSUT published their research findings in 717 scientific sources. The result indicates that maximum number of research papers are published in Advances in Intelligent Systems and Computing (n=123) followed by Materials Today Proceedings (n=78) and Smart Innovation Systems and Technologies (n=43). It can be concluded that the research originated from VSSUT has been communicated in high quality journals but lack of high citations value is observed. The faculty, scientists and researchers of VSSUT need to publicize their work to reach out to the global scientific communities which will increase their attention and possibly citations.

## Research Collaboration Pattern

**Figure-3** shows the top 10 collaborating country of VSSUT for producing research work. Although the researcher of VSSUT collaborated with authors of 41 countries, however it has been observed that there is lack of greater international collaboration. The USA is at the top with



39 publications followed by Italy with 14 and South Korea & Canada with 9 publications each. The other prominent collaborative countries are Saudi Arabia, Taiwan, Germany and United Kingdom.

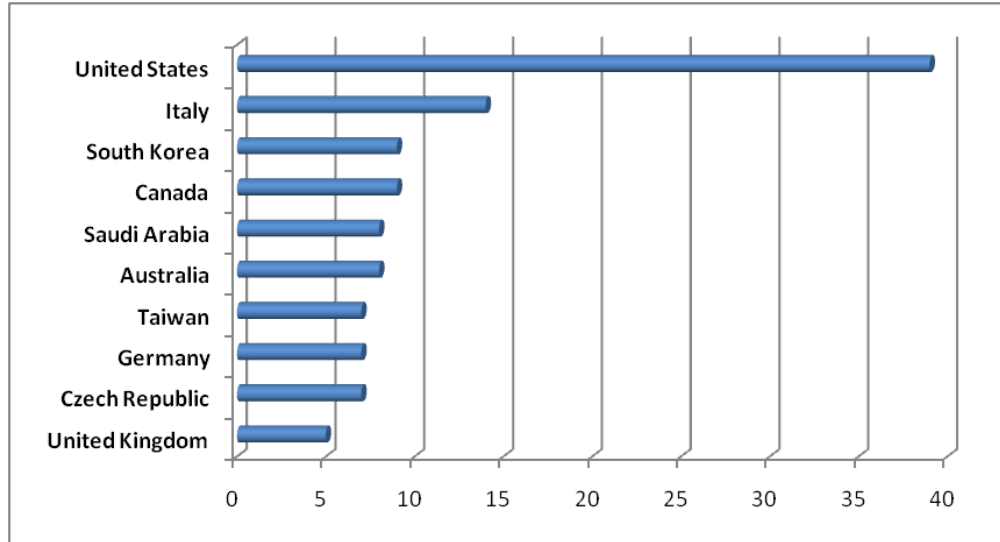


Figure 3: International Collaboration of Research Publications with Top 10 Countries

Further, top ten institutions/organizations involved in the collaborative research with the VSSUT are depicted in **Table-3**.

Table-3: Top 10 Collaborative institution and organization

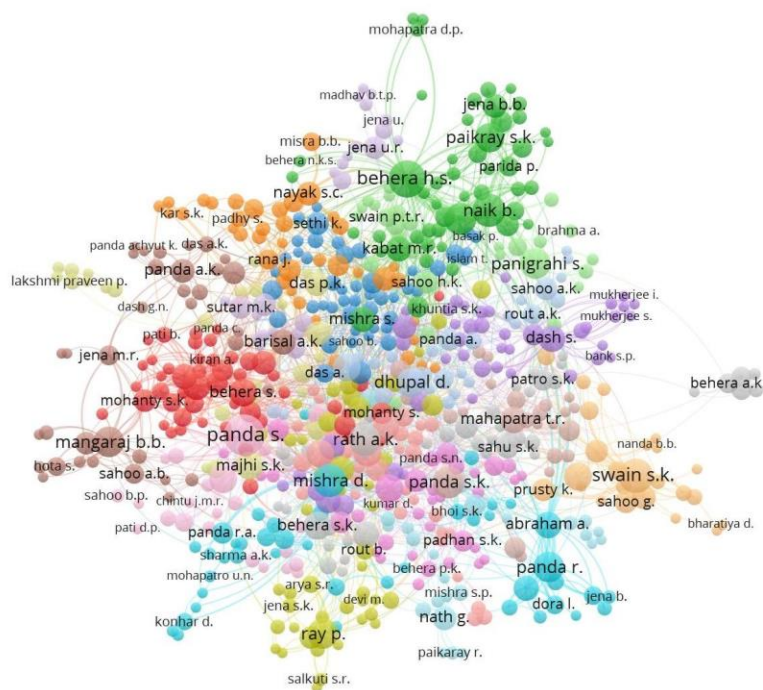
SI No.	Organizations	No. of Publication	%TP
1	National Institute of Technology Rourkela	141	7.46
2	Siksha O Anusandhan Deemed to be University	131	6.93
3	Kalinga Institute of Industrial Technology, Bhubaneswar	126	6.67
4	Sambalpur University	79	4.18
5	BPUT, College of Engineering & Technology	39	2.06
6	National Institute of Science & Technology	36	1.91
7	Silicon Institute of Technology, Bhubaneswar	34	1.80
8	Indian Institute of Technology Kharagpur	32	1.69
9	Machine Intelligence Research Labs (MIR Labs)	31	1.64
10	Gandhi Institute of Engineering and Technology, Gunupur	26	1.38

The result indicates that the National Institute of Technology Rourkela is the top collaborator institute with 141(7.46%) papers followed by Siksha O Anusandhan Deemed to be

University 131(6.93%) and Kalinga Institute of Industrial Technology, Bhubaneswar 126(6.67%). Machine Intelligence Research Labs (MIR Labs) is the only international institute which positioned in the top 10 ranks. It has been found that for VSSUT the domestic collaboration is high and there is lack of international collaboration has been observed in this study.

### Co-authorship Pattern

Co-authorship network map was created using VOSviewer visualization tools and depicted in **Figure-4**. Threshold of author having two or more documents were set up to generate the map and 793 authors has qualified for the network map. The top authors found to be S Panda (TP=121, TC= 1908, TLS=600) followed by HS Behera (TP=91, TC= 680, TLS=171) and SK Swain (TP=71, TC= 499, TLS=268). Other prominent authors are D Mishra (63), B Naik (62), SK Panda (57), AK Rath (57) and J Nayak (53).



**Figure 4:** Co-authorship network map representing the active researchers of VSSUT

## Keyword Cluster Analysis

Keyword cluster map was created using VOSviewer visualization tools and depicted in **Figure-5**. The keywords co-occurrence of 5 or greater than were set up to generate the map and in total 1034 keywords has qualified for the network. The prominent keywords identified and grouped into ten clusters based on their frequency and link strength. Each cluster is distinguished by difference shades of color and represents different characteristics. From this it has been observed that VSSUT research are mainly concentrating in the core areas of control systems, particle swarm optimization, neural network, data mining and artificial intelligence. Significant amount of research were also carried out focusing on microwaves and signal processing & cloud computing.

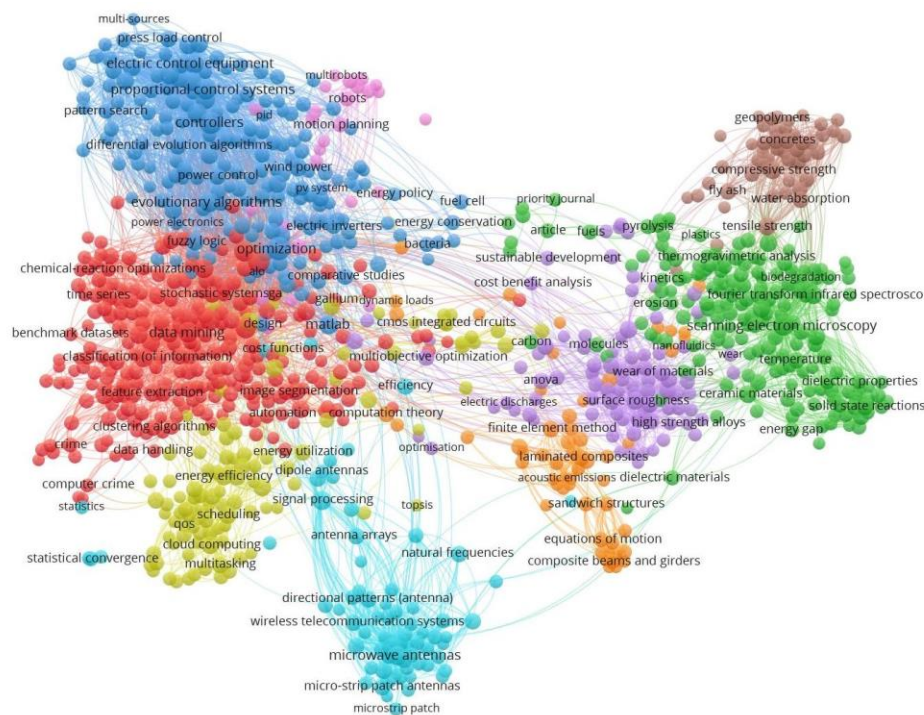


Figure 5: Cluster wise representation of frequent occurrence of key terms

## Top 10 Key Papers based on Most Citations

The **Table-4** depicts the top 10 most cited papers with citation rate. The highest cited paper is “A hybrid firefly algorithm and pattern search technique for automatic generation

*control of multi area power systems*” by RK Sahu with 185 citations. This paper also received the highest citation rate. It has been observed that these most cited papers were published during 2015-2016. A large number of the research publications were received significant number of citations.

**Table-4:** Top 10 most cited papers with citation rate

Sl No.	First Author	Title	Year	Citation	Citation Rate
1	Sahu R.K.	A hybrid firefly algorithm and pattern search technique for automatic generation control of multi area power systems	2015	185	37
2	Sahu R.K.	A novel hybrid PSO-PS optimized fuzzy PI controller for AGC in multi area interconnected power systems	2015	165	33
3	Sahu B.K.	Teaching-learning based optimization algorithm based fuzzy-PID controller for automatic generation control of multi-area power system	2015	144	28.8
4	Das S.	Vibration-based damage detection techniques used for health monitoring of structures: a review	2016	133	33.25
5	Sahu R.K.	Teaching learning based optimization algorithm for automatic generation control of power system using 2-DOF PID controller	2016	118	29.5
6	Barisal A.K.	Comparative performance analysis of teaching learning based optimization for automatic load frequency control of multi-source power systems	2015	115	23
7	Das P.K.	A hybridization of an improved particle swarm optimization and gravitational search algorithm for multi-robot path planning	2016	110	27.5
8	Sahu B.K.	A novel hybrid LUS-TLBO optimized fuzzy-PID controller for load frequency control of multi-source power system	2016	103	25.75
9	Pradhan P.C.	Firefly algorithm optimized fuzzy PID controller for AGC of multi-area multi-source power systems with UPFC and SMES	2016	98	24.5
10	Pradhan R.	Double Integral Sliding Mode MPPT Control of a Photovoltaic System	2016	94	23.5

## CONCLUSION

In present study, we have conducted a detailed quantitative and qualitative analysis of scientific research conducted at VSSUT using various scientometrics indicators. The maximum annual growth rate of 85.91 is recorded in 2018, whereas negative value of AGR of -8.5 is recorded in the year 2016. Engineering is the top productive subject domain and S. Panda found to be the most prominent author in this given period with 121 publications. The researcher of VSSUT mostly preferred to publish their research work in form of ‘Article’. The cluster analysis of key terms indicates that VSSUT research are mainly concentrating in the core areas of control systems, particle swarm optimization, neural network, data mining and artificial intelligence. Significant amount of research were also carried out focusing on microwaves and signal processing & cloud computing. The result indicates that maximum number of research papers are

published in *Advances in Intelligent Systems and Computing* (n=123) followed by *Materials Today Proceedings* (n=78) and *Smart Innovation Systems and Technologies* (n=43). It can be concluded that the research originated from VSSUT has been communicated in high quality journals but lack of high citations value is observed. The faculty, scientists and researchers of VSSUT need to publicize their work to reach out to the global scientific communities which will increase their attention and possibly citations. The study observed that among the disciplines of VSSUT the contribution to engineering research is the highest followed by computer science research and contributions to other disciplines are very less. The collaborative research publication of VSSUT is more because of their team spirit and collaborative approach. The year-wise growth shows that the recent publication output is more than before. The study through lights on different aspects of the research carried out at VSSUT and results of the study will be benchmark for analyzing the research productivity of a university using scientometrics indicators.

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