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Mapping of Engineering Research Trend in Karnataka: A Special Reference to Visvesvaraya Technological University

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ABSTRACT

This paper reports the analysis of doctoral dissertations awarded by Visvesvaraya Technological University (VTU). The primary objective of this study is to understand the growth and development of research activities of VTU in the past 13 years. The data for the present study has been collected from two authenticated sources: (a) the data published in the *University News*: a weekly journal from the Association of Indian Universities and (b) the VTU website (http://www.vtu.ac.in/). There are 250 doctoral degrees awarded from 2007 to 2011, in 14 engineering and allied domains. The data relating to research growth and development were analysed and presented under 9 heads viz., chronological, department-wise, frequency-wise, rank-wise distributed doctoral dissertations, productivity of supervisors, ranking of research supervisors, and rank wise distribution of research centers. The authors analysed the bibliographic details of doctoral degrees awarded by VTU. The present situation is that, on an average 50 doctoral degrees are being awarded in a year. In 2010 and 2011 the research output traced significant growth with the awarding of 156 (62.40 %) doctoral degrees. Substantial research was carried out in mechanical (40.40 %) engineering department. It was also observed that 169 research supervisors are presently engaged in guiding doctoral students.

Keywords: Visvesvaraya Technological University, VTU, research productivity, doctoral dissertations

1. INTRODUCTION

Scientific discoveries and inventions could be of value to mankind. Research leads to invention, and is carried out for acquiring new knowledge, improvement of existing knowledge, to provide solutions to specific problems and to improve processes and practices. Since research findings are of significance and value for the society, research has attained an important place in all the fields of knowledge. In other words research provides solutions to specific problems and improves processes and practices[1]. In recent decades science and engineering research has become an international endeavour. More than ever, the governments around the world acknowledge the role of science and technology (S&T) in generating new jobs, economic prosperity, response to national issues and global challenges, and global competitiveness[2]. As a result, the enormous increase in research activities producing large number of doctoral theses has contributed for the growth and development of existing subject areas, emergence of new fields of knowledge and subfields within a short span of time and these emerging fields are becoming very important disciplines of study. The engineering and allied branches of engineering are fast growing and new areas of study within the field are emerging faster than ever before. Recently a number of technological universities have emerged for sustainable and substantial development of technical education in India.

Universities are centres of higher learning and serve as training grounds for research scholars by providing basic research methodology in specialised fields. The success of their research depends upon the training they acquire in the universities. Being the centres of research, universities are considered to play a vital role in the scientific progress of a nation. During the recent past, good numbers of research activities have been carried out in the universities and research institutions in various parts of the world. In India, due to the establishment of University Grants Commission (UGC) and other similar bodies and their active support, many students are carrying out MPhil and PhD degrees. During

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pre-independence, there were very few doctoral degrees holders, but after independence the research output increased drastically in every field. In India, about 125 universities and research institutions are offering PhD programmes[3].

2. BRIEF PROFILE OF VTU

The Visvesvaraya Technological University (VTU) has been established by the Government of the Karnataka to promote planned and sustainable development of technical education consistent with state and national policies. The VTU is one of the leading technological university in India, having around 200 colleges affiliated to it which offer, under graduate (UG) courses in 28 disciplines and post graduate (PG) programmes in around 80 disciplines. The intake at UG level is about 67100 and about 12666 at the PG level. The University has 13 Quality Improvement Programme (QIP) Centres in various affiliated colleges and 16 extension centres offering PG programmes. There are over 350 departments recognised as research Centres in various affiliated colleges. At present over 1800 students/faculty have registered for PhD degree and over 180 students have registered for MSc (Engg. by Research) for the academic year 2010 -2011. The University has awarded PhD degree to about 120 candidates and MSc (Engg.) degree to about 7 candidates. The University has initiated MBA, MCA and MTech programmes at 'Jnana Sangama', Belgaum with more than 500 students. VTU has a vision to become an outstanding technological university at the cutting edge of science and technology that produces world class knowledge-delivery, research, extension and leadership in technology innovation useful for Industry and Society. Its mission to plan the development of technical education, to establish value-based and need-based education and training in engineering and technology, with a view to generate qualified and competent manpower, responsive to technological and societal needs[4]. The VTU has an exclusive research portal; it has been designed to provide information such as, finding the faculty working in a specific area of research and list of research students, etc. The portal helps the research scholars and students get access to all necessary information. The students can also get access to university announcement on financial support for various research schemes. The portal contains the abstracts of research topics of all the research scholars. Many new features such as 'Refereed Journal Publications', outstanding accomplishment of research scholars and their innovations have been planned to figure on the portal in the coming days[5].

3. RELATED STUDIES

Indian universities play a major role in creation and dissemination of knowledge by providing opportunities for research scholars to conduct research studies and to bring out doctoral dissertations as a unique genre of information resource. It is observed that every year, a significant number of doctoral dissertations are being produced by these universities in India6. Prathap and Gupta[7] examined the ranking of Indian universities for their research output and quality using a new performance index for a ranking of research performance based on quantum of output and quality of research of various Indian universities. A total of 25 universities with high output of publications during a 10-year period from 1999 to 2008 were identified, using data from SCOPUS[8]. Indian Statistical Data Provider[9] a leading statistical data provider on India as macro and micro economy, reports that "As on March 2008, there are 382 universities promoting higher education in India". Of 382, 233 are state, 25 are central and 126 are deemed universities. These universities offer postgraduate courses and doctoral research programmes in various disciplines. They also undertake research projects of national importance sponsored by government and other agencies. The doctoral researches are represented through the doctoral dissertations submitted to universities for the award of doctoral degree. A study of such doctoral dissertations indicates the direction of research in India.

A study on library and information science research in India was carried by Chandrashekara and Ramasesh[3]. They clearly projected with relevant statistical tables the output of doctoral research in India. And also attempt has been made to depict quantity of research output in the form of doctoral theses, state wise, university-wise, topic-wise and supervisor-wise. Further they indicated the areas of research activity in LIS with ranking of universities and states which have contributed comparatively more to the field of LIS research in India. Similarly, another study carried by Singh[10] reported that 2,461 doctoral degrees were awarded by Indian universities in 1970-71 and by 1981-82, it had risen to 6,404. Ten years later, the number had gone up to 8,743 and the figure touched 11,534 doctoral dissertations during the next decade. The University Grants Commission, New Delhi[11] in its 2005-06 Annual Report (2008, p168) states that the total number of PhD degrees awarded during 2003-04 and 2004-05 was 17,853 and 17,898 respectively. The analysis of doctoral dissertations awarded by Bangalore University12 was carried out on the growth and development of research activities of past 4½ decades. There are 1497 doctoral degrees awarded from 1963 to 2005, in 38 domains. The study reveals that an average 34 doctoral theses were awarded and from 1990 to 2002 and the research output traced significance with 1002 (66.93 %) doctoral theses being awarded. Maximum research was carried out in Zoology (149, 9.95 %) and Botany (133, 8.88 %) departments.

It is observed that 737 research supervisors are engaged in guiding doctoral students.

4. OBJECTIVES

The primary objective of this study is to understand the growth and development of research activities in VTU in the past 13 years. The specific objectives are:

- To know the growth of the research productivity in Visvesvaraya Technological University
- To understand the contribution by research supervisors towards their research interest
- To identify the most predominant domain area in the VTU
- To find out the top ranking of research guides

5. METHODOLOGY

The data for the present study has been collected from the two sources. (a) data published in the *University News*: a weekly journal from the Association of Indian Universities and (b) the VTU website[4]. The data obtained from the above two sources were recorded separately and a master spreadsheet containing 250 unique records was created with careful examination to exclude duplicate records. This spreadsheet served as primary data input for analysis and interpretation. Origin statistical software package was used for data analysis. Frequency distribution and cross tables were generated by using the package.

6. DATA ANALYSIS AND INTERPRETATION

There are 250 doctoral degrees awarded so far in 8 domains. The authors have made an attempt to consolidate all the doctoral degrees awarded by VTU, Belgaum, in Karnataka. The data were analysed and presented under 9 heads, viz., chronological distribution of doctoral dissertations, Domain-wise distribution of doctoral dissertations, Frequency-wise distribution of doctoral dissertations, rank-wise distribution of doctoral dissertations, productivity of research supervisors, rank-wise distribution of research supervisors, productivity of second research supervisors, rank-wise distribution of second supervisors, and rank-wise distribution of research centers according to their research output.

6.1 Chronological Distribution of Doctoral Dissertations

Figure 1 indicates that, there has been substantial progress in terms of research output from VTU. The number of doctoral degrees awarded from the VTU from 2007 to 2011. It is clear from the Fig. 1 that research activities were quite low till 2009 and then increased from 2010. This was due to the need and emphasis on recruiting qualified faculty mainly in the universities and constituent/affiliated institutions. It was also true that University Grants Commission (UGC) and All India Council for Technical Education (AICTE)[13] started giving preference to the candidates who have done research in the respective domain. The present situation is that on an average 50 doctoral theses are being awarded every year. During 2007-2009 an average of 31 theses were awarded the doctoral degrees. From the 2010-2011 the research output reached a significant high value of 156 (62.40 %) doctoral theses.

6.2 Domain-wise Distribution of Doctoral Dissertations

Table 1 shows domain-wise productivity of doctoral dissertations. Total 250 doctoral degrees were awarded in engineering, of which 101 (40.40 %) were in mechanical engineering and 45 (18.00 %) in electrical and electronics engineering doctoral degrees were awarded. Similarly in civil engineering 36 (14.40 %) doctoral degrees were awarded and in

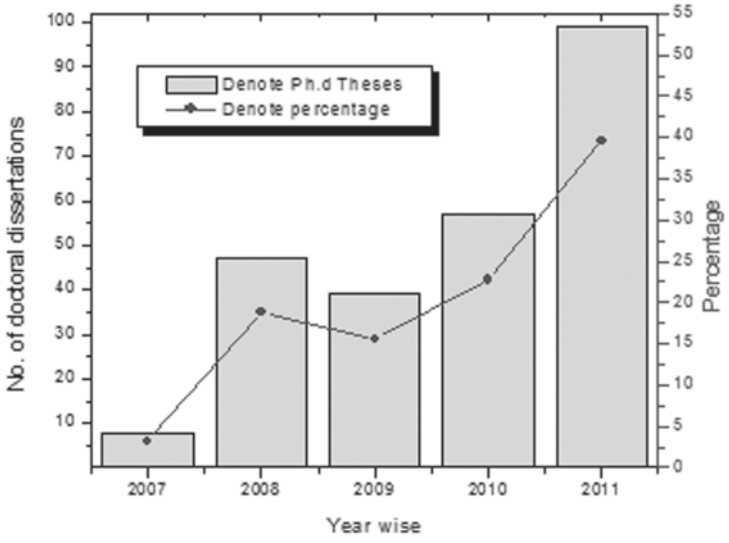

Figure 1. Chronological distribution of doctoral dissertations.

Table 1. Domain-wise distribution of doctoral dissertations

Domains	Subject code	PhD's	%
Mechanical Engineering	ME	101	40.40
Electrical & Electronics Engineering	EE	45	18.00
Civil Engineering	CV	36	14.40
Computer Science & Engineering	CS	24	9.60
Applied Sciences	AS	21	8.40
Electronics & Comm unication Engineering	EC	12	4.80
Technology	TE	8	3.20
Management Sciences	MS	3	1.20
Total		250	100.00

computer science engineering 24 (9.60 %), however in applied science (21, 8.40 %) comparatively more than electronics & communication engineering (12, 4.80 %). The technology and management science doctoral degrees were least with 8 (3.20 %) and 3 (1.20 %) respectively.

6.3 Frequency-wise Distribution of Doctoral Dissertations

Table 2 reveals that maximum research was carried out in 2011. Out of a total of 99 theses, 33 were awarded in mechanical engineering, 19 in electrical and electronics engineering, and 18 in civil engineering. In 2010, out of 57, 26 were in mechanical, 10 in civil, 7 in applied sciences, 6 in electrical and computer, 1 each in electronics and technology. In 2008, out of 47, 20 degrees were awarded in mechanical, 9 in electrical, 6 in computer, 5 in civil, 4 and 3 in applied sciences and technology respectively. In 2009, out of 39, 18 in mechanical, 7 in electrical, 5 in applied sciences, 4 in computer, only 2 in technology. The least research activities were found in 2007, i.e., out of 8 awarded degrees, 4 were in mechanical and 4 were in electrical. This clearly shows that research being carried out at VTU has advanced with an upward trend yearly in these eight fields.

6.4 Rank-wise Distribution of Doctoral Dissertations

Figure 2 projects the rank-wise distribution of doctoral dissertations from the VTU. Mechanical engineering department stands with first rank (101, 40.40 %) among the other departments on the awarded doctoral degrees. Electrical and electronics engineering department stands second with 45 (18.00 %) theses being awarded doctoral degrees. Third place goes to civil engineering (36, 14.40 %) and computer science engineering (24, 9.60 %) in fourth place. Next stands applied sciences with 21 (8.40 %) and 8 (3.20 %) technology doctoral degrees being awarded. In electronics and communication engineering 12 (4.80 %) and management sciences 3 (1.20 %) doctoral degrees were awarded from the VTU which stands in 7th and 8th rank respectively. This clearly indicates that rank-wise research output from VTU in mechanical engineering is considerably more.

6.5 Productivity of Research Supervisors

Research supervisors play an important role in the productivity of research outputs by individual departments. The seriousness of research scholar, proper guidance from supervisor and the infrastructural facilities provided by universities play an important role in the productivity of research output. Figure 3 illustrates the output of research supervisors.

It was observed that about 169 research supervisors were engaged in guiding doctoral students at VTU. The figures indicate that more than half of research supervisors (65.68 %) have produced one doctoral degree. Another 23.08 percent have produced two research degrees. Similarly 8.88 per cent of supervisors guided 15 doctoral students. Only 2.37 per cent of the guides supervised up to 4 students. It clearly shows that comparatively single-guided research output are more in VTU and its affiliated research centres.

Table 2. Frequency wise distribution of doctoral dissertations

S. No.	Department Code	Year wise PhD thesis					Total no. of PhDs	Percentage
		2007	2008	2009	2010	2011		
1	Mechanical Engineering	4	20	18	26	33	101	40.40
2	Civil Engineering	-	5	3	10	18	36	14.40
3	Electrical Engineering	4	9	7	6	19	45	18.00
4	Applied Science	-	4	5	7	5	21	8.40
5	Computer Science	-	6	4	6	8	24	9.60
6	Electronics & Communication	-	-	-	1	11	12	4.80
7	Technology	-	3	2	1	2	8	3.20
8	Management Science	-	-	-	-	3	3	1.20
Total		8	47	39	57	99	250	100.00

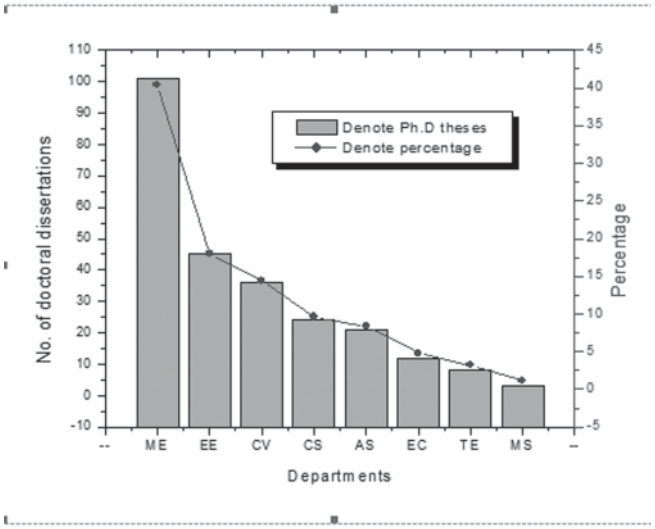

Figure 2. Rank-wise distribution of doctoral dissertations.

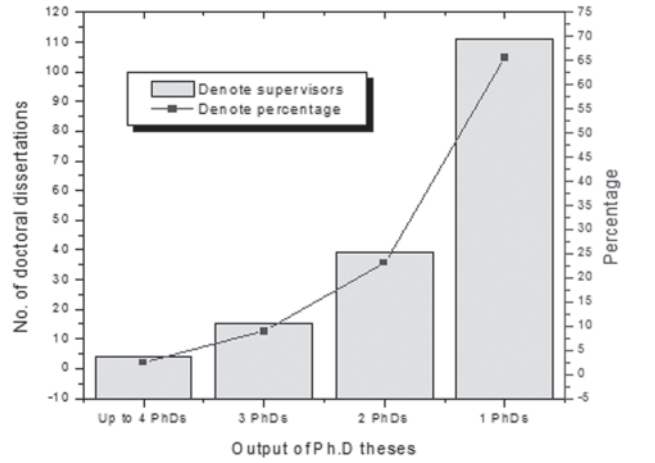

Figure 3. Output of research guides.

6.6 Rank-wise Distribution of Research Supervisors

Table 3 reveals that, the guide-wise output of doctoral theses. Prof. C.S. Ramesh, Prof P.G. Tewari, Prof. P.S. Satynarayana and Prof. V. Krishnan have successfully guided for 4 doctoral degrees in the domain of mechanical and electrical engineering. Prof. H.K. Shivanand, Prof. Joel-Hemanth, Prof. K. Radhakrishna, Prof. K.V.A. Balaji, Prof. M.S. Murali, Prof. M.S. Prabhuswamy, Prof. R. Chandrashekar and Prof. S.M. Shashidhara are in the second place by guiding 3 doctoral theses in the domain of mechanical. Similarly Prof. K.S. Lokesh & Prof. K.B. Prakash from civil engineering department have guided and supervised 3 doctoral theses. However Prof. K.R. Ananda Kumar & Prof. M.G. Venkateshmurthy guided 3 doctoral students successfully in the computer science engineering. It was also observed that the top nineteen faculty guides are from the different departments of affiliated colleges of VTU, i.e. mechanical, electrical, civil, computer science, applied sciences and electronics. This clearly indicates that research guides from VTU are more involved in carrying out research programmes with their research scholars and hence the output is also considerably more.

6.7 Productivity of Co-guides

It can be observed from the Fig. 4 that about 52 second research supervisors are engaged in guiding doctoral students at VTU. Table 3 indicate that majority (90.38 %) of second research supervisors have produced one doctoral student. Another 7.69 percent have produced two doctoral degrees. Only 1.92 per cent of them have guided up to 3 doctoral students.

6.8 Rank-wise Distribution of Co-guides

Table 4 shows the rank-wise distribution of co-guide supervised doctoral theses. Prof. K. Ramakrishnan has successfully guided 3 doctoral degrees in the domain of Applied sciences. Prof. B.G. Pujar and Prof. N.K.S. Rajan are in the second place with 2 doctoral theses each. Similarly, 2 doctoral theses each guided by Prof. R. Sathyamurthy and Prof. S. Sreedhara. They have supervised in the domain of civil and mechanical engineering. This clearly indicates that research co-guides from different departments are more involved in carrying out research programmes with their research scholars.

6.9 Rank-wise distribution of research centres

Table 5 reveals the rank-wise distribution of VTU affiliated college wise distribution of doctoral degrees in engineering and technology. Out of total 250 doctoral degrees, the highest number, i.e., 29 (11.60 %) has been contributed by Sri Jayachamarajendra College of Engineering, Mysore stands first. B.M.S. College of Engineering, Bangalore comes next with 20 (8.00 %), and M.S. Ramaiah Institute of Technology, Bangalore stands in third position with 19 (7.60 %) contribution. It is followed by Malnad College of Engineering, Hassan, with 18 (7.20 %) degrees contribution. Similarly, Basaveshwar Engineering College, Bagalkot and Siddaganga Institute of Technology, Tumkur stand in fifth position with each 15 (6.00 %) degrees. This is followed by other research centres which can be observed from the table. Further the Agricultural University, Raichur; Central Silk Technological Research Institute, Bangalore; Nitte Meenakshi Institute of Technology, Bangalore, Raman Research Institute, Bangalore stand in last place with 1 (0.40 %) each doctoral degree contribution. They stand with 15th rank among the research centre of VTU.

7. CONCLUSION

This study emphasises the perspective of the research activities in VTU. So far 250 doctoral degrees were awarded in the 8 domains, namely mechanical, civil, electrical, applied sciences, computer science,

Table 3. Rank wise distribution of research guides

Name of the most productive guide	Department	No. of PhD theses	Percentage	Rank
C.S. Ramesh	Mechanical Engineering	4	1.60	1
P.G. Tewari	Mechanical Engineering	4	1.60	
P.S. Satyanarayana	Electrical Engineering	4	1.60	
V. Krishnan	Electrical Engineering	4	1.60	
H.K. Shivanand	Mechanical Engineering	3	1.20	2
Joel Hemanth	Mechanical Engineering	3	1.20	
K. Radhakrishna	Mechanical Engineering	3	1.20	
K.V.A. Balaji	Mechanical Engineering	3	1.20	
M.S. Murali	Mechanical Engineering	3	1.20	
M.S. Prabhuswamy	Mechanical Engineering	3	1.20	
R. Chandrashekar	Mechanical Engineering	3	1.20	
S.M. Shashidhara	Mechanical Engineering	3	1.20	
K.S. Lokesh	Civil Engineering	3	1.20	
K.B. Prakash	Civil Engineering	3	1.20	
K.R. Ananda Kumar	Civil Engineering	3	1.20	
M.G. Venkateshmurthy	Computer Science	3	1.20	
B.S. Jaiprakash	Applied Science	3	1.20	
T. Ananthapadmanabha	Electrical Engineering	3	1.20	
V. Sridhar	Electronics & Communication	3	1.20	
39 no. of guides supervised 2 research work		78	31.20	
111 no. of guides supervised 1 research work		111	44.40	
Total		250	100.00	

Table 4. Rank-wise distribution of co-guides

Name of the most productive guide	Department	No. of PhD theses	Percentage	Rank
K. Ramakrishnan	Applied Science	3	5.17	1
B.G. Pujar	Applied Science	2	3.45	2
N.K.S. Rajan	Applied Science	2	3.45	
R. Sathyamurthy	Civil Engineering	2	3.45	
S. Sreedhara	Mechanical Engineering	2	3.45	
47 No. of guide supervised 1 research work		47	81.03	
Total		58	100.00	

electronics, management sciences, and technology. The data was analysed and presented under the 9 heads viz. chronological growth, department-wise, frequency-wise, rank-wise distribution, productivity of supervisors, and ranking of research guides, etc. The authors analysed the bibliographic details of doctoral degrees awarded by VTU during 2007 to 2011. It has been observed that 169 research supervisors are engaged in guiding doctoral students. It is also observed that Prof. C.S. Ramesh, Prof. P.G. Tewari, Prof. P.S. Satynarayana and Prof V. Krishnan stand first, having guided 4 doctoral degrees in the domain of mechanical and electrical engineering. Any research productivity depends on the contributions of the researcher and the role of their guide(s) is highly significant. The present

Table 5. Rank-wise distribution of research centers according to their research output

Name of the research center under the vtu affiliated engineering colleges in Karnataka	Year wise Distribution of PhD Thesis					Total	Percentage	Rank
	2007	2008	2009	2010	2011			
Sri Jayachamarajendra College of Engineering, Mysore	-	6	4	9	10	29	11.60	1
BMS College of Engineering, Bangalore	3	5	2	4	6	20	8.00	2
M.S. Ramaiah Institute of Technology, Bangalore	-	3	3	6	7	19	7.60	3
Malnad College of Engineering, Hassan	-	3	3	2	10	18	7.20	4
Basaveshwar Engineering College, Bagalkot	-	2	2	4	7	15	6.00	5
Siddaganga Institute of Technology, Tumkur	-	2	2	6	5	15	6.00	5
R.V. College of Engineering, Bangalore	-	1	1	2	9	13	5.20	6
The National Institute Engineering, Mysore	-	7	2	1	2	12	4.80	7
P.E.S. College of Engineering, Mandya	2	4	-	1	4	11	4.40	8
B.V. Bhoomaraddi College of Engineering and Technology, Hubli	2	1	2	2	3	10	4.00	9
National Aerospace Laboratories (NAL), Bangalore	-	3	2	2	3	10	4.00	9
Sir M. Visvesvarya Institute of Technology, Bangalore	-	2	6	1	1	10	4.00	9
Jawaharlal Nehru National College of Engineering, Shimoga	-	-	2	-	5	7	2.80	10
SDM College of Engineering and Technology, Dharwad	1	2	1	2	1	7	2.80	10
Bapuji Institute of Engineering & Technology, Davangere	-	-	1	3	2	6	2.40	11
Dr. Ambedkar Institute of Technology, Bangalore	-	-	1	2	3	6	2.40	11
K.L.E. Society's College of Engineering & Technology Belgaum.	-	-	-	3	3	6	2.40	11
Bangalore Institute of Technology, Bangalore	-	2	-	3	-	5	2.00	12
Ghousia College of Engineering, Ramnagaram	-	3	1	-	1	5	2.00	12
NMAM Institute of Technology, Nitte	-	-	-	-	4	4	1.60	13
P.E.S. Institute of Technology, Bangalore	-	-	-	1	3	4	1.60	13
Sri. Siddhartha Institute of Technology, Tumkur	-	1	-	2	1	4	1.60	13
Acharya Institute of Technology, Bangalore	-	-	2	-	-	2	0.80	14
East Point College of Engineering & Technology, Bangalore	-	-	-	-	2	2	0.80	14
Gogte Institute of Technology, Belgaum	-	-	1	-	1	2	0.80	14
Indian Space Research Organisation (ISRO), Bangalore.	-	-	-	1	1	2	0.80	14
S.J.C. Institute of Technology, Chickballapur	-	-	-	-	2	2	0.80	14
Agricultural University, Raichur	-	-	1	-	-	1	0.40	15
Central Silk Technological Research Institute, Bangalore	-	-	-	-	1	1	0.40	15
Nitte Meenakshi Institute of Technology, Bangalore	-	-	-	-	1	1	0.40	15
Raman Research Institute, Bangalore	-	-	-	-	1	1	0.40	15
Total	8	47	39	57	99	250	100.00	

electronics, management sciences, and technology. The data was analysed and presented under the 9 heads viz. chronological growth, department-wise, frequency-wise, rank-wise distribution, productivity of supervisors, and ranking of research guides, etc. The authors analysed the bibliographic details of doctoral degrees awarded by VTU during 2007 to 2011. It has been observed that 169 research supervisors are engaged in guiding doctoral students. It is also observed that Prof. C.S. Ramesh, Prof. P.G. Tewari, Prof. P.S. Satynarayana and Prof V. Krishnan stand first, having guided 4 doctoral degrees in the domain of mechanical and electrical engineering. Any research productivity depends on the contributions of the researcher and the role of their guide(s) is highly significant. The present situation is that on an average 60 doctoral theses are being awarded every year, whereas in the initial stage of establishment of the VTU, i.e., in first decade, only 8 degrees were awarded the degree. However from the year 2010 and 2011 the research output has increased significantly with 62.40 percent of doctoral theses being awarded. Maximum research was carried out in Mechanical (101, 40.40 %) engineering domain and the highest number i.e., 29 (11.60 %) has been contributed by Sri Jayachamarajendra College of Engineering, Mysore, which stands with first rank among the VTU recognized research centres. The primary objective of this study was to understand the growth and development of research activities in VTU, since its inception (1998). It is clear from this study that research productivity increased from the year 2010. This was due to the need and emphasis on recruiting qualified faculty mainly in the universities and constituent/affiliated institutions. It is also true that the research output increased because UGC and AICTE started giving preference to the candidates who have done research in their respective domain. This study leads to new research activity in the field of library and information science, i.e., the citation analysis of these large number of (250) doctoral theses.

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