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Research Article

Citation Analysis of Ph.D Theses in Civil Engineering Submitted to Visvesvaraya Technological University, Belagavi

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A B S T R A C T

This study is included 42 Ph.D theses and 8208 citations of the Civil Engineering which were submitted to Visvesvaraya Technological University Belgravi for the purpose of doctoral degree award in the year 2007-2017. The purpose of this study was to evaluate the type and form of literature cited, authorship pattern of the citations, compiled a rank list of journals in the Civil Engineering field. The study disclosed that journals were the most preferred sources of information used by the researchers in the field of Civil Engineering. In this connection 66.02% citations were journal citations of total, followed by books with 12.58 % citations. The journal "Applied Mechanics and Materials" has ranked the first with 351 citations accounting for 8.32% of the total journal citations. And "Advanced Materials Research journal" was 6.54% occupies the second rank getting 276 citations, followed by " Construction And Building Materials journal" 3.70% with 156 citations. The most of the citations were contributed by multi authors in the Civil Engineering journals.

Keywords: VTU, Ph.D Thesis, Research Trends, Doctoral Degrees, Civil Engineering

Introduction

Civil engineering is the oldest branch of engineering since it is growing right from the Stone Age civilization. ASCE (American Society of Civil Engineering) defines "Civil Engineering as the profession in which a knowledge of the mathematical and physical sciences gained by study, experience and practice is applied with judgment to develop ways to utilize economically the materials and forces of nature for the progressive well being of man". Further, in modern age, Civil Engineering is a core branch of engineering that dispense with the planning, construction, maintenance of fixed structures, or public works, as they are connected to water or earth, civilization and their processes. Civil engineering is the largest of the engineering fields and oldest of all the engineering fields.

Citation analysis is a bibliometric study which measures the relative significance of a publication, an article, or an author by simply counting the number of times it has been cited in other documents. It is necessary to identify core journals in order to procure useful resources within the given budget.

Visvesvaraya Technological University is one of India's leading and largest technological Universities. It has 210 affiliated engineering colleges under its jurisdiction. Every year over 60,000 students graduate from this University who are the next generation technical leaders, thinkers, scholars and innovators. The VTU is spread over the Karnataka in 149 research centers, more than 20,000 teachers, 6000+ research students and 2800 Doctor of philosophy degree awarded during 2007-2021. Hence, in these directions this research

is going to enlighten to research students, innovators, decision making etc.

Objectives of the Study

- To know the various information sources seeking by the research scholars in Civil Engineering
- To observe the nature of the authorship pattern and degree of collaboration in the cited literature of Civil Engineering
- To determine the year wise distribution of theses submitted in the Civil Engineering board
- To determine the most frequently cited journals in Civil Engineering

Need for the Study

The exponential growth of information resources had put a challenge to librarians to select the relevant information resources for his or her library. The rising cost of information resources, limited allocated budget and increased demand for the latest information are crucial challenges to the Librarian. To overcome these challenges librarians have to develop some techniques to measure the cost-effectiveness of the services rendering by the library.

The use study of library holdings should be carried out. Many bibliometric/ statistical tools are used to take many decisions in the library. The Citation analysis is also one among them.

Scope and Methodology for the Study

The present study is based on availability of Civil Engineering Doctoral theses in the VTU Library which was awarded from VTU during 2008 to 2017. All the citations are entered in MS-Excel work sheet as they are cited in the theses. They are analyzed according to the objectives as stated above.

Literature Review

One of the major preliminary steps in research is to go through the available literature pertaining to the problem which researcher has under taken. In this regard, referred more than 19 articles related to the study.

Data Analysis and Interpretation

Data analysis and interpretation is an intermediate step of the research process that converts raw data into results and conclusion. The analysis should be oriented on the aim and goals of research work. There is a thin line difference between data analysis and interpretation.

Distributions of Doctoral Thesis

Figure 1, shows yearly submission of doctoral Theses in the Department of Civil Engineering from 2007-2017. There were 8208 citations in 92 theses. The highest numbers of doctoral theses (15) were submitted in 2014 and the least number of doctoral theses 2 were submitted in 2009. The average awarded for the years is 9.

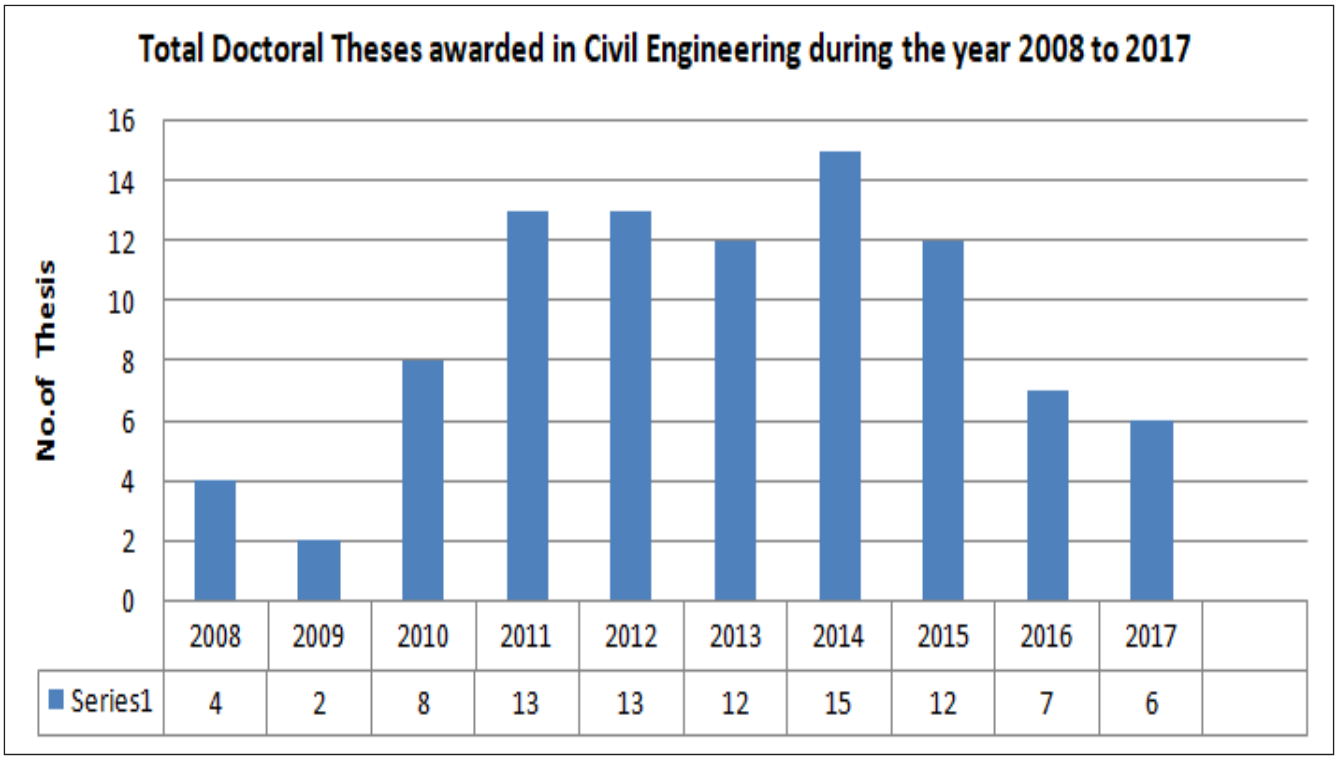

Figure 1

Form-wise Distribution of Citations in Civil Engineering

Citations scattered in more than 17 forms of information sources cited in doctoral theses of civil engineering. The distribution of citations based on its form is presented in the following Table 1. It is observed from the Table 1 that, the highest cited form is journal which has 3619 citations that are 44.09 % of citations. e-journal citations are taken the second percentage is 21.93%. Cumulative citations of journals and e-journals are 5419 which is 66.02% of citations. Citations from the Books are taken the third position it has 622 citations and the percentage is 7.58%.

The other forms of resources such as proceedings, theses, e-books, websites and reports shared the number of citations 861, 518,410,76 and 65 respectively. The cumulative citations of all top 7 ranked forms are 7895 which is of 96.19%. The other forms such as Government publications, newspaper, abstract, handbook, manual monograph, year book and other forms of citations shared 313 citations which is of 3.81%.

Authorship Pattern

Authorship studies mainly deal with kind of authors, nature, degree of collaboration and impact of citation rate on the collaborative trend of authors. Authorship pattern is one of the main objectives of the present study. Authorship pattern of Civil Engineering is discussed as follows.

It is evident from the above table 2 that, there are 2914 citations are of singleauthored and the percentage of citations is 35.5%.

The remaining 64.5% citations are of multi-authored which includes double authors, three, four, five, six, seven more than seven and corporate authors. Citations with corporate author were found 241 in number and percentage of these criteria is 2.94. This indicates that researchers cited multi authored citations more than single authored.

Table 1.Form-wise Distribution of Citations in Civil Engineering

S.No.	Form of Information Source	Citations	Cumulative	Citation %	Cumulative %
1	Journals	3619	3619	44.09	44.09
2	e-Journals	1800	5419	21.93	66.02
3	Books	622	6041	7.58	73.6
4	e-books	410	6451	5	78.59
5	Proceedings of Conference/ seminar/ symposium	861	7312	10.49	89.08
6	Reports	65	7377	0.79	89.87
7	Thesis	518	7895	6.31	96.19
8	Websites	76	7971	0.93	97.11
9	Govt. Publications	16	7987	0.19	97.31
10	Abstracts	22	8009	0.27	97.57
11	Monograph	6	8015	0.07	97.65
12	Hand book	41	8056	0.5	98.15
13	Manual	11	8067	0.13	98.28
14	Year books	14	8081	0.17	98.45
15	Reference books	21	8102	0.26	98.71
16	News Paper	16	8118	0.19	98.9
17	Others	90	8208	1.1	100
Total		8208		100	

Table 2.Authorship Pattern in Civil Engineering

No. of Authors	No. of Citations	Cumulative Citations	Citations %	Cumulative %
Single	2914	2914	35.5	35.5
Double	2712	5626	33.04	68.54
Three	1808	7434	22.03	90.57
Four	462	7896	5.63	96.2

Five	51	7947	0.62	96.82
Six	12	7959	0.15	96.96
More than 6	8	7967	0.1	97.06
Corporate Author*	241	8208	2.94	100
Total	8208		100	

* Corporate author includes company names, name of an organization, name of a club or society, government department, website links and no author name mentioned in the citations

Form wise Authorship Pattern in Civil Engineering

Form-wise authorship pattern in civil engineering is presented in the following Table 3.

According to the following Table 4, collaborative authorship is high in journals, proceedings, reports. There are only 1609 citations of single-authored among 5419 journal articles, remaining 3810 citations were of multi-authored in journals. There are 342 citations are single authored and 519 citations are multi-authored in proceedings. In reports, 28 citations are single authored and 37 citations are multi-authored. The double authorship is high in book form, there are 512 citations are double authored and 359 citations are single authored.

Year wise Collaboration Trend and Degree of Collaboration

The data was interpreted here to present the year wise collaboration trend and degree of collaboration in the following Table 4. It is observed from the Table 4, that the collaborative authorship trend increased after 1980. The degree of collaboration is high in the duration 2001-2010 degree of collaboration is calculated in that duration is 0.65. The degree of collaboration in Civil Engineering is 0.645.

Geographical Distribution of Citations in Civil engineering

Geographical distribution of citations in Civil Engineering doctoral theses is presented in the following table 5.

It is observed from the table that, China originated publications are cited most in Civil Engineering doctoral theses. China is ranked first, 1008 citations published in China and the percentage is 12%.

The second-ranked country is the USA which has 945 citations the percentage of these citations is 12%. The third-ranked Australia has only 393 citations which are 5% of total citations. The cumulative percentage of these three countries is 28%. The data from the table reveals that China literature is preferred most by Civil Engineering researchers in Visvesvaraya Technological University, Belagavi.

Table 3.Form-wise Authorship Pattern in Civil Engineering

Author	Journals/ Ejournals	Books/ E-books	Thesis	Proceedings	Reports	Others	Total
1	1609	359	518	342	28	58	2914
2	1866	512	0	295	14	25	2712
3	1553	112	0	130	10	3	1808
More than 3	391	49	0	94	13	227	774
Total	5419	1032	518	861	65	313	8208

Table 4.Wise Collaboration Trend and Degree of Collaboration in Civil Engineering

Year	Single	Double	Three	Four	Five	Six	More than 6	Corporate Author	NM	NM+NS	DC=NM/ NM+NS
Till 1960	62	34	44	21	2	1	1	6	109	171	0.63743
1961-1970	57	44	46	29	2	1	3	4	129	186	0.69355
1971-1980	213	156	74	43	2	1	0	4	280	493	0.56795
1981-1990	377	240	114	68	5	2	1	5	435	812	0.53571
1991-2000	378	341	216	74	6	3	1	20	661	1039	0.63619
2001-2010	1057	910	891	118	18	3	1	104	2045	3102	0.65925
2011-	770	987	423	109	16	1	1	98	1635	2405	0.67983
Total	2914	2712	1808	462	51	12	8	241	5294	8208	0.64498

Table 5.Geographical Distribution of Citations in Civil Engineering

S.No.	Country of Publication	Citations	Cumulative	Citations %	Cumulative %
1	China	1008	1008	12	12
2	United States	945	1953	12	24
3	Australia	393	2346	5	28
4	Iran	339	2685	4	32
5	United Kingdom	288	2973	4	36
6	Canada	282	3255	3	39
7	Turkey	237	3492	3	42
8	Italy	225	3717	3	45
9	India	201	3918	2	47
10	France	165	4083	2	49
11	Spain	147	4230	2	51
12	Hong Kong	135	4365	2	53
13	South Korea	129	4494	2	54
14	Malaysia	126	4620	2	56
15	Norway	117	4737	1	57
16	Japan	114	4851	1	59
17	Singapore	114	4965	1	60
18	Portugal	111	5076	1	62
19	Taiwan	102	5178	1	63
20	others	3030	8208	37	100
Total		8208		100	

Journal Ranking in Civil Engineering

Ranked list of journals are prepared on the base of the frequency of citation occurrence in doctoral theses of Civil Engineering submitted to the Visvesvaraya Technological University Belgravi. The data is presented in the following table. The journals having less than 20 citations are not included to avoid the bulkiness.

This is observed from the table 6 that, there are 5419 journal citations are scattered among 636 journals. The "Applied Mechanics And Materials" is highest cited journal in the doctoral theses of Civil Engineering in Visvesvaraya Technological University. The journal has 351 (6.48%) Citations. The second highest journal in citing is the "Advanced Materials Research", it has 276 (5.09%) citations.

Table 6.Journals Ranking in Civil Engineering

S.No.	Journal Title	Citations	Cumulative Citations	Citations %	Cumulative %	Rank
1	Applied Mechanics and Materials	351	351	6.48	6.48	1
2	Advanced Materials Research	276	627	5.09	11.57	2
3	Construction and Building Materials	156	783	2.88	14.45	3
4	Transportation Research Record	111	894	2.05	16.50	4
5	Engineering Structures	91	985	1.68	18.18	5
6	Canadian Journal of Civil Engineering	90	1075	1.66	19.84	6
7	Geotechnical Special Publication	87	1162	1.61	21.44	7
8	Procedia Engineering	83	1245	1.53	22.98	8
9	Gongcheng Lixue Engineering Mechanics	82	1327	1.51	24.49	9
10	Yantu Lixue Rock and Soil Mechanics	78	1405	1.44	25.93	10

11	Tumu Gongcheng Xuebao China Civil Engineering Journal	75	1480	1.38	27.31	11
12	Journal of Materials in Civil Engineering	72	1552	1.33	28.64	12
13	Computers and Structures	66	1618	1.22	29.86	13
14	Proceedings Of SPIE The International Society For Optical Engineering	60	1678	1.11	30.97	14
15	Jianzhu Jiegou Xuebao Journal of Building Structures	58	1736	1.07	32.04	15
16	Yanshilixue Yu Gongcheng Xuebao Chinese Journal of Rock Mechanics and Engineering	57	1793	1.05	33.09	16
17	Civil Engineering	51	1844	0.94	34.03	17
18	Journal Of Constructional Steel Research	50	1894	0.92	34.95	18
19	Key Engineering Materials	49	1943	0.90	35.86	19
20	Cement And Concrete Research	48	1991	0.89	36.74	20
21	Zhendong Yu Chongji Journal of Vibration and Shock	44	2035	0.81	37.55	21
22	International Journal of Civil Engineering and Technology	42	2077	0.78	38.33	22
23	Journal of Sound and Vibration	39	2116	0.72	39.05	23
24	Ksce Journal of Civil Engineering	38	2154	0.70	39.75	24
25	International Journal of Solids and Structures	38	2192	0.70	40.45	24
26	Structural Engineering and Mechanics	36	2228	0.66	41.12	25
27	Journal of Construction Engineering and Management	36	2264	0.66	41.78	25
28	Composite Structures	35	2299	0.65	42.43	26
29	Proceedings of the International Offshore and Polar Engineering Conference	34	2333	0.63	43.05	27
30	Canadian Geotechnical Journal	34	2367	0.63	43.68	27
31	Soil Dynamics and Earthquake Engineering	33	2400	0.61	44.29	28
32	Journal of Computing In Civil Engineering	33	2433	0.61	44.90	28
33	Materials and Structures Materiaux Et Constructions	33	2466	0.61	45.51	28
34	International Journal for Numerical Methods In Engineering	32	2498	0.59	46.10	29
35	Journal of Engineering Mechanics	32	2530	0.59	46.69	29
36	Matec Web of Conferences	32	2562	0.59	47.28	29
37	Thin Walled Structures	30	2592	0.55	47.83	30
38	Harbin Gongye Daxue Xuebao Journal of Harbin Institute of Technology	30	2622	0.55	48.39	30
39	Journal of Structural Engineering United States	30	2652	0.55	48.94	30
40	Journal of Structural Engineering	30	2682	0.55	49.49	30
41	Cement and Concrete Composites	28	2710	0.52	50.01	31
42	Journal of Earthquake Engineering and Engineering Vibration	27	2737	0.50	50.51	32

43	Magazine of Concrete Research	27	2764	0.50	51.01	32
44	Automation in Construction	27	2791	0.50	51.50	32
45	Proceedings of the Institution of Civil Engineers Civil Engineering	27	2818	0.50	52.00	32
46	Journal of Hydraulic Engineering	27	2845	0.50	52.50	32
47	Civil Comp Proceedings	26	2871	0.48	52.98	33
48	Journal of the Institution of Engineers India Civil Engineering Division	26	2897	0.48	53.46	33
49	Iop Conference Series Materials Science and Engineering	25	2922	0.46	53.92	34
50	Composites Part B Engineering	23	2945	0.43	54.35	35
51	ACI Structural Journal	23	2968	0.42	54.77	35
52	Jianzhu Cailiao Xuebao Journal of Building Materials	23	2991	0.42	55.19	35
53	Journal of Applied Mechanics Transactions ASME	22	3013	0.41	55.60	36
54	Journal of Wind Engineering and Industrial Aerodynamics	22	3035	0.41	56.01	36
55	Zhongguo Gonglu Xuebao China Journal of Highway and Transport	22	3057	0.41	56.42	36
56	Journal of Civil Engineering and Management	22	3079	0.41	56.83	36
57	Computing in Civil Engineering New York	22	3101	0.40	57.23	36
58	Water Resources Management	22	3123	0.40	57.63	36
59	Wuhan Ligong Daxue Xuebao Journal of Wuhan University of Technology	22	3145	0.40	58.03	36
60	Journal of Bridge Engineering	22	3167	0.40	58.44	36
61	Computer Methods in Applied Mechanics and Engineering	22	3188	0.40	58.83	36
62	International Journal for Numerical and Analytical Methods in Geomechanics	22	3210	0.40	59.23	36
63	Advances in Structural Engineering	21	3231	0.40	59.63	37
64	Building and Environment	21	3252	0.39	60.01	37
65	Ocean Engineering	21	3273	0.38	60.40	37
66	Journal Of Hydraulic Research	21	3294	0.38	60.78	37
67	Journal Of Composites For Construction	20	3314	0.37	61.16	38
68	Journal Of Professional Issues In Engineering Education And Practice	20	3334	0.37	61.53	38
69	Journal Of Transportation Engineering	20	3354	0.36	61.89	38
74	5 Titles with 19 citations	95	3449	1.75	63.64	39
76	2 Titles with 18 citations	36	3485	0.66	64.30	40
79	3 Titles with 17 citations	51	3536	0.94	65.25	41
87	8 Titles with 16 citations	128	3664	2.36	67.61	42
95	8 Titles with 15 citations	120	3784	2.21	69.82	43
106	11 Titles with14 citations	154	3938	2.84	72.66	44
113	7 Titles with13 citations	91	4029	1.68	74.34	45
129	16 Titles with 12 citations	192	4221	3.54	77.89	46
135	6 Titles with 11 citations	66	4287	1.22	79.10	47

146	11 Titles with 10 citations	110	4397	2.03	81.13	48
151	5 Titles with 9 citations	45	4442	0.83	81.96	49
160	9 Titles with 8 citations	72	4514	1.33	83.29	50
171	11 Titles with 7 citations	77	4591	1.42	84.71	51
187	16 Titles with 6 citations	96	4687	1.77	86.49	52
205	18 Titles with 5citations	90	4777	1.66	88.15	53
246	41 Titles with 4 citations	164	4941	3.03	91.17	54
272	25 Titles with 3 citations	75	5016	1.38	92.56	55
311	39 Titles with 2 citations	78	5094	1.44	94.00	56
636	325 Titles with1 citations	325	5419	6.00	100.00	57

The third highest journal is Construction And Building Materials and it has 156 (2.88%) citations. The cumulative citation percentage of the top 10 journals is 1405 25.93% which is more than quarter of the total citations.

The Productivity of Journals in Producing Citations in Doctoral Thesis is given in the following Table 7

This is observed from the Table 7 that, there is 9 journals in the first slab. In the second slab, there are 32 (5.03%) journals. In third slab (67 10.53%) and there are 528 (83.02%) journals in the fourth slab to produce 25% of citations.

Table 7.Productivity of Journals of Civil Engineering Citation

Percent-age Slab	No. of Journals	Percentage of Journals	No. of Citations	Percentage of Citations
0-25%	9	1.42	1327	24.49
26-50%	32	5.03	1383	25.52
51-75%	67	10.53	1369	25.26
76-100%	528	83.02	1340	24.73
Total	636	100	5419	100

Conclusion

Citation studies are considered significant research area in Library and Information Science field. This citations study is conducted to study the information forms approached by the users in civil engineering, to know the geographical distribution of literature, to study the rate of collaborative research, to rank the journals etc. This study provided guidelines to the Librarian to take important decisions in collection management to provide efficient information services to the users.

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