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APPLICATION OF BRADFORD'S LAW OF SCATTERING TO THE MANAGEMENT LITERATURE: A STUDY OF DOCTORAL DISSERTATIONS AT THE PANJAB UNIVERSITY, CHANDIGARH

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Abstract: One of the subareas in bibliometric research concerns the application of most commonly used bibliometric laws such as Bradford's Law of Scattering. The study is on ten years data of journals during 2000-2009 cited by the management scholars of Panjab University, Chandigarh was carried out to examine the applicability of Bradford's Law of Scattering which consisted 215 journals containing 1546 citations collected from 27 doctoral dissertations. Distributions of the journals into three equally journals were made and the number of citations in each zone was then estimated. Applicability of the Bradford's Law was then tested by applying the chi-square test to determine the goodness of fit between theoretical and experimental values.

Keywords: Panjab University, Library, Department, Management, Doctoral dissertations, Citation Analysis, Bradford's Law and Obsolescence/Half-life.

1.0 Introduction

1.1 Panjab University, Chandigarh

Panjab University is one of the oldest universities in India. It was established in 1882 at Lahore. In 1956, it was relocated at Chandigarh. It has 75 teaching and research departments. The Panjab University Library named officially as "A. C. Joshi Library". It has a collection of over 6.4 lakh publications which includes books, bound volumes of journals, theses/dissertations, rare books, reports, government documents, back files of newspapers, and a prized collection of 1490 manuscripts. The Library is now fully computerized with an integrated system connected to the Campus Network providing Internet and e-mail facility to the University community.

1.2 University Business School, PU, Chandigarh

University Business School (UBS), established in 1968, is located in Chandigarh. It is one of the few management institutes in India with a structured Ph.D. program. Additionally UBS offers a three-year MBA (Executive) program for working professionals and a two-year M.Com (E-commerce) program, in addition to four full time MBA programs.

1.3 Management

Management is the act of getting people together to accomplish desired goals and objectives using available resources efficiently and effectively. Management comprises POSDCORB (planning; organizing; staffing; directing; controlling; organization; resourcing and developing).

1.4 Doctoral dissertations

The doctoral dissertations are results of research activity which is an important source of information for giving the experimental evidences, as well as it records a thorough review of works that have already done in a particular field to show that the proposed work is not done elsewhere. In this process, to establish their claim, the researcher cites a large number of references in the theses (Barooah, Begum and Sharma, 1999 p.1).

2.0 Citation Analysis

The part of citations which is cited most can be judged through citation study which provides helpful guidance in the process of collection development of the library.

Citations Analysis is a research tool designed to find pattern within scholarly research. Researchers study the citations that are used in scholarly works to determine trends that will impact library collection. It used to rank, evaluate and categorize journals based on their frequency of article citations (Rethlefsen, 2007 p.264).

Citation Analysis also helps to know about the half-life of literature which helps in deciding how long these documents are useful and should be preserved in the library (Paul and Roy, 1980). Citation Analysis is one of the effective and indirect method to understand the information requirements of users. It helps to identify the most cited journals which can be considered as core journals.

3.0 Review of Literature

Gohain, Mr. Arjun & Saikia, Dr. Mukesh (2014) The study revealed that journals were the most preferred sources of information used by the researchers in the field of chemical sciences accounting for 78.83% of total citations, followed by books with 15.57 % citations. The Journal of Journal of American Chemical Society has ranked the first with 617 citations accounting for 7.13% of the total journal citations. Authorship pattern for journal citations shows that out of the total number of 8658 journal citation, 39.89% are by more than three authors, followed by two authors with 22.28 %. **Banateppanvar, K, Biradar, B. S and Kannappanavar, B.U (2013)** studied doctoral theses of botany, submitted to the Kuvempu University during the years 2000-2006. Findings revealed that journals were the most preferred sources of information used by the researchers in the field of botany, accounting for 74.77 % citations. Authors found that major citations come from journal literature. Authorship pattern for journal citations shows that most of the citations were contributed by multi authors. **Banateppanvar1, K and others (2013)** studied the materials cited in doctoral theses of the Zoology, submitted to the Kuvempu University, India during the year 2002 to 2006. Findings revealed that journals were the most preferred sources of information used by the researchers in the field of Zoology accounting with 74.47% of the total citations followed by books and monographs 18.02% citations. The Journal of Mutation Research occupied first rank with 94 citations accounting for 5.71% of the total journal citations. It was observed that major citation from journal literature and maximum numbers of cited materials were contributed by multi authors and degree of collaboration is 0.71. **Banateppanvar, K., Biradar, B. S. and Kannappanavar, B. U. (2013)** studied citation analysis of doctoral theses in biotechnology submitted to Kuvempu University, Karnataka. Journals were the most preferred sources used by the researchers in the field of biotechnology accounting with 79.72% of total citations. Plant cell tissue & org .cult (Netherlands) has ranked the first with 121 citations accounting for 4.16% of the total journal citations. Furthermore, Bradford's Law of Scattering was applied. The study examined the authorship pattern more cited materials were contributed by multi authors and degree of collaboration is 0.85. **Gupta, J. & Khare, V.P. (2013)** studied on citation analysis of Ph.D. theses of LIS in Dr. Harisingh Gour University, Sagar . Findings revealed that the most of the cited sources were journals. Authors found that most of the contributions of journals were from USA, and the most cited journals are IASLIC Bulletin with11.89%. **Singh, K. P and Bebi (2013)** studied citation analysis of Ph.D. theses submitted in the department of Sociology of the University of Delhi during 1995-2010. The study was based on the 5766 citations taken out from 25 Ph.D. theses of sociology. Authors pattern found that highest number of citations was single authored 83.94 %, and 67.23 % citations were from books and only 22.20 % citations were from journals. **Kumar, K and Reddy, T. R (2012)** studied citations in master's degree dissertations submitted to the department of library and information science, Sri Venkateswara University, Tirupathi during the period 2000 – 2007. Findings showed that journals were the most utilized reference materials in the dissertations. **Trayambakrao, K. D and Sonwane, S (2012)** studied 2876 citations appended in 34 theses of Economics submitted to Dr. Baba Saheb Ambedkar Marathwada University the year 2000-2010. The study was carried out to find the types of cited document, the chronological distribution of cited documents, the authorship pattern of cited document, the rank list of cited journals-books, language wise distribution, geographical distribution of cited documents, the rank list of cited web– sources and the cited authors. **Zafrunnisha, N (2012)** in her study analyzed the productivity of cited journals in Psychology doctoral theses, which was measured after dividing the journals into four equal groups. The journal distribution as per the Bradford's Law revealed the ratio as 17:46:358 in Psychology, dispersion of journal titles in psychology didn't satisfy the Bradford's Law of Scattering.

4.0 Objectives of the Study

The Main objectives of the study are:

1. To know about the forms of cited documents;

2. To know the authorship pattern of books and journals
3. To prepare a rank list of most cited journals by the management scholars;
4. To test the applicability of the Bradford's Law of Scattering;
5. To know about the obsolescence/ half-life of literature.

5.0 Data Collection, Analysis and Interpretations

The basis of this study is the citations collected from 27 doctoral dissertations in the field of Management at the Panjab University, Chandigarh. The total number of citations are 3307 consisted 1546 journal citations from 215 cited journals.

Table 5.1: Format Of Cited Documents: Panjab University, Chandigarh

Sr. No.	Bibliographical Forms	No. of Citations	Cumulative Citations	Percentage	Cumulative Percentage	Rank No.
1	Books	895	895	27.06	27.06	2
2	Journals	1546	2441	46.75	73.81	1
3	Reports	171	2612	5.17	78.98	4
4	Reviews/ Newspapers	152	2764	4.60	83.58	5
5	Magazines	255	3019	7.71	91.29	3
6	Conference Proceedings/ Seminars/ Discussion Papers/ Research Papers/ Working Papers etc.	127	3146	3.84	95.13	6
7	Websites	16	3162	0.48	95.62	9
8	Reference Books/ Glossaries/ Dictionaries etc.	66	3228	2.00	97.61	8
9	Theses/ Dissertations and Unpublished Sources	11	3239	0.33	97.94	10
10	Unidentified	68	3307	2.06	100.00	7
Total		3307				

Table 5.1 deals in all 3307 citations of 27 doctoral dissertations submitted in the Panjab University, Chandigarh distributed among different bibliographical forms. The above given table reveals that Journals are the most used bibliographic form which holds the first position among all sources accounting for 1546 citations (46.75%) of the total citations (3307). The total number of citations from Books are 895 (27.06%); Magazines with 255 citations (7.71%); Reports with 171 citations (5.17%); Reviews/ Newspapers with 152 citations (4.60%); Conference Proceedings/ Seminars/ Discussion Papers/ Research Papers/ Working Papers etc.. with 127 citations (3.84%); Unidentified forms with 68 citations (2.06%); Reference books/ Glossaries/ Dictionaries etc.. with 66 citations (2.00%); Websites with 16 citations (0.48 %) and Theses/ Dissertations and Unpublished Sources with 11 citations (0.33%) respectively.

6.0 Authors Collaborations

Various methods have been proposed to calculate the degree of research collaboration.one of these are following:

6.1 Degree of Collaboration

"Subramanyam (1983) proposed a mathematical formula for calculating author's degree of collaboration in a discipline. It is expressed mathematically as:

$$g = \frac{N_m}{N_m + N_s}$$

Where g = Group Coefficient of a discipline

N_m = Number of multiple authors during a specific period in a discipline

N_s = Number of single-authored works in a discipline during a given period of time

Table 6.1: Authorship Pattern of Cited Journals and Books: Panjab University, Chandigarh

Sr. No.	Authorship Pattern	Journals				Books			
		No. of Citations	Percentage of Citations	Cumulative Citations	Percentage of Cumulative Citations	No. of Citations	Percentage of Citations	Cumulative Citations	Percentage of Cumulative Citations
1	Single	892	57.70	892	57.70	600	67.04	600	67.04
2	Joint	430	27.81	1322	85.51	219	24.47	819	91.51
3	Three	125	8.09	1447	93.60	39	4.36	858	95.87
4	Four	26	1.68	1473	95.28	14	1.56	872	97.43
5	More than four	73	4.72	1546	100.00	23	2.57	895	100.00
Total		1546				895			

DC = 0.42 CC = 0.24 DC = 0.33 CC = 0.18

Table 6.1 depicts the authorship pattern of cited journals and books by the Panjab University, Chandigarh. Out of the total citations 3307, the journals account for 1546 forming 46.75% of the total citations while books account for 895 forming 27.06% of the total citations Authorship pattern of journals indicates that out of the total number of 1546 Journal Citations, 892 are by single author (57.70%), followed by 430 citations (27.81%) by joint authors, 125 citations by three authors (8.09%), 26 citations by four authors (1.68%) and 73 citations by more than four authors (4.72%). Degree of Collaboration of cited journals is 0.42 which indicates the extent of collaboration was not popular among authors. Collaborative co-efficient is 0.24 which indicates less collaboration between authors.

Authorship pattern of book citations shows that out of the total number of 895 Book Citations, 600 are by single author (67.04%), followed by 219 citations (24.47%) by joint authors, 39 citations by three authors (4.36%), 14 citations by four authors (1.56%) and 23 citations by more than four authors (2.57%). Degree of Collaboration of cited journals is 0.33 which indicates the extent of collaboration was not much popular among authors. Collaborative co-efficient is 0.18 which indicates less collaboration between authors.

7.0. Bradford's Law of Scattering

The Bradford's Law derived its universality in application from the basic use in scientific field. The verbal formulation of the Bradford's Law of Scattering is also tested by dividing the total number of journals citations in each universities into three zones. Each zone had approximately one third (1/3) of the total citations. The number of journals in the nucleus and succeeding zones will be as 1: n: n^2 … where n approximates fairly closely to the number 5.

"Bradford applied both graphical and mathematical representation of the data.

7.1 Graphical Representation of Bradford's Law

The result of Bradford's study, when plotted on a semi-log graph paper with log n, (natural logarithm of the total productivity by the journals on the abscissa) against R(n) (cumulative number of relevant papers, contributed by the journals) on the ordinate, it was marked that after an initial rise the curve is very much close to a straight line. The curve was elongated s-shaped.

7.2 Mathematical Representation of Bradford's Law

On the basis of the observations Bradford suggested the following linear relation to describe the scattering phenomenon as:

$$F(x) = a + b \log x$$

Where, F(x) = cumulative number of references contained in the first x most productive journals.

a and b = constants.

Soon after the publication of Bradford's Law, a number of studies were carried out to verify the authenticity of the Law. Vickery(1948) extended the verbal formulation to show that it can be applied to any number of zones of equal yield not only the three zones that Bradford had used.

Leimkuhler's model is known as "Bradford distribution". It was used to predict the references yield of abstracting services in terms of papers and their sources in the field of thermo-physical property data.

The mathematical expression of Leimkuhler's formula is:

$$F(x) = \frac{\log_e(1+\beta x)}{\log_e(1+\beta)}$$

Where, x = the fraction of the document collection.

$F(x)$ = the proportion of total productivity contained in the fraction 'x'.

β = a constant related to the document collection.

Leimkuhler's analysis of Bradford's law offered a formula which could be used to express the distribution of papers relevant to a topic cover the range of journals known to be productive for the topic.

Leimkuhler had derived his distribution function from Bradford's verbal expression" (Mahapatra 2009, 132-135).

Table 7.1: Ranking of Journals: Panjab University, Chandigarh

Sr. No.	Rank No.	Title of Journal	No. of Citations	Percentage of Citations	Cumulative Citations	Cumulative Percentage
1	1	Economic and Political Weekly	52	3.36	52	3.36
2	2	Journal of Finance	49	3.17	101	6.53
3	3	Management Accountant	43	2.78	144	9.31
4	4	Indian Journal of Industrial Relations	39	2.52	183	11.84
5	5	Journal of Accountancy	36	2.33	219	14.17
6	6	International Journal of Physical Distribution and Material Management	35	2.26	254	16.43
7	7	Computer Today	33	2.13	287	18.56
8	8	Financial Management	31	2.01	318	20.57
9	8	Personnel Journal	31	2.01	349	22.57
10	9	Journal of Indian Institute of Bankers	30	1.94	379	24.51
11	10	Academy of Management Journal	29	1.88	408	26.39
12	11	Vikalpa	27	1.75	435	28.14
13	12	Business Horizons	25	1.62	460	29.75
14	12	Chartered Accountant	25	1.62	485	31.37
15	12	Lok Udyog	25	1.62	510	32.99
16	12	Management Accounting	25	1.62	535	34.61
17	12	Journal of Advertising Research	25	1.62	560	36.22
18	12	Journal of Applied Psychology	25	1.62	585	37.84
19	13	Journal of Cost Management	22	1.42	607	39.26
20	13	Journal of General Management	22	1.42	629	40.69
21	13	Productivity	22	1.42	651	42.11
22	13	Fortune India	22	1.42	673	43.53
23	13	Journal of Cross Cultural Psychology	22	1.42	695	44.95
24	13	Journal of Decision Science	22	1.42	717	46.38
25	13	Chartered Secretary	22	1.42	739	47.80
26	14	Indian Journal of Marketing	20	1.29	759	49.09

27	14	Journal of Management Information Systems	20	1.29	779	50.39
28	14	Financial Executive	20	1.29	799	51.68
29	14	Journal of Management Studies	20	1.29	819	52.98
30	14	Indian Banking Today-Tomorrow	20	1.29	839	54.27
31	15	Journal of International Business Studies	15	0.97	854	55.24
32	15	Indian Journal of Labour Economics	15	0.97	869	56.21
33	15	Journal of Accounting and Business Research	15	0.97	884	57.18
34	15	Journal of Industrial Relations	15	0.97	899	58.15
35	15	Personnel Psychology	15	0.97	914	59.12
36	15	Indian Journal of Commerce	15	0.97	929	60.09
37	15	Management Executive	15	0.97	944	61.06
38	15	Journal of Marketing Accounting Research	15	0.97	959	62.03
39	16	Accounting Horizons	12	0.78	971	62.81
40	16	Journal of Consumer Research	12	0.78	983	63.58
41	16	Administrative Science Quarterly	12	0.78	995	64.36
42	16	IBA Bulletin	12	0.78	1007	65.14
43	16	Journal of Financial Economics	12	0.78	1019	65.91
44	16	Harvard Business Journal	12	0.78	1031	66.69
45	16	Business World	12	0.78	1043	67.46
46	17	International Journal of Psychology	10	0.65	1053	68.11
47	17	Financial Analysis Journal	10	0.65	1063	68.76
48	17	International Journal of Development Banking	10	0.65	1073	69.40
49	17	Journal of Marketing	10	0.65	1083	70.05
50	17	International Journal of Production Research	10	0.65	1093	70.70
51	17	ASCI Journal of Management	10	0.65	1103	71.35
52	17	Journal of Applied Financial Economics	10	0.65	1113	71.99
53	17	Economic Journal	10	0.65	1123	72.64
54	18	International Journal of Information Management	9	0.58	1132	73.22
55	18	Journal of Credit and Financial Management	9	0.58	1141	73.80
56	18	Accounting Research Studies	9	0.58	1150	74.39
57	18	Journal of Human Relations	9	0.58	1159	74.97
58	18	Accounting and Business Research	9	0.58	1168	75.55
59	18	European Journal of Operational Research	9	0.58	1177	76.13
60	18	Journal of Marketing Research	9	0.58	1186	76.71
61	----	Other (155) Journals	360	23.29	1546	100.00
Total			1546			

Table 7.1 gives a rank list of periodicals of Panjab University, Chandigarh which indicates that among 215 periodicals cited only thirty two periodical accounts for more than 60% (i.e. 60.48%) of the citations and therefore they may be considered as core periodicals. Table also indicates that "Economic and Political Weekly" is the first most frequently cited periodical i.e. 7.05%.

Table 7.2: Verbal Formulation of the Bradford's Law of Scattering: Panjab University, Chandigarh

Number of Zones	Number of Journals	Number of Journals Citations
Zone 1 (Nuclear)	7	537
Zone 2	42	515
Zone 3	166	494

Table 7.2 shows the journal distribution as per the Bradford's Law which reveals the ratio as **7:42:166** in Punjab University, Chandigarh. It is evident from the above ratio that the number of journal titles in each zone is not increasing geometrically. Hence it is concluded that the dispersion of journals' titles in Management does not satisfy the verbal formulation of Bradford's Law of Scattering.

7.3: Application of Bradford's Law: Punjab University, Chandigarh: Result

7.3.1 Hypotheses:

H_0: Data doesn't fit with Bradford's Law of Distribution.

H_1: Data fits with Bradford's Law of Distribution.

The Bradford's Law was applied to the Data of the management and the relevant statistics were computed using Leimkuhler's equation which is stated as follows:

$$F(x) = \frac{\log_e(1+\beta x)}{\log_e(1+\beta)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where β is connected with $\bar{x}$ as follows:

$$\bar{x} = \frac{1}{\log_e(1+\beta)} - \frac{1}{\beta} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where $\bar{x} = \frac{\sum i.f(i)}{n}$

$\bar{x}$ = 44.9521/215 = 0.2091. . . . . (Computed from Table 8.3)

Using trial and error method and from equation (2) we find the value of beta 94. For goodness to fit the chi square test has been applied.

$$\chi^2 = \sum \frac{[f(x)-F(x)]^2}{F(x)}$$

Where $f(x)$ is Observed value and $F(x)$ is Theoretical value.

$\chi^2_{calculated}$ = 0.1023 . . . . . (Computed from Table 8.3)

At 5% level of significance for n = 215 the tabular value of $\chi^2_{0.05}$ for 214 df is 243.13.

Therefore $\chi^2_{calculated} < \chi^2_{0.05}$

7.3.2 Results: Hence we may accept the null hypothesis i.e. Data does not fit well with Bradford's Law of distribution.

Table 7.3: Application of Bradford's Law: Panjab University, Chandigarh

No of Journals (i)	No. of Citations	Cumulative Citations	No of Citations/Total Citations f(i)	i*f(i)	No of Journals / Total No of Journals (x)	Observed Value = Cumulative Citations/Total Citations $f(x)$	Expected Value $F(x)$	$\frac{[f(x)-F(x)]^2}{F(x)}$
1	109	109	0.0705	0.0705	0.0047	0.0705	0.0803	0.0012
2	98	207	0.0634	0.1268	0.0093	0.1339	0.1379	0.0001
3	85	292	0.0550	0.1650	0.0140	0.1889	0.1844	0.0001
4	79	371	0.0511	0.2044	0.0186	0.2400	0.2220	0.0015
5	66	437	0.0427	0.2135	0.0233	0.2827	0.2547	0.0031
6	57	494	0.0369	0.2214	0.0279	0.3195	0.2827	0.0048
7	43	537	0.0278	0.1946	0.0326	0.3473	0.3079	0.0050
8	43	580	0.0278	0.2224	0.0372	0.3752	0.3301	0.0062
9	37	617	0.0239	0.2151	0.0419	0.3991	0.3507	0.0067
10	31	648	0.0201	0.2010	0.0465	0.4191	0.3691	0.0068
11	22	670	0.0142	0.1562	0.0512	0.4334	0.3865	0.0057
12	22	692	0.0142	0.1704	0.0558	0.4476	0.4023	0.0051
13	20	712	0.0129	0.1677	0.0605	0.4605	0.4173	0.0045
14	20	732	0.0129	0.1806	0.0651	0.4735	0.4310	0.0042
15	20	752	0.0129	0.1935	0.0698	0.4864	0.4442	0.0040

16	15	767	0.0097	0.1552	0.0744	0.4961	0.4565	0.0034
17	15	782	0.0097	0.1649	0.0791	0.5058	0.4683	0.0030
18	15	797	0.0097	0.1746	0.0837	0.5155	0.4792	0.0027
19	12	809	0.0078	0.1482	0.0884	0.5233	0.4899	0.0023
20	12	821	0.0078	0.1560	0.0930	0.5310	0.4999	0.0019
21	12	833	0.0078	0.1638	0.0977	0.5388	0.5096	0.0017
22	10	843	0.0065	0.1430	0.1023	0.5453	0.5188	0.0014
23	10	853	0.0065	0.1495	0.1070	0.5517	0.5277	0.0011
24	10	863	0.0065	0.1560	0.1116	0.5582	0.5361	0.0009
25	10	873	0.0065	0.1625	0.1163	0.5647	0.5444	0.0008
26	10	883	0.0065	0.1690	0.1209	0.5712	0.5522	0.0007
27	9	892	0.0058	0.1566	0.1256	0.5770	0.5600	0.0005
28	9	901	0.0058	0.1624	0.1302	0.5828	0.5672	0.0004
29	9	910	0.0058	0.1682	0.1349	0.5886	0.5745	0.0003
30	9	919	0.0058	0.1740	0.1395	0.5944	0.5813	0.0003
31	8	927	0.0052	0.1612	0.1442	0.5996	0.5881	0.0002
32	8	935	0.0052	0.1664	0.1488	0.6048	0.5945	0.0002
33	8	943	0.0052	0.1716	0.1535	0.6100	0.6009	0.0001
34	8	951	0.0052	0.1768	0.1581	0.6151	0.6069	0.0001
35	8	959	0.0052	0.1820	0.1628	0.6203	0.6130	0.0001
36	8	967	0.0052	0.1872	0.1674	0.6255	0.6187	0.0001
37	7	974	0.0045	0.1665	0.1721	0.6300	0.6244	0.0001
38	7	981	0.0045	0.1710	0.1767	0.6345	0.6299	0.0000
39	7	988	0.0045	0.1755	0.1814	0.6391	0.6353	0.0000
40	7	995	0.0045	0.1800	0.1860	0.6436	0.6405	0.0000
41	7	1002	0.0045	0.1845	0.1907	0.6481	0.6457	0.0000
42	7	1009	0.0045	0.1890	0.1953	0.6527	0.6507	0.0000
43	7	1016	0.0045	0.1935	0.2000	0.6572	0.6556	0.0000
44	6	1022	0.0039	0.1716	0.2047	0.6611	0.6605	0.0000
45	6	1028	0.0039	0.1755	0.2093	0.6649	0.6651	0.0000
46	6	1034	0.0039	0.1794	0.2140	0.6688	0.6698	0.0000
47	6	1040	0.0039	0.1833	0.2186	0.6727	0.6742	0.0000
48	6	1046	0.0039	0.1872	0.2233	0.6766	0.6787	0.0000
49	6	1052	0.0039	0.1911	0.2279	0.6805	0.6829	0.0000
50	6	1058	0.0039	0.1950	0.2326	0.6843	0.6872	0.0000
51	6	1064	0.0039	0.1989	0.2372	0.6882	0.6913	0.0000
52	5	1069	0.0032	0.1664	0.2419	0.6915	0.6955	0.0000
53	5	1074	0.0032	0.1696	0.2465	0.6947	0.6994	0.0000
54	5	1079	0.0032	0.1728	0.2512	0.6979	0.7034	0.0000
55	5	1084	0.0032	0.1760	0.2558	0.7012	0.7072	0.0001
56	5	1089	0.0032	0.1792	0.2605	0.7044	0.7111	0.0001
57	5	1094	0.0032	0.1824	0.2651	0.7076	0.7148	0.0001
58	5	1099	0.0032	0.1856	0.2698	0.7109	0.7185	0.0001
59	5	1104	0.0032	0.1888	0.2744	0.7141	0.7221	0.0001
60	5	1109	0.0032	0.1920	0.2791	0.7173	0.7256	0.0001
61	4	1113	0.0026	0.1586	0.2837	0.7199	0.7291	0.0001
62	4	1117	0.0026	0.1612	0.2884	0.7225	0.7326	0.0001
63	4	1121	0.0026	0.1638	0.2930	0.7251	0.7359	0.0002
64	4	1125	0.0026	0.1664	0.2977	0.7277	0.7393	0.0002
65	4	1129	0.0026	0.1690	0.3023	0.7303	0.7426	0.0002
66	4	1133	0.0026	0.1716	0.3070	0.7329	0.7458	0.0002
67	4	1137	0.0026	0.1742	0.3116	0.7354	0.7490	0.0002
68	4	1141	0.0026	0.1768	0.3163	0.7380	0.7522	0.0003
69	4	1145	0.0026	0.1794	0.3209	0.7406	0.7552	0.0003
70	4	1149	0.0026	0.1820	0.3256	0.7432	0.7583	0.0003
71	4	1153	0.0026	0.1846	0.3302	0.7458	0.7613	0.0003
72	4	1157	0.0026	0.1872	0.3349	0.7484	0.7643	0.0003

73	4	1161	0.0026	0.1898	0.3395	0.7510	0.7672	0.0003
74	4	1165	0.0026	0.1924	0.3442	0.7536	0.7702	0.0004
75	4	1169	0.0026	0.1950	0.3488	0.7561	0.7730	0.0004
76	4	1173	0.0026	0.1976	0.3535	0.7587	0.7758	0.0004
77	4	1177	0.0026	0.2002	0.3581	0.7613	0.7786	0.0004
78	4	1181	0.0026	0.2028	0.3628	0.7639	0.7814	0.0004
79	4	1185	0.0026	0.2054	0.3674	0.7665	0.7841	0.0004
80	4	1189	0.0026	0.2080	0.3721	0.7691	0.7868	0.0004
81	4	1193	0.0026	0.2106	0.3767	0.7717	0.7894	0.0004
82	4	1197	0.0026	0.2132	0.3814	0.7743	0.7921	0.0004
83	4	1201	0.0026	0.2158	0.3860	0.7768	0.7946	0.0004
84	4	1205	0.0026	0.2184	0.3907	0.7794	0.7972	0.0004
85	4	1209	0.0026	0.2210	0.3953	0.7820	0.7997	0.0004
86	4	1213	0.0026	0.2236	0.4000	0.7846	0.8022	0.0004
87	4	1217	0.0026	0.2262	0.4047	0.7872	0.8047	0.0004
88	4	1221	0.0026	0.2288	0.4093	0.7898	0.8071	0.0004
89	4	1225	0.0026	0.2314	0.4140	0.7924	0.8096	0.0004
90	4	1229	0.0026	0.2340	0.4186	0.7950	0.8120	0.0004
91	4	1233	0.0026	0.2366	0.4233	0.7975	0.8143	0.0003
92	4	1237	0.0026	0.2392	0.4279	0.8001	0.8167	0.0003
93	4	1241	0.0026	0.2418	0.4326	0.8027	0.8190	0.0003
94	4	1245	0.0026	0.2444	0.4372	0.8053	0.8213	0.0003
95	4	1249	0.0026	0.2470	0.4419	0.8079	0.8236	0.0003
96	4	1253	0.0026	0.2496	0.4465	0.8105	0.8258	0.0003
97	4	1257	0.0026	0.2522	0.4512	0.8131	0.8280	0.0003
98	4	1261	0.0026	0.2548	0.4558	0.8157	0.8302	0.0003
99	4	1265	0.0026	0.2574	0.4605	0.8182	0.8324	0.0002
100	4	1269	0.0026	0.2600	0.4651	0.8208	0.8345	0.0002
101	4	1273	0.0026	0.2626	0.4698	0.8234	0.8367	0.0002
102	4	1277	0.0026	0.2652	0.4744	0.8260	0.8388	0.0002
103	3	1280	0.0019	0.1957	0.4791	0.8279	0.8409	0.0002
104	3	1283	0.0019	0.1976	0.4837	0.8299	0.8430	0.0002
105	3	1286	0.0019	0.1995	0.4884	0.8318	0.8450	0.0002
106	3	1289	0.0019	0.2014	0.4930	0.8338	0.8471	0.0002
107	3	1292	0.0019	0.2033	0.4977	0.8357	0.8491	0.0002
108	3	1295	0.0019	0.2052	0.5023	0.8376	0.8511	0.0002
109	3	1298	0.0019	0.2071	0.5070	0.8396	0.8531	0.0002
110	3	1301	0.0019	0.2090	0.5116	0.8415	0.8550	0.0002
111	3	1304	0.0019	0.2109	0.5163	0.8435	0.8570	0.0002
112	3	1307	0.0019	0.2128	0.5209	0.8454	0.8589	0.0002
113	3	1310	0.0019	0.2147	0.5256	0.8473	0.8608	0.0002
114	3	1313	0.0019	0.2166	0.5302	0.8493	0.8627	0.0002
115	3	1316	0.0019	0.2185	0.5349	0.8512	0.8646	0.0002
116	3	1319	0.0019	0.2204	0.5395	0.8532	0.8665	0.0002
117	3	1322	0.0019	0.2223	0.5442	0.8551	0.8683	0.0002
118	3	1325	0.0019	0.2242	0.5488	0.8571	0.8701	0.0002
119	3	1328	0.0019	0.2261	0.5535	0.8590	0.8720	0.0002
120	3	1331	0.0019	0.2280	0.5581	0.8609	0.8738	0.0002
121	3	1334	0.0019	0.2299	0.5628	0.8629	0.8756	0.0002
122	3	1337	0.0019	0.2318	0.5674	0.8648	0.8773	0.0002
123	3	1340	0.0019	0.2337	0.5721	0.8668	0.8791	0.0002
124	3	1343	0.0019	0.2356	0.5767	0.8687	0.8808	0.0002
125	3	1346	0.0019	0.2375	0.5814	0.8706	0.8826	0.0002
126	3	1349	0.0019	0.2394	0.5860	0.8726	0.8843	0.0002
127	3	1352	0.0019	0.2413	0.5907	0.8745	0.8860	0.0001
128	3	1355	0.0019	0.2432	0.5953	0.8765	0.8877	0.0001
129	3	1358	0.0019	0.2451	0.6000	0.8784	0.8894	0.0001

130	3	1361	0.0019	0.2470	0.6047	0.8803	0.8910	0.0001
131	3	1364	0.0019	0.2489	0.6093	0.8823	0.8927	0.0001
132	3	1367	0.0019	0.2508	0.6140	0.8842	0.8943	0.0001
133	3	1370	0.0019	0.2527	0.6186	0.8862	0.8960	0.0001
134	3	1373	0.0019	0.2546	0.6233	0.8881	0.8976	0.0001
135	3	1376	0.0019	0.2565	0.6279	0.8900	0.8992	0.0001
136	3	1379	0.0019	0.2584	0.6326	0.8920	0.9008	0.0001
137	3	1382	0.0019	0.2603	0.6372	0.8939	0.9023	0.0001
138	3	1385	0.0019	0.2622	0.6419	0.8959	0.9039	0.0001
139	3	1388	0.0019	0.2641	0.6465	0.8978	0.9055	0.0001
140	3	1391	0.0019	0.2660	0.6512	0.8997	0.9070	0.0001
141	3	1394	0.0019	0.2679	0.6558	0.9017	0.9086	0.0001
142	3	1397	0.0019	0.2698	0.6605	0.9036	0.9101	0.0000
143	3	1400	0.0019	0.2717	0.6651	0.9056	0.9116	0.0000
144	3	1403	0.0019	0.2736	0.6698	0.9075	0.9131	0.0000
145	3	1406	0.0019	0.2755	0.6744	0.9094	0.9146	0.0000
146	3	1409	0.0019	0.2774	0.6791	0.9114	0.9161	0.0000
147	3	1412	0.0019	0.2793	0.6837	0.9133	0.9176	0.0000
148	3	1415	0.0019	0.2812	0.6884	0.9153	0.9191	0.0000
149	3	1418	0.0019	0.2831	0.6930	0.9172	0.9205	0.0000
150	3	1421	0.0019	0.2850	0.6977	0.9191	0.9220	0.0000
151	3	1424	0.0019	0.2869	0.7023	0.9211	0.9234	0.0000
152	3	1427	0.0019	0.2888	0.7070	0.9230	0.9248	0.0000
153	3	1430	0.0019	0.2907	0.7116	0.9250	0.9262	0.0000
154	3	1433	0.0019	0.2926	0.7163	0.9269	0.9276	0.0000
155	3	1436	0.0019	0.2945	0.7209	0.9288	0.9290	0.0000
156	3	1439	0.0019	0.2964	0.7256	0.9308	0.9304	0.0000
157	3	1442	0.0019	0.2983	0.7302	0.9327	0.9318	0.0000
158	3	1445	0.0019	0.3002	0.7349	0.9347	0.9332	0.0000
159	3	1448	0.0019	0.3021	0.7395	0.9366	0.9345	0.0000
160	3	1451	0.0019	0.3040	0.7442	0.9386	0.9359	0.0000
161	3	1454	0.0019	0.3059	0.7488	0.9405	0.9372	0.0000
162	3	1457	0.0019	0.3078	0.7535	0.9424	0.9386	0.0000
163	3	1460	0.0019	0.3097	0.7581	0.9444	0.9399	0.0000
164	3	1463	0.0019	0.3116	0.7628	0.9463	0.9413	0.0000
165	3	1466	0.0019	0.3135	0.7674	0.9483	0.9426	0.0000
166	2	1468	0.0013	0.2158	0.7721	0.9495	0.9439	0.0000
167	2	1470	0.0013	0.2171	0.7767	0.9508	0.9452	0.0000
168	2	1472	0.0013	0.2184	0.7814	0.9521	0.9465	0.0000
169	2	1474	0.0013	0.2197	0.7860	0.9534	0.9478	0.0000
170	2	1476	0.0013	0.2210	0.7907	0.9547	0.9490	0.0000
171	2	1478	0.0013	0.2223	0.7953	0.9560	0.9503	0.0000
172	2	1480	0.0013	0.2236	0.8000	0.9573	0.9516	0.0000
173	2	1482	0.0013	0.2249	0.8047	0.9586	0.9528	0.0000
174	2	1484	0.0013	0.2262	0.8093	0.9599	0.9541	0.0000
175	2	1486	0.0013	0.2275	0.8140	0.9612	0.9553	0.0000
176	2	1488	0.0013	0.2288	0.8186	0.9625	0.9566	0.0000
177	2	1490	0.0013	0.2301	0.8233	0.9638	0.9578	0.0000
178	2	1492	0.0013	0.2314	0.8279	0.9651	0.9590	0.0000
179	2	1494	0.0013	0.2327	0.8326	0.9664	0.9602	0.0000
180	2	1496	0.0013	0.2340	0.8372	0.9677	0.9614	0.0000
181	2	1498	0.0013	0.2353	0.8419	0.9690	0.9626	0.0000
182	2	1500	0.0013	0.2366	0.8465	0.9702	0.9638	0.0000
183	2	1502	0.0013	0.2379	0.8512	0.9715	0.9650	0.0000
184	2	1504	0.0013	0.2392	0.8558	0.9728	0.9662	0.0000
185	2	1506	0.0013	0.2405	0.8605	0.9741	0.9674	0.0000
186	2	1508	0.0013	0.2418	0.8651	0.9754	0.9685	0.0000

187	2	1510	0.0013	0.2431	0.8698	0.9767	0.9697	0.0001
188	2	1512	0.0013	0.2444	0.8744	0.9780	0.9709	0.0001
189	2	1514	0.0013	0.2457	0.8791	0.9793	0.9720	0.0001
190	2	1516	0.0013	0.2470	0.8837	0.9806	0.9732	0.0001
191	2	1518	0.0013	0.2483	0.8884	0.9819	0.9743	0.0001
192	2	1520	0.0013	0.2496	0.8930	0.9832	0.9754	0.0001
193	2	1522	0.0013	0.2509	0.8977	0.9845	0.9766	0.0001
194	2	1524	0.0013	0.2522	0.9023	0.9858	0.9777	0.0001
195	2	1526	0.0013	0.2535	0.9070	0.9871	0.9788	0.0001
196	1	1527	0.0006	0.1176	0.9116	0.9877	0.9799	0.0001
197	1	1528	0.0006	0.1182	0.9163	0.9884	0.9810	0.0001
198	1	1529	0.0006	0.1188	0.9209	0.9890	0.9821	0.0000
199	1	1530	0.0006	0.1194	0.9256	0.9897	0.9832	0.0000
200	1	1531	0.0006	0.1200	0.9302	0.9903	0.9843	0.0000
201	1	1532	0.0006	0.1206	0.9349	0.9909	0.9854	0.0000
202	1	1533	0.0006	0.1212	0.9395	0.9916	0.9864	0.0000
203	1	1534	0.0006	0.1218	0.9442	0.9922	0.9875	0.0000
204	1	1535	0.0006	0.1224	0.9488	0.9929	0.9886	0.0000
205	1	1536	0.0006	0.1230	0.9535	0.9935	0.9897	0.0000
206	1	1537	0.0006	0.1236	0.9581	0.9942	0.9907	0.0000
207	1	1538	0.0006	0.1242	0.9628	0.9948	0.9918	0.0000
208	1	1539	0.0006	0.1248	0.9674	0.9955	0.9928	0.0000
209	1	1540	0.0006	0.1254	0.9721	0.9961	0.9939	0.0000
210	1	1541	0.0006	0.1260	0.9767	0.9968	0.9949	0.0000
211	1	1542	0.0006	0.1266	0.9814	0.9974	0.9959	0.0000
212	1	1543	0.0006	0.1272	0.9860	0.9981	0.9969	0.0000
213	1	1544	0.0006	0.1278	0.9907	0.9987	0.9980	0.0000
214	1	1545	0.0006	0.1284	0.9953	0.9994	0.9990	0.0000
215	1	1546	0.0006	0.1290	1.0000	1.0000	1.0000	0.0000
Total				44.9521				0.1023

8.0 Obsolescence and Half/ Life

Analysis of citations by the age of the cited documents can indicated the useful life of documents. The useful life has been called as half-life it sometimes expressed as the rate of obsolescence.

Half-life denotes the time during which half of the currently active literature was published.

Obsolescence is due process whereby materials become no longer useful or reliable (Madkey and Rajyalakshmi, 1994 p.73).

Obsolescence study is useful for researchers, librarians and decision makers of information centres in identifying the practical shelf life of documents within disciplines and can be used as decision support tool in the development of retention of back volumes and space planning (Pillai and Sudhier, 2007 p.168).

Table 8.1: Obsolescence/ Half-Life of Documents: Panjab University, Chandigarh - Books

Sr. No.	Period	No. of Citations	Percentage of Citations	Cumulative Citations	Cumulative Percentage	Citations in 'tail' T
1	0 - 10	395	44.13	395	44.13	895
2	11 - 20	197	22.01	592	66.15	500
3	21 - 30	155	17.32	747	83.46	303
4	31 - 40	103	11.51	850	94.97	148
5	41 - 50	30	3.35	880	98.32	45
6	51 - 60	8	0.89	888	99.22	15
7	61 - 70	4	0.45	892	99.66	7
8	71 - 80	2	0.22	894	99.89	3
9	81 - 90	1	0.11	895	100.00	1
10	91 - 100	0	0.00	895	100.00	0
11	Above 100	0	0.00	895	100.00	0

Total	895				

Table 8.1 shows the obsolescence/ half-life of books in Management at Panjab University, Chandigarh. The obsolescence study of books is based on a total number of 895 citations. These citations are distributed in 11 periods of 10 years each. The obsolescence graph shows the median citation age of books citations as 13 years. This means that 50 per cent of the books used by a research scholar were published during the last 13 years prior to the year of submission of his/her thesis. This also shows that though a research scholar has used books belonged to the last 100 years, yet 50 per cent of the total books used belonged to the period only 13 years prior to the year of submission of his/her thesis. This implies that a library should not procure books 13 years after their publication and may also maintain a separate stack for such old books as these are not likely to be in active use.

Obsolescence/ Half-Life of Documents: Panjab University, Chandigarh - Books

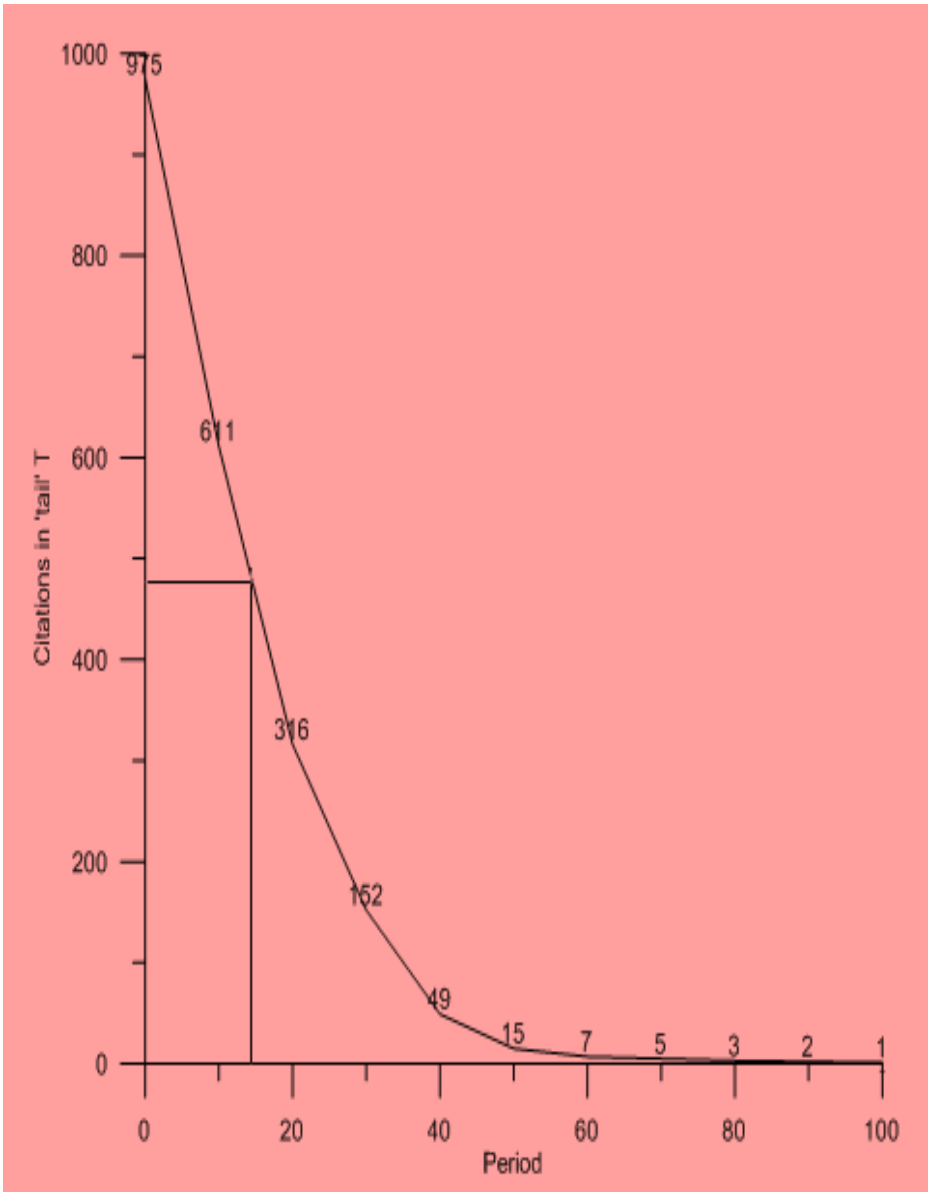

Figure 8.1

Table 8.2: Obsolescence/ Half-Life of Documents: Panjab University, Chandigarh- Journals

Sr. No.	Period	No. of Citations	Percentage of Citations	Cumulative Citations	Cumulative Percentage	Citations in 'tail' T
1	0 - 10	765	49.48	765	49.48	1546
2	11 - 20	435	28.14	1200	77.62	781

3	21 - 30	237	15.33	1437	92.95	346
4	31 - 40	94	6.08	1531	99.03	109
5	41 - 50	7	0.45	1538	99.48	15
6	51 - 60	2	0.13	1540	99.61	8
7	61 - 70	2	0.13	1542	99.74	6
8	71 - 80	3	0.19	1545	99.94	4
9	81 - 90	0	0.00	1545	99.94	1
10	91 - 100	1	0.06	1546	100.00	1
11	Above 100	0	0.00	1546	100.00	0
Total		1546				

Table 8.2 shows the obsolescence/ half-life study of Journals which is based on a total number of 1546 citations. These citations are distributed in 11 periods of 10 years each. By plotting the obsolescence graph, it is found that the median citation age of journals citations is 10 years, which means that 50 per cent of the journals referred to by a research scholar were published during the last 10 years prior to the year of submission of his/her thesis. This also means that though a research scholar consults journals pertaining to the last 100 years, 50 per cent of the total numbers of journals used are 10 years old. This also implies that the library may not procure back volumes of journals which are more than 10 years old. They may also maintain separate stacks for shelving the back volumes older than 10 years, because these are not in active use.

Obsolescence/ Half-Life of Documents: Panjab University, Chandigarh - Journals

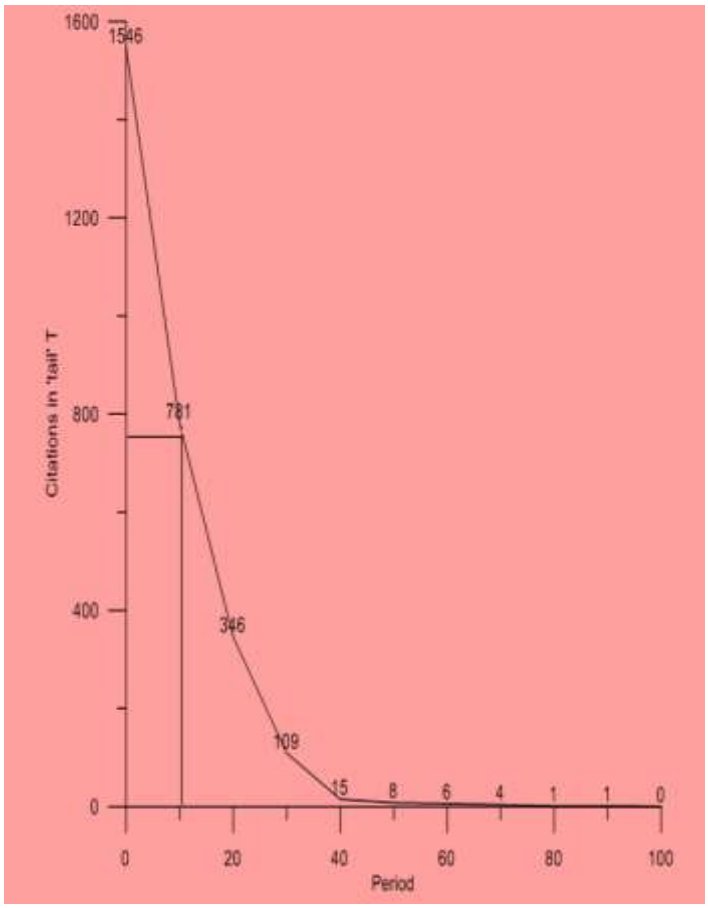

Figure 8.2

9.0 Conclusion

Finally it may be concluded that the librarian should consider the findings of this study at the time of selection, acquisition, processing and organization of reading materials particularly in the field of Management. Citations study play a vital role in identification and retrieval of earlier works. Librarians are expected to know enough about key subjects in order to assist patrons with their research needs. The findings of the study are much

helpful for librarians and information scientists while taking decisions regarding stock, maintaining, weeding, and binding of back volumes of journals and also in developing a need based collection in the library.

The results of such kind of study will help staff gain further insight into the understanding of core journals. This study help librarians facing limited budgets when making selection.

10.0 References

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