APPLICATION OF GROWTH MODELS IN KNOWLEDGE MANAGEMENT LITERATURE: A BIBLIOMETRIC STUDY BASED ON LISA DATABASE DURING 1975-2019

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ABSTRACT

The paper is based on modelling the growth of KM literature in LIS field from 1975 to 2019, indexed in Library and Information Science Abstracts (LISA) database. Bibliometric or growth indicators such as chronological distribution of publications, Relative Growth Rate (RGR), Doubling Time (Dt) and Growth Models (Linear, Exponential, Power and Logarithmic) have been used to measure the growth trend of the study. The fluctuating growth trend of publications has been observed with decreasing RGR from 0.41 to 0.03 and increasing Dt from 1.71 to 20.29 during the study period. The goodness of fit test in terms of Chi-Square reveals that the growth of publications does not follow any of the growth models. On the contrary, the goodness of fit test in terms of co-efficient of regression (R^2) reveals that the present dataset follows Linear (R^2 =0.9098), Exponential (R^2 =0.901), and Power Growth Model (R^2 = 0.9199) and does not follow Logarithmic Growth Model (R^2 =0.5951). The graphical representation of cumulative observed and expected number of publications reveals that Power Growth curve is the best-fit curve for the growth pattern of the publications under study.

Keywords: ***Knowledge Management, Library and Information Science, Relative Growth Rate, Doubling Time, Growth Models, Exponential Growth Model, Power Growth Model, Logarithmic Growth Model, Linear Growth Model, Chi-Square.***

1. Introduction

The rapid increase in the scientific literature necessitates the conducting of different growth-related studies in the modern time, which are aimed to understand the growth pattern of research publications in various disciplines. The systematic study of the growth of publications help to understand different aspects of science, which further aids in assessing and improving the quality of research and different policy-making decisions. Relative Growth Rate (RGR), Doubling Time (Dt) and different growth models like linear growth model, exponential growth model etc. are few examples of science indicators that are used to measure various aspects related to growth of scientific literature systematically (Nayak & Bankapur, 2017).

The application of Knowledge Management (KM) concept in libraries has become a relevant subject in Library and Information Science (LIS) field during recent years and this led to the rapid growth of research publications in this particular area. The present study is based on the growth pattern study of KM publications in LIS field during 1975-2019 to

observe different growth aspects of scientific literature in this particular area.

2. Review of Literature

This literature review summarizes the concept and characteristics of different growth models and their applications in different disciplines. It aims to understand the growth pattern of the scientific publications in different fields of study during recent years so that it can be used as a base to relate and compare the findings of the present study to the earlier ones.

Publication data from two data bases (Web of Science and Scopus) to investigate the scientific growth process from beginning of modern science till 2021 has been studied by Bornmann et al. (2021).

Elangovan (2020) applied goodness of fit test (by using R^2 value and chi-square test) of linear and non- linear growth models to the scientific publications (2007-2016) by the faculty of AIIMS. Scientometric analysis of Neuroscience research in Asian countries was studied jointly by Keshava and Raghavan (2020) to analyse the growth of Neuroscience research during 1989-2018. PubMed database has been used to retrieve the data. Relative growth rate, exponential growth rate, doubling time etc. of encephalitis literature during 2008-2017 was studied jointly by Rathika and Thanuskodi (2020). Nishavathi (2020) analysed the linear and non-linear growth models are applied to 10 years medical literature published by the faculties of All India Institute of Medical Sciences, Delhi to determine goodness of fit.

Growth pattern of literature on information literacy covering 9,946 research papers published during ten years period from 2008 to 2017 by Verma and Shukla (2019) using Scopus data base. Nayak and Bankapur (2017) studied the growth of scientific literature on agriculture subject at both global and national levels, using CAB Abstracts and covering years from 1930 to 2016. Application of growth models to Science and Technology literature in research specialties has been studied by Sharma et al. (2015). The growth pattern of neurology literature for the time period 1961-2010 was studied by Hadagali and Anandahalli (2015) retrieving from Science Direct data base.

Sangam et al. (2015) examined the growth pattern of Genetics literature at both world and national levels since 1993 using several science indicators like Relative Growth Rate (RGR), Doubling time (Dt), Attractive Index (AAI), etc. with the help of PubMed.

Priya and Ponnudurai (2011) evaluated Relative Growth Rate (RGR) and Doubling Time (Dt) of 61,633 conference articles based on neural network research at both the world and India level during 1969-2007. The lectures by Rao (2010) delivered during 27th Sarada Ranganathan Endowment deals with different growth models applicable to the growth of literature, indicators to scientific productivity of scientists, and issues of scientometrics.

Egghe and Ravichandra Rao (1992) classified the best growth models for science and technology, social sciences and humanities databases using two different growth rate functions- (a) from time t to t+1 and (b) from time t to 2t in 1992. The study used the particular 20 data sets collected by Wolfram, Chuand Lu that referred to the content of twenty online databases. Findings revealed the power model as the best fit for science and technology databases, Gompertz function for social sciences and humanities databases and the exponential, logistic and Ware models did not fit either of the databases.

3. Objectives of the Study

a) To find out chronological distribution of publications under study.

b) To calculate Relative Growth Rate (RGR) and Doubling Time (Dt) of KM literature in LIS field during the study period.

c) To assess the applicability of linear, exponential, power and logarithmic growth model (using chi-square and regression analysis methods) to the particular dataset under study.

d) To identify the best fitting growth curve for the observed cumulative number of publications in terms of different growth models.

4. Scope and Methodology

Library and Information Science Abstracts (LISA) database has been used for the retrieval of 7,326 research writings published during 1975-2019 and the keyword used for searching is 'knowledge management' in library and information science. The data exported to MS-Excel software for further mathematical and statistical calculations. The type of research publications are limited to dissertations and thesis, articles, books, reviews, literature reviews, case studies, editorials, conference papers, and proceedings.

Relative Growth Rate (RGR) and Doubling time (Dt) have been calculated. The data has been put to goodness of fit tests of the observed dataset under study to different growth models like linear, exponential, power and logarithmic model, using chi-square method and regression analysis method and also, the best fitting curve has been identified with the help of graph plotting method.

4.1. Relative Growth Rate (RGR) and Doubling Time (Dt)

RGR stands for the increase in number of publications per unit of time and Dt is related to RGR, which evaluates years taken by a particular number of publications to become double. Both are calculated by using the following formula derived by Mahapatra in 1985 (Nayak & Bankapur 2017)

$$RGR = \frac{(W2 - W1)}{(T2 - T1)}$$

where, W1 = Ln (natural log of the initial number of contributions)

W2 = Ln (natural log of the final number of contributions)

T1 = the unit of initial time

T2 = the unit of final time

Doubling Time Dt= 0.693D R

4.2 Linear Growth Model: the constant growth per unit of time is known as linear growth and its mathematical representation is as follows (Nayak & Bankapur, 2017)

$$y = mx + b$$

where m is the slope and b is the intercept.

4.3. Exponential Growth Model: the constant percentage growth per unit of time is called exponential growth that can be represented in equation form as follows (Nayak & Bankapur, 2017):

$$y = ce^{bx}$$

where, c and b = constant

e = base of the natural logarithm

4.4 Power Growth Model: the mathematical representation of power growth is as follows (Nayak & Bankapur, 2017):

$$y = cx^{b}$$

where, c and b= constant

4.5. Logarithmic Growth Model: the mathematical representation of logarithmic growth is as follows:

$$y = c \ln x + b$$

where, c and b = constant

ln = the natural logarithm function

5. Data Analysis and Interpretation

The retrieved data has further been organized and analysed with the help of different statistical and mathematical methods in MS-Excel software. Later, the output has gone through data interpretation process, which is given in the following sections.

5.1. Chronological Distribution

Table 1 depicts chronological distribution of 7,326 publications based on KM literature in LIS field indexed in LISA database since 1975. The maximum number of documents is 468 (6.39%) published in 2011 and the least number of documents is 1 (0.01%) published in 1984 and 1991. The average number of publications per year is 222. The table as well as figure shows the fluctuating trend of publications during the study period.

Table 1
Chronological Distribution of Publications

X	Year	No. of Publications (f)	% of Publications	Cumulative Frequency of Publications
1	1975	2	0.03	2
2	1984	1	0.01	3
3	1988	6	0.08	9
4	1989	3	0.04	12
5	1991	1	0.01	13
6	1992	2	0.03	15
7	1993	3	0.04	18
8	1994	11	0.15	29
9	1995	9	0.12	38
10	1996	14	0.19	52
11	1997	52	0.71	104
12	1998	140	1.91	244
13	1999	225	3.07	469
14	2000	286	3.90	755
15	2001	269	3.67	1024
16	2002	271	3.70	1295
17	2003	295	4.03	1590
18	2004	289	3.94	1879
19	2005	305	4.16	2184

20	2006	403	5.50	2587
21	2007	365	4.98	2952
22	2008	465	6.35	3417
23	2009	426	5.81	3843
24	2010	424	5.79	4267
25	2011	468	6.39	4735
26	2012	461	6.29	5196
27	2013	449	6.13	5645
28	2014	362	4.94	6007
29	2015	301	4.11	6308
30	2016	228	3.11	6536
31	2017	268	3.66	6804
32	2018	276	3.77	7080
33	2019	246	3.36	7326
Total		**7326**	**100.00**	—
Average		**222**		—

Fig. 1. Year-wise Growth of Publications during 1975-2019

5.2. Relative Growth Rate and Doubling Time

Results (table 2) shows Relative Growth Rate (RGR) and Doubling Time (Dt) of publications during 1975-2019. RGR has decreased from 0.41 in 1984 to 0.03 in 2019 and Dt has increased from 1.71 in 1984 to 20.29 in 2019 indicating inverse relationship between RGR and Dt which has also been shown in fig. 2. The average values of RGR and Dt are 0.26 and 6.21 respectively.

Table 2
Relative Growth Rate (RGR) and Doubling Time (Dt)

X	Year	No. of Publica-tions (f)	Cumulative Frequency	% Cumulative Frequency	W1 (ln of initial value)	W2 (ln of final value)	RGR (W2-W1)	Dt (0.693/ R)
1	1975	2	2	0.03	—	0.69	—	—
2	1984	1	3	0.04	0.69	1.10	0.41	1.71
3	1988	6	9	0.12	1.10	2.20	1.10	0.63
4	1989	3	12	0.16	2.20	2.48	0.29	2.41
5	1991	1	13	0.18	2.48	2.56	0.08	8.66
6	1992	2	15	0.20	2.56	2.71	0.14	4.84
7	1993	3	18	0.25	2.71	2.89	0.18	3.80
8	1994	11	29	0.40	2.89	3.37	0.48	1.45
9	1995	9	38	0.52	3.37	3.64	0.27	2.56
10	1996	14	52	0.71	3.64	3.95	0.31	2.21
11	1997	52	104	1.42	3.95	4.64	0.69	1.00
12	1998	140	244	3.33	4.64	5.50	0.85	0.81
13	1999	225	469	6.40	5.50	6.15	0.65	1.06
14	2000	286	755	10.31	6.15	6.63	0.48	1.46
15	2001	269	1024	13.98	6.63	6.93	0.30	2.27
16	2002	271	1295	17.68	6.93	7.17	0.23	2.95
17	2003	295	1590	21.70	7.17	7.37	0.21	3.38
18	2004	289	1879	25.65	7.37	7.54	0.17	4.15
19	2005	305	2184	29.81	7.54	7.69	0.15	4.61
20	2006	403	2587	35.31	7.69	7.86	0.17	4.09
21	2007	365	2952	40.29	7.86	7.99	0.13	5.25
22	2008	465	3417	46.64	7.99	8.14	0.15	4.74
23	2009	426	3843	52.46	8.14	8.25	0.12	5.90
24	2010	424	4267	58.24	8.25	8.36	0.10	6.62
25	2011	468	4735	64.63	8.36	8.46	0.10	6.66
26	2012	461	5196	70.93	8.46	8.56	0.09	7.46
27	2013	449	5645	77.05	8.56	8.64	0.08	8.36
28	2014	362	6007	82.00	8.64	8.70	0.06	11.15
29	2015	301	6308	86.10	8.70	8.75	0.05	14.17
30	2016	228	6536	89.22	8.75	8.79	0.04	19.52
31	2017	268	6804	92.87	8.79	8.83	0.04	17.25
32	2018	276	7080	96.64	8.83	8.87	0.04	17.43
33	2019	246	7326	100.00	8.87	8.90	0.03	20.29
Total		**7326**						
	Average						**0.26**	**6.21**

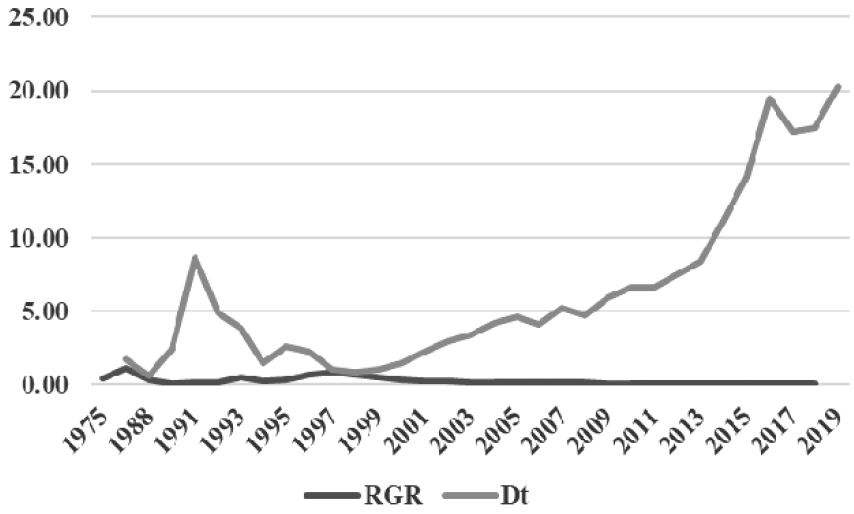

Fig. 2. Relative Growth Rate (RGR) and Doubling Time (Dt)

Several other studies based on the growth pattern of scientific publications in different subject domains have also observed the decreasing relative growth rate (RGR) trend and increasing doubling time (Dt) trend. (Priya & Ponnudurai, 2011; Verma & Shukla, 2019; Nayak & Bankapur, 2017; Hadagali & Anandhalli, 2015; Sangam et al. 2015).

5.3. Applicability of Growth Models Using Chi-Square Test and Best Fit Curve

5.3.1. Linear Growth Model

Table 3

Linear Growth Model

X	Year	Observed No. of Publications	Cumulative Frequency (f)	Expected No. of Publications (p)	f-p	$(f-p)^2$	$(f-p)^2/p$
1	1975	2	2	-1581.04	1583.04	2506015.64	-1585.04
2	1984	1	3	-1323.28	1326.28	1759018.64	-1329.29
3	1988	6	9	-1065.52	1074.52	1154593.23	-1083.60
4	1989	3	12	-807.76	819.76	672006.46	-831.94
5	1991	1	13	-550.00	563.00	316969.00	-576.31
6	1992	2	15	-292.24	307.24	94396.42	-323.01
7	1993	3	18	-34.48	52.48	2754.15	-79.88
8	1994	11	29	223.28	-194.28	37744.72	169.05

9	1995	9	38	481.04	-443.04	196284.44	408.04
10	1996	14	52	738.80	-686.80	471694.24	638.46
11	1997	52	104	996.56	-892.56	796663.35	799.41
12	1998	140	244	1254.32	-1010.32	1020746.50	813.78
13	1999	225	469	1512.08	-1043.08	1088015.89	719.55
14	2000	286	755	1769.84	-1014.84	1029900.23	581.92
15	2001	269	1024	2027.60	-1003.60	1007212.96	496.75
16	2002	271	1295	2285.36	-990.36	980812.93	429.17
17	2003	295	1590	2543.12	-953.12	908437.73	357.21
18	2004	289	1879	2800.88	-921.88	849862.73	303.43
19	2005	305	2184	3058.64	-874.64	764995.13	250.11
20	2006	403	2587	3316.40	-729.40	532024.36	160.42
21	2007	365	2952	3574.16	-622.16	387083.07	108.30
22	2008	465	3417	3831.92	-414.92	172158.61	44.93
23	2009	426	3843	4089.68	-246.68	60851.02	14.88
24	2010	424	4267	4347.44	-80.44	6470.59	1.49
25	2011	468	4735	4605.20	129.80	16848.04	3.66
26	2012	461	5196	4862.96	333.04	110915.64	22.81
27	2013	449	5645	5120.72	524.28	274869.52	53.68
28	2014	362	6007	5378.48	628.52	395037.39	73.45
29	2015	301	6308	5636.24	671.76	451261.50	80.06
30	2016	228	6536	5894.00	642.00	412164.00	69.93
31	2017	268	6804	6151.76	652.24	425417.02	69.15
32	2018	276	7080	6409.52	670.48	449543.43	70.14
33	2019	246	7326		658.72	433912.04	65.08
		7326					**995.80**

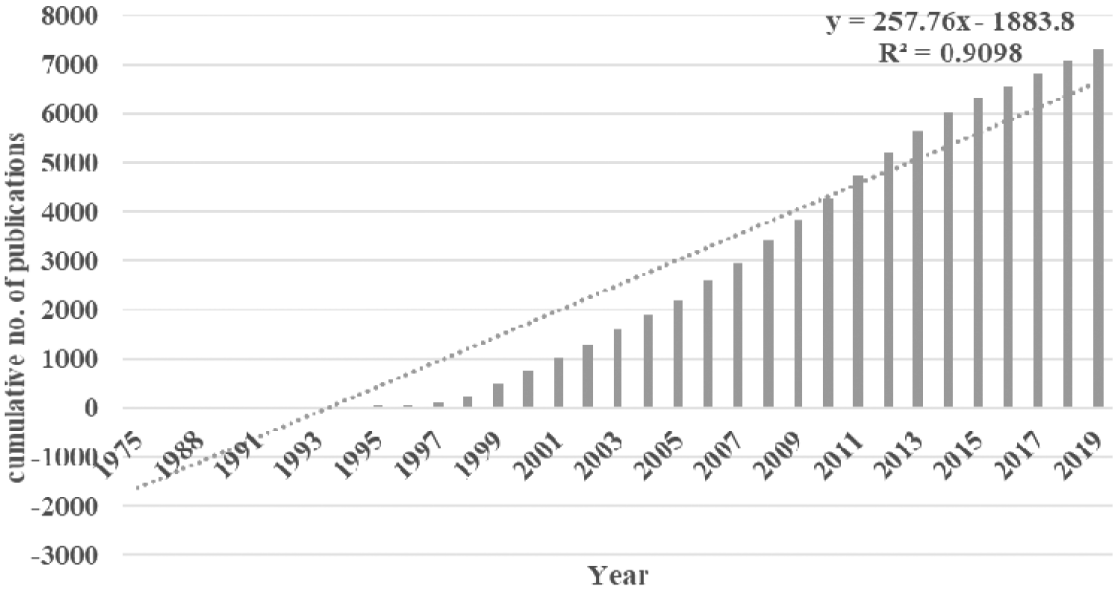

Fig 3. Linear Growth Model

Table 3 depicts the chi-Square goodness of fit test of the growth pattern of present data set to the linear growth model. Fig. 3 shows the linear growth equation (y = 257.76x-1883.8) and R^2 (0.9098) value obtained from the application of statistical operations available in MS-Excel software.

Hypothesis 1: The growth of publications in particular area of KM in LIS field follows the Linear Growth Model.

Inference: The calculated Chi Square value is 995, which is much greater than the theoretical value of 46.19 for 32 degrees of freedom (df) and at 0.05 level of significance. It indicates that the present data does not fit to the linear growth model. Hence, the Hypothesis 1 is rejected and the growth of KM literature in LIS field during 1975-2019 does not follow the linear growth model.

However, R^2 value reflect the growth of publications under study fits to the linear growth model with 91% of variance.

5.3.2. Exponential Growth Model

Table 4
Exponential Growth Model

X	Year	No. of Publications	Cumulative Frequency (f)	Expected number of Publications (p)	f-p	$(f-p)^2$	$(f-p)^2/p$
1	1975	2	2	7.37	-5.37	28.86	3.91
2	1984	1	3	9.58	-6.58	43.30	4.52
3	1988	6	9	12.45	-3.45	11.90	0.96
4	1989	3	12	16.18	-4.18	17.45	1.08

5	1991	1	13	21.02	-8.02	64.36	3.06
6	1992	2	15	27.32	-12.32	151.75	5.55
7	1993	3	18	35.50	-17.50	306.27	8.63
8	1994	11	29	46.13	-17.13	293.52	6.36
9	1995	9	38	59.95	-21.95	481.75	8.04
10	1996	14	52	77.90	-25.90	670.96	8.61
11	1997	52	104	101.23	2.77	7.65	0.08
12	1998	140	244	131.55	112.45	12644.33	96.12
13	1999	225	469	170.95	298.05	88832.64	519.64
14	2000	286	755	222.15	532.85	283928.52	1278.09
15	2001	269	1024	288.68	735.32	540691.50	1872.96
16	2002	271	1295	375.14	919.86	846141.20	2255.53
17	2003	295	1590	487.49	1102.51	1215523.87	2493.42
18	2004	289	1879	633.49	1245.51	1551291.19	2448.80
19	2005	305	2184	823.22	1360.78	1851730.98	2249.38
20	2006	403	2587	1069.76	1517.24	2302008.14	2151.89
21	2007	365	2952	1390.15	1561.85	2439382.80	1754.77
22	2008	465	3417	1806.48	1610.52	2593759.60	1435.80
23	2009	426	3843	2347.51	1495.49	2236487.30	952.71
24	2010	424	4267	3050.57	1216.43	1479701.93	485.06
25	2011	468	4735	3964.19	770.81	594149.60	149.88
26	2012	461	5196	5151.43	44.57	1986.58	0.39
27	2013	449	5645	6694.24		1100897.68	164.45
28	2014	362	6007	8699.10		7247413.03	833.12
29	2015	301	6308	11304.41		24964081.08	2208.35
30	2016	228	6536	14689.98		66487351.39	4526.03
31	2017	268	6804	19089.50		150933443.29	7906.62
32	2018	276	7080	24806.63		314233570.77	12667.32
33	2019	246	7326	32236.00		620508311.82	19248.92
		7326					**67750.04**

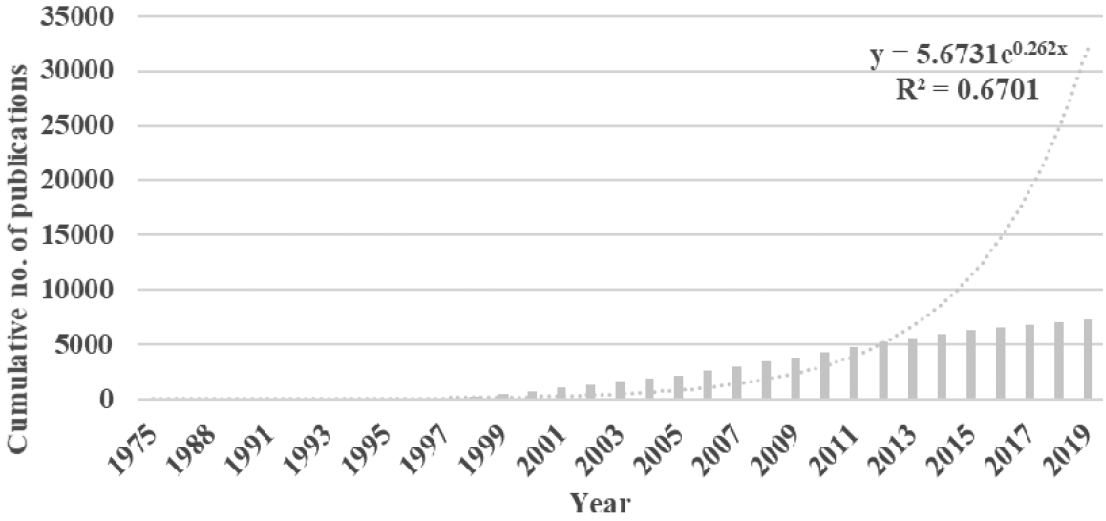

Fig. 4. Exponential Growth Model

Table 4 depicts the Chi-Square of goodness of fit test of the growth pattern of present data set to the exponential growth model. Fig.4 shows the exponential growth equation ($y = 5.6731e^{0.262x}$ and R^2 (0.901) value obtained from the application of statistical operations available in MS-Excel software.

Hypothesis 2: The growth of publications in particular area of KM in LIS field follows the Exponential Growth Model.

Inference: The calculated Chi Square value is 67750.04, which is much greater than the theoretical value of 46.19 for 32 degrees of freedom (df) and at 0.05 level of significance. It indicates that the present data does not fit to the exponential growth model. Hence, the Hypothesis 2 is rejected and the growth of KM literature in LIS field during 1975-2019 does not follow the exponential growth model.

However, R^2 value reflect the growth of publications under study fits to the exponential growth model with 90% of variance.

5.3.3. Power Growth Model

Table 5
Power Growth Model

X	Year	No. of Publications	Cumulative Frequency (f)	Expected number of Publications (p)	f-p	$(f-p)^2$	$(f-p)^2/p$
1	1975	2	2	0.22	1.78	3.15	14.10
2	1984	1	3	1.77	1.23	1.52	0.86
3	1988	6	9	5.93	3.07	9.43	1.59
4	1989	3	12	13.98	-1.98	3.94	0.28

5	1991	1	13	27.21	-14.21	201.83	7.42
6	1992	2	15	46.87	-31.87	1015.40	21.67
7	1993	3	18	74.22	-56.22	3160.94	42.59
8	1994	11	29	110.54	-81.54	6648.24	60.15
9	1995	9	38	157.06	-119.06	14176.46	90.26
10	1996	14	52	215.06	-163.06	26588.63	123.63
11	1997	52	104	285.77	-181.77	33041.63	115.62
12	1998	140	244	370.45	-126.45	15990.55	43.16
13	1999	225	469	470.35	-1.35	1.82	0.00
14	2000	286	755	586.70	168.30	28324.85	48.28
15	2001	269	1024	720.75	303.25	91957.71	127.59
16	2002	271	1295	873.75	421.25	177448.91	203.09
17	2003	295	1590	1046.94	543.06	294918.65	281.70
18	2004	289	1879	1241.54	637.46	406352.82	327.30
19	2005	305	2184	1458.81	725.19	525901.92	360.50
20	2006	403	2587	1699.97	887.03	786815.33	462.84
21	2007	365	2952	1966.27	985.73	971659.89	494.16
22	2008	465	3417	2258.94	1158.06	1341108.79	593.69
23	2009	426	3843	2579.20	1263.80	1597180.25	619.25
24	2010	424	4267	2928.30	1338.70	1792107.12	611.99
25	2011	468	4735	3307.47	1427.53	2037845.55	616.13
26	2012	461	5196	3717.93	1478.07	2184694.00	587.61
27	2013	449	5645	4160.91	1484.09	2202510.06	529.33
28	2014	362	6007	4637.65	1369.35	1875108.53	404.32
29	2015	301	6308	5149.38	1158.62	1342409.96	260.69
30	2016	228	6536	5697.31	838.69	703405.36	123.46
31	2017	268	6804	6282.68	521.32	271779.58	43.26
32	2018	276	7080	6906.71	173.29	30031.07	4.35
33	2019	246	7326	7570.62	-244.62	59840.33	7.90
		7326					**7228.78**

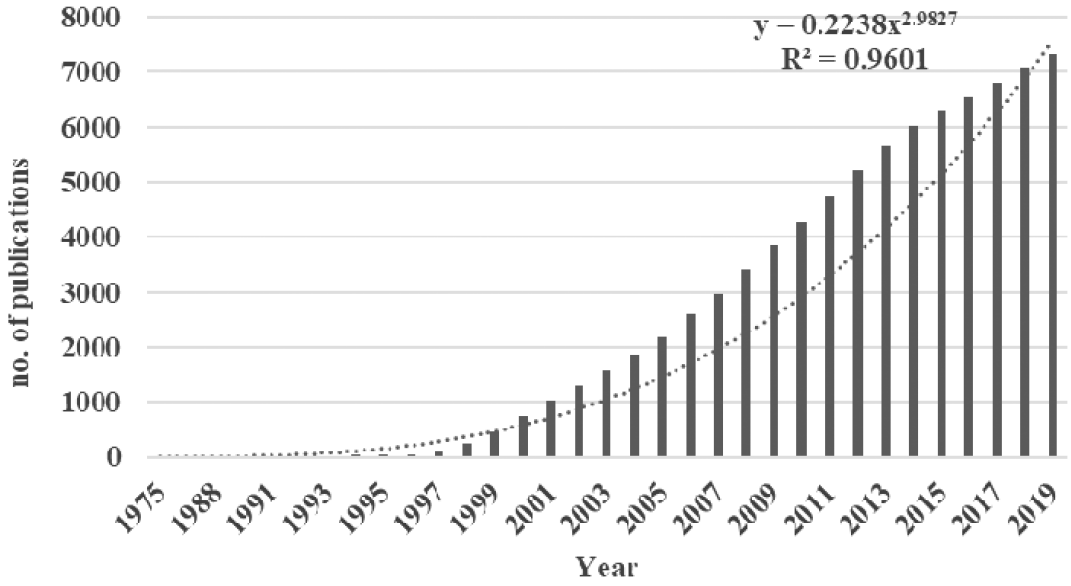

Fig. 5. Power Growth Model

Table 5 depicts the Chi-Square test of goodness of fit test of the growth pattern of present data set to the power growth model. Fig.5 shows the equation of power growth $y = 0.2238x^{2.9827}$ and R^2 (0.9199) value obtained from the application of statistical operations available in MS-Excel software.

Hypothesis 3: The growth of publications in particular area of KM in LIS field follows the Power Growth Model.

Inference: The calculated Chi Square value is 7228.78 that is much greater than the theoretical value of 46.19 for 32 degrees of freedom (df) and at 0.05 level of significance. It indicates that the present data does not fit to the exponential growth model. Hence, the Hypothesis 3 is rejected and the growth of KM literature in LIS field during 1975-2019 does not follow the power growth model.

However, R^2 value reflects the growth of publications under study fits to the power growth model with 92% of variance.

5.3.4. Logarithmic Growth Model

Table 6
Logarithmic Growth Model

X	Year	No. of Publications	Cumulative Frequency (f)	Expected number of Publications (p)	f-p	$(f-p)^2$	$(f-p)^2/p$
1	1975	2	2	-3554.60	3556.60	12649403.56	-3558.60
2	1984	1	3	-1926.81	1929.81	3724178.84	-1932.82
3	1988	6	9	-974.62	983.62	967506.14	-992.70
4	1989	3	12	-299.03	311.03	96737.37	-323.51

5	1991	1	13	225.00	-212.00	44945.69	199.76
6	1992	2	15	653.17	-638.17	407258.32	623.51
7	1993	3	18	1015.18	-997.18	994358.77	979.49
8	1994	11	29	1328.76	-1299.76	1689377.40	1271.39
9	1995	9	38	1605.36	-1567.36	2456624.26	1530.26
10	1996	14	52	1852.79	-1800.79	3242847.62	1750.25
11	1997	52	104	2076.62	-1972.62	3891218.85	1873.83
12	1998	140	244	2280.95	-2036.95	4149184.76	1819.06
13	1999	225	469	2468.93	-1999.93	3999708.29	1620.02
14	2000	286	755	2642.96	-1887.96	3564401.39	1348.64
15	2001	269	1024	2804.99	-1780.99	3171907.90	1130.81
16	2002	271	1295	2956.55	-1661.55	2760739.61	933.77
17	2003	295	1590	3098.92	-1508.92	2276834.19	734.72
18	2004	289	1879	3233.15	-1354.15	1833719.61	567.16
19	2005	305	2184	3360.12	-1176.12	1383259.43	411.67
20	2006	403	2587	3480.58	-893.58	798481.05	229.41
21	2007	365	2952	3595.16	-643.16	413650.27	115.06
22	2008	465	3417	3704.40	-287.40	82601.12	22.30
23	2009	426	3843	3808.79	34.21	1170.01	0.31
24	2010	424	4267	3908.74	358.26	128349.07	32.84
25	2011	468	4735	4004.61	730.39	533472.49	133.21
26	2012	461	5196	4096.71	1099.29	1208429.91	294.98
27	2013	449	5645	4185.34	1459.66	2130597.69	509.06
28	2014	362	6007	4270.75	1736.25	3014567.29	705.86
29	2015	301	6308	4353.16	1954.84	3821409.09	877.85
30	2016	228	6536	4432.77	2103.23	4423568.31	997.92
31	2017	268	6804	4509.78	2294.22	5263465.82	1167.12
32	2018	276	7080	4584.33	2495.67	6228347.81	1358.62
33	2019	246	7326	4656.60	2669.40	7125705.13	1530.24
		7326					**17961.49**

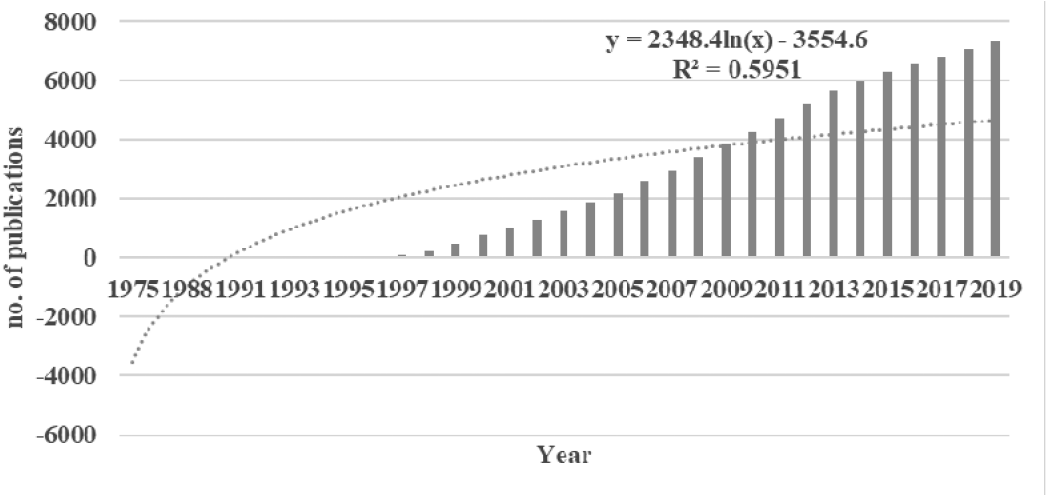

Fig. 6. Logarithmic Growth Model

Table 6 depicts the Chi-Square test of goodness of fit test of the growth pattern of present data set to the logarithmic growth model. Fig. 6 shows the logarithmic growth equation (y = 2348.4ln(x) - 3554.6) and R^2 (0.5951) value obtained from the application of statistical operations available in MS-Excel software.

Hypothesis: The growth of publications in particular area of KM in LIS field follows the Logarithmic Growth Model.

Inference: The calculated Chi Square value is 17,961.49, which is much greater than the theoretical value of 46.19 for 32 degrees of freedom (df) and at 0.05 level of significance. It indicates that the present data does not fit to the logarithmic growth model. Hence, the Hypothesis 4 is rejected and the growth of KM literature in LIS field during 1975-2019 does not follow the logarithmic growth model.

R^2 value also shows that the growth of publications under study least fit to the logarithmic growth model with 60% of variance.

5.3.5. Application of Growth Models (using R^2 value)

Table 7 shows the application of different growth models in terms of R^2 values, which is known as coefficient of regression value and it is the percentage of variation between the observed values and fitted values. The higher R^2 represents less difference between observed data and fitted data and vice-versa.

The growth of KM literature in LIS field best fits to the Power Model with 92% of variance, followed by Linear Model with 91% of variance, Exponential Model with 90% of variance and then least fits to the Logarithmic Model with 60% of variance.

Table 7
R^2 values of different models

Sl. No.	Growth Models	R^2	F Value
1	Linear	0.91	144.496
2	Exponential	0.90	74.71
3	Power	0.92	328.44
4	Logarithmic	0.60	142.19

5.4. Identification of Best-fit Curve

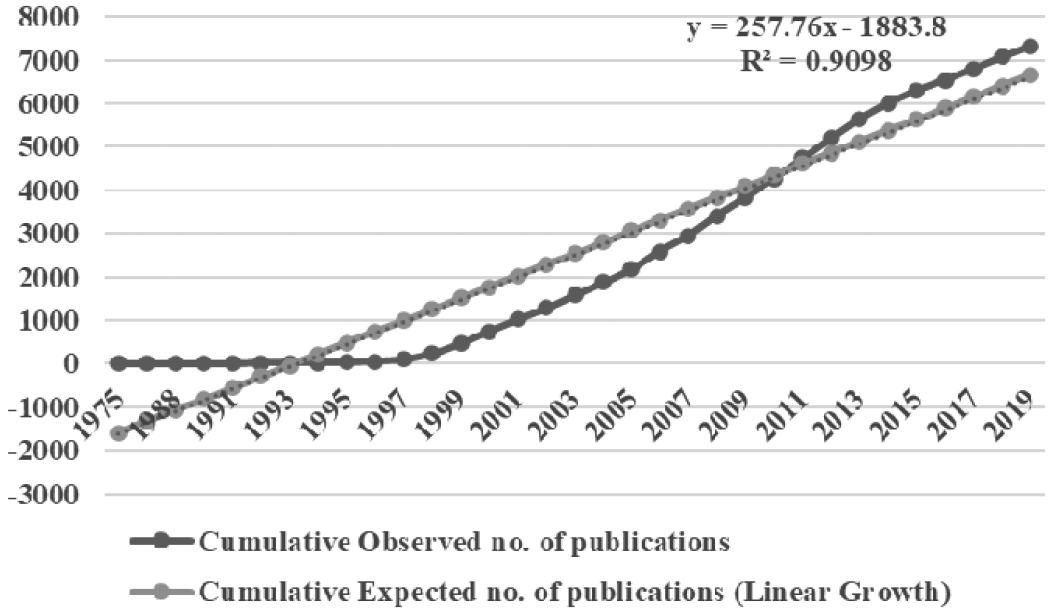

Fig. 7. Linear Fit Curve

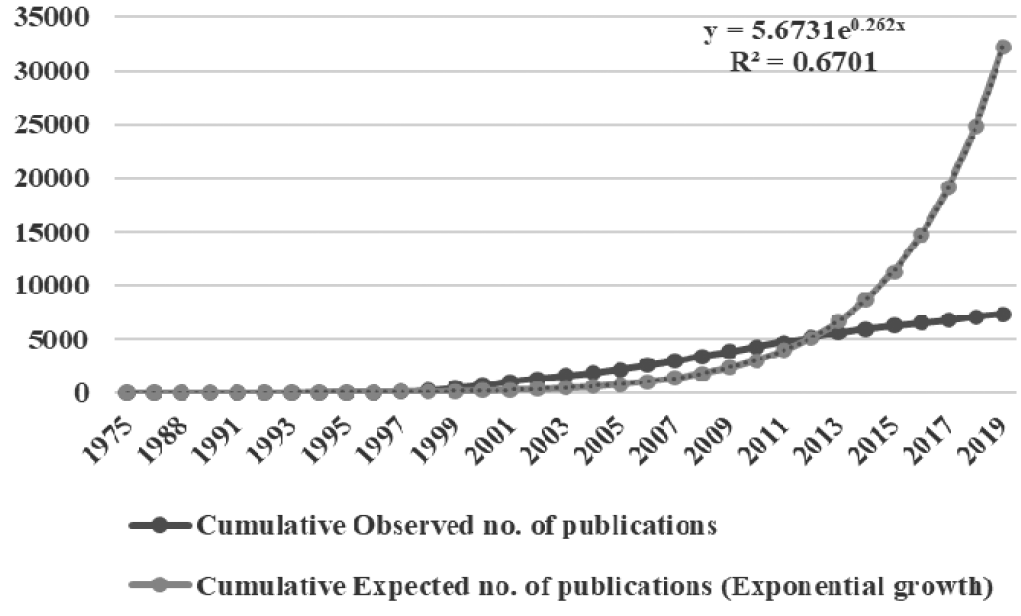

Fig. 8. Exponential Fit Curve

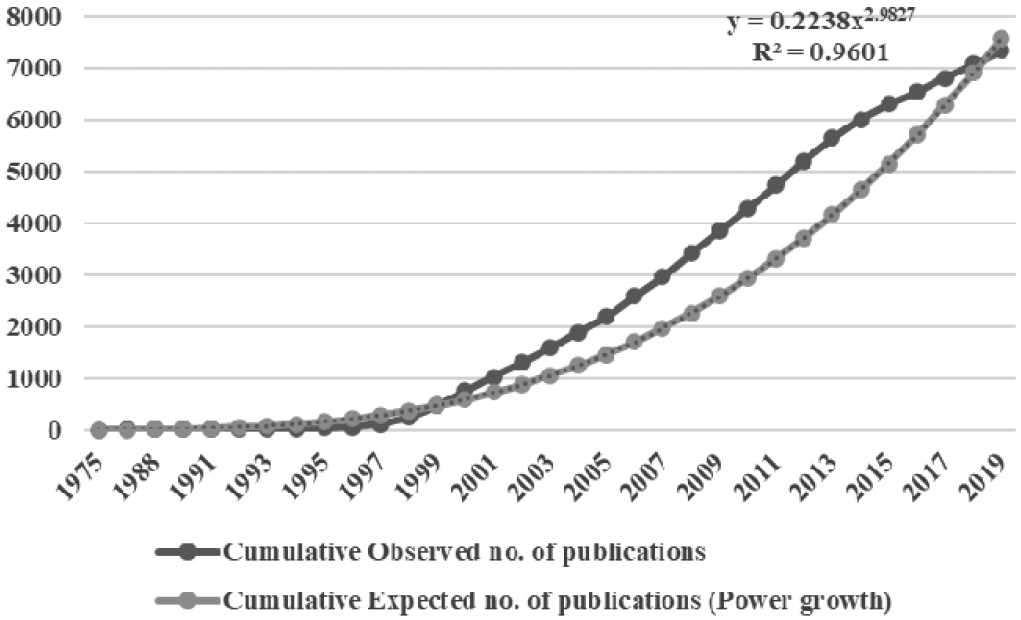

Fig. 9. Power Fit Curve

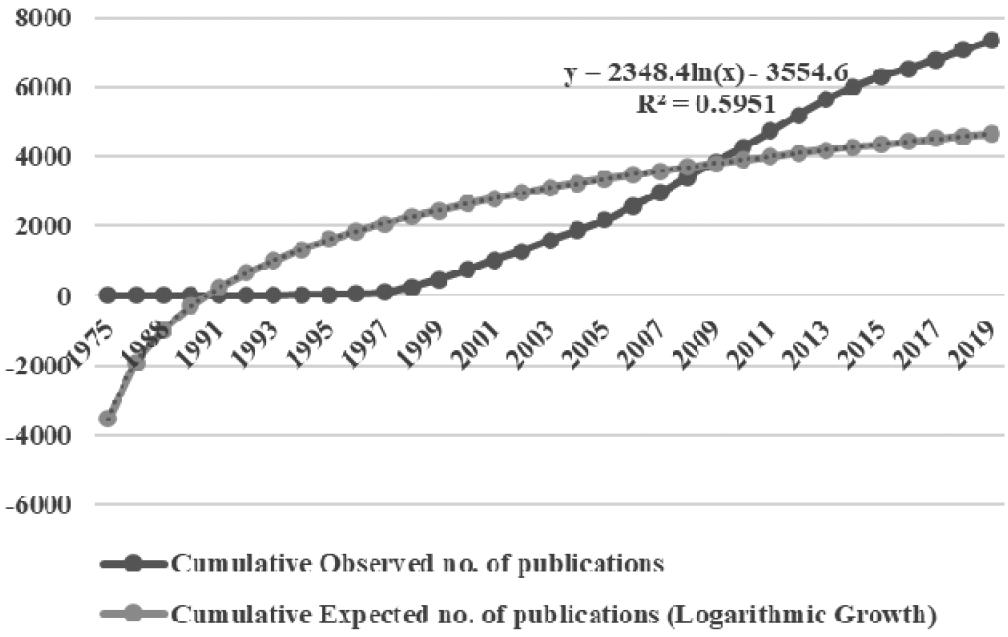

Fig. 10. Logarithmic Fit Curve

Graph-plotting method has been used to identify the best fitting curve for the particular dataset of present study. The graphical presentation of cumulative observed number of publications and cumulative expected number of publications for each growth model has been shown in Fig. 7, 8, 9 and 10. Then their closeness to each other has been observed. The cumulative expected number of publications have been calculated using different mathematical growth equations obtained from the application of different

growth trend operations in MS-Excel software. The careful observation of the figure outputs reveal that the power growth curve fits best for the literature with R^2 value 0.9199, followed by linear growth curve (R^2 value 0.9098), exponential growth curve (R^2 value 0.901) and the least fitting curve is the logarithmic growth curve (R^2 value 0.5951).

6. Findings and Conclusion

This study is an attempt to measure the growth trend of scientific publications in the area of KM in LIS field using some bibliometric indicators: Chronological distribution of publications, Relative Growth Rate (RGR) and Doubling Time (Dt); the application of Linear Growth Model, Exponential Growth Model, Power Growth Model and Logarithmic Growth Model using Chi-Square and Coefficient of Regression (R^2) goodness of fit tests; and the identification of best fit curve through graphical representations. A total of 7,326 publications have been retrieved from LISA database covering years from 1975 to 2019.

The steady and fluctuating growth trend has been observed with maximum number of publications (468; 6.39%) in 2011 and the least number of publications (1; 0.01%) in 1984 and 1991. The average number of publications per year is 222. The decreasing RGR from 0.41% in 1984 to 0.03% in 2019 and increasing Dt from 1.71 years in 1984 to 20.29 years in 2019 reflect the inverse relationship between them and this finding is similar to various other growth studies in different fields. Average RGR and Dt values are 0.26 and 6.21 respectively.

The application of growth models using Chi-Square goodness of fit test indicates that the growth pattern of publications follows none of the growth models. However, the application of growth models using co-efficient of regression value (R^2) shows that the Linear, Exponential and Power growth models fit to the dataset of the present study and the Logarithmic Model is the only one which doesn't fit. At last, the graphical presentation of observed and expected number of publications in every growth model shows that Power Growth curve is the best fit curve, followed by Linear curve, Exponential curve and the least fit curve is the Logarithmic curve.

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