Scientometric Analysis of Global Publication Output in Mobile Technology

R. Santha Kumar* and K. Kaliyaperumal**

*SKR Engineering College, Agarmel, Poonamallee, Chennai-600 123
E-mail: santham74@yahoo.co.in

**University of Madras, Chennai- 605 005
E-mail: kkperumal3@gmail.com

ABSTRACT

This paper presents the growth and development of mobile technology research across the world publications output on Web of Science during the period 2000 to 2013. A total of 10638 publications were published in the field and an average number of publications published per year was 759.86. The highest number of publications 1495 was published in 2013 and the lowest number of publications is 270 in 2000. The relative growth rates (RGR) has decreased from 2001 (0.78) to 2013 (0.15) in the span of 13 years. The doubling time (DT) has gradually increased from 0.89 in 2001 to 4.62 in 2013. Out of total publications, 4597 were produced by multi authors and 2593 by mega authors. Pattern of co-authorship revealed the improving trend of co-authored publications. The average value of collaboration co-efficient for mobile technology is 0.56. The top 10 countries listed from USA to Spain contributed to 81 % of total output of the literature, USA topped the list with highest share of publications (2738) followed by UK (890), China (823), and South Korea (802) publications, etc. University of California System (USA) is the highly contributed institution with 243 publications followed by University of London (UK) with 149 publications.

Keywords: Mobile technology, scientometric analysis, author productivity, relative growth rates, doubling time, relative citation impact

1. INTRODUCTION

The present paper is furtherance of earlier study by same author on mobile technology 'Mapping of Mobile Technology Publications: A Scientometric Approach' in *DESIDOC Journal of Library and Information Technology* **34**(4) 2014. The major facts of the study are postulated to mobile technology research in engineering index database. The research shows that mobile technology researcher's preferred medium of communication is conference articles with the majority of publications were published in English language and a total of 144567 publications were published during 2003 to 2012. The RGR has decreased from 2004 (0.98) to 2012 (0.13) in the span of 10 years. The DT has gradually increased from 0.71 in 2004 to 5.15 in 2012. A total of 1337 authors had contributed entire research output of the period. The research is mainly focused on the growth of literature in the field of mobile technology, identify the prolific authors in the mobile technology, analyse country-wise contributions of the publications and quantify the publications as per the Engineering Index subject fields. Thus the purpose of the present study is to analyse the growth and development of mobile technology research across

the world publications output on Web of Science using relative growth rate and doubling time, pattern of co-authorship using co-authorship index and collaboration coefficient, citations per publication and relative citation impact of highly productive countries and most prolific authors along with their origin of the country.

2. OBJECTIVES

The main objective of this study is to analyse the global research performance in the field of mobile technology as reflected in the publication output during 2000 to 2013. The study focuses on the following aspects:

- Forms of publications;
- Language-wise distribution of publications;
- Relative growth rate and doubling time of publications;
- Co-authorship pattern of the authors;
- Citations per publication and relative citation impact of highly productive countries;
- Share of publications of highly productive institutes;

- Most prolific authors;
- Highly preferred source titles for publication in the field; and
- Subject-wise distribution of mobile technology research output.

3. METHODOLOGY

The Web of Science database was used for retrieving data on mobile technology during 2000-2013, using search term namely 'mobile technology' in 'topic field'. A total of 10638 publications and 138297 citations received to these publications were transferred to spread sheet application and analysed the data as per objectives of the study.

4. DATA ANALYSIS AND INTERPRETATIONS

4.1 Forms of Publications

A total of 10638 publications were published in mobile technology during 2000-2013. The highest numbers of publications 8474 (79.66 %) were published as journal articles, followed by conference proceedings with 1418 (13.33 %) publications. Review papers ranks the 3rd position with 417 (3.92 %) and letters in the fourth place with 162 (1.52 %).

4.2 Language-wise Distribution of Publications

Publications on mobile technology are spread over 23 languages. The most predominant language used for communication was English. The English language articles were about 97.80 % and the rest of 2.20 % were scattered in other 22 languages.

4.3 Relative Growth Rate and Doubling Time

The Relative Growth Rate (RGR) is the increase in number of articles or pages per unit of time. The mean RGR over the specific period of interval can be calculated from the following equation.

Mean RGR = $1-2^R = \log_e W_2 - \log_e W_1 / T_2 - T_1$

where, $1-2^R$ is mean relative growth rate over the specific period of interval; $\log_e W_1$ is log of initial number of articles; $\log_e W_2$ is log of final number of articles after a specific period of interval and; T_2-T_1 is the unit difference between the initial time and the final time.

The year can be taken here as the unit of time. Therefore, $1-2^R$ (aa^{-1} year^{-1}) can represent the mean relative growth rate per unit of articles per unit of year over a specific period of interval.

Doubling time (DT) = 0.693/R

Doubling time for articles DT (a)
  = $0.693/1-2^R$ (aa^{-1} year^{-1})

The analysis of data on the mobile technology output has been done with parameters such as RGR and DT. The data has been analysed and presented in Table 1. It has been observed from Table 1, that RGR decreased from 0.78 in 2001 to 0.16 in 2009. In 2010 to 2012, it remained constant (0.16) which is less than the earlier years. In 2013, of RGR was decreased to 0.15. The value of of publications increased from 0.89 in 2001 to 4.33 in 2009. In 2010 to 2012, it remained constant (4.33) which is more than the earlier years. In 2013, the value of DT was increased to 4.62.

Table 1. Relative growth rate (RGR) and doubling time (DT) of publications

| Year	No. of publications	Cumulative total	W_1	W_2	RGR	DT
2000	270	270		5.60		-
2001	318	588	5.60	6.38	0.78	0.89
2002	434	1022	6.38	6.93	0.55	1.26
2003	477	1499	6.93	7.31	0.38	1.82
2004	568	2067	7.31	7.63	0.32	2.16
2005	632	2699	7.63	7.90	0.27	2.56
2006	642	3341	7.90	8.11	0.21	3.33
2007	707	4048	8.11	8.31	0.20	3.46
2008	780	4828	8.31	8.48	0.17	4.08
2009	841	5669	8.48	8.64	0.16	4.33
2010	962	6631	8.64	8.80	0.16	4.33
2011	1130	7761	8.80	8.96	0.16	4.33
2012	1382	9143	8.96	9.12	0.16	4.33
2013	1495	10638	9.12	9.27	0.15	4.62
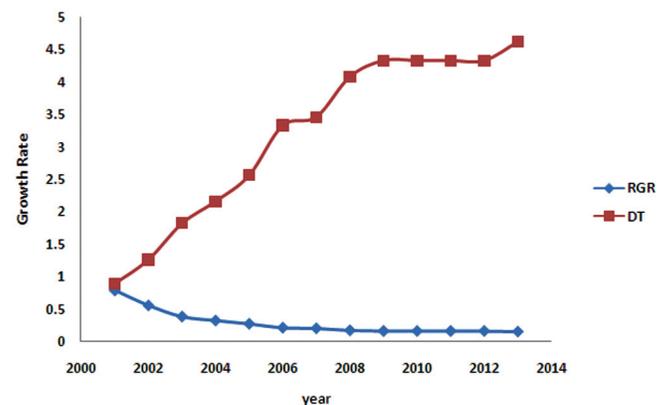
Figure 1. Relative growth rate and doubling time for research output.

Table 1 indicates that, the RGR is decreased from 0.78 in 2001 to 0.15 in 2013. Correspondingly, the of DT of the publications gradually increased from 0.89 in 2001 to 4.62 in 2013.

4.4 Authorship Pattern of Publications

Table 2 presents the distribution of output by

single, two, multi and mega authored papers besides the values of the co-authorship index (CAI) and collaboration coefficient (CC) for the entire data was divided into 3 blocks—2000 to 2004, 2005 to 2009 and 2010 to 2013. The average value of CC for mobile technology is 0.56. The calculated value of collaborative coefficient for the study period does not vary much for different years. The value of CC is highest (0.58) for 2002 and 2008 and lowest (0.52) in 2004. However, the value of CC is showing increasing and decreasing trend in the three block year periods.

Table 2 reveals that the result of co authorship index and it is observed that the value of CAI for increasing and decreasing trend in the three block year periods. The values of CAI for two, meganewspapers. This implies that the collaborative pattern in mobile technology field is mainly characterised by co-authored papers not by single authored papers.

4.5 Highly Productivity Countries

There were 101 countries involved in research in mobile technology field and which published at least one publication as per the database. Table 3 shows that top 20 countries (≥130 publications) actively pursuing research in the field. It was observed that top 10 countries listed from USA to Spain 81 % of total output of the research. The USA topped the list with highest share of 25.74 % publications with 47175 citations and citation per publications is 17.23. UK ranked second with 8.37 % share

of publications with 11143 citations and its CPP is 12.52, followed by China with 7.74 % share of publications with 8145 citations and CPP is 9.91.

Among the counties listed in Table 3 only four countries, viz., USA, Switzerland, Sweden and Singapore have more than average value of CPP. The remaining 16 countries are less than the average value of CPP. India is the lowest value of CPP. The average value of CPP for the entire research output in the field is 13. Regarding relative citation impact (RCI) it is observed that USA, Switzerland, Sweden and Singapore have >1 values of RCI and remaining 16 countries values are <1. This indicates that papers published by these four countries were cited more than the average of other countries papers. The value of RCI is highest for Switzerland and lowest for India.

4.6 Highly Productive Institutes

Table 4 shows the top 10 institutions that are contributing more than 40 publications. It is seen form the table that the top ranking institutions viz., University of California System, USA contributed 243 publications and its CPP is 5.14 followed by this, University of London, UK contributed with 149 publications and its CPP is 3.90. Remaining institutions listed in the table contributed less than hundred publications with minimum citations. It is interesting to note that the highest value of CPP 10.52 is belongs to Pennsylvania Commonwealth System for Higher Education (PCSHE), USA contributed 83

Table 2. Authorship pattern of publications

Block No.	Year	Single	CAI	Two	CAI	Multi (3&4)	CAI	Mega (>4)	Total	CAI	CC
1.	2000	46	96	61	129	98	105	65	270	80	0.54
	2001	52	92	53	95	97	88	116	318	121	0.57
	2002	61	79	76	100	175	116	122	434	94	0.58
	2003	84	99	85	102	169	102	139	477	97	0.54
	2004	125	124	87	87	177	90	179	568	105	0.52
	Total	**368**		**362**		**716**		**621**	**2067**		**0.55**
2.	2005	109	116	107	112	228	88	188	632	102	0.56
	2006	87	91	93	96	243	93	219	642	117	0.57
	2007	96	91	104	97	344	119	163	707	79	0.57
	2008	124	107	117	99	356	112	183	780	80	0.55
	2009	119	95	123	97	300	87	299	841	122	0.58
	Total	**535**		**544**		**1471**		**1052**	**3602**		**0.57**
3.	2010	141	104	194	106	411	88	216	962	121	0.55
	2011	142	89	217	101	548	100	223	1130	107	0.56
	2012	198	102	289	110	648	97	247	1382	97	0.56
	2013	217	103	241	85	803	111	234	1495	85	0.55
	Total	**698**		**941**		**2410**		**920**	**4969**		**0.56**

CAI–Co-authorship Index, CC–Collaboration Coefficient

Table 3. Highly productive countries

Rank	Country	Total publications (%)	Total citations	CPP	RCI
1.	USA	2738 (25.74 %)	47175	17.23	1.33
2.	UK	890 (8.37 %)	11143	12.52	0.96
3.	China	823 (7.74 %)	8155	9.91	0.76
4.	South Korea	802 (7.54 %)	5516	6.88	0.53
5.	Germany	732 (6.88 %)	8736	11.93	0.92
6.	Taiwan	672 (6.32 %)	7126	10.60	0.82
7.	Japan	577 (5.42 %)	4161	7.21	0.55
8.	Canada	507 (4.76 %)	5562	10.98	0.84
9.	Italy	458 (4.30 %)	4864	10.62	0.82
10.	Spain	455 (4.28 %)	3551	7.80	0.60
11.	Australia	385 (3.62 %)	4639	12.05	0.93
12.	France	309 (2.90 %)	3682	11.91	0.92
13.	Finland	264 (2.48 %)	3056	11.57	0.89
14.	Netherlands	241 (2.26 %)	2958	12.27	0.94
15.	Greece	226 (2.12 %)	2366	10.47	0.81
16.	India	202 (1.90 %)	1366	6.76	0.52
17.	Switzerland	176 (1.65 %)	3741	21.25	1.63
18.	Sweden	171 (1.61 %)	3067	17.93	1.38
19.	Singa-pore	142 (1.33 %)	1923	13.54	1.04
20.	Scotland	131 (1.23 %)	1407	10.74	0.83

CPP-Citations per publication, RCI-Relative citation impact

Table 4. Highly productive institutes

Rank	Institutes	Total publications (%)	Total citations	CPP
1.	University of California System, USA	243 (2.28 %)	1249	5.14
2.	University of London, UK	149 (1.4 %)	581	3.90
3.	Florida State University System, USA	88 (0.83 %)	633	7.19
4.	National Chiao Tung University, China	88 (0.83 %)	517	5.88
5.	National Taiwan University, Taiwan	85 (0.8 %)	438	5.15
6.	Chinese Academy of Sciences, China	83 (0.78 %)	358	4.31
7.	Pennsylvania Commonwealth System for Higher Education (PCSHE), USA	83 (0.78 %)	873	10.52
8.	Samsung, South Korea	78 (0.73 %)	542	6.95
9.	University of Michigan System, USA	50 (0.47 %)	297	5.94
10.	Aalto University, Finland	49 (0.46 %)	259	5.28
Total of 10 organisations		**996 (9.4 %)**	**5747**	**6.03**

CPP-Citations per publication

publications. Among the institutions listed in Table 4, out of 10 institutions, four institutionsare from USA, and two from China and one each from UK, Taiwan, South Korea, and Finland. A total of 827 individual institutions were involved in producing 10638 articles during the study period.

4.7 Highly Productive Authors

Table 5 presents rank list of authors who have contributed more than 20 articles are taken into account to avoid a long list. It reveals that Kim, S. University of Rochester, USA is the most productive author contributing 42 articles (0.39 %) followed by Kim, H. Korea University, South Korea with 36 articles (0.34 %) and Kim, J. Kyung Hee University, South Korea with 36 articles (0.3 4 %).

4.8 Most Preferred Source Titles

Table 6 shows top 10 source titles along with their country, impact factor and *h* index for contributing mobile technology articles in Web of Science. The publications on mobile technology were spread over 341 journals. It is found that *Lecture Notes in Computer Science*, Germany top the list with the highest number of publications of 591 (5.55 %) and the impact factor is 0.51, h index is 118. Followed by this, *IEEE Communications Magazine*, USA with a share of 216 (2.03 %) with their impact factor 4.46 and h index is 144 and *Wireless Personal Communications*, Netherlands occupy the third position with 127 (1.19 %) publications with impact factor 0.43 and *h* index is 29. Highest impact factor of the source titles are *IEEE Communications Magazine,* USA (4.46) followed by *Journal of Chromatography A*, Netherlands (4.258).

4.9 High Productivity Subject Areas

Table 7 shows high productivity subjects which are contributing more than 300 articles. It is observed that subject Engineering has highest number of articles, i.e, 3600 with 38699 citations and CPP is 10.75. Followed by Computer Science contributing 3430 articles with 29674 citations and citation per publication is 8.65. Telecommunications occupy the third position with 2509 articles along with 17279 citations and CPP is 6.88. The fourth highest articles belonged to the subject Business Economics 552 articles with 7916 citations and CPP is 14.34.

5 FINDINGS

The present paper shows the mobile technology publication output on Web of Science during the period 2000 to 2013. Total 10638 publications were published in the field and an average number of publications published per year was 759.86. But in the earlier study mobile technology publication output as reflected in Engineering Index database during 2003 to 2012 and a total of 144567 publications were published in the field and an average number

Table 5. Highly productive authors

Rank	Author	Institution	Country	Total publications (%)
1.	Kim, S.	University of Rochester	USA	42 (0.39 %)
2.	Kim, H.	Korea University	South Korea	36 (0.34 %)
3.	Kim, J.	Kyung Hee University	South Korea	36 (0.34 %)
4.	Lee, J.	Seoul National University	South Korea	35 (0.33 %)
5.	Lee, S.	Texas technological University	USA	33 (0.31 %)
6.	Anonymous	Reed Business Information	USA	28 (0.26 %)
7.	Kim, K.	Samjeong KPMG Advisory Inc.	South Korea	26 (0.24 %)
8.	Kim, Y.	Yonsei University	South Korea	24 (0.22 %)
9.	Park, J.	Pohang University of Science and Technology	South Korea	24 (0.22 %)
10.	Hwang, G J.	Hanyang University	South Korea	23 (0.22 %)
11.	Zhang, J.	Telecom Ecole Management	France	22 (0.21 %)
12.	Lee, H.	Korea Mil Academy	South Korea	21 (0.20 %)
13.	Zhang, Y.	Institute of Scientific and Technical Information of China	China	21 (0.20 %)
14.	Kim, D.	Valdosta State University	USA	20 (0.19 %)
15.	Lee, J H.	National Taiwan University	Taiwan	20 (0.19 %)
16.	Zhou, T.	Yonsei University	South Korea	20 (0.19 %)

Table 6. Source title of publications

Rank	Source title	No. of publications	Impact factor	h ndex
1.	*Lecture Notes in Computer Science,* Germany	591 (5.55 %)	0.51	118
2.	*IEEE Communications Magazine,* USA	216 (2.03 %)	4.46	144
3.	*Wireless Personal Communications,* Netherlands	127 (1.19 %)	0.43	29
4.	*Computer Communications,* Netherlands	114 (1.07 %)	1.352	58
5.	*International Journal of Mobile Communications,* UK	108 (1.01 %)	1.221	25
6.	*IEICE Transactions on Communications,* Japan	102 (0.99 %)	0.252	42
7.	*Journal of Chromatography A,* Netherlands	87 (0.82 %)	4.258	162
8.	*IEEE Wireless Communication Systems,* USA	84 (0.79 %)	0.057	118
9.	*IEEE Transactions on Consumer Electronics,* USA	83 (0.78 %)	1.157	69
10.	*Telecommunications Policy,* UK	81 (0.76 %)	1.128	40

Table 7 High productivity subject areas

Rank	Subject	No. of articles (%)	Total citations	Citations per publications
1.	Engineering	3600 (33.84 %)	38699	10.75
2.	Computer Science	3430 (32.24 %)	29674	8.65
3.	Telecommunications	2509 (23.58 %)	17279	6.89
4.	Business Economics	552 (5.19 %)	7916	14.34
5.	Chemistry	499 (4.69 %)	12101	24.25
6.	Educational Research	453 (4.26 %)	4829	10.66
7.	Information Science Library Science	412 (3.87 %)	4986	12.10
8.	Communication	398 (3.74 %)	3141	7.89
9.	Health Care Sciences Services	306 (2.88 %)	3333	10.89
10.	Environmental Sciences Ecology	304 (2.86 %)	6163	20.27

of publications published per year was 14456.7. The highest numbers of publications 8474 (79.66 %) were published in journal articles, followed by conference proceedings with 1418 (13.33 %) publications. But in the earlier study conference articles with 94205 (65.16 %) followed by journal articles with 48363 publications (33.45 %).

As per language distribution, in the present

paper it is spread over 23 languages. But in the earlier study, there are 20 languages. More than 95 % of publications are published in English in both studies. The RGR is decreased from 0.78 in 2001 to 0.15 in 2013 and DT of the publications gradually increased from 0.89 in 2001 to 4.62 in 2013 in the span of 14 years of this study. But in earlier study, the RGR has decreased from 2003 (0.98) to 2012 (0.13) and the DT increased from 0.71 in 2003 to 5.15 in 2012 in the span of 10 years.

In this study, there were 101 countries involved in research in mobile technology field. The USA topped the list with 2738 publications followed by UK with 890 publications. China ranked 3rd position with 823 publications and India stood 16th rank with 202 publications. But in the earlier study, there are 75 countries involved in carrying out research in the field. China ranked 1st 33010 publications followed by USA with 19166 publications. Japan ranked third position with 11730 publications and India stood 7th rank with 6150 publications.

Total 1337 authors had contributed entire research output of the earlier study. Wang, Wei is the most productive author contributing 223 articles followed by Barolli, Leonard with 160 articles and Wong, Kin Lu with 154 articles respectively. The analysis on author affiliation reveals that in the earlier paper the Institute of Electrical and Electronics Engineering of USA tops the list with 1248 articles followed by National Mobile Communications Research Laboratory, Southeast University, China with 508 publications. But in the current paper the University of California System, USA tops the list with 243 articles followed by University of London, UK with 149 publications.

The high productive subjects areas identified this paper is Engineering with 3600 publications and CPP is 10.75, followed by Computer Science contributing 3430 publications and CPP is 8.65. The highest number of articles contributed on Wireless Telecommunication Systems with 20585 publications followed by Mobile Telecommunication Systems with 18423 publications in the earlier study.

6. CONCLUSIONS

The present paper is mobile technology publication output on Web of Science during the period 2000 to 2013. The highest numbers of publications 8474 (79.66 %) were published in journal articles, followed by conference proceedings with 1418 (13.33 %) publications. Kim, S. University of Rochester, USA is the most productive author contributing 42 articles

(0.39 %) followed by Kim, H. Korea University, South Korea with 36 articles (0.34 %) and Kim, J. Kyung Hee University, South Korea with 36 articles (0.34 %) respectively. *Lecture Notes in Computer Science*, Germany gets top rank in terms of number of publications and *IEEE Communications Magazine*, USA gets top rank in terms of impact factor. As usual, journal articles were the preferred medium of authors in the field to communicate their research works and English was the most predominant language in which 98 % of the articles was published. The pattern of authorship indicates that the discipline of mobile technology is dominated by multi authored publications. The findings of the present Scientometric study will be beneficial for the researchers, who are engaged in research on various disciplines of mobile technology in future.

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About the Authors

Dr R. Santhakumar is presently working as Librarian in SKR Engineering College, Chennai. He obtained MSc (Physics) from Alagappa University, Karaikudi, and MLIS, MPhil and PGDCA from Madurai Kamaraj University. He has published 12 articles in national and international journals and presented 16 articles both in national and international conferences.

Dr K. Kaliyaperumal is presently working as University Librarian, I/C, Madras University Library. He has authored 3 books and one is bestselling book on 'research methodology'. He has published 30 journal articles and national and international conference papers. He is guiding PhD scholars in the field of LIS.