RFID APPLICATIONS IN LIBRARIES: A SCIENTOMETRIC ASSESSMENT OF GLOBAL PUBLICATIONS OUTPUT DURING 1998-2019

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The paper provides quantitative and qualitative assessment of research on "RFID Applications in Libraries" based on global publications output (273 publications), as covered in Scopus database covering the 22-year period 1988-2019. The subject "RFID Applications in Libraries" registered annual average growth of 27.15% and eleven years cumulative growth of 195.65%. It averaged to 8.1 citations per paper and bulk of global output (73.99%) and the global citations (59.84%) in the field emanates from top 10 countries. The paper further provides an insight into qualitative performance of research on "RFID Applications in Libraries" in terms of relative citation index, citations per paper, highly cited papers, besides analyzing the top 20 global organizations and authors in the field, the distribution of publications by broad subjects, the identification of the most significance keywords, the most productive journals and the analysis of higher-cited papers in the field. The study found that Kyush University, Japan, University of Malaya and University of Technology Kingston, Jamaica (with 5 papers each) were the most productive organizations and Swansea University, U.K. (24.0 and 2.98), City University of Hong Kong (20.75 and 2.57), Kyush University, Japan (19.80 and 2.46) were the most significant organizations in terms of citation per paper and relative citation index. Similarly, K. Fujisaki (6 papers), P. Golding and V. Tennant (with 5 papers each) were the most productive authors and C. Kern (20.0 and 2.48), S.C. Yu (19.25 and 2.39), N. Dindar (14.67 and 1.82) were leading authors in terms of citation per paper and relative citation index. *Electronic Library* (with 8 papers), *Library Philosophy and Practice* (5 papers) and *Library & Archival Security* (4 papers) were the leading journals contributing to the field.

Keywords: RFID, Applications, Libraries, Global publications, Scientometrics, Bibliometrics.

INTRODUCTION

Radio Frequency Identification, known as RFID, was mainly used in the laboratory research in the 1940s for replicated communication systems. Later in 1980s, it was prominently used by the business organizations to manage their commercial items. Recently, RFID technology has received attentions of library systems all around the world. RFID is the latest fast

growing technology to be used in library for minimizing the theft of documents and as an access control system. RFID-based systems move beyond security to become tracking systems that combine security with more efficient tracking of materials throughout the library, including easier and faster charge and discharge, inventorying, and materials handling. RFID is a combination of radio-frequency-based technology and microchip technology. The information contained in inbuilt microchips in the tags affixed to library materials is read using radio frequency technology regardless of item orientation or alignment and distance from the item. The tags can be read at a distance of up to two feet by each of two parallel exit sensors. The devices used for circulation are usually called "readers" while the ones used at building exits are usually called "sensors" [1].

LITERATURE REVIEW

Some of the studies related to the topic have already been conducted across different parts of the world. Few studies have been published on bibliometric analysis of global RFID literature (including its applications). Amongst such studies, Shakiba, Zavvari, Ebrahim and Singh [2] evaluated the global trend in RFID technology publications (5159 records) from 2001-2014. The authors focused on aspects such as contributions by country, organizations, funding agencies, journal title, authors, research area and Web of Science Category. Content analysis was applied to the top 100 most cited documents and based on their contents; these have been classified into four different categories with each category divided into several sub-categories. Irani, Gunasekaran and Dwivedi[3] analyzed the distribution/trends of RFID research (1984-2007) across subject category, source titles (journals), geographical locations, document types and year of publications, frequently published authors and productive institutions for conducting RFID related research, explored the trend of topics/research issues and utilized methods and synthesized the existing research to develop a research model/framework that reflects current status and trends of RFID research and may guide the practitioner for implementing and managing RFID applications in both public and private sectors. Singh, Gupta and Gupta [4] examined the global publications output (23957) on RFID published during 2005-14, using a series of quantitative and qualitative indicators. Rekha and Jayaprakash[5] presented an analysis of 2735 global publications in RFID (Radio Frequency Identification), indexed in Web of science database during 2014-2018. It attempted to reveal the year, country and institution, form-wise distribution, authorship pattern, degree of collaboration, relative growth rate and doubling time of publications.

Only one bibliometric study has been published so far on. Singh, Dhawan and Gupta [6] examined the world publications output (205) on "RFID Technology and Libraries" published during 2002-14, using a series of bibliometric indicators. The present bibliometricstudy is an update of this study and provides a more comprehensive picture of the theme of the paper.

OBJECTIVES

The main aim of the present study is to assess the qualitative and qualitative performance of research on "RFID Applications in Libraries" based on publications indexed in Scopus database during 1998-2019. In particular, the study focuses on distribution of publication by document type and sources type, annual and cumulative growth rate, citation analysis in terms of citation impact of research output, identification and analysis of top 10 countries, 20 global organizations and 20 authors and top 15 journals in terms of various parameters. It also examines distribution of publication output by broad sub-fields, media of communications and characteristics of highly-cited papers.

METHODOLOGY

The data for the present study on "RFID Applications in Libraries" was retrieved from the Scopus database (http://www.scopus.com) covering the period 1988-2019 (22 years). Keywords for search included such as "Radio Frequency Identification" and "Librar*". These two keywords were suffixed to "keyword tag" and "Article Titletag", and the global search output was restricted to period '1998-2019'. This main global search strategy was further refined by country to identify top 10 most productive countries in "RFID Applications in Libraries" The global search output was distributed by subject, collaborating countries, author-wise, organization-wise and journal-wise, etc. by using analytical provisions of Scopus database such as "subject area tag", "country tag", "source title tag", "journal title name" and "affiliation tag". Citations to publications were counted from date of their publication till 4 December 2019. The study analyzed the publications data across select raw and relative bibliometric indicators, with a view to understand the dynamics of research on "RFID Applications in Libraries" (((KEY(Radio Frequency Identification AND Librar*) OR TITLE(Radio Frequency Identification AND Librar*))) OR ((KEY(RFID AND Librar*) OR TITLE(RFID AND Librar*))))

ANALYSIS AND RESULTS

The global research output in field of "RFID Applications in Libraries" resulted in 273 total publications in 22 years during1998-2019. The research in this field increased from 1 to 18 from the year 1998 to the year 2019, registering 27.15% growth per annum.The eleven-year growth of publications registered 195.65%in the field, up from 69 (1998-2008) to 204(2009-19). The global publication in the field together registered citation impact per paper (CPP) of 8.1 citations during 1998-2019, which decreased from 16.00 CPP (1998-2008) to 5.4 CPP (2009-19)(Table 1). Of the total publication in the subject, conference papers contributed 52.75% share (144), followed by articles (39.93%, 109), reviews (3.66%, 10), book chapters (2.93%, 8) and book and undefined (0.37%, 1 each).

Citation Distribution to Papers

2201 citations were registered by 273 publications on "RFID Applications in Libraries" was counted till 4 December 2019, averaging to 8.1 citations per paper during 1998-2019.More than one fourth (28.94%) of total publications did not get any citations, while the remaining 71.16%

Table 1: Annual and cumulative publication Output and Citations Count in Research on "RFID Applications in Libraries"during1998-2019

Publication Period	World		
	TP	TC	CPP
1998	1	0	0.0
1999	1	4	4.0
2000	0	0	0.0
2001	0	0	0.0
2002	1	6	6.0
2003	4	18	4.5
2004	4	593	148.3
2005	9	113	12.6
2006	14	150	10.7
2007	19	123	6.5
2008	16	99	6.2
2009	12	108	9.0
2010	24	144	6.0
2011	20	100	5.0
2012	19	70	3.7
2013	22	411	18.7
2014	22	69	3.1
2015	17	101	5.9
2016	12	28	2.3
2017	16	37	2.3
2018	22	19	0.9
2019	18	8	0.4
1998-08	69	1106	16.0
2009-19	204	1095	5.4
1998-19	273	2201	8.1

TP=Total Papers; TC=Total Citations; CPP=Citations Per Paper

of global publications received uneven distribution of citations. From the table 2, it is indicated that one hand 57.51% of the publications (receiving 1-10 citations) received only 26.03% citations, as against 2.93% publications (receiving 51-536 citations) received 49.61% citations (Table 2).

Table 2: Distribution of Citations to Publications on "RFID Applications in Libraries" during 1998-2019

Citation Range	No. of Papers	No. of Citations	Share of Papers	Share of Citations
0	79	0	28.94	0.00
1-10	157	573	57.51	26.03
11-20	18	227	6.59	10.31
21-30	7	172	2.56	7.81
31-40	3	90	1.10	4.09
41-50	1	47	0.37	2.14
51-100	5	282	1.83	12.81
101-536	3	810	1.10	36.80
Total	273	2201		

Table 3: Global Publication Output & Citation Impact of Top 10 Most Productive Countries in "RFID Applications in Libraries" during 1998-2019

Sl. No.	Name of the Country	Number of Papers			Share of Papers			TC	CPP	ICP	%ICP	RCI
		1998-2008	2009-2019	1998-2019	1998-2008	2009-2019	1998-2019	1998-2019				
1	China	3	51	54	4.35	25.00	19.78	143	2.65	2	3.70	0.33
2	India	3	26	29	4.35	12.75	10.62	154	5.31	0	0.00	0.66
3	USA	12	14	26	17.39	6.86	9.52	444	17.08	4	15.38	2.12
4	Japan	9	16	25	13.04	7.84	9.16	61	2.44	2	8.00	0.30
5	U.K.	3	14	17	4.35	6.86	6.23	168	9.88	3	17.65	1.23
6	Malaysia	3	12	15	4.35	5.88	5.49	60	4.00	1	6.67	0.50
7	Taiwan	5	9	14	7.25	4.41	5.13	102	7.29	0	0.00	0.90
8	South Korea	5	4	9	7.25	1.96	3.30	42	4.67	1	11.11	0.58
9	Hong Kong	3	4	7	4.35	1.96	2.56	97	13.86	0	0.00	1.72
10	Australia	2	4	6	2.90	1.96	2.20	46	7.67	2	33.33	0.95
	Total of 10 countries	48	154	202	69.57	75.49	73.99	1317	6.52	15	7.43	0.81
	World total	69	204	273				2201	8.06			
	Share of top 10 countries in world	69.57	75.49	73.99				59.84				

Subject-Wise Distribution of Research Output

Computer Science is the most dominant subject in "RFID Applications in Libraries" with global publication share of 58.97%, followed by engineering (35.53%), social science (31.87%) and other 3 subjects from 4.03% to 9.52% share during the period under consideration. These 7 sub-fields of theme "RFID Applications in

Table 4: Subject-Wise Breakup of Global Publications in "RFID Applications in Libraries" during 1998-2019

Sl. No.	Subject*	Number of Papers (TP)			Activity Index		TC	CPP	%TP
		1998-2008	2009-2019	1998-2019	1998-2008	2009-2019	1998-2019		
1	Computer Science	41	120	161	100.76	99.74	1696	10.53	58.97
2	Social Sciences	27	60	87	122.79	92.29	689	7.92	31.87
3	Engineering	22	75	97	89.74	103.47	354	3.65	35.53
4	Mathematics	7	19	26	106.52	97.79	42	1.62	9.52
5	Physics and Astronomy	3	13	16	74.18	108.73	43	2.69	5.86
6	Decision Sciences	3	9	12	98.91	100.37	52	4.33	4.40
7	Business, Management and Accounting	4	7	11	143.87	85.16	61	5.55	4.03
	World Output	69	204	273			2201	8.06	
* There is overlapping of literature covered under various subjects									
TP=Total Papers; TC=Total Citations; CPP=Citations Per Paper									

Table 5: List of Significant Keywords on the theme "RFID Applications in Libraries" arranged according to the frequency of their appearance during 1998-2019

Sl. No.	Name of the Keyword	Frequency	Sl. No.	Name of the Keyword	Frequency
1	Radio Frequency Identification(RFID)	186	21	Academic Libraries	8
2	Libraries	89	22	Automatic Identification	8
3	RFID Technology	65	23	Inventory Control	8
4	Digital Libraries	48	24	Privacy	8
5	Library Management	47	25	Library Services	7
6	RFID Systems	23	26	RFID Applications	7
7	Automation	22	27	Smart Cards	7
8	Internet of Things	22	28	Electronic Data Interchange	6
9	Information Technology	20	29	Library & Information Systems	6
10	Library Circulation	19	30	Library Systems	6
11	Library Systems	18	31	Mobile Phones	6
12	Cryptography	18	32	User Interfaces	6
13	RFID Tags	16	33	Library Management Systems	5
14	University Libraries	15	34	Mobile Antennas	5
15	Information Management	12	35	Security	5
16	Antennas	11	36	Security Systems	5
17	RFID Readers	11	37	Digital Storage	4
18	Smart Libraries	11	38	Data Processing	4
19	Bar Codes	10	39	Intelligent Libraries	4
20	Library Automation	10	40	Library Catalogue	4

Libraries" (as identified in Scopus database classification) witnessed fluctuations in their activity index during 1998-2008 to 2009-2019 compared to world average index of 100. In most sub-fields their activity index changed above and below to world average in 2009-2019 compared to their corresponding status in 1998-2008: increase in activity index was observed in engineering, physics & astronomy, and decision sciences, as against decrease in computer science, social sciences, mathematics and business, management and accounting. Computer Science registered the highest citation impact per paper of 10.53 and mathematics the least (1.62) (Table 4).

Significant Keywords

40 most frequently keywords (based on the frequency of their appearance) used in the literature in the theme of the paper on "RFID Applications in Libraries"were identified and presented in the following Table 4. These keywords also throw significant hint on the various application of RFID in libraries [Table 5].

Top 20 Most Productive Global Organizations

The 150 organizations participated in research on "Application of RFID in Libraries" during 1999-2019, of which 94 published 1 paper each, 35 organizations 2 papers each, 10 organizations 3 papers each, 8 organizations 4 papers each and 3 organizations 5 papers each. The productivity of top 20 most productive organizations varied from 3 to 5 publications per organization; together they contributed 27.11% (600) global publications share and 27.26% (600) global citations share during 1998-2019. Their scientometric profile is presented in Table 6.

Table 6: Scientometric Profile of Top 20 Most Productive Global Organizations in "RFID Applications in Libraries" during 1998-2019

Sl. No.	Name of the Organization	TP	TC	CPP	RCI
1	Kyush University, Japan	5	99	19.80	2.46
2	University of Malaya, Malaysia	5	11	2.20	0.27
3	University of Technology Kingston, Jamaica	5	32	6.40	0.79
4	ZigZagee Limited, U.K.	4	2	0.50	0.06
5	Swansea University, U.K.	4	96	24.00	2.98
6	City University of Hong Kong	4	83	20.75	2.57
7	Aristotle University of Thessaloniki, Greece	4	16	4.00	0.50
8	Kyushu Institute of Information Science, Japan	4	13	3.25	0.40
9	ETH, Zurich, Switzerland	4	48	12.00	1.49
10	Shih Hsin University, Taiwan	4	77	19.25	2.39
11	University of Nicosia, Cyprus	4	16	4.00	0.50
12	Yazd University, Iran	3	33	11.00	1.36
13	UniversitiSains Malaysia	3	6	2.00	0.25
14	Hong Kong Polytechnic University	3	14	4.67	0.58
15	Fukuoka Institute of Technology, Japan	3	3	1.00	0.12
16	Surugadai University, Japan	3	6	2.00	0.25
17	Shenyang Aerospace University, China	3	13	4.33	0.54
18	Cheng Shiu University, Taiwan	3	3	1.00	0.12
19	Shanghai Jiao Tong University, China	3	4	1.33	0.17
20	Soonchunhyang University, South Korea	3	25	8.33	1.03
	Total of 20 organizations	74	600	8.11	1.01
	Total of World	273	2201	8.06	
	Share of top 25 organizations in World total output	27.11	27.26		

- Eleven organizations registered their productivity above the group average (3.7)) of all organizations:Kyush University, Japan, University of Malaya, Malaysia and University of Technology Kingston, Jamaica (5 papers each), ZigZagee Limited, U.K., Swansea University, U.K., City University of Hong Kong, Aristotle University of Thessaloniki, Greece, Kyushu Institute of Information Science, Japan, ETH, Zurich, Switzerland, Shih Hsin University, Taiwan and University of Nicosia, Cyprus(4 papers each); and

Seven organizations registered their citation impact per paper and relative citation index above the group average (8.11 and 1.01) of all organizations: Swansea University, U.K. (24.0 and 2.98), City University of Hong Kong (20.75 and 2.57), Kyush University, Japan (19.80 and 2.46), Shih Hsin University, Taiwan (19.25 and 2.39), ETH, Zurich, Switzerland (12.0 and 1.49), Yazol University, Iran(11.0 and 1.36) and Soonchunhyang University, South Korea (8.33 and 1.03).

Top 20 Most Productive Authors

The 160 authors participated in research on "RFID Applications in Libraries" during 1998-2019, of which 91 authors published 1 paper each, 52, 2 authors 5 papers each and 1 author 6 papers. The research productivity of top 17 most productive authors varied from 3 to 6 publications per author. Together they contributed 23.08% (63) global publications share and 20.08% (442) global citations share during 1998-2019. Their detailed scientometric profile is presented in Table 6.

Table 7: Scientometric Profile of Top 17 Most Productive Authors In "RFID Applications in Libraries" during 1998-2019

Sl. No.	Name of the Author	Affiliation of the Author	TP	TC	CPP	RCI
1	K. Fujisaki	Fukuoka Institute of Technology, Japan	6	20	3.33	0.41
2	P. Golding	University of Technology Kingston, Jamaica	5	32	6.40	0.79
3	V. Tennant	University of Technology Kingston, Jamaica	5	32	6.40	0.79
4	J. Minami	Kyushu Institute of Information Sciences, Japan	4	13	3.25	0.40
5	I. Pratt	ZigZagee Limited, U.K.	4	2	0.50	0.06
6	J.N. Sahales	Aristotle University of Thessaloniki, Greece	4	16	4.00	0.50
7	S.C. Yu	Shih Hsin University, Taiwan	4	77	19.25	2.39
8	S. Zhong	ZigZagee Limited, U.K.	4	2	0.50	0.06
9	A. Butter	Not available, Australia	3	26	8.67	1.08
10	N.Dindar	ETH , Zurich, Switzerland	3	44	14.67	1.82
11	C. Kern	Bibliotheca RFID Library System, AG, Switzerland	3	60	20.00	2.48
12	Y.Z. Mehrjerdi	Yazd University, Iran	3	33	11.00	1.36
13	A.C. Polycarpou	Aristotle University of Thessaloniki, Greece	3	16	5.33	0.66
14	T. Samaras	Aristotle University of Thessaloniki, Greece	3	16	5.33	0.66
15	S.T, Shih	Cheng ShiuUniersity, Taiwan	3	3	1.00	0.12
16	N. Sugie	Surugadai University, Japan	3	6	2.00	0.25
17	N. Tabul	ETH , Zurich, Switzerland	3	44	14.67	1.82
	Total		63	442	7.02	0.87
	Total of World		273	2201	8.06	
	Share of 17 authors in world Total Output		23.08	20.08		

- Eight of top 17 organizations registered their publications output above the group average of 3.70: K. Fujisaki (6 papers), P. Golding and V. Tennant (5 papers each), J. Minami, I. Pratt, J.N. Sahales, S.C. Yu Shih Hsin and S. Zhong (4 papers each); and
- Six of top 17 authors registered their citation impact per paper and relative citation index above the group average (7.02 and 0.87) of all authors: C. Kern (20.0 and 2.48), S.C. Yu (19.25 and 2.39), N. Dindar and N. Tabul (14.67 and 1.82 each),Y.Z. Mehrjerdi (11.0 and 1.36) and A. Butter (8.67 and 1.08)

Medium of Research Communication

Of the total world output in "RFID Applications in Libraries",43.22% (118) appeared in journals, 38.83% (106) in conference proceedings, 13.19% (36) in book series, 3.30% (9) as books and 1.47% (4) as trade publications and 1.79%(131) as books. Of the 84 journals which reported 118 articles, 65 published 1 paper each, 11 published 2 papers each, 2 published 3 papers each, 4 published 4 papers each, 1 each published 5 and 8 papers during 1998-2019.The top 19 most productive journals accounted for 48.31% share of total output on 'Role of RFID in Libraries" that appeared in journal medium during 1998-2019, which decreased from 55.17% to 46.07% between 1998-2008 and 2009-2019. The top most productive journal (with 8 papers) was *Electronic Library*, followed by *Library Philosophy and Practice* (5 papers), Journal of

Table 8: Top Most Productive Journals in research on "RFID Applications in Libraries" during 1998-2019

Sl. No.	Name of the Journal	Number of Papers		
		1998-2008	2009-2019	1998-2019
1	Electronic Library	3	5	8
2	Library Philosophy and Practice	0	5	5
3	Journal of Access Services	2	2	4
4	Library & Archival Security	4	0	4
5	Library High Tech	2	2	4
6	Library High Tech News	1	3	4
7	Program	0	3	3
8	Scientific & Technological Information Processing	0	3	3
9	Australian Academic & Research Libraries	1	1	2
10	DESIDOC Journal of Library & Information Technology	0	2	2
11	IEICE Transactions on Information Systems	0	2	2
12	International Journal of Information Management	0	2	2
13	International Journal of Online Engineering	0	2	2
14	International Journal of Technology Intelligence & Planning	0	2	2
15	Journal of Academic Librarianship	1	1	2
16	Journal of Educational Media & Library Science	2	0	2
17	Life Science Journal	0	2	2
18	Proceedings of the ASIST Annual Meeting	0	2	2
19	Malaysian Journal of Library and Information Science	0	2	2
	Total of 19 journals	16	41	57
	Total global journal output	29	89	118
	Share of top 20 journals in global journal output	55.17	46.07	48.31

Access Services, Library & Archival Security, Library High Tech and Library High Tech News (4 papers each) during 1998-2019 (Table 68.

Highly-cited Papers

Of the total world output in ""RFID Applications in Libraries" (273 publications), only 17 (6.23% share) cumulated 21 to 536 citations per paper (cumulative total 1365 citations) since their publication during 1998-2019, averaging to 80.29 citations per paper. The distribution of 17 highly cited papers is skewed. Nine papers cumulated citations in the range 21-50 per paper, 5 papers were in citation range 51-100, 2 papers in citation range 101-200 and 1 paper received 536 citations. Of the 17 highly-cited papers, 15 were non-collaborative and 2 were collaborative (1 each national and international). Among highly-cited papers, USA contributed the largest number of papers (4 papers), followed by U.K.and India (3 papers each), Taiwan and Switzerland (2 papers each), Hong Kong and South Korea (1 paper each). The 17 highly-cited papers involve 42 authors and 23 organizations.

The leading organizations participating in highly-cited papers were: Massachusetts Institute of Technology, USA , Swansea University, U.K. and Shin-Hsin University, Taipei, Taiwan (2 papers each), AG, Bibliotheca RFID Library System, Zug, Switzerland, Brunel University, London, United Kingdom, Cal Poly State University, USA, Central Institute of Post - Harvest Engineering and Technology , Ludhiana, India 11, City University of Hong Kong, Drexel University, USA, ETH Zurich, Switzerland, Nottingham Trent University, U,K., Soonchunhyang University, South Korea, University of Hudders field, U.K., University of Jammu, India and University of Pune, India (1 paper each). The leading authors participating in highly cited papers were: Dwivedi, Y.K., Kapoor, K.K, Wang, J., Katabi, D and Yu, S.-C (2 papers each) and all other authors with 1 paper each. Of the 17highly-cited papers, 10 were published as articles, 5 as conference papers and 2 as reviews.

These17 highly-cited papers appeared across 11 journals, of which 3 papers were published in *Electronics Library* and 1 paper each in other 10 journals: *Computer Communication Review, IEEE Transactions on Industrial Electronics, Information Technology and Libraries, International Journal of Information Management, Journal of Academic Librarianship, Journal of Enterprise Information Management, Library High Tech, Library Philosophy and Practice, Program* and *Trends in Food Science and Technology*. The list of top 9 highly cited papers is given in Appendix 1

SUMMARY AND CONCLUSION

The analysis unveils that the global publication data on "RFID Applications in Libraries" is not well taken among academic and R& D community. As evidenced from the literature, the annual and eleven-years cumulative global output recorded as 27.15% average growth rate and 195.65% absolute growth during the last 22 years. The literature still seems in its infancy accounting 273 papers from 47 countries written by 160 authors.

The concept is popular among other subjects with Computer Science as the leader accounting

for highest (58.79%) global publications share, followed by engineering (35.53%), social science (31.87%) and other 3 subjects contributing 4.03% to 9.52% during 1988-2019. Libraries are still lagging behind. They reason might be the gradual adoption of this technology in libraries. Perhaps scope for extensive adoption of RFID technology into libraries could hopefully expedite the momentum of research and come up with further areas of research.

The publications output was reported with an average of 8.1 citations per paper (CPP) in 22 years, decreasing from 16.00 CPP to 5.4 CPP from 1998-08 to 2009-19. The 150 organizations and 160 authors participated in global research on "RFID Applications in Libraries" during 1988-2019. The top 20 most productive research organizations and the authors on "Role of RFID in Libraries" collectively contributed 27.11% and 23.08% global publication share and 27.26% and 20.08% global citation share respectively during 1988-2019. The journals medium accounted for 43.22% global share in global research output with top 19 most productive journals accounting for 48.31% of total publications output in journals during 2001-18. Electronic Library contributed the largest number of papers (5), followed by Library Philosophy and Practice, Journal of Access Services, Library & Archival Security, Library High Tech and Library High Tech News.

Only 17 (6.23%) publications out of 273 global publications registered 21 to 536 citations per paper since the time they started publishing. These 17 papers altogether received 1365 citations, leading to 80.29 citations per paper. Of the 17 papers, USA contributed the largest number of papers (4 papers), followed by U.K. and India (3 papers each). The 17 highly cited papers involve 42 authors and 23 organizations and have been published in 11 journals, of which 3 papers were published in Electronics Library journal. Conclude that there is a need to expand research in this area so libraries can fully utilize the benefits of this technology in terms of economy and for its various applications.

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5. Rekha A.J and Jayaprakash M. Publication trends in global output on RFID: A bibliometric profile (2019). Library Philosophy and Practice (e-journal). 3023.

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Appendix – 1

Table 9: List of Top 9 High-Cited Papers on "Role of RFID in Libraries"

Sl. No.	Authors	Title	Source	Citations
1	Molnar, D. and Wagner, D.	Privacy and security in library RFID issues, practices, and architectures.	Proceedings of the ACM Conference on Computer and Communications Security, 2004, pp. 210-219.	536
2	Wang, J. and Katabi, D.	Dude, where's my card? RFID positioning that works with multipath and non-line of sight	SIGCOMM 2013 - Proceedings of the ACM SIGCOMM 2013 Conference on Applications, Technologies, Architectures, and Protocols for Computer Communication, 2013, pp. 51-62.	153
3	Wang, J. and Katabi, D	Dude, where's my card? RFID positioning that works with multipath and non-line of sight	Computer Communication Review, 2013, 43 (4), pp. 51-62.	121
4	Dwivedi, Y.K. ,Kapoor, K.K. , Williams, M.D. and Williams, J	RFID systems in libraries: An empirical examination of factors affecting system use and user satisfaction	International Journal of Information Management, 2013, 33 (2), pp. 367-377.	63
5	Coyle, K.	Management of RFID in libraries	Journal of Academic Librarianship, 2005, 31 (5), pp. 486-489.	58
6	Lau, P.-Y., Yung, K.K.-O. and Yung, E.K.-N	A low-cost printed CP patch antenna for RFID smart bookshelf in library	IEEE Transactions on Industrial Electronics, 2010, 57 (5), art. no. 5332285, pp. 1583-1589.	57
7	Singh, J andBrar, N. and Fong, C.	The state of RFID applications in libraries	Information Technology and Libraries, 2006, 25 (1), pp. 24-32.	53
8	Yu, S.-C.	RFID implementation and benefits in libraries	Electronic Library, 2007, 25 (1), pp. 54-64.	51
9	Kern, C.	Radio-frequency-identification for security and media circulation	Electronic Library, 2004, 22 (4),	47

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