Application of Artificial Intelligence in Banking and Finance : Bibliometric Review and Emerging Research Agenda

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Abstract

Artificial Intelligence (AI) has been growing at the fastest pace during the last few decades. It has affected all sectors directly or indirectly. The application of AI is getting more mature with the passage of time and the banking sector is adopting it intensively. Existing literature in the subject is scattered across all regions of the world. The purpose of this study is to understand major contributions of researchers, subject experts, and the sources along with countries that are actively involved in the area of research. To do the bibliometric study, systematic review of 756 documents published from 1972 to 2021 in Scopus database has been used as it is the largest of all databases available. With this bibliometric analysis, it was found that the USA, China, UK, India, and Taiwan have been the major countries in making extra efforts continuously for unfolding the new possibilities of Artificial Intelligence in the banking and finance sector.

Keywords : Artificial Intelligence, banking and finance, bibliometric study, Scopus database, systematic analysis

I. INTRODUCTION

Artificial Intelligence has made a mark in all sectors for a decade. A noticeable growth has been seen in the economy with the acceleration in the adoption of Artificial Intelligence. Today, the growth of any sector depends on the direct or indirect use of Artificial Intelligence. Banking and finance is one of the sectors where AI has been applied intensively [1], [2]. The effect of AI in the banking and finance sector has been observed and studied by various researchers and academicians since the 19th century. The consistent growth of AI in the banking and finance sector can be studied in the manuscripts published since the last century. The present article aims to understand a different kind of impact of Artificial Intelligence in the banking and finance sector.

The presence of AI is noticeable in all the rage of business, especially in the finance sector. It accelerates economic growth with increased efficiency and productivity. Multiple combinations of technological innovations can be observed in the banking sector and financial sector. In banking it has covered front-end and back-end offices and in the financial sector it has covered financial markets (stock, bonds, derivatives, interest rates, and foreign exchange), and financial institutions (banks, insurance companies, payment firms, mutual funds, and microfinance organizations [3]. AI has revolutionized the strategy of the banking and financial sector in a more collaborative and innovative way [4].

II. APPLICATION OF AI IN BANKING AND FINANCE

Artificial Intelligence in banking and finance is helping the competitiveness of banks and financial institutions.

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The use of AI in the financial industry has been increasing in recent years [5]. Banks are carrying out AI for distinguishing cheats, improving client experience, following client transactional behavior for suggesting more customized products and services, breaking down client financial records to foresee chances related with assigning credits, and many more [6], [2]. The following are the most prominent uses and applications of AI in banking and finance.

1) Artificial Intelligence Chatbots

Chatbots help clients in numerous ways. Artificial Intelligence based Chatbot service is one of the critical uses of AI in banking and financial areas [2]. Simulated intelligence chatbots in finance and banking are modernizing the way in which financial institutions offer various types of assistance to their clients. The chatbots in banking and financial industry can help clients 24*7 and give precise reactions to their questions. These chatbots give a customized insight to users [7].

Thus, AI chatbots for finance and banking activities let banks draw in user consideration, streamline administration quality, and extend the brand mark in the banking industry market [8].

2) Automation and Seamless Process

Automation is one of the most incredible AI use cases in banking and finance. Artificial Intelligence has incredible potential in the financial business [1]. Artificial Intelligence programming helps banks in smoothing out and computerizing each errand which is finished by people and simplifying the whole interaction and virtual activities [9]. Consequently, AI applications can decrease the responsibility of investors and enhance the nature of work [10].

3) Information Collection and Analysis

AI in the financial area can proficiently perform data assortment and analysis processes. Checked informational indexes are fundamental for AI machines to break down the data. Artificial Intelligence fueled mobile banking apps gather and make an appropriate learning technique for improving the general customer experience. After an appropriate investigation of the information, the customer experience can turn out to be more customized [11].

4) Artificial Intelligence Mobile Apps Detects Fraud

Artificial Intelligence banking applications and apps recognize chances of risks and limit fake activities [21]. Artificial Intelligence innovation can analyze value-based information and distinguish unpredictable customer standards of behavior [6]. Subsequently, utilizing shrewd AI devices and apps, banking, and financial institutions can shield their business from fraudulent activities [12], [6].

5) Artificial Intelligence for compliance in banking

AI innovation is spreading at a fast speed. Most big institutions check out banks that give consistent guidelines on banking and finance activities. The banking and financial sector needs to ceaselessly upgrade its work processes under the current consistency rules and guidelines [2]. Thus, the application and uses of AI in banking and finance are increasing in recent periods for sustaining market share in the competitive world [13]. Every banking and financial institution is using AI in various day-to-day activities to enhance customer service experience, which is increasing banking and finance business.

III. REVIEW OF LITERATURE

Artificial Intelligence empowers banks to oversee record-level rapid information to get important insights of information. Artificial Intelligence (AI) and Big Data Analytics (BDA) have risen and played a significant role in the banking and finance area. Besides, elements like digital banking, AI bots, and biometric extortion recognition frameworks further lead to excellent administrations for a more extensive client base.

Nobanee et al. [5] covered the topics that incorporate profit, investment, competition, credit hazard investigation, banking wrongdoing, and Fintech with the use of big data analysis. This article likewise connotes the significance, utilization of big data, and its uses in the banking and financial area [18]. Indriasari et al. [9] investigated the utilization of AI and BDA in banking for utilizing client experience. Malekipirbazari and Aksakalli [14] explained risk assessment in social lending by banks and its impact on performance of banks.

There are few studies that have used bibliometric analysis related to application of Artificial Intelligence in

banking and finance [5]. Cvetkoska and Savic [15] utilized bibliometric analysis to recognize the patterns of DEA application in banking. Ikra et al. [16] applied the bibliometric approach to Islamic banking effectiveness. However, the number of such studies which focus on application of Artificial Intelligence in banking and finance are very few. The current study is conducted to fill this research gap and to find out the answers of the following research questions:

⇨ **RQ1:** What are the publication and citation trends in application of Artificial Intelligence in banking and finance?

⇨ **RQ2:** What are the top sources, publications and authors in application of Artificial Intelligence in banking and finance?

⇨ **RQ3:** Which directions should future research pursue to advance in application of Artificial Intelligence in banking and finance?

IV. RESEARCH METHODOLOGY

The study tries to conduct a bibliometric analysis on the authors' contribution to explore different dimensions of research on applications of Artificial Intelligence in banking and finance. Scopus is the largest database for abstract and citations as it contains all types of studies conducted around the world in the field of Science, Technology, Medical, Social Sciences, and Arts and Humanities. Therefore, Scopus Database has been used for this study.

To begin the study, first of all relevant terms were identified and then initial search was processed. The keywords used in the combination are shown in Table I. The search was conducted in Scopus Database using default search fields, namely, 'title', 'abstract,' and 'keywords'. Initially, 2,726 documents were identified but the list was narrowed down to 756 by eliminating conference papers, book chapters, reviews, conference reviews, books, and editorial works, and only journals were selected from the source type. This is to note that this study was conducted on Scopus database till December 2021. Thus, any other studies that are not in Scopus Database and have been published after December 2021 were not considered in this research.

V. RESULTS AND DISCUSSION

1) Yearly Distribution and Growth Trend

The study on Artificial Intelligence in banking and finance was not getting much attention in the early 90s. The first manuscript was published by Lippey [17], and even after this studies were going on at a very low pace as few studies were conducted until 2012. After 2012, the numbers kept rising and are still rising in each coming year (Fig. 1). This indicates that the application of Artificial Intelligence in banking and finance is getting deeper and wider. Thus, it is creating more possibilities for further research areas.

2) Distribution of Publication on a County Level

Considering the popularity of the theme, applications of Artificial Intelligence in banking and finance, it becomes very important to understand which countries are significantly contributing in this area of research and as per SCOPUS Database, it has been observed that USA, China, UK, India, and Taiwan are the top five countries which are contributing the most with 145, 111, 73, 66, and 46 documents published so far. More details have been given in Table II.

TABLE I.

PRELIMINARY DATA SEARCH OF ARTIFICIAL INTELLIGENCE IN BANKING AND FINANCE IN SCOPUS DATABASE

	Search results (Number of articles, conference papers, book chapters, and reviews)	Research Results after scrutiny
Artificial Intelligence and banking OR finance	2,726	748
Artificial Intelligence and banking and finance	12	08
	Total result found	756

No of Publications per Year

Source : Scopus https://www.scopus.com
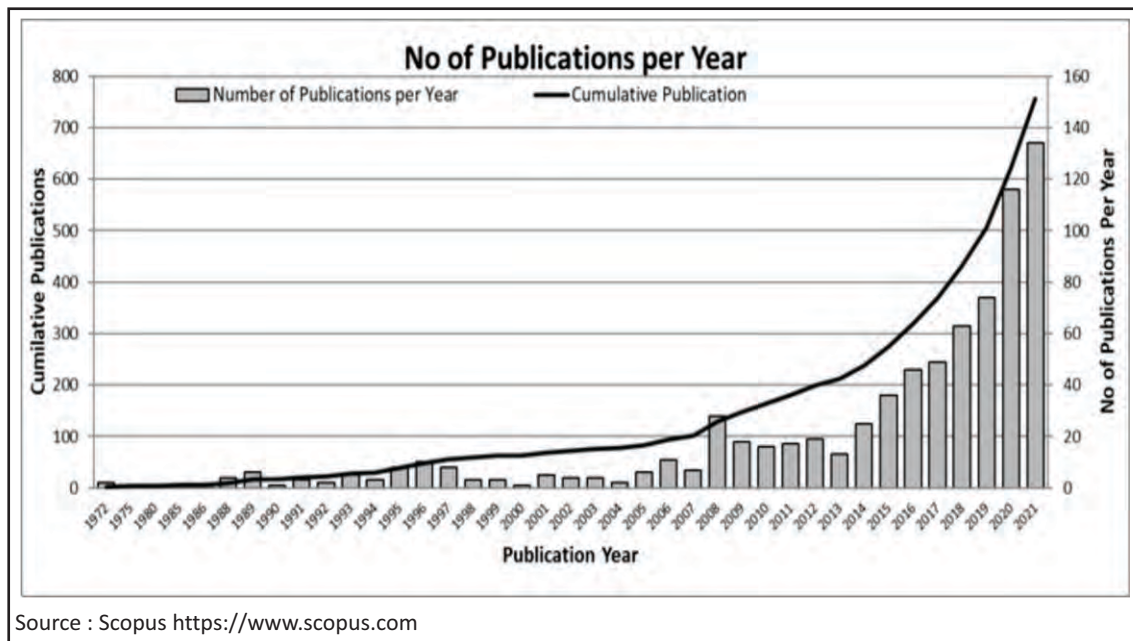
Fig. 1. Number of publications and cumulative publications on year-on year basis

TABLE II.

TOP 20 COUNTRIES THAT PUBLISHED MORE THAN THREE DOCUMENTS

S. No.	Country	Documents	Percentage of Documents	Citations	Average Citations	GDP Ranking*	Total Link Strength**
1	United States	145	15.25	4,142	28.57	1	39
2	China	111	11.67	1,775	15.99	2	39
3	United Kingdom	73	7.68	1,729	23.68	5	33
4	India	66	6.94	1,403	21.26	6	31
5	Taiwan	46	4.84	1,189	25.85	22	52
6	Spain	33	3.47	515	15.61	14	27
7	Italy	32	3.36	827	25.84	8	16
8	Germany	30	3.15	739	24.63	4	16
9	South Korea	28	2.94	646	23.07	11	20
10	Australia	22	2.31	561	25.50	13	4
11	Canada	18	1.89	216	12.00	9	1
12	Japan	18	1.89	271	15.06	3	6
13	Turkey	18	1.89	653	36.28	21	21
14	France	17	1.79	800	47.06	7	28
15	Iran	17	1.79	261	15.35	17	14
16	Russian Federation	17	1.79	61	3.59	12	0
17	Malaysia	15	1.58	118	7.87	39	12
18	Greece	14	1.47	501	35.79	51	5
19	Hong Kong	14	1.47	615	43.93	40	15
20	Saudi Arabia	14	1.47	266	19.00	19	8

Note. *nominal GDP; **Link strength means, with how many they have collaborated

Source : Scopus https://www.scopus.com and www. imf.org. World Economic Outlook (October - 2021)

Table II highlights the information about the total documents published with its percentage by top 20 countries keeping the criteria of more than 3 documents published by the countries. It also highlights the total number of citations achieved by the countries for their respective publications with average citations allocated. It also highlights their GDP ranking to understand the relationship between GDP ranking of a country and its focus on the publication on Artificial Intelligence with respect to banking and finance. The table also highlights the link strengths, which means it gives an idea of the number of countries they have collaborated with. The link strength can also be understood with graphical presentation given in Fig. 2.

Table II shows that the USA is the highest in terms of studying the influence of Artificial Intelligence in the field of banking and finance with 145 publications having an average of 29 citations approximately. China has secured the second position in this order with 111 publications but not in terms of citations as UK, India, Taiwan, and many other countries have better average citations than that of China. The Russian Federation, Malaysia, and Canada are the countries that have a position in the top 20 list, but have very less average citations. The noticeable fact is that the Russian Federation, Canada, and Australia have been lowest in terms of collaborations with other countries, whereas Taiwan has got maximum collaborations on this topic with different countries. The collaborations can be understood with Fig. 2 as well.

3) Author and Co-authorship

After getting knowledge about the country's contribution to the theme, it is important to know the researchers or subject matter experts who have made a significant contribution to studying Artificial Intelligence with respect to banking and finance. In Table III, top 20 names

Source : Scopus https://www.scopus.com
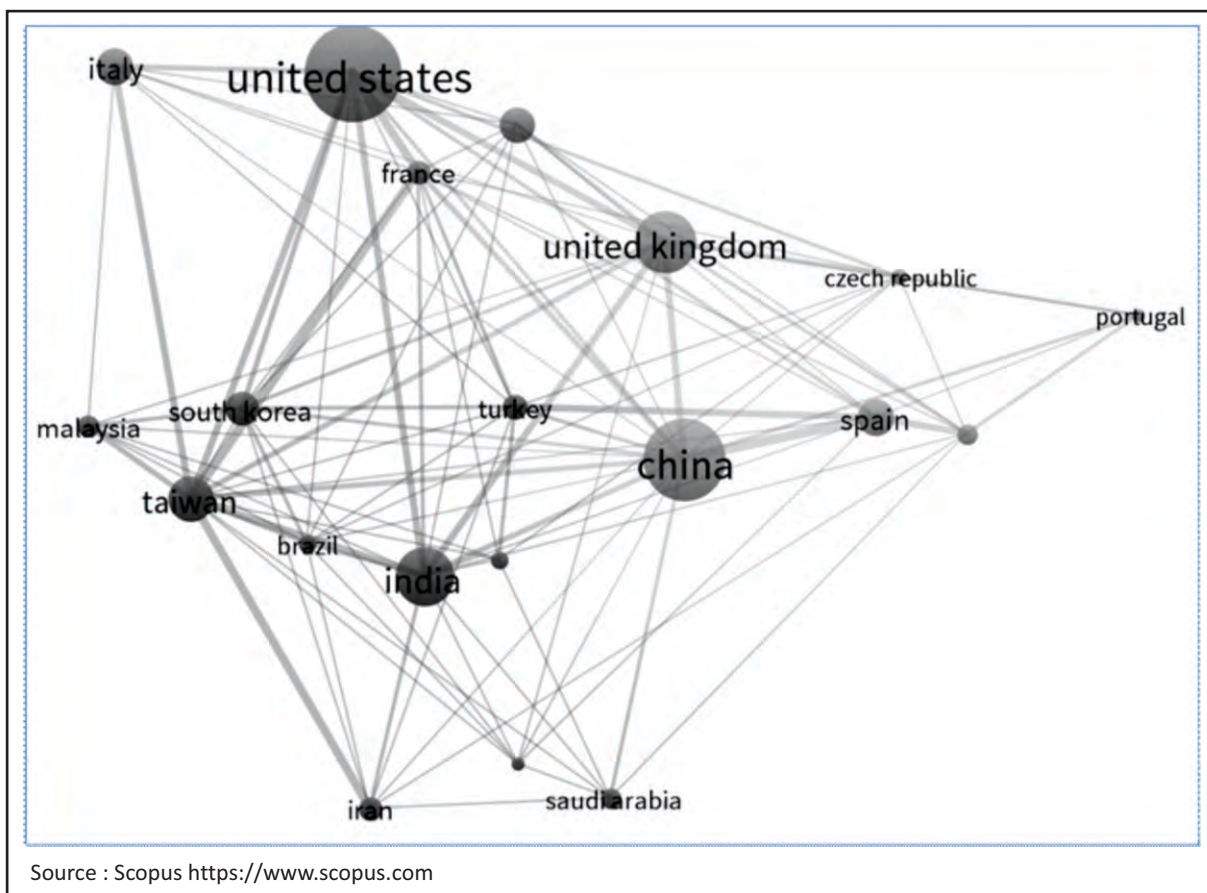
Fig. 2. Major contributing countries in publishing articles on Artificial Intelligence with respect to banking and finance and their collaborations with other countries

TABLE III.

TOP AUTHORS WHO PUBLISHED MORE THAN THREE DOCUMENTS

| S. No.	Author	Documents	Citations	Average Citation	Total Link Strength
1	X. Li	5	28	5.60	0
2	M. Nwogugu	5	59	11.80	0
3	J. Zhang	5	39	7.80	0
4	X. Zhang	5	23	4.60	0
5	J. Kim	4	13	3.25	4
6	J. Lee	4	35	8.75	0
7	D. Mhlanga	4	31	7.75	0
8	V. Sharma	4	66	16.50	0
9	R. Singh	4	146	36.50	0
10	T. Yigitcanlar	4	112	28.00	0
11	M.-Y. Chen	3	141	47.00	0
12	X. Chen	3	74	24.67	0
13	J. M. Corchado	3	42	14.00	0
14	P. Danenas	3	19	6.33	0
15	M. Doumpos	3	163	54.33	0
16	S. Fu	3	21	7.00	1
17	T. Gramespacher	3	0	0.00	0
18	P. Isasi	3	13	4.33	0
19	J. Li	3	22	7.33	0
20	Y. Li	3	35	11.67	0

Source : Scopus https://www.scopus.com

of researchers are mentioned who have worked on and published more than three articles and contributed the most in this particular area of research.

From Table III, it can be observed that X. Li has contributed the most when it comes to publishing the work as he has published 5 research papers, but M. Doumpos has the maximum citations with 163 citations for 3 documents published followed by R. Singh and M.-Y. Chen, who have 146 and 141 citations for their published manuscripts. T. Gramespacher has 0 citations, even though he has published three articles on the same, and consequently, he has the lowest average citations. M. Doumpos has 54 verage citations and M.-Y. Chen has average of 47 citations because of which they got the highest and second highest positions in this category as well. It is interesting to note that J. Kim is the only subject matter expert who has collaborated with the researchers of four different countries, which is missing in the case of other contributors except S. Fu, who has collaborated with one researcher of a different country.

4) Publication Source and Co-citation Relationship

After getting the information about the significant contributors in the field of Artificial Intelligence with respect to banking and finance, it is important to find out the journals or publishers who have constantly been promoting the studies of this domain. In Table IV, the top 20 sources have been mentioned that have published three or more articles.

It is evident from the available information that 'Expert Systems with Application,' a referred international journal has published maximum papers related to Artificial Intelligence with respect to banking and finance and is a way ahead than any other journal. Therefore, it has obtained maximum citations with 3,445 total citations. The European Journal of Operational Research (EJOR) and IEEE Access have published 14 articles and research papers. It is interesting to observe that even though these journals have published equal number of papers but the total average citations achieved

Source : VOSviewer and Scopus https://www.scopus.com
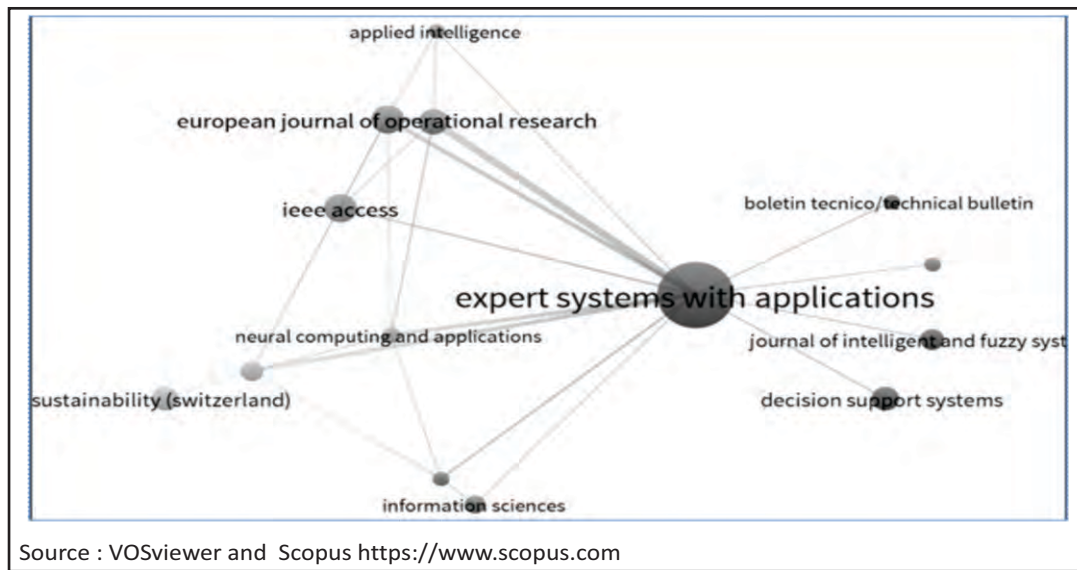
Fig. 3. Source and citation relationship of the sources that published documents of Artificial Intelligence and Banking and Finance

TABLE IV.

TOP JOURNALS WHERE MORE THAN THREE DOCUMENTS WERE PUBLISHED

S. No.	Source	Documents	Citations	Average Citation Per Document	Total Link Strength
1	Expert Systems With Applications	53	3,445	65.00	42
2	European Journal of Operational Research	14	1,039	74.21	16
3	IEEE Access	14	66	4.71	5
4	Applied Soft Computing Journal	12	652	54.33	17
5	Decision Support Systems	11	357	32.45	1
6	Sustainability (Switzerland)	11	127	11.55	1
7	Journal of Intelligent and Fuzzy Systems	9	17	1.89	1
8	Journal of the Operational Research Society	8	203	25.38	0
9	Knowledge-Based Systems	8	399	49.88	11
10	Information Sciences	7	257	36.71	2
11	Neural Computing and Applications	6	350	58.33	14
12	Applied Artificial Intelligence	5	314	62.80	0
13	Applied Intelligence	5	98	19.60	3
14	Boletin Tecnico/Technical Bulletin	5	19	3.80	1
15	Frontiers in Artificial Intelligence	5	10	2.00	1
16	Informatica (Ljubljana)	5	1	0.20	0
17	International Journal of Advanced Computer Science and Applications	5	3	0.60	0
18	International Journal of Financial Studies	5	23	4.60	0
19	International Journal of Innovative Technology and Exploring Engineering	5	4	0.80	0
20	Neurocomputing	5	106	21.20	5

Source : Scopus https://www.scopus.com

by them are poles apart as the former has 1,039 total citations and 74 average citations, whereas the latter has achieved only 66 citation in total and average 4 citations on every article published. Informatica (Ljubljana), International Journal of Advanced Computer Science and Applications and International Journal of Innovative Technology and Exploring Engineering are the journals that have published five articles on the same theme but have got the lowest citations (1, 3, and 4 citations) respectively, which clearly defines that these journals have not been so much successful in promoting research as comparison to other journals (Fig. 3).

5) Documents and Citation Relationship

Citations is one such parameter that gives recognition to the efforts taken by a researcher. Therefore, it is important to find out who are the researchers whose studies have been recognized more than hundred times, especially in the area of Artificial Intelligence with respect to banking and finance. Table V has highlighted the top 20 such researchers whose study has been cited more than hundred times by other researchers along with their connections with other researchers for similar kinds of studies.

The article published by Das and Chen [19] has the highest citations (671) so far for their article published in 2007. Zhang et al. [20] along with three other authors have achieved 399 citations, which is the second highest in this row but it is also to be noticed that even though the article was published in 1999, that is, much earlier than that of the former still they could not get more citations [20]. Tsai and Wu [21] along with five other authors published their work in 2008 and got the third highest number of citations with 324 citations in total whereas Pindoriya et al. [22] citid with 235 citations. Wang et al. [23] has received 283 citations. The lowest in this order is Fountas et al. [24] and Varetto who published article in 2015 and 1998 respectively, and they got 147 citations for their work.

TABLE V.

TOP DOCUMENTS THAT HAVE BEEN CITED ATLEAST HUNDRED TIMES

S. No.	Document	Citations	Links
1	S. R. Das (2007)	671	1
2	G. Zhang (1999)	399	4
3	C.-F. Tsai (2008)	324	6
4	G. Wang (2011)	283	2
5	Y. K. Dwivedi (2021)	264	0
6	R. C. Cavalcante (2016)	252	2
7	A. Bahrammirzaee (2010)	239	7
8	N. M. Pindoriya (2008)	235	0
9	J. Patel (2015)	227	2
10	R. D. King (1995)	195	0
11	M. Malekipirbazari (2015)	193	2
12	D. Sornette (2002)	187	0
13	S. Canbas (2005)	185	2
14	T. Preis (2010)	183	0
15	D. Gunning (2019b)	177	0
16	J.T.S. Quah (2008)	173	0
17	S. Moro (2015)	170	0
18	J. Smailovic (2014)	149	0
19	F. Varetto [14] [12]	147	0
20	S. Fountas (2015)	147	0

Source : https://www.scopus.com

VI. FUTURE RESEARCH AGENDA

The AI application in banking and finance is rapidly increasing in all the areas. The research on application of AI in banking and finance is more popular among the researchers from engineering and technology community. There is ample of scope of study in this field for the researchers of business and management. The research on application of AI in banking and finance is limited to risk assessment, credit application evaluation, robotics, and credit risk. There are different areas for future research like financial inclusion, dividend policy, chatbot, ethics, trust, consumer psychology, and decision support, where the research on AI application is negligible. Therefore, one needs to fill this research gap through future research in these areas. There is substantial scope for studies in fraud detections, forensic accounting, and decision on selection of creditworthy customers. The application of AI in banking and finance is the future of banking system in the world and it would be interesting to do research on how banking sector will balance between use of AI and human capital resources, expenditure on AI and product diversification.

VII. CONCLUSION

The application of AI in banking and finance is increasing rapidly in recent times. To increase efficiency and productivity, AI has been used by banking and financial institutions across the world. The research on this theme is diversified and increasing in the current era. The following important conclusions can be derived from the present study:

First, the study on Artificial Intelligence in the banking sector was not a popular theme of research until 2012 after which this topic started creating a lot of buzz for new researchers. The promotion of digitalization can be one of the reasons. Second, it is found that USA, China, UK, and India have been dominant countries in this area of research. Italy, Germany, South Korea, and Australia are upcoming countries that have started focusing on the new possibilities of Artificial Intelligence in the banking and finance industry. Finally, it is observed that "Expert Systems with Applications" has been the highest and the oldest source to promote the studies conducted in the said theme. The findings of the study highlighted in this review can help stakeholders, including researchers, funding agencies, industry experts, and software developers in planning and aligning future actions.

AUTHORS' CONTRIBUTION

Dr. Priyanka Gujrati worked on writing of results and discussion, conceptualized the research, conducted literature search on Scopus database. Dr. Jivan Biradar conceptualized the research, conducted literature search on Scopus database, worked on use of AI in banking and finance and future research agenda.

CONFLICT OF INTEREST

The authors declare no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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