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# A Systematic Review of The Application of AI in Banks Through Bibliometric Analysis; Research Trends and Patterns

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***Abstract***

*Financial institutions including banks in particular, are increasingly adopting artificial intelligence (AI) solutions to enhance service standard and adapt to evolving market dynamics. AI impacts various banking aspects from customer service, risk management, operational efficiency and regulatory compliance. The study aims to provide insights that will guide future research and promote the sustainable growth of this rapidly developing field while also identifying gaps and unexplored areas. Therefore, this paper employed bibliometric analysis, using VOSviewer to analyze multiple scholarly items from Scopus, to comprehensively examine the role of AI in banking (AIB). Keywords were used in the Scopus database, and 1784 articles meeting the inclusion and exclusion criteria were selected. Publication trend, keyword analysis, co-citation & bibliometric analysis were undertaken. By examining academic literature through citation analysis, network and density visualizations, and trend assessments, this study identified significant themes and patterns in the implementation of implementing AI within the banking industry. The findings offer valuable information for banking professionals and planners. From the findings in this paper, future studies could focus on more usage of the technology in the BFSI space.*

***Keywords:*** *Bibliometric analysis, AI in banking, Artificial intelligence, vosviewer, technology in banking*

## 1 Introduction

Artificial Intelligence (AI) has revolutionized the entire financial sector and banking sector across the globe. It has and continues to transform operational processes, redefine customer engagement and make breakthroughs in risk management. AI's emergence and successive growth in banking has been marked by a shift from basic work automation and data analysis to more complex and curated applications. These include personalized financial services, real-time fraud prevention and smart customer support through chatbots and voice assistants.

AI enables banks to make informed decisions by analyzing vast datasets and extracting valuable insights, leading to more precise risk evaluations, enhanced fraud prevention systems and advanced investment strategies. Additionally, AI has boosted operational efficiency by automating many tasks, resulting in quicker & accurate transaction processing, streamlined account management and improved data analysis capabilities.

The usage of AIB has become increasingly important because of the increasing complexities of financial products & services, rapid statutory changes as well as the velocity and volume of financial data.

In the academic space, we have evidence of the possible benefits that AI can accumulate over a period of time in multiple areas (the areas have been defined, too), the possible risks, and there is growing literature of case studies around the same. It is to be noted out here that there is also empirical evidence linking AI development and ESG performance. We have scientific linkage and growing proof of the increase in carbon footprints because of the use of AI.

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*Fig 1: Possible areas of AI in banks*

*Source: Authors*

**1.1Research Questions**

The authors chose to address the following Research Questions (RQ)

RQ1: What has been the pattern of research publications in the research area of "AI in banking (AIB)" over the years?

RQ2: In what ways have countries, institutions and authors helped with research in this space?

RQ3: Which journals and articles in the AIB field have the most significant citations?

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RQ4: Based on citations, which of these research works is the most widely cited in the AIB space?

**2 Developments in the AI applications in banking**

| *Sl. No.* | *Authors* | *Year* | *Description / development(s)* |
|---|---|---|---|
| 1 | Kindle, Kyle W and Cann, Ross et al | 1989 | Chase Lincoln First Bank propounded PFPS, which was an integrated personal financial planning system encompassing the following areas of personal finance: investment planning, debt planning, retirement savings and settlement of retirement plans, education and other children's goal funding, life insurance planning, disability insurance planning, income tax planning and savings for the achievement of as many major financial goals. This is one of the earliest mentions of AI in banking & finance. |
| 2 | Sahin, Kenan and Sawyer, Keith | 1989 | International banking depends on messages, and IBM proposed software exclusively to improvise and help data entry operators easily transmit requisite data. Ai was resorted to as it was felt that traditional programming techniques were inadequate in adhering to the specific data transmission format. |
| 3 | Senator, Ted and Goldberg, Henry et al | 1995 | FinCEN Artificial Intelligence System (FAIS) was designed intelligently (aided by AI) to detect possible money laundering by evaluating cash transactions. The model used could check the same after running through millions of weekly transactions. |
| 4 | Hodgkinson, Luke and Walker, Ellen | 2003 | A credit evaluation system called Credit Evaluation and Explanation Expert System (CES) was designed to evaluate loan eligibility for corporates. This is one of the earliest evaluation models for corporates. |
| 5 | Rao, M. Rajeshwar | 2016 | A suggestive framework by any bank while implementing any policy/project around AI should cover the following areas: Fairness, transparency, Accuracy, Consistency, Explainability, data privacy, robustness, accountability, monitoring and human oversight. Typical financial models rely on fixed rules and parameters. In contrast, AI models transform this process by learning the rules and adjusting their parameters iteratively. This adaptability, however, makes AI models like a "black box," challenging to decipher for audits and regulatory reviews. |
| 6 | Oskarsdóttir, Maria and Bravo, Cristian et al | 2018 | Models can be built to combine non-financial information to further improve individuals' credit mechanisms for loans. A range of socio-demographic and banking information can be coupled to format a score. |
| 7 | Fountaine, T. and McCarthy, B et al | 2019 | Banks need mentoring in implementing AI technology due to cultural and organizational barriers. There is an element of a leadership challenge in convincing employees towards usage of AI, and there would not be any predictive detrimental effect on their jobs. |

| | | | |
|---|---|---|---|
| 8 | Dumouchel, P | 2019 | For the successful integration of AI into a banking organization organisation, it is crucial that both leadership and employees comprehend, accepts and actively supports its direct and indirect contributions. Recognizing that humans and artificial intelligence are fundamentally different is important. |
| 9 | Richad, Richad and Vivensius V et al | 2019 | The behavioral intention to use a chatbot (for banking) was influenced by innovativeness, perceived usefulness, perceived ease of use, and attitude towards using the chatbot. |
| 10 | Bartlett, Robert and Morse, Adair et al | 2019 | Discrimination in lending can be checked to a large extent by the usage of AI. However, there are risks of discrimination increasing too. The issue of whether AI designed decision-making fosters or prevents impermissible discrimination is particularly critical in consumer lending (through banks and otherwise). This is due to the historical difficulties in eradicating discrimination in this type of loan and the vital role consumer lending plays in household financial stability. |
| 11 | Bazarbash, Majid | 2019 | One of the key strengths of AI in promoting financial inclusion is its ability to enable low-cost, automated evaluation of small borrowers who might otherwise be excluded from the traditional credit market. |
| 12 | Kaur, N. and Sahdev, S. L et al | 2020 | AI as a technology was initially used by banks to analyze, approve, and oversee customer loans. |
| 13 | Ris, Krunoslav and Stankovic, Zeljko et al | 2020 | Customers would rather use virtual assistants and Chatbots rather than go to a bank branch. AI powered Virtual Assistants and other applications enhance business process performance across all sectors, particularly in banking, by making operations faster, more reliable, and less reliant on human intervention. |
| 14 | Elegunde, Ayobami Folarin and Shotunde, Oladimeji Idris et al | 2020 | To a significant and justifiable degree, AI has a profound influence on business performance of banks. There was a positive correlation between AI and customer satisfaction. Achieving a competitive edge largely depends on how effectively we can leverage artificial intelligence in our banking operations. |
| 15 | Shambira, Leonard | 2020 | The main reasons for adopting AI in the banking sector include reducing costs, enhancing customer satisfaction, and overcoming barriers to AI adoption. The risks involve the lack of AI expertise among staff and the need to establish governance for ethical AI, data privacy, and other ethical concerns. |
| 16 | Mamela, Tebego Lucky and Sukedo, Nita et al | 2020 | The adoption of AI largely hinges on the possession of the requisite skills by the workforce. Consequently, banks need to upskill their workforce to effectively embrace AI-driven technologies and remain relevant in the future. |

| | | | |
|---|---|---|---|
| 17 | Wamba-Taguimdje, Serge-Lopez and Wamba, Samuel Fosso et al | 2020 | Benefits that accrue to banks upon utilization AI techniques: automation of transactions increasing capacities, revenue growth post application, reduction is time delays in activating mobile apps, reduction in customer service cost, measurable and improved customer experience, increased customer acquisition and fostering of innovation. |
| 18 | Ghandour, Ahmad | 2021 | AI offers banks a competitive edge, but realizing its full potential requires careful consideration of potential drawbacks. Key challenges include privacy breaches, job displacement, ensuring data quality and availability, and aligning AI strategies with overall business goals. |
| 19 | Alta, Monoka and Ibolya, Vizeli | 2021 | The chatbot users could there be distinctly bifurcated into 3 buckets, namely: innovators (highly educated and employed in business), late majority (educated and working in the services sector) and laggards (educated & middle-aged working in the business sector). |
| 20 | Haefner, Naomi and Wincent Joakim et al | 2021 | Artificial intelligence transforms organizations and streamlines innovation management within them, and it is an influential factor for management to reassess the innovation process at an Institutional level. |
| 21 | Raghavan, Suresh and Pai, Ramesh | 2021 | Banks have reaped significant benefits from omnichannel and digital marketing strategies and AI in delivering a seamless customer experience. NPS scores from customers have significantly improved with the usage of AI. |
| 22 | Fares, O. H. and Butt, I et al | 2022 | Research in human language analysis, image & voice recognition, deep learning and analysis of human emotions helped banks adopt AI. |
| 23 | Naik, B. and Mehta, A et al | 2022 | AI-based fraud detection methods are significantly more advanced than conventional methods currently used by banks. These were very useful for the banks. |
| 24 | Truby, J. and Brown, R et al | 2022 | Regulators will have an important role to play in the acceptance of AI among banks. They have to be the guardian instead of just being the monitor. It is also their responsibility to ensure collaboration among all banks. |
| 25 | Dhashanamoorthy, Balaji | 2023 | In addition to enhancing customer service, AI substantially increases operational efficiency through the automation of repetitive tasks, such as data entry and transaction processing. |
| 26 | Farishy, Reza | 2023 | With the improvement of technology, AI will certainly assume a more significant role in the banking sector, enabling them to enhance risk management, elevate customer experience and improve profitability. |
| 27 | Kamalnath, Vishnu and Lerner, Larry et al | 2023 | Every AI model designed by banks also contributes to the ESG index as carbon emissions are increased. This may derail the ESG commitments of the banking companies. |
| 28 | Atadoga, Akoh and Obi, Oguga Chimezie et al | 2024 | AI is playing a crucial role in helping banks comply with regulatory requirements by automating compliance processes and conducting real-time transaction monitoring. |

| | | | |
|---|---|---|---|
| 29 | Ridzuan, Nurhadhinah Nadiah and Masri, Masairol et al | 2024 | Implementing an AI governance framework requires rules and guidelines to address issues like data privacy & security, bias & fairness, accountability & transparency and skill gaps. |
| 30 | Oke, Oluwafemi Ayotunde and Cavus, Nadire | 2024 | To understand the future of banking, research must explore how new technologies will transform bank branches and applications. This research should also examine how clients engage with cutting-edge bank channels and financial services through physical and virtual interactions. |
| 31 | Rao, M. Rajeshwar | 2025 | A crucial but frequently neglected obstacle to the responsible implementation of AI in finance is the scarcity of professionals capable of interpreting and supervising AI models. Should financial institutions be deficient in staff possessing the requisite expertise in AI, data science, and regulatory compliance, the issue of model explainability is significantly compounded, rendering AI-driven decisions even more inscrutable. |

**3 Methodology & Data**

Scopus, published by Elsevier Co., is a database for abstracts and indexing that includes links to full-text articles. Scopus database has emerged to be a reliable database for research. It is useful for academic research for searching articles similar to one's area of research, and it has a comprehensive collection of knowledge on every important area of research collated over the years. The collation is in the form of conference publications, academic articles, review articles, books, book reviews, editorials, book chapters and book series (Guz, A N and Rushchitsky, J J, 2009).

VOSviewer is a popular bibliometric tool frequently utilized to construct bibliometric networks involving various entities, such as authors and organizations. It employs diverse network analysis techniques, including co-authorship, co-citation, term co-occurrence, and bibliographic coupling (Van Eck & Waltman, 2009). In this study, we used the mentioned analysis extensively and played with the various aspects, namely authors, journals, articles, countries and keywords. The maps obtained from this software include nodes and edges, indicating the keywords (nodes) and their relationship (edges). Interested readers should refer to the VOSviewer manual for more details about these different analyses.

VOSviewer is a software program used to create network visualizations based on frequently used terms within a specific field. Highly favored in bibliometric analysis, it effectively highlights influential authors by placing them centrally in a visual map, while less influential authors are positioned on the periphery, clearly distinguishing their impact. Furthermore, VOSviewer provides a more precise and insightful data representation than other mapping methods.(Van Eck, Nees Jan and Waltman, Ludo, 2009).

Unlike SPSS and Pajek, which are also extensively opted by researchers for conducting bibliometric mapping, VOSviewer prioritizes the visual representation of bibliometric data. Its functionalities are especially useful for presenting extensive bibliometric maps in a way that is both clear and easy to understand. VOSviewer strongly emphasizes the graphical visualization of bibliometric maps (Van Eck, Nees Jan and Waltman, Ludo, 2009).

The development of research that eventually gave rise to the specialized area of bibliometrics is traced from its origins up to 1969 when the term "bibliometrics" was first introduced as an alternative to "statistical

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bibliography." (Broadus, Robert, 1987). Allan Pritchard first introduced the term "Bibliometrics" in 1968, but it gained greater popularity during the 1980s. He defined the term as a novel discipline that employed quantitative methods to examine scientific communication by quantifying and analyzing various facets of written works.

Nicholas and Ritchie (1978), in their book entitled "Literature and Bibliometrics", stated that bibliometrics "…provide information about the structure of Knowledge and how it is communicated…". Sengupta (1990) defined this term as the "organization, classification and quantitative evolution of publication patterns of all macro and micro communications along their authorship by mathematical and statistical calculus".

The increasing volume of publications presents challenges in analyzing these studies through traditional methods (Olson, David and Delen, Dursun (2008)). For example, identifying the research topics favored by authors and understanding how trends in these areas have evolved can be complicated. The significant increase in data and publications on each topic has led to exploring newer methods for managing it. In this regard, some researchers have started using systematic reviews and bibliometric analysis to identify trends and research topics within a particular field (Nie, Binling and Sun, Shouqian (2016)).A core element of bibliometric analysis involves evaluating the connections between different bibliometric components, such as journals, documents, authors, or keywords. These relatedness measures are employed for various purposes, including creating maps or visual representations that illustrate the connections among all items within the dataset (Klavans, Richard and Boyack, Kevin (2004)).

### 3.1 Need for the study

We found very few papers on the bibliometric analysis of AIB. Technology and the applications of AI are increasing with each passing day and thus there is an increment in the number of publications. Thus, it is essential for future researchers to have a documented list of journals and articles. Rules and regulations are also frequently changing in the BFSI space, and hence, there is a growing number of research papers and publications; thus, the necessity of synthesis of them.

### 3.2 Dataset

For the work, the Scopus database was searched on 19-Feb-2025. The steps involved in choosing the set of articles for review are as follows

| | | *Include* | *Exclude* | *Net* |
|---|---|---|---|---|
| Step 1 | Scopus search using the following keywords: (artificial AND intelligence AND bank*) or (ai AND bank*) | 5479 | | 5479 |
| Step 2 | Filter & limit to Publication years from 2015 to 2025 | 4249 | | 4249 |
| Step 3 | Filter & limit "Document type" to "Article", "Book" and "Book Chapter" | 2205 | | |
| Step 4 | Filter & limit to "Final" in "Publication Stage" | 2134 | | 2134 |
| Step 5 | Filter & limit to "English" in "Language" | 2066 | | 2066 |
| Step 6 | Filter & limit "Source type" to "Journal", "Book" and "Book Series" | 2055 | | 2055 |

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| | | | | |
|---|---|---|---|---|
| Step 7 | Filter and exclude articles with the following keywords: Credit Risks (14), Language (14), Trust (14), Metabolism (16), Databases, Protein (17), Physiology (17), Protin Conformation (18), Protein Database (18), Amino Acid Sequence (19), Protein (19), Protein Structure (20), United States (20), Random forecasts (21), Random forecast (24), Animal (25), Animals (25), China 926), Chemistry (34), Protein data bank (37), Male (81), Female (77) | | 256 | 1799 |
| Step 8 | Filter and manually exclude article(s) with missing author names | | 1 | 1798 |
| Step 9 | Filter and manually exclude article(s) with missing publisher name | | 1 | 1797 |
| Step 10 | Filter and manually exclude article(s) with missing abstracts | | 13 | 1784 |

The copy of the exact query is as follows: ((TITLE-ABS-KEY(artificial intelligence and bank*) OR TITLE-ABS-KEY(ai and bank*)) AND PUBYEAR > 2014 AND PUBYEAR< 2026 AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "bk") OR LIMIT-TO (DOCTYPE, "ch" )) AND (LIMIT-TO (PUBSTAGE, "final")) AND (LIMIT-TO ( LANGUAGE, "English")) AND ( LIMIT-TO ( SRCTYPE, "j" ) OR LIMIT-TO ( SRCTYPE, "b" ) OR LIMIT-TO ( SRCTYPE, "k" )) AND (EXCLUDE (EXACTKEYWORD, "Credit Risks") OR EXCLUDE ( EXACTKEYWORD, "Language") OR EXCLUDE ( EXACTKEYWORD, "Trust" ) OR EXCLUDE ( EXACTKEYWORD, "Metabolism" ) OR EXCLUDE ( EXACTKEYWORD, "Databases, Protein" ) OR EXCLUDE ( EXACTKEYWORD, "Physiology" ) OR EXCLUDE (EXACTKEYWORD, "Protein Conformation") OR EXCLUDE ( EXACTKEYWORD, "Protein Database") OR EXCLUDE ( EXACTKEYWORD, "Amino Acid Sequence" ) OR EXCLUDE ( EXACTKEYWORD, "Protein" ) OR EXCLUDE ( EXACTKEYWORD, "Protein Structure" ) OR EXCLUDE ( EXACTKEYWORD, "United States" ) OR EXCLUDE ( EXACTKEYWORD, "Random Forests" ) OR EXCLUDE ( EXACTKEYWORD, "Random Forest" ) OR EXCLUDE ( EXACTKEYWORD, "Animals" ) OR EXCLUDE ( EXACTKEYWORD, "Animal" ) OR EXCLUDE ( EXACTKEYWORD, "China" ) OR EXCLUDE ( EXACTKEYWORD, "Chemistry" ) OR EXCLUDE ( EXACTKEYWORD, "Protein Data Bank" ) OR EXCLUDE ( EXACTKEYWORD, "Male" ) OR EXCLUDE ( EXACTKEYWORD, "Female" ) ) )

All the analysis in this paper would be basis these 1784 research items. The categories are as follows

| ***Publication types*** | ***Number*** |
|---|---|
| Article | 1265 |
| Book Chapters | 424 |
| Book | 95 |
| ***Total*** | ***1784*** |

*Table 1: Types of publications covered for the bibliometric analysis*

*Source: Collated by authors basis data from Scopus*

**4 Analysis and interpretations based on data from Scopus and VosViewer**

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### 4.1Publications trends

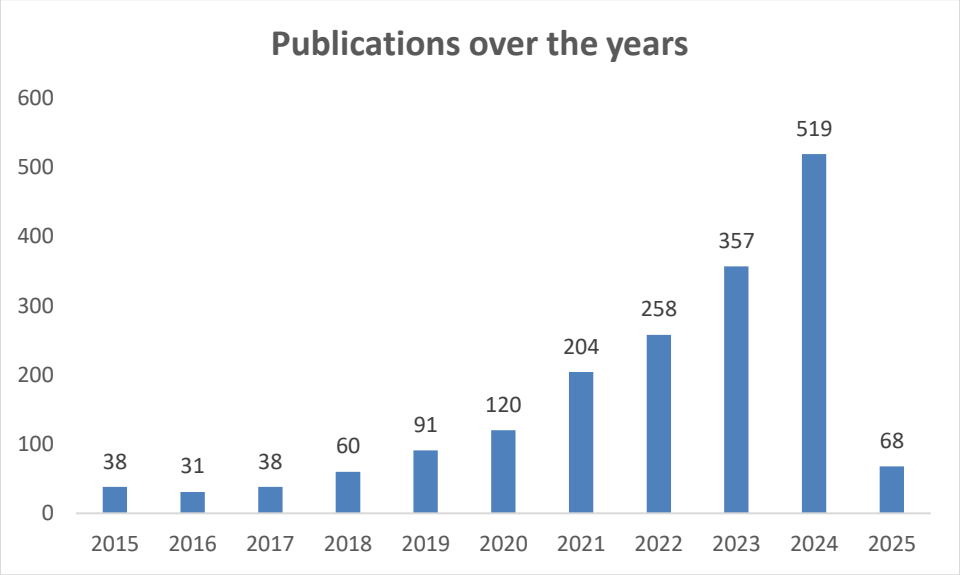


*Fig 2: Publication over the years*

*Source: Compiled by authors based on data from Scopus*

It is clearly observed that there has been a distinct trend in the improvement of a number of articles being published in the space of AIB. This can be attributed to the fact that banking is seeing many and rapid changes, because of which there is interest by researchers too.

### 4.2 Basis article publications

The details of journals with the maximum published articles on AIB are as follows

| ***Journal name*** | ***# articles*** | ***ISSN*** | ***Publisher*** |
|---|---|---|---|
| IEEE Access | 32 | 2169-3536 | Institute of Electrical and Electronics Engineers Inc. |
| Expert Systems with Applications | 21 | 0957-4174 | Elsevier Ltd |
| Sustainability (Switzerland) | 18 | 2071-1050 | Multidisciplinary Digital Publishing Institute (MDPI) |
| Studies in Systems, Decision and Control | 17 | 2198-4182 | Springer Science and Business Media Deutschland GmbH |
| Journal of Theoretical and Applied Information Technology | 13 | 1992-8645 | Little Lion Scientific |
| Studies in Computational Intelligence | 13 | 1860-949X | Springer Science and Business Media Deutschland GmbH |
| International Journal of Bank Marketing | 12 | 265-2323 | Emerald Publishing |
| International Journal of Intelligent Systems and Applications in Engineering | 12 | 2147-6799 | Ismail Saritas |

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| | | | |
|---|---|---|---|
| Applied Sciences (Switzerland) | 11 | 2076-3417 | Multidisciplinary Digital Publishing Institute (MDPI) |
| Journal of Risk and Financial Management | 11 | 1911-8074 | Multidisciplinary Digital Publishing Institute (MDPI) |
| Lecture Notes in Networks and Systems | 10 | 2367-3370 | Springer Science and Business Media Deutschland GmbH |

*Table 2: Best journals in terms of articles published on AIB*

*Source: Authors basis data from Scopus*

The journals have been stacked in descending order of number of publications on the subject of AIB. IEEE Access has the largest number of papers.

**4.3 Publication basis countries**

| ***Country*** | ***# articles*** |
|---|---|
| India | 438 |
| United States | 214 |
| China | 149 |
| United Kingdom | 134 |
| Saudi Arabia | 86 |
| Italy | 66 |
| Germany | 60 |
| Malaysia | 60 |
| Spain | 58 |
| Australia | 57 |

*Table 3: Country-wise publications*

*Source: Authors basis data from Scopus*

The countries have been stacked in descending order of papers published on the theme of AIB. research is happening substantially in developing countries. India is distinctly ahead of all countries. On an overall basis, it is clear that the large and developed countries are contributing largely to the literature on AIB.

**4.4 Basis journal citations**

| ***Journal*** | ***Citations*** | ***ISSN*** | ***Publisher*** |
|---|---|---|---|
| Expert Systems with Applications | 1850 | 0957-4174 | Elsevier Ltd |
| International Journal of Information Management | 1718 | 0268-4012 | Elsevier Ltd |
| JMIR Medical Education | 1095 | 2369-3762 | JMIR Publications Inc. |
| IEEE Access | 699 | 2169-3536 | Institute of Electrical and Electronics Engineers Inc. |
| Sustainability (Switzerland) | 503 | 2071-1050 | Multidisciplinary Digital Publishing Institute (MDPI) |
| International Journal of Bank Marketing | 475 | 0265-2323 | Emerald Publishing |
| Industrial Management and Data Systems | 422 | 0263-5577 | Emerald Publishing |

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|---|---|---|---|
| Journal of Research in Interactive Marketing | 379 | 2040-7122 | Emerald Group Holdings Ltd. |
| European Journal of Operational Research | 359 | 0377-2217 | Elsevier B.V. |
| International Journal of Precision Engineering and Manufacturing - Green Technology | 316 | 2288-6206 | Korean Society for Precision Engineering |

*Table 4: Best journals in terms of citations on articles on AIB*

*Source: Authors basis data from Scopus*

t is to be noted here that these top 10 journals constitute about 30.95 per cent of the total citations. "Expert Systems with Applications", "International Journal of Information Management", and "JMIR Medical Education" are the only journals which have citations of more than 1000. Based on the number of articles (Table 2) and citations (Table 4), it comes out that the following journals are the most important journals in terms of good research related to AIB:

IEEE Access

Expert Systems with Applications

Sustainability (Switzerland)

International Journal of Bank Marketing

**4.5 Basis Article Citations**

| *Article* | *Authors* | *Citations* | *Year* | *Journal Name* | *ISSN* |
|---|---|---|---|---|---|
| "So what if ChatGPT wrote it?" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy | Dwivedi Y.K. and Kshetri N et al | 1718 | 2023 | International Journal of Information Management | 0268-4012 |
| How Does ChatGPT Perform on the United States Medical Licensing Examination? The Implications of Large Language Models for Medical Education and Knowledge Assessment | Gilson A. and Safranek C.W et al | 971 | 2023 | JMIR Medical Education | 2369-3762 |
| Machine learning based phishing detection from URLs | Sahingoz O.K. and Buber E et al | 482 | 2019 | Expert Systems with Applications | 0957-4174 |
| Artificial Intelligence in FinTech: understanding robo-advisors adoption among customers | Belanche D and Casaló L.V et al | 411 | 2019 | Industrial Management and Data Systems | 0263-5577 |
| Optimization of hybrid renewable energy power systems: A review | Bhandari B. and Lee K et al | 316 | 2015 | International Journal of Precision Engineering and | 2288-6206 |

| | | | | | |
|---|---|---|---|---|---|
| | | | | Manufacturing - Green Technology | |
| Ensemble boosted trees with synthetic features generation in application to bankruptcy prediction | Zięba M. and Tomczak S.K et al | 289 | 2016 | Expert Systems with Applications | 0957-4174 |
| Business intelligence in banking: A literature analysis from 2002 to 2013 using text mining and latent Dirichlet allocation | Moro S. and Cortez P et al | 266 | 2015 | Expert Systems with Applications | 0957-4174 |
| Financial ratios and corporate governance indicators in bankruptcy prediction: A comprehensive study | Liang D and Lu C.-C et al | 254 | 2016 | European Journal of Operational Research | 0377-2217 |
| A historical perspective of explainable Artificial Intelligence | Confalonieri R. and Coba L et al | 227 | 2021 | Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery | 1942-4787 |
| CatBoost model and artificial intelligence techniques for corporate failure prediction | Jabeur S.B. and Gharib C et al | 223 | 2021 | Technological Forecasting and Social Change | 0040-1625 |

*Table 5: Best articles in terms of citations on articles on AIB*

*Source: Authors basis data from Scopus*

The articles have been selected basis number of citations of each. They have been sorted in decreasing order of number of citations. We have 3 articles with each having atleast 500 citations. We observe that the article titled““So what if ChatGPT wrote it?” Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy” has the largest number of citations. It tops the list and is the only article with citations of over 1718.

**4.6 Basis Productive Authors**

The details with respect to the best productive authors are as follows

| ***Authors*** | ***# of articles*** |
|---|---|
| Hamdan, Allam | 5 |
| Khang, Alex | 5 |
| Grima, Simon | 4 |
| Sood, Kiran | 4 |
| Srivastava, Ankita | 4 |
| Jindal, Priya | 4 |

*Table 6: Productive authors basis number of articles on AIB*

*Source: Authors basis data from Scopus*

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These authors were chosen based on their authorship contributions. It's worth noting that each of them has experience both as primary authors and co-authors in numerous papers where they are listed as authors. Allam Hamdan and Alex Khang have the largest papers in the area of AIB.

### 4.7 Basis Productive Co-Authors

The details of paper publications with multiple authors are as follows

| ***Authors*** | ***# articles*** |
|---|---|
| Kanimozhi V.; Jacob T.P. | 3 |
| Alzeaideen K. | 2 |
| Ceron B.M.; Monge M. | 2 |
| Dagur A.; Singh K.; Mehra P.S.; Shukla D.K. | 2 |
| du Jardin P. | 2 |
| Fasnacht D. | 2 |
| Hageback N. | 2 |
| Kadhim Y.A.; Al Ani S.A.M. | 2 |
| Königstorfer F.; Thalmann S. | 2 |
| Kumar A.; Srivastava A.; Gupta P.K. | 2 |
| Madir J. | 2 |
| Maree C.; Omlin C.W. | 2 |
| Martín S. | 2 |
| Mhlanga D. | 2 |
| Newton P.F. | 2 |
| Nwogugu M.I.C. | 2 |
| Piotrowski D. | 2 |
| Rezk E.; Eltorki M.; El-Dakhakhni W. | 2 |
| Teng H.-W.; Lee M. | 2 |
| Vetrivel S.C.; Mohanasundaram T.; Saravanan T.P.; Maheswari R. | 2 |
| Vučinić M.; Luburić R. | 2 |
| Woodford M. | 2 |

*Table 7: Productive co-authors basis number of articles on AIB*

*Source: Authors basis data from Scopus*

These authors were chosen based on their co-authorship. It is evident that there are few co-authors involved in this subject, suggesting they likely collaborate with various authors. The data has been organized according to the number of authors. Kanimozhi V. and Jacob T.P. have published 3 papers. There are 21 combinations of authors who have 2 papers each.

### 4.8 Country coupled bibliometric analysis

We used the minimum number of documents for a country as 5 and arrived at 68 countries. The screenshot of Vosviewer result is appended below.

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| *Countries* | *Documents* | *Citations* | *Total link strength* | *Citations per document* |
|---|---|---|---|---|
| India | 434 | 4654 | 6696.67 | 10.72 |
| United States | 209 | 6146 | 6092.22 | 29.41 |
| United Kingdom | 133 | 4048 | 4925.51 | 30.43 |
| China | 148 | 1656 | 3645.58 | 11.19 |
| Saudi Arabia | 86 | 2789 | 3321.54 | 32.43 |
| Malaysia | 60 | 804 | 2944.01 | 13.4 |
| Australia | 56 | 3119 | 2710.55 | 55.69 |
| Italy | 66 | 3149 | 2419.74 | 47.71 |
| France | 42 | 3025 | 2302.56 | 72.02 |
| Germany | 60 | 2593 | 2302.46 | 43.21 |

*Table 8: Country couple data basis total link strength*

*Source: Vosviewer results basis data from Scopus*

The countries have been sorted basis the total link strength. France and Australia have the highest average citations per article. China and India have large number of articles but their citations strength is low in comparison to all other countries in Table 8.

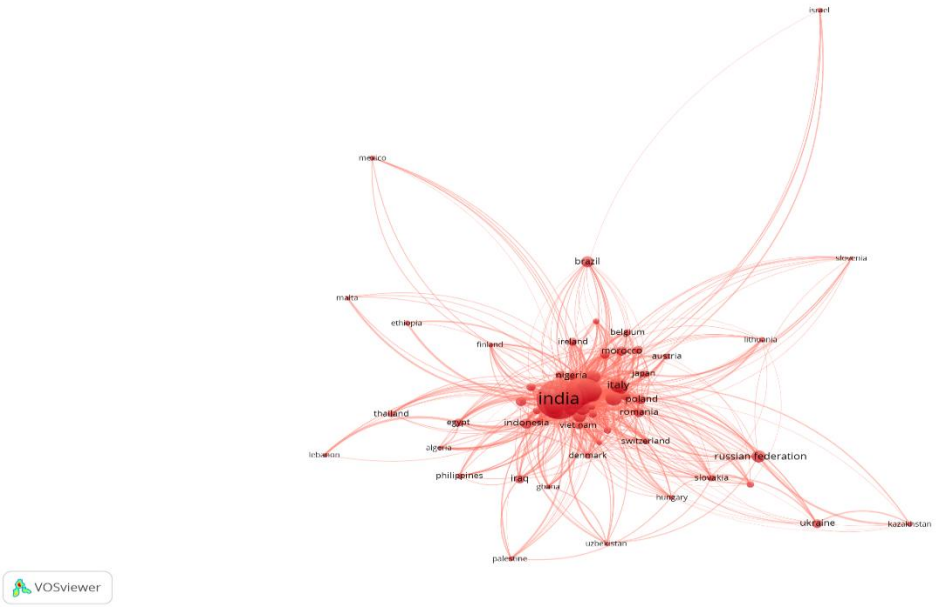


*Fig 3: Country couple data basis total link strength*

*Source: Vosviewer basis data from Scopus*

**4.9 Co-occurrence of author keywords**

We used the minimum number of co-occurrence of author keywords as 10, and we arrived at 66 keywords out of 4905, which meet the threshold. The screenshot of Vosviewer result is appended below.

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| *Keyword* | *Occurrences* | *Total link strength* |
|---|---|---|
| artificial intelligence | 537 | 381 |
| machine learning | 204 | 169 |
| fintech | 104 | 90 |
| banking | 70 | 67 |
| deep learning | 84 | 66 |
| big data | 51 | 46 |
| block chain | 46 | 40 |
| ai | 44 | 35 |
| artificial intelligence (ai) | 57 | 34 |
| finance | 27 | 25 |
| banking industry | 24 | 23 |
| digital transformation | 27 | 23 |

*Table 9: Author keywords basis total strength*

*Source: Vosviewer results basis data from Scopus*

"artificial intelligence" and "machine learning" have the highest link strengths. It is evident that the keywords are primarily technological but they are on the fringes of management basis their applications. AI, ML or Block Chain technologies; there are primarily technological terms but the theories around these are woven around applications in utilization areas like banking.

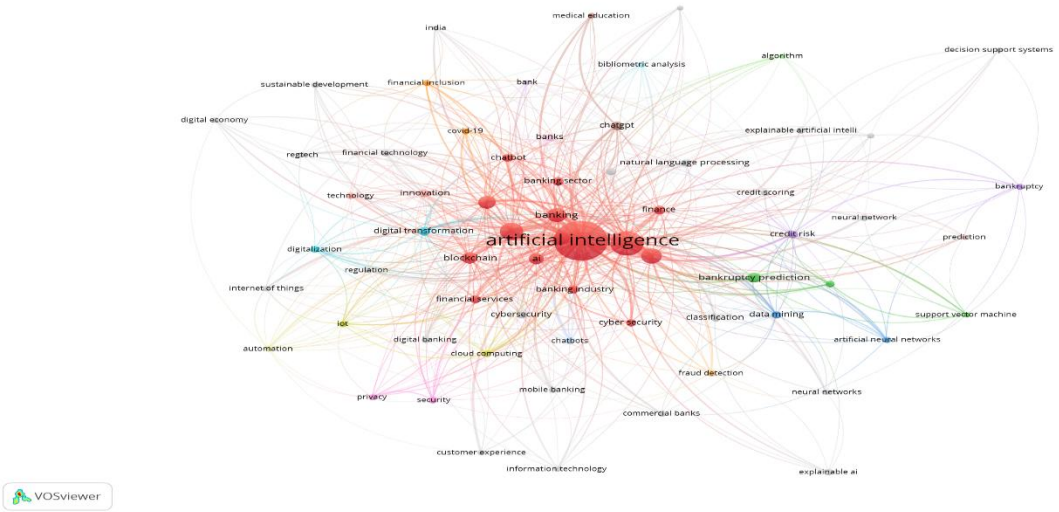


*Fig 4: Cooccurrence of author's keywords*

*Source: Vosviewer basis data from Scopus*

We can see that "artificial intelligence" literally overshadows every other keyword.Besides these, the top keywords were: credit risk, natural language processing, financial technology, risk management, chatgpt, digital transformation, regulation, data mining, regtech

### 4.10 Co-occurrence of index keywords

We used the minimum number of co-occurrence of index keywords as 10, and we arrived at 94 keywords

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out of 5663, which meet the threshold. The screenshot of Vosviewer result is appended below.

| ***Keyword*** | ***Occurrences*** | ***Total link strength*** |
|---|---|---|
| artificial intelligence | 309 | 1040 |
| learning systems | 88 | 422 |
| forecasting | 79 | 363 |
| machine learning | 78 | 326 |
| human | 64 | 315 |
| finance | 67 | 312 |
| decision making | 66 | 298 |
| article | 58 | 278 |
| deep learning | 55 | 255 |
| humans | 46 | 241 |

*Table 10: Author keywords basis total strength*

*Source: Vosviewer results basis data from Scopus*

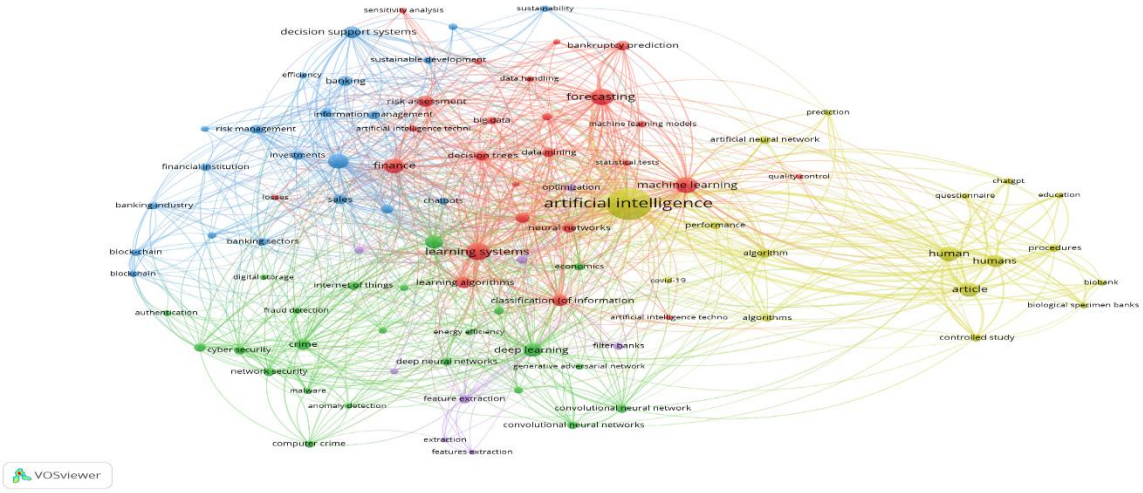


*Fig 5: Cooccurence of index keywords*

*Source: Vosviewer basis data from Scopus*

Here, we also see that "artificial intelligence" literally overshadows every other keyword. Besides these, the top keywords were learning algorithms (and algorithm), risk assessment (and risk management), bankruptcy prediction, cyber security (cybersecurity), neural network, deep neural network, fraud detection, and biological specimen banks.

It is clear from the keyword (author and index) analysis and observation that AI is being used for the following broad areas in banks: fraud detection, risk management, credit analysis, neural language processing, compliance, algorithm trading, financial forecasts, underwriting, behavioral finance, chatbot, digital automation.

### 4.11 Co-authorship Countries Analysis

We used the minimum number of documents of a country as 10 and the minimum number of citations of a country as 5. Accordingly, we obtained 53 countries out of a total of 126 countries. The country-wise

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analysis basis strengths and the screenshot of Vosviewer result is appended below.

| *Countries* | *Documents* | *Citations* | *Total link strength* |
|---|---|---|---|
| India | 434 | 4654 | 106 |
| United States | 209 | 6146 | 104 |
| United Kingdom | 133 | 4048 | 76 |
| Saudi Arabia | 86 | 2789 | 62 |
| China | 148 | 1656 | 58 |
| Malaysia | 60 | 804 | 44 |
| Italy | 66 | 3149 | 39 |
| Australia | 56 | 3119 | 34 |
| Germany | 60 | 2593 | 34 |
| France | 42 | 3025 | 33 |

*Table 11: Country wise co-authorship analysis*

*Source: Vosviewer results basis data from Scopus*

The countries have been sorted in the descending order of total link strengths.

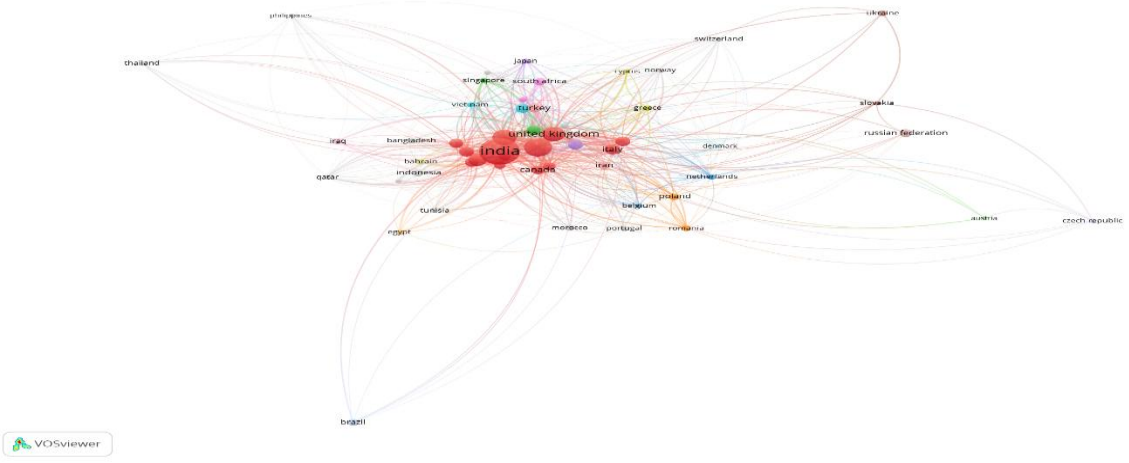


*Fig 6: Co-authorship-countries analysis*

*Source: Vosviewer basis data from Scopus*

India clearly overshadows other countries as is evident from the image. This is possibly because of the large number of papers and the second best being much lower.

**4.12 Funding**

A total of 417 projects have been funded by 412 funding agencies. The large funding agencies are as follows:

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| ***Funding agencies*** | ***# projects*** |
|---|---|
| Natural Sciences and Engineering Research Council of Canada | 3 |
| Department of Civil Engineering; National Institute of Technology Rourkela, India | 2 |
| Johannes Kepler University, Linz, Austria | 2 |
| Ministry of Science and Technology, Taiwan | 2 |

*Table 12: Top funding agencies*

*Source: Authors basis data from Scopus*

**5 Limitations and Directions for Future Research**

The research outcome is highly dependent on the papers selected and acquired from the Scopus database. It is possible that certain pertinent publications, particularly those in non-indexed or specialized journals, were not included in the analysis, thereby increasing the chances of missing out on some good & critical research papers of some serious researchers.

Although the search terms employed in the study are comprehensive and encompass several expressions relating to "AIB", it is important to acknowledge that researchers and academicians may have used alternate terminologies to indicate or represent the idea of AI. We have other alibis like Machine Learning. Some banking searches may be there in the BFSI area, too. Besides, we have excluded 20 keywords; literature or research documents may also cover those keywords.

Limiting the search to only journal articles, books, and book series may lead to overlooking important insights in other publication formats, such as conference proceedings or reports.

The study exclusively examined the articles published in English; hence, it is possible to have missed a few good articles in other languages.

We have taken articles, books and book chapters from 2015 to 2025; the research done in this paper excludes the previous research documents.

While bibliometric analysis provides a systematic approach for evaluating research output and impact, it falls short of fully capturing the qualitative influence of these research. For a simple explanation as an example, citation counts measure acceptance and popularity but may not accurately convey how research findings are utilized in practical settings like mentoring or policymaking by planners. This approach might only reflect academic interests rather than the significance of the research in addressing real-world problems.

It is useful to mention here that research is inherently interdisciplinary, but bibliometric analysis tends to be centered around one discipline, which may hinder the emergence of true output. There is an expected high level of innovation in inter-disciplinary publications (Bromham, Lindell and Dinnage, Russell et al., 2016).

It is recommended that future researchers do the analysis utilizing metadata from additional relevant sources, such as the Web of Science and the like, to perform a comparative analysis.

Future researchers (new to this area and wanting to improve further) can take the help of this paper to find the best journals, articles and authors. It can help them immensely. Authors and researchers specializing in structured literature review formats can take note of the cited articles. Besides, researchers may plan to link this topic with other disciplines like economics, innovation, governance, legalities, et al.

**6 Future directions**

There has to be proper research on the acceptance of and perception by employees and customers towards the application of AI in transactions. The evaluations should check the convergence of both i.e. increment of ease & comfort by employees and acceptance by the employees. There have been research, but intrinsic & extensive population should be used.

AI must also be an integral part of stakeholder management. Banks must clearly explain the usage of AI transparently to all stakeholders and seek guidance and feedback. Banks may take the lead in enhancing AI applications for the smaller vendors and smaller companies associated with it. This can enhance a good competitive ecosystem. Mutual learning and sharing of feedback may develop a competitive edge for the bank.

AI models rely heavily on data for learning, especially in scenarios where the dataset size is significantly larger than those used in traditional credit scoring methods. This situation sees the possible emergence of risk that noisy or irrelevant information could influence the outcomes of credit analysis. This could lead to the exclusion of creditworthy applicants from accessing financial services. Analysts should try to identify and mitigate any biases in the sample data.

**7 Contribution of authors**

Dr Sukhamaya Swain: Scopus searches and VosViewer analysis, writing – original draft

Dr Siddhartha Bhattacharya: Conceptualization, Writing - review & editing

Dr Zenzile Khetsha: Final review

**8 Discussion and Conclusion**

A crucial aspect of the application of AI in banking is the assurance of academic linkage. We always knew that academic theories (and concepts) like game theory, smart contracts, efficient market hypothesis, concepts of behavioural finance, algorithm-based trading and many more could make the banking system better. With the advent of AI, it will now be possible to ensure the benefits of as many theories to be ingrained into mainstream banking.When combined with other crucial digital technologies such as big data analytics, cloud computing, IoT, robotics, and additive manufacturing, AI is anticipated to revolutionize production and manufacturing like how the steam engine and conveyor belt assembly lines transformed these industries decades ago.

This paper clearly showcases the growing interest in this area. Needless to say, AI's growing usage in banking is reflected in the voluminous research in the space. Banks are aiming at using AI for the improvement of customer experience and also to improve lending guards. Data Analytics remains an area where a lot of work is already happening, and with the advent of AI, it will be further improved. AIB will ensure the improvement of convergence concepts like embedded finance. Governance (internal as well by regulators) will see improvement in the days to come.

The key focus areas w.r.t. practical AI usage in banking today is in 3 areas: customer support, fraud detection & protection and lending & risk management. Another aspect which needs focus is the growing expenditure on account of AI. Some of the expenditure is attributed to the herd mentality of all banks going for it, and the other is the wider expectation of getting huge benefits.

The growing use of AI, however, comes with its own challenges. The challenges are similar to the typical financial risks already in the banking industry. Thus, the threats can be grouped according to the standard division, i.e., risk management, governance, and consumer protection.These encompass individual financial risks like credit risk, insurance risk, model risk, operational risks and reputational risks, conduct & consumer protection risks, and macro-prudential and financial stability risks. To address these, policymakers build guard rails around governance, data management, third-party regulations and business models of engagement.

Banks have a recorded history of successfully implementing new technologies while maintaining operational safety and compliance with regulatory standards. In fact, the banking industry has possibly the highest adoption of technology. Over the years, they have embraced digital transformation, become online, adopted mobile services, automated many customer & internal processes, migrated infrastructure to the cloud and integrated various technologies,

including AI. Despite the new risks introduced or exacerbated by these advancements, banking organizations have effectively managed these challenges and adapted to better serve their customers. Despite all the challenges and the possible risks, the banking industry should be able to manage the usage of AI well.

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