



“Role Of Artificial Intelligence In Banking Sector: A Systematic Literature Review”

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ABSTRACT

The primary goal of the research is to integrate particular evidence about the general application of artificial intelligence in the banking industry through a structurally organized review. This well-organized overview focuses on artificial intelligence in the banking industry. There are numerous chances for banks to implement the aforementioned technology, which improves the calibre of services offered to the banks' diverse stakeholders. There are obstacles to overcome while implementing the aforementioned technology, such as banks' reluctance to make the decision to adopt it. It can be divided into several sections: the first figure explains the research methodology and sample selection technique that was used; the first table covers the research work review by country; the second table covers publications by year; the third table covers citations by year; the fourth table covers citations by country; the fifth table covers the research methodology that was modified by earlier research works; the sixth table covers the number of publications based on the data collection method that was used; the seventh table focuses on the summary of review; the eighth table discusses opportunities; the ninth table focuses on challenges; the tenth table covers Applications; and the final table describes Artificial Intelligence Implementation in Banking Sector. The primary source of prior study on this subject is the Google Scholar databases. The aforementioned earlier studies were both exploratory and descriptive in nature. When the literature of the prior research works was finalized for review, 2,97,000 were found, of which 17,500 were from 2019 to 2023. Of these, 17449 were deemed irrelevant, and two articles lacked full text were among them. Ultimately, 47 research works were selected for this review article.

Key words – Artificial intelligence (AI), banking, technology, opportunities, challenges.

Introduction of Artificial Intelligence in Banking Sector

The banking industry has reaped tremendous benefits from artificial intelligence (AI). The delivery of banking services has been completely transformed by the use of AI-powered devices and web apps, which offer ease, tailored experiences, and improved customer support [54]. Additionally, AI technologies have enhanced operational effectiveness, promoted financial inclusion, and helped detect and prevent fraud [3]. Banks in India are using AI to help them transition from traditional to digital banking procedures [13]. Numerous financial services, such as investment management, risk assessment, fraud detection, and customer support, already heavily rely on AI [23]. But as AI becomes more widely used, it also presents additional difficulties, like worries about data security and privacy, the openness and explicability of AI choices, and the possibility of job displacement [12].

Literature Review

In the banking industry, artificial intelligence (AI) and machine learning (ML) have been thoroughly researched. Researchers have offered definitions for regulatory purposes that permit explicit classification of methodologies, and they have compared scientific and regulatory approaches to defining AI and ML [13]. The

application of AI in insurance, financial controlling, and the financial industry has been studied, with a focus on the benefits and drawbacks of doing so [4]. increased operational efficiency, financial inclusion, fraud detection and prevention, and increased customer service are some of the banking industry's advantages from AI [54]. It has also been investigated how AI is being used and advanced in the Indian banking and financial services industry [12]. Virtual assistants and contemporary banking trends are two important areas where AI has the potential to improve banking procedures [3].

Research Gap

The banking industry has shown a rising interest in the application of artificial intelligence (AI), with a focus on improving client experiences and addressing issues with trust, privacy, security, and emotional connections [69]. The literature draws attention to knowledge gaps regarding the causes of people's unfavorable attitudes toward AI chatbots as well as strategies for mitigating these sentiments [3]. Furthermore, the banking industry requires the creation of chatbot troubleshooting for technical objectives [20]. The application of artificial intelligence (AI) in the fields of banking, insurance, and financial controlling has also been studied, with an emphasis on the benefits and drawbacks of doing so [4]. Additionally, studies have looked at how AI can help banks gain market share, albeit they haven't shown that AI has a substantial moderating effect on the relationship between market share and innovative financial processes [45]. In general, further study is required to fully comprehend and handle the opportunities and difficulties associated with implementing AI in the banking industry.

Statement of the Problem:

The statement of artificial intelligence in the banking industry is a complex problem. First of all, as AI frequently works with vast volumes of sensitive and personal data, there are worries regarding data security and privacy [31]. Second, certain AI models have a "black box" quality that makes it challenging to comprehend the decision-making process, which presents a barrier to the transparency and explain ability of AI decisions [23]. Furthermore, ethical questions are brought up by the application of AI in banking due to the possibility of inaccurate credit rating, incorrect information sharing, miss-selling, and illicit trading [46]. Moreover, the use of AI in banking may result in the loss of jobs, especially in low-skilled jobs that can be automated [2]. It is advised to create committees to oversee ethical observance and verify human concerns about dangerous platforms in order to address these problems [3]. Overall, to fully utilize AI's benefits in the banking industry, careful consideration of data protection, transparency, ethics, and job displacement is required.

Objectives of the study:

1. To find the country-wise research publications dealt in studying the role of artificial intelligence in Banking sector.
2. To list the Year-Wise research publications dealt in studying the role of artificial intelligence in Banking sector.
3. To examine the Year wise Number of Citations dealt in studying the role of artificial intelligence in Banking sector.
4. To examine the Number of Country Wise Citations that are dealt in studying the role of artificial intelligence in Banking sector.
5. To study the method of research adopted in the research publications relating to the study of role of artificial intelligence in Banking sector.
6. To study the method of Data collection adopted in research publications relating to the study of role of artificial intelligence in Banking sector.
7. To summarise the objectives and findings in the research articles on the role of artificial intelligence in Banking sector.
8. To summarise the opportunities available in banking sector with the use of artificial intelligence.
9. To summarise the challenges faced by banking sector by the use of artificial intelligence in Banking sector.
10. To study the areas of applications of artificial intelligence in Banking sector.
11. To identify the banks that have implemented artificial intelligence in its sector.

Research Questions:

Research on artificial intelligence (AI) in the banking industry is multifaceted. Through the use of AI technology, the research seeks to improve the inventiveness, flexibility, and adaptability of businesses [3]. It offers definitions for regulatory reasons and contrasts scientific and regulatory approaches to characterizing artificial intelligence (AI) and machine learning (ML) [13]. AI is being used in financial services for customer service, fraud detection, risk assessment, and investment management [23]. The banking industry has benefited greatly from AI, which has increased operational efficiency, reduced fraud, and provided convenient, personalized experiences [54]. The study also looks at how AI might affect fraud detection and the decline in non-performing assets (NPA) in the Indian banking industry [29]. The influence, difficulties,

and viable approaches for applying AI to different banking procedures are the main topics of research issues in the field of artificial intelligence for the banking industry.

Therefore the study is taken to answer the following research questions:

1. How many country-wise research publications dealt in studying the role of artificial intelligence in Banking sector?
2. How many Year-Wise research publications dealt in studying the role of artificial intelligence in Banking sector?
3. How many Year wise Number of Citations that are dealt in studying the role of artificial intelligence in Banking sector.
4. How many Number of Country Wise Citations that are dealt in studying the role of artificial intelligence in Banking sector?
5. Which method of research is adopted in the research publications in studying the role of artificial intelligence in Banking sector?
6. Which method of Data collection is adopted in research publications in studying the role of artificial intelligence in Banking sector?
7. What are the objectives and outcomes of the research articles that dealt in the study of role of artificial intelligence in Banking sector.
8. What are the opportunities that are available in banking sector after the implementation of artificial intelligence?
9. What are the challenges faced by banking sector after the implementation of artificial intelligence in Banking sector.
10. Which are the areas that have applied the artificial intelligence in Banking sector?
11. Which banks have implemented artificial intelligence in its sector?

Methodology used

The banking industry uses artificial intelligence (AI) approaches that apply AI technologies to improve banking operations and services. Developing chatbots for troubleshooting purposes is one of these approaches, as is utilizing virtual assistants and AI-powered chatbots for customer service and technical problem-solving, incorporating AI into digital banking procedures, and applying AI to fraud detection and risk management. These approaches heavily rely on AI technologies like cybersecurity, predictive analytics, and natural language understanding (NLU). The need to improve overall growth, boost productivity, and improve client services is what is driving the adoption of AI in the banking industry. These approaches seek to make the most of AI's powers in order to improve bank balance sheets, decrease errors, and offer customized customer experiences.

In this study descriptive methodology and bibliographic and content analysis method was used.

Bibliographic analysis is widely used investigation technique that allows researchers to assess the progress of scientific work over the years (2019 to 2023).

Content Analysis method is a qualitative technique that scholars use to uncover insights about a study's findings and aims, in general, content analysis is a widely established approach in the social sciences.

It can be divided into several sections: the first figure explains the research methodology and sample selection technique that was used; the first table covers the research work review by country; the second table covers publications by year; the third table covers citations by year; the fourth table covers citations by country; the fifth table covers the research methodology that was modified by earlier research works; the sixth table covers the number of publications based on the data collection method that was used; the seventh table focuses on the summary of review; the eighth table discusses opportunities; the ninth table focuses on challenges; the tenth table covers Applications; and the final table describes Artificial Intelligence Implementation in Banking Sector.

The primary source of prior study on this subject is the Google Scholar databases. The aforementioned earlier studies were both exploratory and descriptive in nature. When the literature of the prior research works was finalized for review, 2,97,000 were found, of which 17,500 were from 2019 to 2023. Of these, 17449 were deemed irrelevant, and two articles lacked full text were among them. Ultimately, 47 research works were selected for this review article.

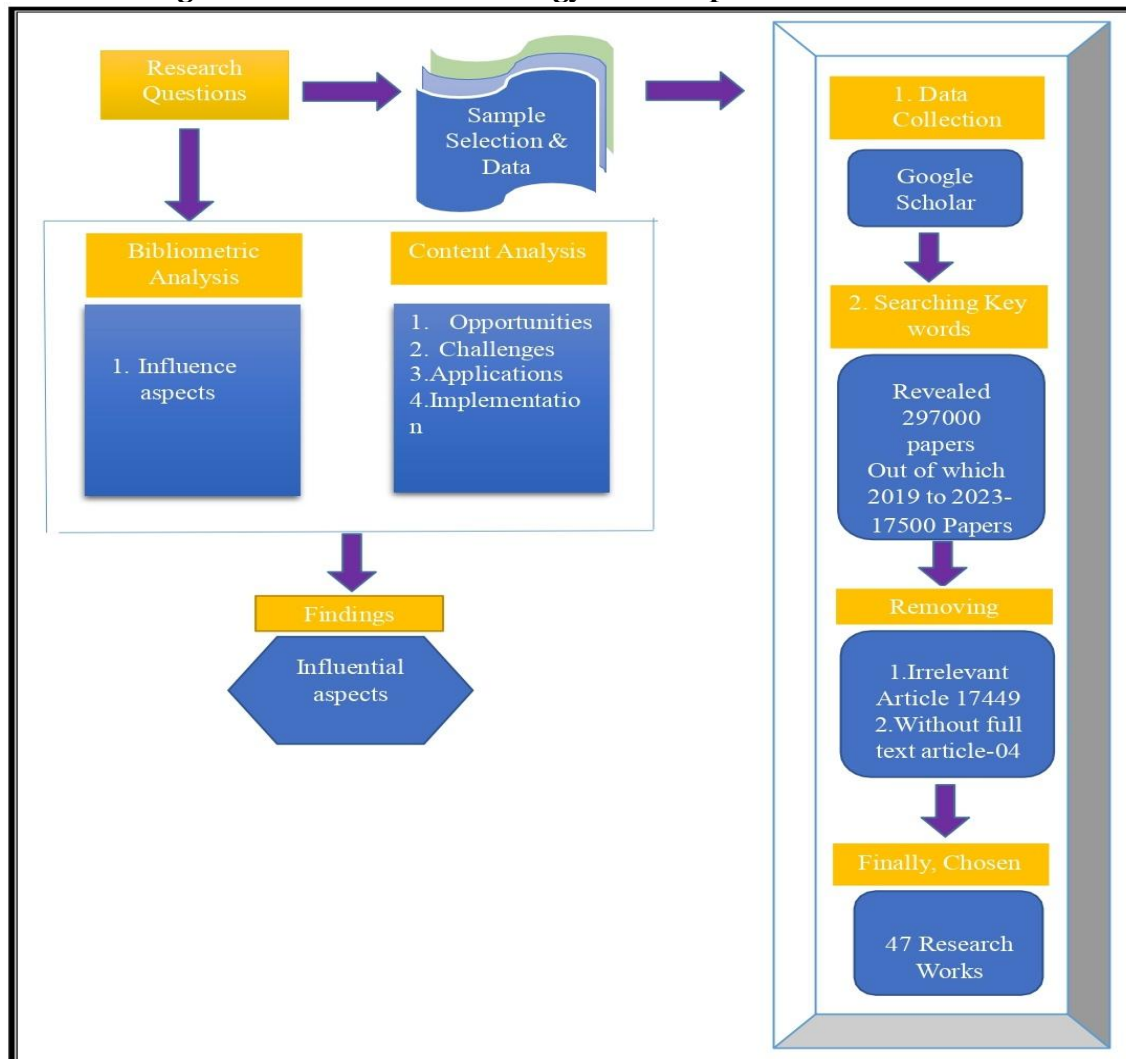
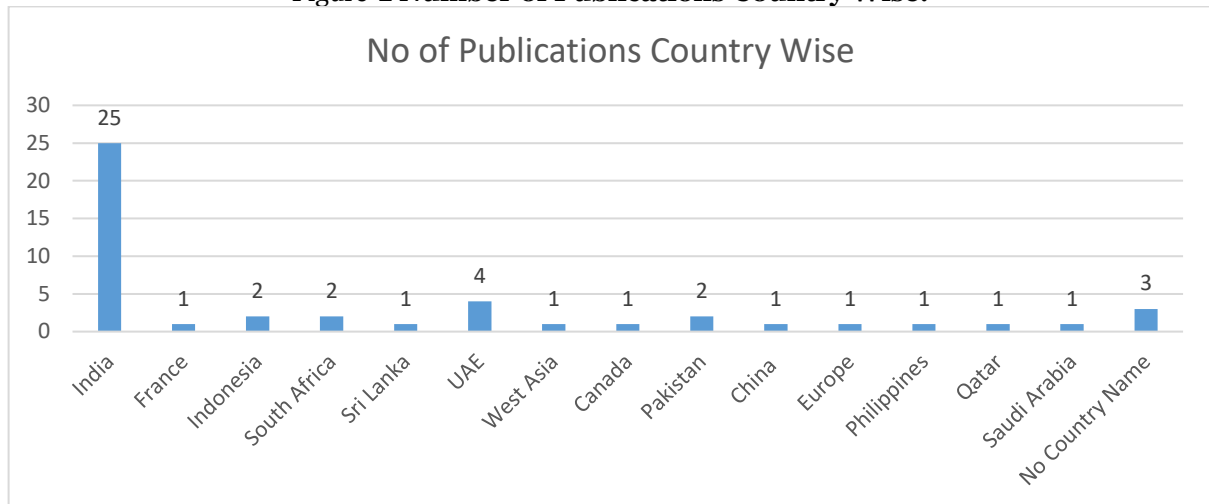
Figure:1 Research Methodology and Sample Section Methods:

Table 1 lists the number of publications by country. Of the 47 research works, the majority are from India (25 publications), followed by the United Arab Emirates (4 publications). There are 3 articles without a country name, 2 from Indonesia, South Africa, and Pakistan, and 1 each from France, Sri Lanka, West Asia, Canada, China, Europe, the Philippines, Qatar, and Saudi Arabia.

Table No: 1 Number of Publications Country Wise:

Sl No	Country	No of Publications	Percentage
1	India	25	53.19
2	France	1	2.13
3	Indonesia	2	4.26
4	South Africa	2	4.26
5	Sri Lanka	1	2.13
6	UAE	4	8.51
7	West Asia	1	2.13
8	Canada	1	2.13
9	Pakistan	2	4.26
10	China	1	2.13
11	Europe	1	2.13
12	Philippines	1	2.13
13	Qatar	1	2.13
14	Saudi Arabia	1	2.13
15	No Country Name	3	6.38
	Total	47	100

Figure-2 Number of Publications Country Wise:

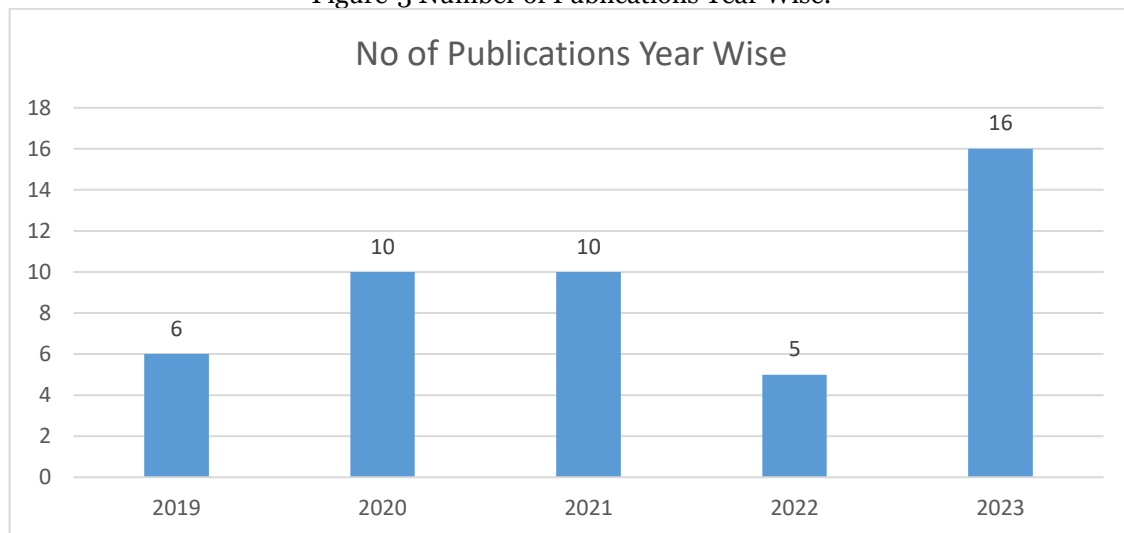


In Table 2, the number of publications is broken down by year. Of the 47 research works, 16 were published in 2023, 10 in each of the years 2020 and 2021, 6 in 2019 and the remaining 5 in 2022.

Table No: 2 Number of Publications Year Wise:

Sl No	Year	No of Publications	Percentage
1	2019	6	12.77
2	2020	10	21.28
3	2021	10	21.28
4	2022	5	10.64
5	2023	16	34.04
	Total	47	100

Figure-3 Number of Publications Year Wise:



The third table lists the number of citations broken down by year. For the previous five years, from 2019 to 2023, there were 808 citations in 2020, 320 in 2021, and then 190 in 2019 through 2022.

Table No: 3 Number of Citations Year wise

Sl No	Year	No of Citation	Percentage
1	2019	190	12.33
2	2020	808	52.43
3	2021	320	20.77
4	2022	105	6.81
5	2023	118	7.66
	Total	1541	100

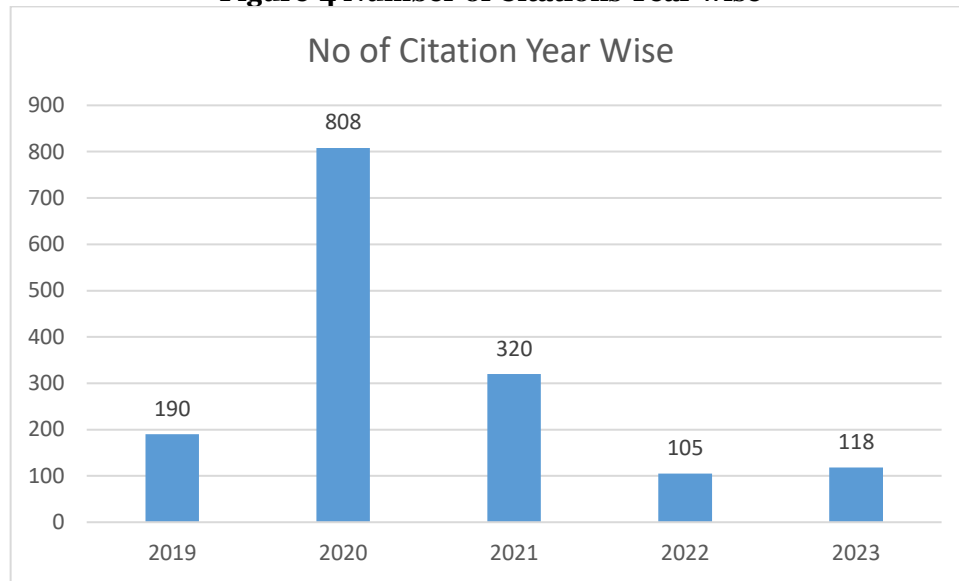
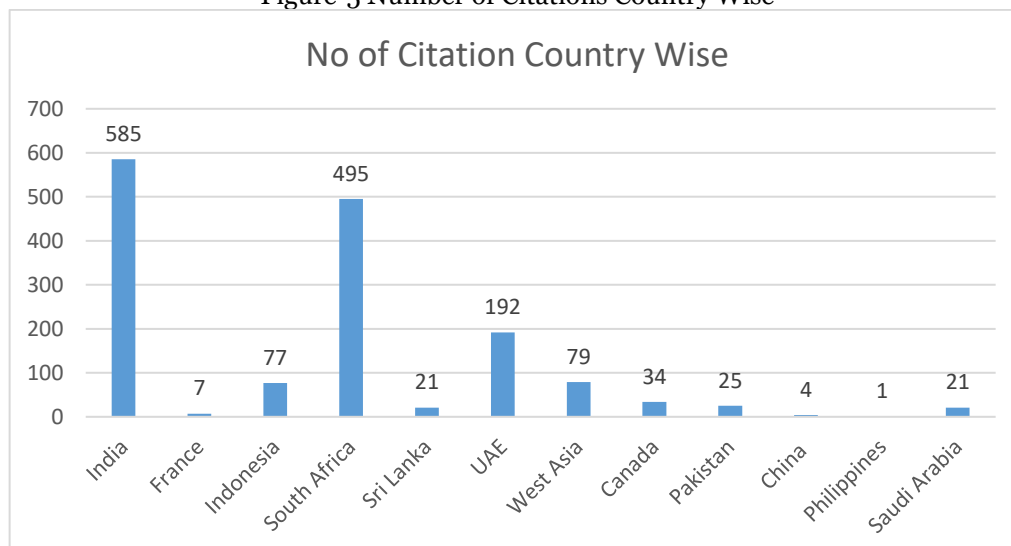
Figure-4 Number of Citations Year wise

Table 4 lists the number of citations by country. Of the 47 research works, the bulk are from India, with 495 citations from South Africa, UAE, West Asia, Indonesia, Canada, Pakistan, Sri Lanka, France, China, and the Philippines following.

Table No: 4 Number of Citations Country Wise

Sl No	Country	No of Citation	Percentage
1	India	585	37.96
2	France	7	0.45
3	Indonesia	77	5.00
4	South Africa	495	32.12
5	Sri Lanka	21	1.36
6	UAE	192	12.46
7	West Asia	79	5.13
8	Canada	34	2.21
9	Pakistan	25	1.62
10	China	4	0.26
12	Philippines	1	0.06
14	Saudi Arabia	21	1.36
	Total	1541	100

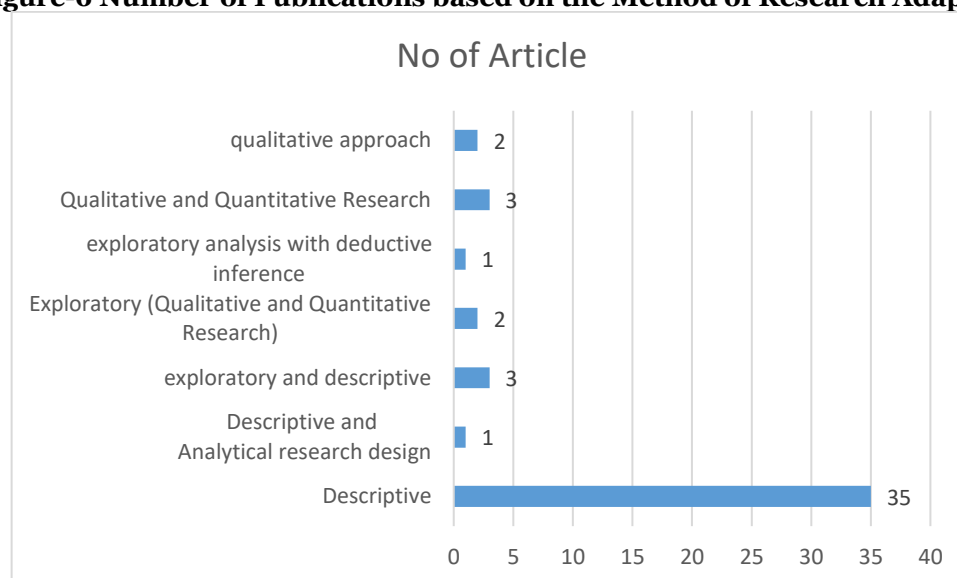
Figure-5 Number of Citations Country Wise

The number of publications based on the adopted research methodology is calculated in Table 5. Of the 47 research work, the majority used an adapted descriptive approach. This was followed by exploratory and descriptive, qualitative and quantitative, descriptive and analytical, and exploratory analysis utilizing deductive inference research work.

Table No: 5 Number of Publications based on the Method of Research Adapted

Sl No	Method of Research	No of Article	Percentage
1	Descriptive	35	74.47
2	Descriptive and Analytical research design	1	2.13
3	exploratory and descriptive	3	6.38
4	Exploratory (Qualitative and Quantitative Research)	2	4.26
5	exploratory analysis with deductive inference	1	2.13
6	Qualitative and Quantitative Research	3	6.38
7	qualitative approach	2	4.26
	Total	47	100

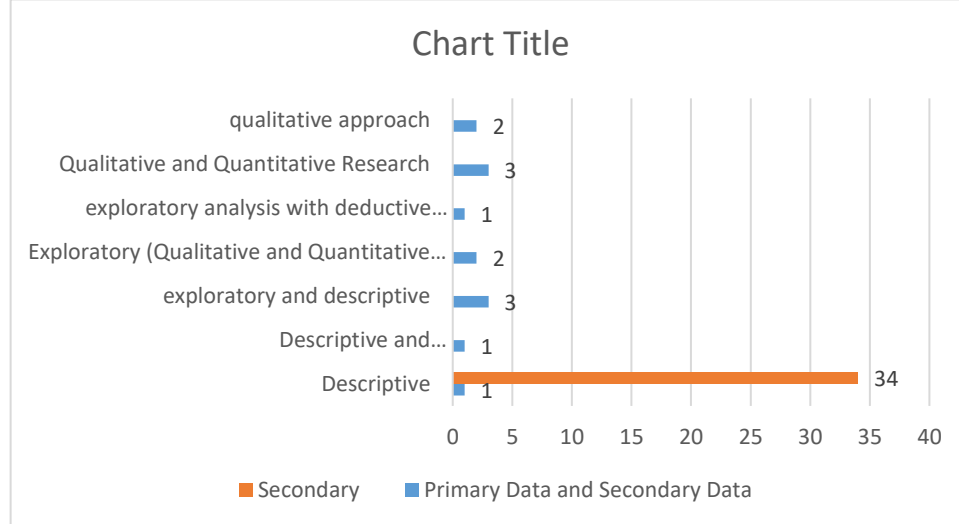
Figure-6 Number of Publications based on the Method of Research Adapted



Based on the adopted data collection approach, the number of publications is highlighted in Table 6. Of the 47 research works, the bulk were adapted from secondary and descriptive methods of data collection, of which 34 were from secondary and 1 from primary. The remaining research works were from primary methods, and they included exploratory and descriptive as well as qualitative and quantitative research, descriptive and analytical research, and exploratory analysis with deductive inference.

Table No 7: Number of Publications based on the Method of data collection adapted:

Sl No	Method of Research	Primary Data and Secondary Data	Secondary	Total
1	Descriptive	1	34	35
2	Descriptive and Analytical research design	1		1
3	exploratory and descriptive	3		3
4	Exploratory (Qualitative and Quantitative Research)	2		2
5	exploratory analysis with deductive inference	1		1
6	Qualitative and Quantitative Research	3		3
7	qualitative approach	2		2
	Total			47

Figure-7: Number of Publications based on the Method of data collection adapted:

Prioritized items are listed in Table 7, which outlines the goals and conclusions. The main themes that are present in the chosen articles are arranged in an overview of the findings.

Table No: 7 Summary of Review: objectives and findings

Sl No	Objectives	Findings	Source
1	Application of AI in Banking Sector	AI applications in banking enhance efficiency, decision-making, and customer satisfaction, despite challenges like data privacy and job displacement.	[29],[34],[60],[48],[25],[37],[42],[34],[65],[35],[50],[6],[23]
2	Implementation of AI in Banking Sector	AI applications in banking enhance operational efficiency, credit scoring, and risk assessment, lowering risk, boosting returns, and improving customer satisfaction, despite only slightly increasing performance.	[29],[57],[40],[39],[67],[52],[18],[65],[54],[4]
3	Impact of AI in Banking Sector	AI applications in banking improve digital financial inclusion, predict habits, and reduce expenses, but concerns about data privacy, transparency, and employment displacement persist. Further research is needed.	[29],[38],[63],[59],[01],[23],[03],[05],[46]
4	Regulatory aspects and support to implement AI in Banking Sector	Cybersecurity concerns are increased when AI is used in service delivery without regulation, particularly in financial institutions. AI can improve investing and trust capacities, but it can also present difficulties when used without direction.	[64],[35],[13]
5	Opportunities of AI in Banking Sector	AI solutions are transforming the Indian banking industry by improving customer comprehension, data analytics, and operational efficiency. However, challenges like inequality, high implementation costs, employee apathy, and privacy concerns persist.	[29],[56],[66],[32],[27],[42],[62],[63],[40],[21],[65],[34],[54],[12],[60],[33],[51]
6	Challenges of AI in Banking Sector	Blockchain, AI, and cloud computing are revolutionizing banking in India, cutting costs and increasing productivity. AI-oriented role models, predictive analytics, and chatbots are influencing public-sector operations.	[56],[66],[32],[27],[42],[62],[35],[63],[59],[01],[21],[65],[03],[41],[60],[5],[33]
7	Evolution of fintech and Present Fintech	By 2020, the software market is expected to rise to USD 2.4 billion, making India the country with the fastest-growing fintech industry in the world.	[66]

	in India		
8	Machin Learning Methods and Techniques	A research approach for creating datasets in financial banking for applications using supervised machine learning is presented in this study.	[48]
9	Enhancing Customer Experience	The study explores AI and BDA in digital banks, highlighting their potential to restore trust in Indian and Indonesian banking systems, despite challenges in implementation.	[25],[37],[35], [53],[8],
10	Dynamics of AI in Baking and Financial Industry	Artificial Intelligence (AI) exhibits considerable promise in a number of industries, but banking and financial services stand out due to the importance and ramifications of the technology.	[36]
11	Information process	Traditional financial models are changing quickly due to the push toward digitalization, and firms are now more vulnerable to cyber security threats.	[49]
12	Ethical Concern in AI	The necessity of a committee to guarantee AI ethics in the banking industry is emphasized in the paper.	[2]
13	AI Relationship between Banking Share Markets	A bank's market share is increased by creative financial procedures; however artificial intelligence has little effect on this relationship.	[45]
14	Consumer Perceptions	The intention to embrace AI in the banking industry is positively influenced by factors such as awareness, attitude, subjective norms, perceived utility, and knowledge; on the other hand, perceived risk has a substantial impact on this intention.	[43]

Table 8 presents the potential and problems related to artificial intelligence (AI), while Table 10 discusses the use of AI, and Table 11 details its deployment in the banking sector. These findings are the result of a systematic literature review (SLR). diverse terminologies were used in the studies to characterize diverse AI potential and difficulties; as a result, the terminologies were normalized to establish standardization and ease analysis.

Table No: 8 Opportunities

1	2	3	4
Sl No	Opportunities	Summary	Source
1	Fraud Detection:	By studying spending patterns, spotting odd transactions, and learning from mistakes, artificial intelligence (AI) technologies are improving fraud detection in banking and financial organizations and reducing risk	56,36,27,42
2	Customer Support and Helpdesk	AI-powered solutions are transforming customer service, increasing productivity and cutting costs, providing professional guidance and services, and helping organizations save time and money.	56,36,42
3	Risk Management:	Because AI and ML offer very accurate computations and data analysis, they are gradually displacing human analysts. AI saves time and money by automating fields and providing intelligent analytics. Both commercial and non-commercial activity can be changed by it	56,36
4	Security:	Security breaches can be avoided and possibly predicted with the use of log analysis, spurious email detection, and tracking suspicious behaviour.	56,42
5	Digitization and automation in back-office processing:	The back-office processing times can be greatly decreased by capturing document data using OCR and machine learning/AI.	56,42
6	Wealth management for masses	Bot Advisors can manage clients' customized portfolios by considering factors like lifestyle, risk tolerance, anticipated returns on investment, etc.	56
7	ATMs	At ATMs, sophisticated AI methods like deep	56,42

		learning and real-time camera images can be employed for image and facial recognition to identify and stop fraud and other crimes	
8	Presence of many start-ups focusing on banking AI solutions	Several startups offering AI solutions for banking indicate that banks can choose from a wide range of technology companies when it comes to sourcing and contracting AI-based systems.	21
9	Banking regulators forcing banks to adopt AI through regulation and effective collaboration	RBI, central banks, and FCA are collaborating to promote AI adoption among banks, aiming to make it more efficient and effective	21
10	Personalized financial services	In order to improve financial services, artificial intelligence is being used to assess market trends, financial objectives, personal portfolios, and other data.	21,42
11	Smart wallets	By enabling "anytime, anywhere" payment transactions via mobile devices, advanced digital wallets lessen the need for actual currency and increase financial inclusion.	21
12	Data-driven AI systems to support forecasting, decision-making and problem-solving processes	To enable financial planning, predictions, and proactive risk management, banking systems are being combined with personal robots, big data analytics, neural networks, machine learning, and predictive analytics.	21
13	Strong customer satisfaction and relationship	Natural language processing technology can reduce human error, improve consumer understanding, and eliminate annoyances like in-person bank visits and lengthy lines. Customers will be more satisfied and loyal when products and services are tailored thanks to data analytics and machine learning.	21
14	Anti-money laundering and fraud detection	In the banking industry, artificial intelligence (AI) models, machine learning algorithms, neural networks, and anomaly detection systems can improve the precision of anti-money laundering and fraud detection.	21
15	Automation of repetitive, voluminous and time-intensive banking tasks	Routine chores can be automated and expedited by intelligent robotic assistants, which can save a significant amount of money and increase worker productivity.	21,42
16	Enhanced cybersecurity, especially with respect to payment processing	To proactively identify and stop questionable financial activity, technologies like block chain, machine learning, deep learning, big data analytics, and predictive analytics can be applied.	21
17	Opportunity to promote digital financial inclusion	AI can improve financial inclusion through lowering risk, resolving information asymmetry, and offering customer support for young people, women, low-income earners, and small enterprises.	21
18	Financial Advisory Service	Future prospects for robot-advisors are highlighted in the PWC Report 2017 because they can lower commission expenses for individual investments. Furthermore, bionic advisory approaches integrate human and mechanical insights to offer more effective solutions than separate parts.	36

19	Managing Finance	Finance management, especially personal financial management (PFM), is being revolutionized by AI. The PFM wallet from San Francisco start-up reduces the need for paper transactions and database building by using AI algorithms to make intelligent spending decisions.	36
20	Accurate Decision-Making	In the era of data-driven management, organizations such as financial, insurance, and banking institutions depend less on experts and more on systems to make choices based on massive amounts of data.	36,42
21	Claims Management	By enabling intelligent data collecting, evaluating user behaviour, and automating claim settlement procedures, artificial intelligence (AI) technologies are transforming the claims administration industry and cutting costs and processing times.	36
22	Insurances Management	AI significantly enhances insurance underwriting by collecting vast data, making informed decisions, and expediting insurance obligations. However, it often fails to submit health records, reducing indemnity chances.	36
23	Automated Virtual Financial Assistants	Financial companies and Fintech startups are contributing to the growing usage of "Robo-Advisors," AI-powered financial experts who help customers make informed judgments regarding stocks and bonds by assessing market trends and investment affordability.	36,42
24	Predictive Analysis in Financial Services	A crucial instrument for financial services, predictive analytics affects sales, revenue production, and company strategy. It gathers, organizes, and analyzes data using sophisticated algorithms to deliver individualized answers.	36
25	Drive thru Banking	A business called Clinc, situated in Ann Arbor, is creating a speech AI system to take the position of employees in drive-through banking. Conversational AI can rectify orders in talks by identifying those with strong accents or language obstacles.	27
26	Bank Stations	The front, middle, and back offices of banks are integrating artificial intelligence, which is revolutionizing the sector by improving client relations and organizing data. For modern consumers, this is the banking of the future.	27
27	Passbook updation kiosks	Self-service passbook printing kiosks, such as Swayam, have been developed by Indian banks including SBI and Bank of Baroda. These kiosks use barcode technology to make printing simple. The type of front-end talent needed in the sector has changed as a result of this change in banking.	27
28	Chatbot-The Intelligent Banking Assistant	To make communication between humans and computers in the banking industry easier, Indian Bank SBI introduced SIA, an AI-driven chatbot. Through the SBI gateway chat box, it offers quick solutions for NRI consumers and helps users with daily activities.	27,42

29	Cash Deposit Machine	Cash deposit machines are self-service terminals that enable multiple account payments and cut down on lengthy bank lines by providing fast, dependable, and instantaneous cash deposits.	27
30	ATM Machine Helpline	In order to improve the user experience, ATMs now provide emergency hotlines as well as artificial intelligence (AI) for cybersecurity, machine learning, facial recognition, predictive maintenance, and cash demand forecasting.	27
31	Mobile Banking	Mobile banking apps with AI capabilities provide users with individualized virtual assistants, track their activities, and improve financial planning, all of which make everyday transactions easier and more productive.	27
32	Blockchain Technology and Banking	Decentralized digital ledgers like blockchain are predicted to transform record storage, KYC, loan syndication, crypto banking, cross-border transfers, interbank transactions, and greater transparency.	27
33	AI-based Algorithms and Fraud Detection	As demonstrated by Feedzai's e-commerce fraud detection, machine learning algorithms identify patterns in real-time, questionable activities, and provide recommendations for risk mitigation.	27
34	Solving complex problems	Even though complicated computations take a lot of time and complexity, AI is capable of addressing complex issues accurately.	42
35	Foundation for need of innovations	the basis for the requirement for innovations in the goods and services that banks provide	42
36	multiple task continuously without much error	Thinks and acts more quickly than human minds, and is capable of continually completing several tasks with little error	42
37	deployed in hazardous environment and more reliable and consistent	AI devices can be used in dangerous environments, lowering human risk. Additionally, AI systems are more dependable and stable.	42

Table No: 9 Challenges:

1	2	3	4
Sl No	Challenges	Challenges	Source
1	Quality data	In order to enhance user experience and guarantee optimal performance in real-world settings, banks must guarantee data quality for AI and BDA technologies. This will help to minimize unexpected behavior and inaccurate predictions.	56,25,21, 41,51,42, 67
2	Infrastructure limitation	In order to integrate AI applications, banking institutions need to update their infrastructure. This is because big private banks find it difficult to integrate AI because their systems are 20–30 years old.	25,67
3	Legacy technologies lacking integration capabilities	Data accessibility is essential for any technology, and incorrect data can pose a significant risk to artificial intelligence.	25,42
4	Regulatory constrains	Organizations using AI in finance must go by current norms and regulations since they have an impact on how the technology is used and managed.	25,41
5	Inflexible business process and teams	Teams and the business process are becoming less flexible.	25

6	Trained Manpower	The personnel of banks is a huge challenge because they are not up to date on the latest technology and applications, and they lack trained data scientists.	25,67,41,42
7	The cost for adopting AI and BDA might be high	Financial organizations must make large investments in hardware, software, and staff in order to adopt AI due to its high production and maintenance costs, complex software, and requirement for frequent updates.	67,51,25,42
8	Security and Storage	Large data sets are used by AI applications to make intelligent decisions, however this might cause storage and security problems. Users have to decide how much data to share while balancing privacy and personalization.	67,41
9	Trust in AI	Adoption of AI calls for a high degree of confidence, but because money is involved, banks, companies, consumers, and clients continue to be afraid of it. This is especially true in the fintech and banking sectors.	67
10	Could result in obsolescence of some skills	Ensuring user acceptance is a major concern because AI-based banking systems have the potential to change work responsibilities and make some skills obsolete, which could result in job losses.	21
11	Privacy violation concerns	Data manipulation undermines AI security, and large-scale customer data analysis by banks AI systems puts customer safety and privacy at risk.	21,41,42
12	Deprivation of creativity and adaptability	Over-reliance on AI to make decisions and solve problems may cause workers' inventiveness and flexibility to decline.	21
13	Restrictive AI implementation and operational resources	Large-scale AI system implementation and operation can be expensive, particularly for small banks with limited funding, and effective operations need qualified data scientists.	21
14	Potential digital divide	Customers from lower socioeconomic backgrounds, in particular, who lack internet connectivity, current personal devices, and ICT skills, may not be able to effectively utilize banking AI systems.	21
15	Integrating AI with conventional banking processes	The evidence available at this time does not support the theory that combining AI with conventional banking procedures will maximize the benefits of AI adoption.	21
16	Loss of emotional "human touch"	While branch networks and human bankers cannot be replaced by AI, their responsibilities should be rediscovered in order to foster close banker-customer interaction.	21
17	Localization	In banking, localization is essential for creating market-specific models, but in financial services, AI needs to take language, culture, and demography into account for a smooth client experience.	41
18	Lack of Transparency	In order to foster client trust, banks must increase the transparency of their AI implementation. This is because technological complexity can sometimes create trust concerns, and more study is required.	41,51
19	Unwillingness	Because of the standardized and firmly embedded procedures of traditional banking, banks in tier two and three cities are reluctant to implement AI practices.	41
20	Modelling Techniques	The difficult part of modelling is coming up with methods that precisely estimate model parameters from small samples of data, which calls for a high degree of precision.	41,42
21	Different approaches of enforcement	Due to differing enforcement techniques, businesses encounter difficulties in establishing global standards and assessing the risks involved with the use of AI technology.	41

22	Explainability of AI models	Because AI relies heavily on algorithms, its decision-making processes might be difficult for people who aren't familiar with these systems to understand.	41
23	Bias and discrimination	Because AI can amplify social prejudices, banks must make sure their AI systems are equitable. To comprehend and resolve bias in AI-powered systems, especially in financial decision-making, more research is required. Additionally, new methodologies must be developed.	41,51
24	Integration with legacy systems	To guarantee the smooth integration of AI systems with current ones and overcome the hurdles posed by antiquated and complicated systems, banks must engage in modernization and integration projects.	41
25	Interpretability	In order to guarantee efficient auditing and control of AI-powered systems, as well as to improve their transparency and interpretability, more research is required.	51
26	Application of 'speech to text and text to speech' depends on natural language processing	Natural language processing is necessary for the "speech to text" and "text to speech" processes.	42
27	Ensuring right process in collecting, validating, standardising, correcting and distributing relevant data.	It is made sure that pertinent data is gathered, verified, standardized, corrected, and distributed in an accurate and effective manner.	42
28	Massive data management and ability to handle it is very crucial.	It is crucial to handle and manage large amounts of data.	42
29	Ethical, moral and legal issues	There are significant moral, legal, and ethical concerns raised by the growing usage of AI.	42
30	High negative impact on traditional skills	The dynamic process changes brought about by AI have the potential to seriously harm traditional abilities.	42

Table No: 10 Applications:

1	2	3	4
Sl No	Applications	Applications	Source
1	Data Analytics	For the BFSI sector, AI-analytics is essential for forecasting future results and trends. It helps with cash flow forecasting, risk management, and influencing sales, marketing, and resource use in the company.	12,36,29
2	Chatbots	AI is transforming banking by cutting costs, expediting response times, and offering round-the-clock customer support via chatbots created by financial institutions such as SBI and Yes Bank.	65,12,41,8,67, 59,53,36,27,29
3	Robotic Process Automation (RPA)	Banks utilize robotic process automation (RPA), a rule-based technology that is expected to increase from \$250 million in 2016 to \$2.9 billion by 2021. RPA is used to streamline back-office processes.	12,67,29

4	Customer Support and Helpdesk	Artificial intelligence (AI)-powered technologies, such as voice systems and chatbots, are transforming customer service by offering round-the-clock, economical, and effective solutions that save businesses time and effort.	65,36,37,42
5	Hedge Fund Trading & Risk Management	AI-based mobile app solutions balance short-term liquidity risk with long-term profitability, improve customer service, and provide real-time market intelligence to improve hedge fund trading and banking management.	65,51,8,53,36,37,42
6	Security	By improving transaction speed and security, identifying user behavior, providing personalized experiences, and lowering personnel expenses by monitoring suspicious activity and anticipating security breaches, artificial intelligence (AI) can improve banking security.	65,37
7	Wealth management for masses	Smart wallets with AI capabilities help control spending and cut costs. In the banking and financial sector, automation broadens skill sets, lowers costs, and enhances client satisfaction. Successful commercialization is ensured through fintech cooperation.	8,36,37,42
8	ATMs & ATMs Help Line	Advanced artificial intelligence (AI) techniques, such as automatic facial recognition, machine vision cameras, predictive maintenance, and cash demand forecasting, are being used by ATMs to detect frauds, increase security, and improve user experience.	41,86,37
9	Financing and Loans	Personal financial management (PFM) in particular is being revolutionized by AI, with the market for RPA systems predicted to reach USD 12 billion by 2023.	12,8,36,42
10	Sales , Trading and Marketing	AI systems are used by investment firms to evaluate data, spot abnormalities, and forecast market positions with precision. Informed investment decisions are made possible by AI, which offers risk-aware solutions and notifies investors of market patterns.	65,8,36,42
11	Decision making	By using technology to analyze massive amounts of data, banks, financial firms, and insurance providers can take advantage of lower-cost management methods in the data-driven era. This lessens the need for experts by enabling managers to make well-informed judgments and take appropriate action.	41,40,36,42
12	Customers Service and relationship management	AI, natural language processing, and subjective reasoning are being used by banks to improve customer service and create client-driven societies. The first house loan selection engine in India was introduced by startup Easiloan.	51,8,67,59,42,32
13	Mobile Apps/Banking	While 66% more money is made from mobile banking than from branch visits, 91% of people do not use a phone. Banks could employ AI-enabled apps and customers segmentation to draw in additional business.	67,53,40,27
14	Machine Learning& Algorithmic Trading	By evaluating massive data sets, spotting fraud, and predicting default risk, machine learning techniques can lower risk in banks. With AI models used for hedge funds and real-time pattern identification in e-commerce fraud	67,59,36,27

		detection, over 70% of trade is automated.	
15	Robo-Advisors for Financial Products	Online platforms employ algorithms to create portfolios, reinvest dividends, and offer financial advice with little need for human participation. Reports from PwC and Deloitte examine the potential of AI now and in the future.	65,51,59,36
16	Smart/Digital Wallets	AI, big data, and machine learning are being incorporated into mobile wallets and banking systems to lessen the need for real currency and to advance financial inclusion.	65,41,32
17	Employee Effectiveness & Customer Experience	Artificial intelligence improves customer satisfaction, increases sales, increases employee effectiveness, and increases sales representative efficiency. It improves accuracy and precision in a variety of tasks and is available on PCs, smartphones, and other devices.	65
18	Increase in Efficiency and Accuracy	Banks can now detect quality deals based on historical initial margin reduction levels thanks to artificial intelligence, which improves mathematical computations and can handle massive records.	65
19	AML Pattern Detection/KYC/ Fraud detection	In order to accurately detect fraud and evaluate client spending habits, the banking industry is moving from rule-based software to AI-based solutions. This shift will save operating costs and increase profitability.	65,12,51,41,8,67,59,53,40,36,27,37,42
20	Data based Artificial Intelligence applications	Applications for financial institutions, end-user devices, and personal robots analyze vast amounts of data, offer forecasts, predictions, and personalized advice, and support loan, rate, and investment tracking.	32
21	Voice Assistance	vocal assistance lowers errors and boosts the effectiveness of financial services by allowing users to use touch displays and vocal instructions when using banking services.	32
22	Drive thru Banking	A business called Clinc, situated in Ann Arbor, is creating a speech AI system to take the position of employees in drive-through banking. Conversational AI can rectify orders in talks by identifying those with strong accents or language obstacles.	27
23	Bank Stations	The front, middle, and back offices of banks are integrating artificial intelligence, which is revolutionizing the sector by improving client relations and organizing data. For modern consumers, this is the banking of the future.	27
24	Passbook updation kiosks	Self-service passbook printing kiosks, such as Swayam, have been developed by Indian banks including SBI and Bank of Baroda. These kiosks use barcode technology to make printing simple. The type of front-end talent needed in the sector has changed as a result of this change in banking.	27
25	Cash Deposit Machine	Cash deposit machines are self-service terminals that enable multiple account payments and cut down on lengthy bank lines by providing fast, dependable, and instantaneous cash deposits.	27

26	Blockchain Technology and Banking	Blockchain is a decentralized digital ledger that benefits several industries, including cryptocurrencies, interbank transactions, and KYC. Blockchain leverages AI for decision-making, data analysis, and security.	41,40,27
27	Automation of Business and Financial Reports and regulatory compliance	Account reconciliation, data entry, and financial reporting are all made more accurate and error-free by AI embedded software, which automates data retrieval and report preparation. Because of its great efficiency and openness, creating reports quickly and storing and accessing audit trails are made simple.	12,8
28	Facial Recognition and Bio Matrices	Despite privacy concerns, the banking industry uses biometric systems, such as facial recognition and iris scans, to prevent fraud and tax evasion.	12,8
29	Digitalization instead of branch lines	Digital transformation requires digitizing paper documents and leveraging AI and document management systems for purposes like fraud prevention and customer support.	12,41,8
30	Cognitive process automation	Through machine learning, cognitive process automation in banking can enhance claims management, resulting in a guaranteed return on investment, reduced costs, and quicker, more precise service processing.	41
31	Credit Assessment	By evaluating market conditions, lifestyle, risk tolerance, and financial objectives, a personal assistant employing neural networks can handle credit evaluation and decision-making, lowering risk and averting fraud and bankruptcy.	51,41,8,53
32	Cloud Security	Effective risk management and Levenberg-Marquardt-based backpropagation are necessary for data analysis, training, testing, and cloud security prediction since security problems in cloud computing projects are often the cause of project failure.	53
33	Phishing Websites	Phishing websites deceive people into disclosing passwords, which results in unauthorized transactions. Banking consumers are primarily drawn to these sites by spam emails, thus while AI approaches are able to recognize and anticipate these sites, it is still difficult to find crucial attributes.	53
34	Banking Failure	Risk prediction and appropriate credit decisions employing profit analyses, discriminant, logit, and financial soundness indicators—with artificial neural networks being especially useful—can prevent banking failures.	53
35	Alarm System	By identifying robberies at banks and ATMs, artificial intelligence enhances the security of the banking system. Three phases are used in the system: GSM technology, picture processing, and neural network categorization. An alert and a warning message are sent if the output is 1.	53
36	Customer Loyalty	Using factor analysis, feed forward backpropagation, and K-fold cross validation, an artificial neural network predicts client loyalty in the banking sector with high accuracy in performance evaluations.	53

37	Intelligence and Augmented Reality	Healthcare, gaming, and media are just a few of the industries that augmented reality is transforming with its ability to simplify complicated issues, streamline workflows, and improve consumer satisfaction.	53
38	Claims Insurance & Management	AI-powered tools are essential to the insurance industry for obtaining evidence, evaluating data, and spotting anomalous activity. They avoid the stages of claim settlement, make data administration easier, and cut down on processing expenses and times. Prior to the admission of insurance claims, they are able to diagnose ailments.	36

Table No: 11 Implementation:

1	2	3	4
Sl No	Implementation	Implementation	Source
	Indian Banks		28
1	State Bank of India	AI is being used by State Bank of India (SBI) to enhance banking services. 10,000 queries per second are handled by the SBI Intelligent Assistant, which also encourages creative solutions.	65,37,42,29,32
2	HDFC Bank	With 85% accuracy, HDFC Bank's AI chatbot Eva uses Google Assistant to respond to consumer inquiries. The bank is also investigating robotic applications for use in stores.	65,37,42,29,32
3	ICICI Bank	The second-biggest bank in India, ICICI Bank, has implemented software robotics in 200 business operations, managing two million transactions every day and introducing iPal, an AI-powered chatbot with a 90% accuracy rate.	65,37,42,29,32
4	Axis Bank	The third-biggest bank in India, Axis Bank, has introduced AXAA, an AI-powered bot that answers consumer banking questions without requiring human assistance. The bank also has a "Though Factory" innovation lab.	65,37,42,29,32
5	Canara Bank	The Mitra and Candi robots that Canara Bank in Karnataka has placed have the potential to promote AI cooperation between China and India because they can greet customers in Kannada and respond in English.	37,42,29
6	Bank of Baroda	In 2018, Bank of Baroda, a public sector lender, partnered with IBM and Accenture to deploy AI to improve banking services and customer care.	65,42
7	Allahabad Bank	The Allahabad Bank claimed in a media release that significant updates to its "EmPower" app, including chatbots and AI-powered e-commerce payments, are planned.	42
8	YES Bank	The AI chatbot 'YES Power' for loan products and 'YES Robot' for banking inquiries are the products of YES Bank's partnership with Gupshup. It was the first bank in India to offer banking via chatbots.	42

9	Andhra Bank:	Andhra Bank has automated customer service and internal staff onboarding for over 20,000 employees by integrating the AI chatbot "ABHi" into its Core Banking Servers.	65,42
10	City Union Bank	It introduced Lakshmi, the banking robot. The robot can converse with clients on over 125 topics. In addition to responding to standard inquiries, the robot is designed to establish a connection with the primary banking system.	42
11	IndusInd Bank	It has introduced the "IndusAssist" Alexa Skill, which enables bank account holders to interact with Amazon's virtual assistant, Alexa, to do both financial and non-financial banking activities.	42
12	Punjab National Bank	In 2018, the bank used artificial intelligence (AI) for analytics and account reconciliation in an effort to strengthen audit systems in the wake of a big fraud scandal involving Mehul Choksi and Nirav Modi.	42
13	Kotak Mahindra Bank	In order to improve its phone-banking assistance, Kotak Mahindra uses a bilingual AI chatbot named Keya. This practice is anticipated to continue in India's well-regulated banking sector.	65
14	City Bank	With 83% of operations conducted online, City Union Bank Lakshmi is introducing a customized ChatBot to answer inquiries about specific accounts and details about everyday banking transactions.	8,37
	Foreign Banks		
1	Malaysian Banks	Malaysian banks are working with regional and global FinTech startups to integrate automation and artificial intelligence into digital banking to increase efficiency and security.	29
2	US Banks	AI-based expenditure management apps, Contract Intelligence chatbots, and Erica chatbots for spending alerts and recurring payments are just a few examples of how JPMorgan Chase and US Bank have improved the client experience with technology.	29
3	JPMorgan Chase	Mobile applications (finn) to facilitate customer interactions and draw in new customers, particularly millennials	8,25
4	Wells Fargo	Smartphone apps (greenhouse) to facilitate customer interactions and draw in new customers, particularly millennials	8,25
5	City Bank	Fraud Identification	25
6	Bank of America	Voice and text message financial advice for bank customers is provided by an AI-powered chatbot.	8,25

Results and Discussions:

The banking industry has reaped tremendous benefits from artificial intelligence (AI). The delivery of banking services has been completely transformed by the use of AI-powered devices and web apps, which offer ease, tailored experiences, and improved customer support [54]. Additionally, AI technologies have enhanced operational effectiveness, promoted financial inclusion, and helped detect and prevent fraud [3]. AI

is being applied to a number of public-sector banking processes, such as credit scoring, robo-advice, chatbots, and predictive analytics [23]. In the financial services industry, artificial intelligence is already having a significant impact on fraud detection, risk assessment, investment management, and customer service [29]. The banking industry in India has benefited from the application of AI by using it to detect fraudulent accounts, lower non-performing assets (NPA), and enhance individualized customer care [43]. Asian consumers are generally in favor of artificial intelligence (AI) being used in the banking industry. Their desire to accept AI is influenced by a number of elements, including awareness, attitude, subjective norms, perceived utility, and knowledge of AI technology.

Conclusions:

The banking industry has been significantly impacted by artificial intelligence (AI). It has improved customer service, raised productivity, and strengthened banking procedures. Banks have incorporated artificial intelligence (AI) technology, including chatbots, robo advising, predictive analytics, and cyber security, to enhance their operations and offer customized experiences [3]. Knowledge of AI technology, awareness, attitude, subjective norms, and perceived utility have all had a favorable impact on the banking industry's adoption of AI [43]. Additionally, AI has been useful in enhancing operational effectiveness, promoting financial inclusion, and detecting and preventing fraud [54]. Moreover, AI has strengthened bank balance sheets by managing non-performing assets (NPAs) through big data analytics [29]. Nevertheless, AI has not significantly moderated the relationship between a bank's market share and an innovative financial procedure [45]. In general, artificial intelligence (AI) has transformed the banking industry by offering ease, tailored experiences, and enhanced services.

Scope for further Research

There is a great deal of room for future study on artificial intelligence (AI) in the banking industry. When employing AI chatbots, academics and industry professionals are actively investigating methods to improve user experiences and address concerns about security, privacy, trust, and emotional ties [69]. The definition of artificial intelligence (AI) and machine learning (ML) for regulatory reasons, a comparison of quantitative banking methodologies, and strategies for developing interpretability in AI and ML solutions are the main areas of research in this field [13]. A framework for AI financial services has been proposed, and study themes in the strategy, process, and client domains have been identified in studies that have also looked at the application of AI in banking [18]. Research has also been conducted on the effects of AI and ML on banking risk management, specifically credit risk management, and has shown promise for future advancement and beneficial effects in a number of risk management domains. Additionally, studies on the application of AI in banking, insurance, and financial managing have been conducted; these studies have identified trends, benefits, and drawbacks, as well as future research directions.

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