An Empirical Study on the Integration of Artificial Intelligence in Public Sector Banks in India: Impact on Efficiency and Customer Experience

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Abstract
The incorporation of AI is now seen as an influential factor in the banks that influences banks operations and customer service. This paper attempts to identify the impact of AI integration on operational efficiency and customer experience in Indian Public Sector Banks. Due to the rise in digitalization and the emergence of new technologies, such institutions as the "State Bank of India" and "Punjab National Bank" incorporate AI in their banking operations such as chatbot services, predictive analysis, and automation.
An exploratory research is used for analyzing the influence of AI integration in Indian Public Sector Banks on the efficiency of operations and customer experience. Primary data obtained via a questionnaire based on the five-point Likert scale were utilized and subjected to analysis based on Cronbach's Alpha, regression analysis, and correlation.
The research outcome revealed that the implementation of AI technologies improves the operations as well as the customer experience in public banks, since it helps to reduce processing time and errors and increase optimization. Moreover, AI improves customer experience by delivering fast services, being responsive, and offering personalized banking services. This research study is beneficial as it focused on the AI integration in PSBs in India.

Keywords: climate risk; banking stability; Basel III; capital adequacy; climate finance; prudential regulation; Indian commercial banks; climate-adjusted risk-weighted assets; CABRF

Introduction

Rapid changes are occurring in the Indian banking industry, Artificial Intelligence (AI) is one of the key drivers of change in Public Sector Banks (PSB) of India as they look forward to becoming more efficient and competitive.

AI is rapidly developing as the main technology in the banking industry, with the primary aim being to make the experience of individuals more personalized through data analytics, blockchain technology, and machine learning. Technologically, the capabilities of AI continue to evolve in sophistication, allowing an increasing number of banks to integrate AI into their systems.

Some examples of AI technologies being used in banks include chatbots, machine learning tools, and predictive analytics. These have been adopted by PSBs despite the traditional characteristics of bureaucracy and slow technological uptake associated with them.

Despite growing adoption, there is limited research study on "Impact of AI integration on operational efficiency and customer experience in PSBs". This study aims to fill this gap by providing data-driven insights into how AI contributes to banking performance and service quality.

The integration of Artificial Intelligence (AI) in public sector banks in India has significantly impacted efficiency and customer experience. AI technologies are being leveraged to enhance operational processes, improve customer engagement, and ensure compliance with regulatory standards. This transformation is crucial for banks aiming to meet the evolving expectations of tech-savvy customers in a competitive landscape.

Some of the important AI Tools used by the Public Sector Banks to enhance the business efficiency and customers experience and also helped to compete with the private sector banks.

1. AI Chatbots and Virtual Assistants: "State Bank of India" use chatbots to offer round-the-clock customer support. The chatbots are able to respond to customer queries instantly while at the same time reducing the workload of the staff.

2. Fraud Detection Using AI: Artificial Intelligence allows financial organizations such as Punjab National Bank to be able to monitor transactions in real time thus detecting any possible fraudulent activity instantly.

3. Predictive Analytics and Credit Scoring: Enhanced predictive analytics through AI helps in faster and better loan approval and increased accessibility to credit.

4. Robotic Process Automation (RPA): AI-powered automation of processes such as KYC and data entry reduces the chances of mistakes and increases efficiency.

5. Voice Banking and NLP Tools: Voice AI offers greater convenience to the customers to answer their queries easily and in their own native language.

6. AI in Compliance and Documentation: Use of technologies such as OCR allows faster and efficient processing of documents.

7. AI-Digital Platforms: Applications like YONO offer customized banking solutions and allow customers to transact easily and efficiently.

Objectives:

1. To examine the level of AI integration in Public Sector Banks in India
2. To analyze the impact of AI on operational efficiency
3. To evaluate the effect of AI on customer experience
4. To study digital transformation role in AI adoption

Review of Literature:

Artificial Intelligence (AI) is gradually reshaping the banking sector, especially in areas like customer service, efficiency, and digital transformation have been studies.

1. According to Bhattacharya & Sinha (2022), the use of AI technology can promote customer engagement and enhance the overall customer experience. The study demonstrates that the use of AI helps banks provide better services, thus boosting the level of customer satisfaction. Consequently, the study highlighted the importance of AI technology while considering the requirements of today's customers.
2. The use of AI in the banking industry has both positive sides and drawbacks according to Triveni et al. (2020). According to the research, AI improves automation and increases customer satisfaction levels while causing such problems as data privacy, security, and other aspects that require attention. In particular, the author was emphasizing data protection measures and investing in skills.
3. Fares et al. (2022) review several articles about AI application in banking, thus providing an extensive overview of the topic. The three areas where AI applications can be used in banking are strategies, processes, and customer service. The analysis performed by Fares et al. is especially valuable as it bridges theory and practice.
4. Radenkovic et al. (2023) expressed the significant role of artificial intelligence (AI) in fostering digital transformation in the banking industry. The findings illustrate how technology solutions like chatbots, predictive analytics, and cybersecurity frameworks change the way banks operate. Furthermore, they argue that the implementation of AI technology becomes essential because of the demands of the modern digitally minded customers.
5. Lakshminarayana et al. (2019) explored the rapid transformation taking in PSBs after post-demonetization period. According to their findings, technologies such as AI, cloud computing, and blockchain help reduce costs and increase efficiency. The authors noted that the high level of digitalization increases cyber threats that require cautious consideration.
6. Srivastava (2021) discusses an important change that occurs in the Indian banking industry because of AI. The author explains how AI is being used to ensure compliance, manage risks, and provide better customer services. According to him, AI allows for providing services around the clock and increasing convenience. Also, the researcher stated that AI objectives is to support the banking operations carried by the employees efficiently rather than replacing them.

Overall, the literature proves that the use of AI is crucial for transforming the banking sector. Inspite of certain challenges such as security of data, high expenses, and untrained employees should be addressed.

Research Methodology:

- Research Design: Empirical and descriptive study
- Data Collection: A survey was conducted to collect the Primary data
- Sample Technique: Applied Non-Random Convenient Sampling technique
- Sample size: 150 respondents - Bank employees and customers
- Tools Used: Likert Scale (5-point) and Python Library for analysis
- Statistical Techniques - Correlation Analysis and Regression Analysis

Limitations

1. The research study is focused on the quantitative aspects of the objectives and do not covered qualitative aspects.
2. The sample size of the research study is limited, so the findings cannot be generalized
3. The study conducted in few Public Sector Bank.

So the outcome cannot generalize to other banks.

4. The survey conducted has restricted Mumbai geographical area for the study. The outcome cannot match with other cities.
5. The study is focused only on important variables related to the title.
6. There may be a bias in the responses from the respondent's side.

Data Analysis:

"The questionnaire was structured based on the study objectives, where AI integration is independent variable, operational efficiency and customer experience as dependent variables, and digital transformation as a mediating variable."

Section A - Demographic Profile of the Respondents			
Sr. No.	**Description**	**Number**	**Percentage**
	Category		
1	Bank Managers	10	6.67
2	Bank Officers / Staff	40	26.67
3	Customers	100	66.67
	Age		
1	Below 25	40	26.67
2	26 Years to 35 Years	35	23.33
3	36 - 45 Years	55	36.67
4	45 Years and Above	20	13.33
	Genders		
1	Male	85	56.67
2	Female	65	43.33
	Work Experience		
1	Less than 5 Years	5	10.00
2	5 Years to 10 Years	15	30.00
3	11 Years to 15 Years	20	40.00
4	Above 15 Years	10	20.00
	Customers responded from Banks		
1	State Bank of India	45	45.00
2	Punjab National Bank	30	30.00
3	Bank of Baroda	25	25.00

Interpretation of the above demographic profile are as follows:

Demographic Profile of the Respondents

Category:

- Customers constitute the largest group, making up 66.67% (100 respondents) of the total.
- Bank Officers / Staff are the second largest at 26.67% (40 respondents).
- Bank Managers represent the smallest proportion at 6.67% (10 respondents).

Age:

- The largest age group is 36 - 45 Years, accounting for 36.67% (55 respondents).
- Below 25 years old is the next significant group at 26.67% (40 respondents).
- 26 Years to 35 Years comprises 23.33% (35

respondents).

- 45 Years and Above is the smallest age group at 13.33% (20 respondents).

Genders:

- Male respondents make up the majority at 56.67% (85 respondents).
- Female respondents account for 43.33% (65 respondents).

Work Experience:

- 11 Years to 15 Years is the most common work experience bracket, with 40.00% (20 respondents).
- 5 Years to 10 Years represents 30.00% (15 respondents).
- Above 15 Years accounts for 20.00% (10 respondents).
- Less than 5 Years is the smallest group at 10.00% (5 respondents).

Customers responded from Banks:

- The highest number of customer respondents are from State Bank of India at 45.00% (45 respondents).
- Punjab National Bank customers make up 30.00% (30 respondents).
- Bank of Baroda customers account for 25.00% (25 respondents).

Section B, C, D and E: AI Integration in Public Sector Banks (Objective 1)

(Figure in Percentage)

Section B: AI Integration in Public Sector Banks (Objective 1)	SA	A	N	DA	SDA	Total
(Independent Variable)						
1. AI technologies are widely implemented in banking operations	50	30	10	10	-	100
2. My bank actively uses AI-based tools (chatbots, automation, analytics)	30	40	10	10	10	100
3. AI systems are integrated into daily banking processes	40	50	10	-	-	100
4. AI adoption has increased in recent years	60	30	10	-	-	100
5. AI tools are reliable and efficient	40	60		-	-	100
6. The bank invests in AI technologies	40	50	10	-	-	100
Section C: Operational Efficiency (Objective 2)						
(Dependent Variable 1)						
1. AI reduces transaction processing time	60	40	-	-	-	100
2. AI improves employee productivity	50	40	10	-	-	100
3. AI reduces operational costs	40	40	10	10	-	100

4. AI minimizes errors in banking operations	40	40	10	10	-	100
5. AI improves workflow efficiency	30	50	10	10	-	100
6. AI helps in faster decision-making	60	40	-	-	-	100
Section D: Digital Transformation (Objective 4)						
(Mediating Variable)						
1. AI has accelerated digital transformation in banks	40	50	10	-	-	100
2. Banking services are AI oriented	40	40	10	10	-	100
3. AI supports online and mobile banking services	60	40	-	-	-	100
4. Digital banking platforms have improved due to AI	40	60	-	-	-	100
5. AI enables seamless and paperless banking	50	40	10	-	-	100
6. AI enhances innovation in banking services	40	40	10	10	-	100
Section E: Challenges in AI Adoption (Optional but Valuable)						
1. Employees lack adequate training to use AI tools	20	20	10	30	20	100
2. AI implementation is costly for banks	30	60	10	-	-	100
3. Data privacy and security concerns exist	50	50	-	-	-	100
4. Resistance to change affects AI adoption	20	10	10	30	30	100
5. Technical issues limit AI effectiveness	20	20	10	30	20	100

Statistical Tests Performed and Justification:

1. Descriptive Statistics (Mean, Standard Deviation, Min, Max, Quartiles): Descriptive statistics are considered for summarizing the important factors of dataset. They provide a simple

summary about the sample and the measures. By calculating means, we understand the central tendency or average perceived agreement/impact for each variable. Standard deviation revealed the variability or spread of responses.

Analysis of Objective 2:

AI's impact on operational efficiency: A summary of the average scores across all banks, from highest to lowest impact:

Efficiency_Error_Minimization: 3.14

Efficiency_Employee_Productivity: 3.00

Efficiency_Workflow_Efficiency: 2.96

Efficiency_Cost_Reduction: 2.96

Efficiency_Faster_Decision_Making: 2.96

Efficiency_Time_Reduction: 2.94

These scores suggest that, on average, respondents perceive AI to have the most positive impact on minimizing errors, followed by improving employee productivity. The impact on workflow efficiency, cost reduction, faster decision-making, and time reduction are also seen as positive, though slightly less so.

Analysis of Objectives 3:

The analysis for AI's effect on Customer Experience: The average scores across all banks, sorted from highest to lowest perceived impact:

- CX_Quick_Response: 3.21
- CX_Service_Quality: 3.09
- CX_Ease_Of_Use: 3.03
- CX_Customer_Satisfaction: 3.01
- CX_Personalized_Services: 3.00
- CX_Overall_Experience: 2.96

The above analysis of mean scores show that respondents perceive AI to have the most significant positive impact on enabling quick responses to customer queries and improving service quality. While all aspects show a positive impact, personalized services and overall experience are perceived as slightly less affected, yet still positive.

Analysis of Objective 4:

The analysis for AI's role in Digital Transformation: The average scores across all banks, sorted from highest to lowest perceived impact:

- DT_AI_Acceleration: 3.23 (AI has significantly accelerated digital transformation)
- DT_Platform_Improvement: 3.07 (Digital banking platforms have improved due to AI)
- DT_Online_Mobile_Support: 3.03 (AI supports online and mobile banking services)
- DT_Seamless_Paperless: 2.96 (AI enables seamless and paperless banking)
- DT_Digitalization_Due_To_AI: 2.89 (Banking services are AI oriented)

The outcome of the analysis show that customers and staff agreed that AI has accelerated digital transformation and improved banking platforms, online/mobile support, and seamless operations. All scores are above the neutral point (assuming a 1-5 scale), suggesting a positive perceived role of AI in digital transformation.

1. Comparing AI Integration Level Across Respondent Categories (ANOVA Results)

ANOVA Results for AI_Integration_Level by Category:

F-statistic: 0.11

P-value: 0.956

Mean AI_Integration_Level by Category:

Customer: 3.17

Manager: 3.12

Officer: 3.06

Staff: 3.00

Interpretation: Since the p-value (0.956) is much greater than 0.05, we fail to reject the null hypothesis. This means there is no statistically significant difference in the mean AI_ Integration Level across the different respondent categories (Customer, Manager, Officer, Staff).

2. Investigating Factors Influencing AI Adoption or Integration (Correlations with AI_Integration_Level)

The correlation of AI_Integration_Level with other factors viz. AI tools usage, daily processes, adoption increase, reliability, investment, efficiency, customer experience, digital transformation, and challenges. The results are sorted, showing which factors have the strongest positive or negative linear relationships with AI_Integration_Level.

Key Observations from Correlations (sorted from strongest positive to strongest negative):

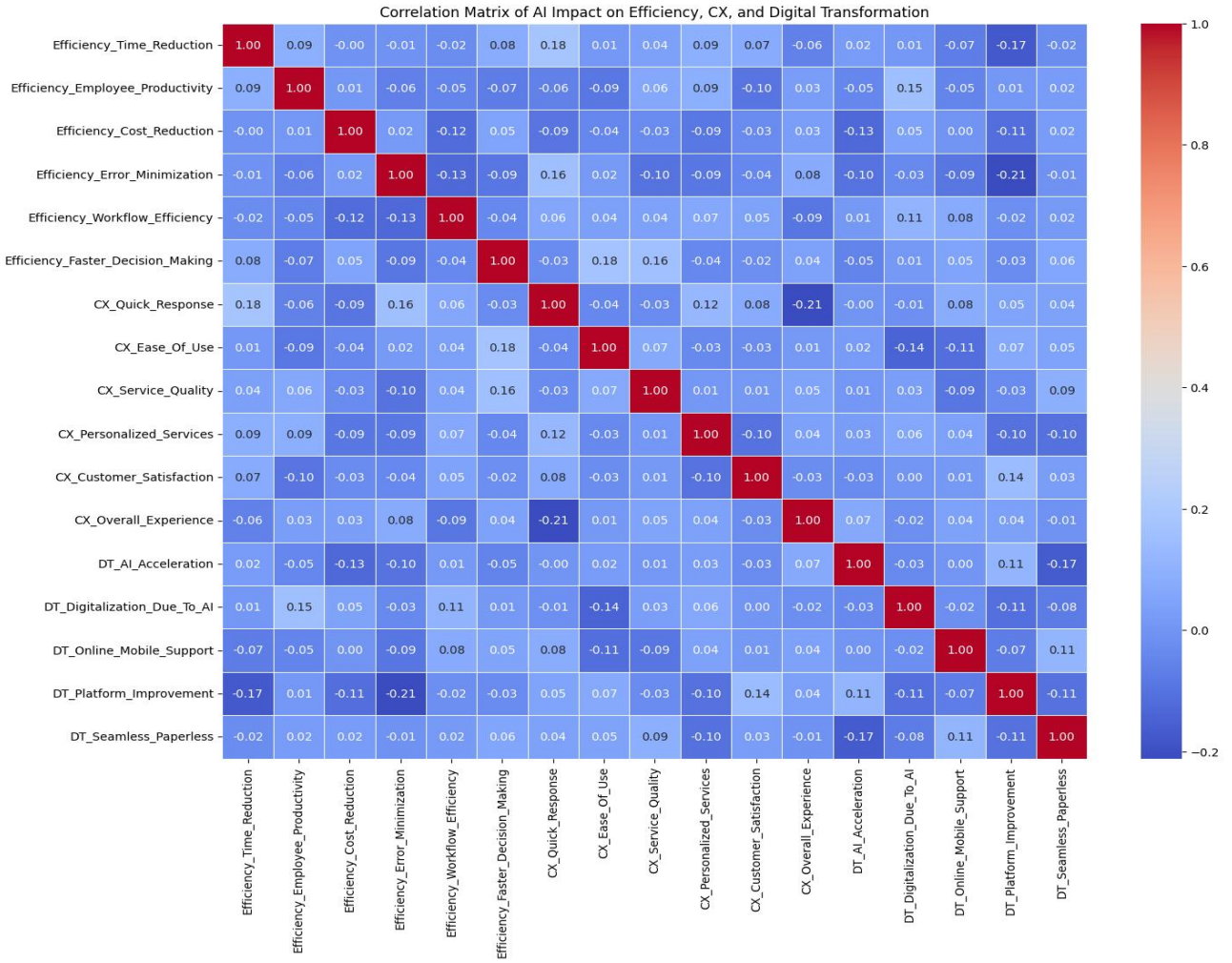
Strongest Positive Correlations:

AI_Adoption_Increase (0.177): Not surprisingly, the perception of increased AI adoption is positively correlated with the general level of AI integration.

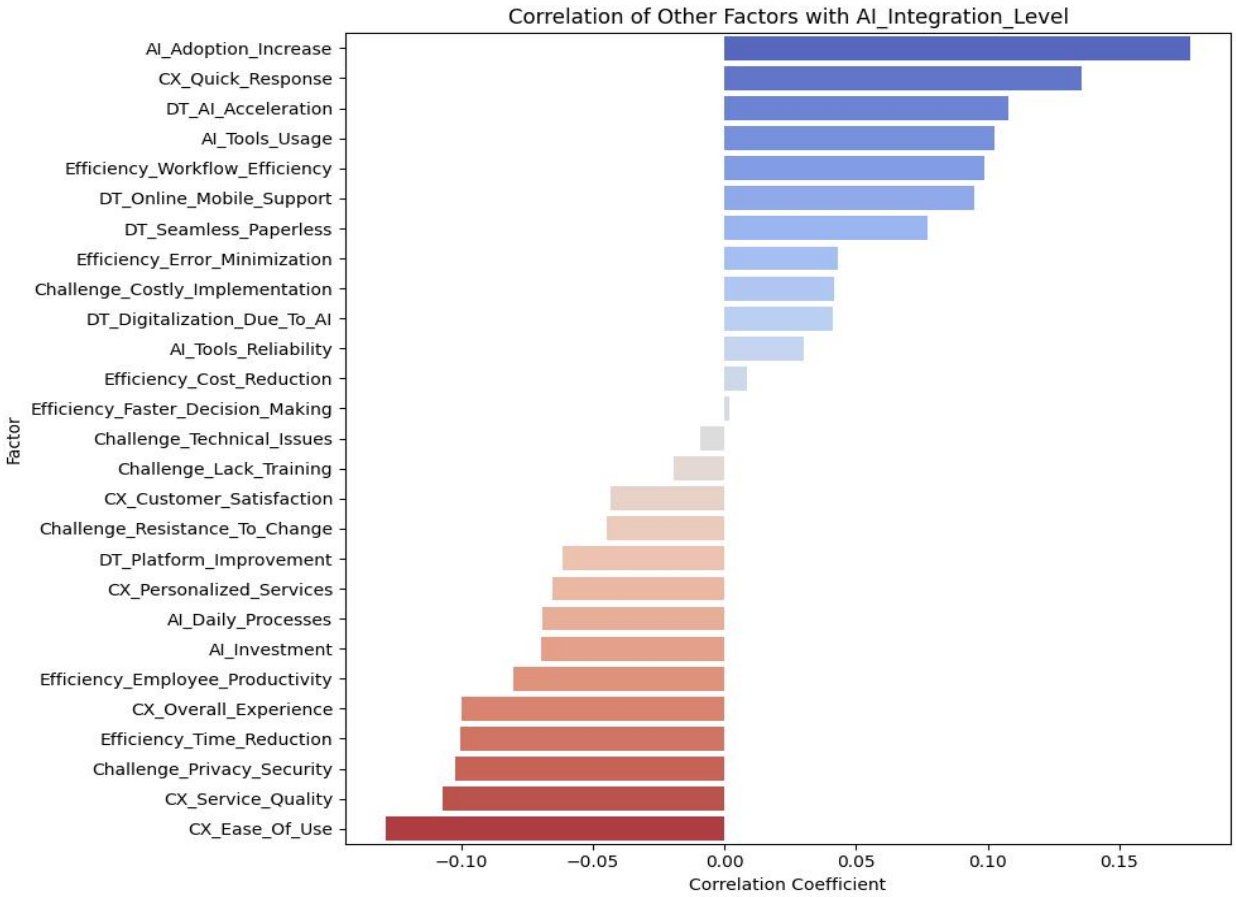
CX_Quick_Response (0.136): Banks with higher AI integration levels tend to be perceived as having quicker responses to customer queries.

DT_AI_Acceleration (0.108): AI integration is associated with the acceleration of digital transformation.

1. Plot: The plot shows the correlation Matrix of AI Impact on Efficiency, Customers Experience and Digital Transformation:



2. The heatmap show the relationships between the factors through colors indicating the strength and direction of the correlation.



Positive correlations (warmer colors) suggest that as one variable increases, the other tends to increase as well.

Negative correlations (cooler colors) suggest that as one variable increases, the other tends to decrease.

Values close to zero (lighter colors) indicate a weak or no linear relationship.

We observed specific correlations by looking at the values in the heatmap reveals positive correlation between the efficiency variables themselves, or between certain CX and DT variables. This helps in understanding how different aspects of AI's impact are related.

A comprehensive summary of all the analyses performed:

1. Objective 1: Examine AI integration level in Public Sector Banks.

We identified 'SBI' and 'BOB' as example public sector banks and calculated descriptive statistics for AI_Integration_Level for these banks. The average AI_Integration_Level was approximately 3.23, indicating a moderate level of integration.

2. Objective 2: Analyze the impact of AI on operational efficiency.

Mean scores for six efficiency attributes were calculated. Efficiency_Error_ Minimization (3.14) and Efficiency_Employee_Productivity (3.00) showed the highest perceived positive impact of AI on operational efficiency.

3. Objective 3: Evaluate the effect of AI on customer experience.

Mean scores for six customer experience attributes were calculated CX_ Quick_ Response (3.21) and CX_Service_Quality (3.09) had the highest average perceived positive effect of AI on customer experience.

4. Objective 4: Study the role of digital transformation in AI adoption.

Mean scores for five digital transformation attributes were calculated. DT_AI_Acceleration (3.23) and DT_Platform_Improvement (3.07) were seen as areas where AI had the strongest role in digital transformation.

5. Correlation Matrix (Overall): Correlation matrix for all efficiency, CX, and DT variables was computed and visualized with a heatmap to understand the interrelationships between these different impact areas.

6. Comparing AI Integration Level Across Respondent Categories (ANOVA):

A one-way ANOVA test was performed on AI_Integration_Level grouped by Category (Staff, Customer, Manager, Officer).

Result: The p-value (0.956) was not statistically significant ($p > 0.05$). This indicates that there is no statistically significant difference in AI_Integration_ Level among the different respondent categories.

7. Investigating Factors Influencing AI Adoption or Integration (Correlations):

The correlation of AI_Integration_Level with various other factors (AI tools usage, adoption increase, reliability, investment, all efficiency, CX, DT metrics, and challenges) was calculated and visualized.

Key Findings: AI_Adoption_Increase, CX_Quick_Response, and DT_AI_ Acceleration showed the strongest positive correlations with AI_Integration_ Level. Interestingly, CX_Ease_Of_Use and CX_Service_Quality showed slight negative correlations, while Challenge_ Privacy_ Security also had a slight negative correlation.

Summary and Conclusions:

The study summarized how Artificial Intelligence (AI) is used in public sector banks in India? and what difference it's making? Based on responses from 150 people, it shows that AI is slowly becoming a regular part of banking, with tools like chatbots and automation already in use.

The results suggest that AI helps banks work more efficiently by reducing mistakes, improving productivity, and speeding up processes. Also, customers receive quicker responses and better services from the banks. Digital transformation plays an important role in making all of this possible. Some challenges exists such as high costs, data security, and staff training.

Conclusion

AI is clearly changing how public sector banks operate. It's making services faster, smoother, and more customer friendly. But to get the most out of it, banks need to invest in the right systems, train their employees, and take security seriously. In the long run, using AI is not just helpful, it's necessary for banks to keep up in today's digital world.

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